ABSTRACT

How do militaries learn in war? This dissertation takes a novel approach to understanding how militaries learn in war by developing and testing a theory of wartime military learning in the joint operational context. In doing so, the dissertation makes three related arguments. First, it examines not just whether militaries learn in war, but how militaries learn in war. Specifically, it defines learning as a process that includes two distinct but related phases: first, identifying a problem and, second, implementing a solution. From this conceptual standpoint, the dissertation then proposes a theory of wartime military learning that can explain and predict both whether and how a military is likely to learn the lessons of war, which I call Military Filtration Theory (MFT). MFT argues that wartime military learning is best explained by examining the interaction of two key variables: first, the state's national military strategy and, second, the military's resource endowments. These two variables act as a filter on the information that is identified and absorbed by military organizations throughout the learning process. Finally, the dissertation tests MFT against several alternative explanations in the novel and challenging empirical setting of joint operations. Specifically, I examine the different experiences of the British, American, and German militaries in successfully learning to execute tactical airpower operations during World War II. In addition to demonstrating variation in the learning process, these three cases allow me to focus on a subset of joint operations that sets a high bar for existing theories of military learning in ways that the extant literature does not. The findings of this study provide new theoretical and empirical insights for students of military learning, as well as several practical lessons for policymakers and warfighters.
"The Eighth army and the Western Desert Air Force, together constituting one fighting machine, are ready to advance. We all know what that means; and so does the enemy"

- Bernard Montgomery
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Chapter 1: Introduction and Theory

1 Motivation and Puzzle

How do militaries learn in war? Though the question may be simple, the answer has eluded scholars and practitioners of conflict since its earliest days. Indeed, as Clausewitz famously remarked, “Everything in war is simple, but even the simplest thing is difficult.” Learning is no exception to this rule. This is not to say, however, that the question of wartime learning has been ignored by war’s practitioners. In fact, efforts to distill and internalize the “lessons learned” of conflict have become a perennial feature of post-conflict analysis in most militaries around the world. The recent drawdowns from Iraq and Afghanistan have been no exception, as every service of the U.S. military has directed their communities to take the question of learning from these wars seriously.

Given the stakes, this should not come as a surprise—militaries which fail to learn the right lessons from conflict may pay a deadly price. However, despite commendable efforts by the military to better understand how to distill lessons from conflict in real-time, there remain big, unanswered, questions of when, how, and why militaries are capable of learning during war.

For its part, the scholarly literature on how militaries learn and change over time has benefitted from the insights of several scholars in a wide array of fields. Academic work in the military innovation and organizational behavior literature has much to say about the problem of military learning, albeit indirectly. Work by Barry Posen, Stephen Rosen, Harvey Sapolsky, and others prescribes several solutions to the challenge of encouraging...

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military innovation. Similarly, work in the field of organizational behavior has much to offer scholars of military learning, especially the work of Peter Senge, Anthony DiBella, David Garvin, and George Huber, each of which grapples with the conditions under which organizations are most likely to learn and change. More recently, studies by Williamson Murray, Theo Farrell, Colin Jackson, Nina Kollars, and Frank Hoffman have all examined the issue of wartime learning directly, and each have provided important insights on this issue by integrating theories from both the military innovation and organizational learning literatures.

My dissertation builds on this burgeoning scholarship on wartime learning as well as the extant literature on military innovation and organizational learning in three ways. First, my dissertation conceives of wartime learning outcomes in a more nuanced way than in the existing literature by examining not just whether militaries learn in war, but how militaries learn in war. In short, I interrogate the process and quality of learning from state to state,

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rather than the binary outcome of learning and not learning. More specifically, I argue that even among states that learn the “right” lessons from war, there are meaningful differences in the way that these lessons are learned. Thus, I argue that understanding learning as a process, consisting of several distinct phases allows for more nuanced and accurate explanations of wartime learning. Specifically, I argue that the phases of the learning process include: first, identifying a problem and, second, implementing a solution. In conceiving of learning in this way, I argue that we should expect different militaries will proceed through these two stages in different ways.

In adopting this more nuanced conception of wartime military learning, my dissertation argues that existing theories of learning and change do not offer sufficient explanatory granularity to explain the process by which different militaries learn during war. Accordingly, I propose a theory of wartime military learning that can explain and predict both whether and how a military is likely to learn the lessons of war, which I call Military Filtration Theory (MFT). MFT argues that wartime military learning is best explained by examining the interaction of two key variables: first, the state’s national military strategy and, second, the military’s resource endowments. These two variables act as a filter on the information that is identified and absorbed by military organizations throughout the learning process. MFT argues, first, that national military strategy—i.e. the type of war that a state believes it will fight or is fighting—dictates which problems the military identifies as worthy of further study. Second, it argues that a military’s resource endowments dictate the nature of its interservice relationships and, therefore, influence how those services will work together in implementing a solution to the identified problem. By tracing the interaction of these variables over time, MFT is able to explain not just whether a military will learn the lessons of battle, but how they will proceed through both stages of the learning process.
Finally, my dissertation makes an important empirical contribution to the existing work on wartime military learning by testing MFT against several alternative explanations in the novel and challenging empirical setting of joint operations. Specifically, I examine the different experiences of the British, American, and German militaries in successfully learning to execute tactical airpower operations during World War II. In the British and American cases, the identification of the challenges presented by tactical airpower operations emerged only after the national military strategy of both states shifted toward fighting an offensive ground war in the late 1930s. But even after acknowledging the many challenges presented by tactical airpower operations, constrained resources resulted in interservice tension that ultimately prevented both the American and British militaries from implementing identified solutions, even after it was clear that failure to do so would come at a high cost. On the other hand, in the German case, the national military strategy, which emphasized large-scale ground conflict, along with the unusual resource endowments of the prewar period meant that its military was able to both diagnose and remedy the challenges of tactical airpower operations rapidly and uniformly well before the war began.

In addition to demonstrating variation in the learning process, these three cases allow me to focus on a subset of joint operations that sets a “high bar” for existing theories of military learning in ways that the existing literature does not. For both theoretical and practical reasons, the successful conduct of joint operations has proven difficult for most militaries to master. Tactical airpower is among the most fraught examples of this difficulty. Moreover, tactical airpower's persistent use by modern militaries makes understanding this case of significant practical importance. Accordingly, by examining the demanding cases of

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6 I explain the term “tactical airpower operations” at length in the following chapter but, broadly, I define tactical airpower operations as the employment of tactical aviation as part of a joint campaign with ground forces.
learning in the British, American, and German experience with joint tactical airpower operations, my dissertation is able to assess the dynamics of military learning in a rigorous empirical environment with significant practical implications, thereby making an important contribution to our understanding of military learning and change on the battlefield.

The remainder of this chapter lays the theoretical groundwork for the dissertation. To do so, it proceeds in three parts. The following section provides the theoretical context for the remainder of the chapter by outlining the central dilemma for scholars of military learning: learning requires change, and military organizations are not designed to change. From there, the section identifies several existing explanations of wartime military learning and illustrates both the logic and deficiencies of these approaches when it comes to explaining the process of learning on the battlefield. In the third section, I present my theory of wartime learning rooted in, but distinct from, the existing work in the field: Military Filtration Theory (MFT). This theory makes two key observations: first, it conceives of wartime military learning as a process; and second, it argues that the manner in which military organizations move through this process is best explained by the interaction of two variables: (a) the state’s national military strategy and (b) the resource endowments of a state’s military. In the final section, I lay out the empirical approach used to test MFT against competing theories of wartime learning in the context of the British, American, and German experience with tactical airpower operations during World War II.7

2 The Problem of Change and Existing Literature

7 Although I make reference to the concept and measurement of tactical airpower operations throughout this chapter, I reserve the bulk of this discussion to the next chapter, which is concerned exclusively with explaining how I define and measure tactical airpower operations, as well as conveying the substantive importance of these operations during World War II.
2.1 The Problem of Change: Uncertainty, Autonomy, and Resources

As I define it in the next section, learning is about change—it requires an organization to create new knowledge, disseminate that knowledge and, critically, change its mindsets and behaviors to reflect the acquisition of that new knowledge. Unsurprisingly, I am not the first scholar to consider questions of how and why militaries change their behavior. Scholars have devoted much intellectual energy to excavating the conditions under which change in several forms—innovation, adaptation, and learning—can take place in war and peace. But despite approaching questions of change from different vantage points, the central dilemma for any theorist of organizational change—military or otherwise—is constant: organizations are, generally, designed not to change. The basis for this dilemma is relatively straightforward. Organizations are inherently concerned with pursuing a goal. In service

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9 Some recent scholarship in the organizational behavior literature takes issue with this proposition. However, the broader observation that the fundamental components of organizations are resistant to change remains widely accepted. For more on this debate, see: W. Richard Scott, Organizations: Rational, Natural, and Open Systems, 3rd ed. (Prentice Hall College Div, 1991); Richard M. Cyert and James G. March, Behavioral Theory of the Firm, 2 edition (Cambridge, Mass., USA: Wiley-Blackwell, 1992); Michael Cohen and James March, “A Garbage Can Model of Organization Choice,” Administrative Science Quarterly 17, no. 1 (March 1972): 1-25.

10 Again, there are organizational theorists—generally belonging to the “natural” school—who would disagree with this proposition, arguing instead that the rational pursuit of a single goal is unlikely in practice. Although there may be good reason to hold this view in other organizational contexts, in the military context the pursuit if a specific goal is an animating feature of the organization. See, for example, Scott, Organizations; Barry R. Posen, “Foreword: Military Doctrine and the Management of Uncertainty,”
of this end, members of the organization execute a series of prescribed tasks that are combined to meet the goal to which organization is devoted. As a result of this core function, however, anything that interrupts an organization's ability to pursue its goals will be viewed with hostility. Among the most egregious offenders in this respect is uncertainty. Best said by James Wilson, "The reason an organization is created is in large part to replace the uncertain expectation and haphazard activities of voluntary endeavors with the stability and routine of organized relationships." Barry Posen echoes this view when he notes, "The biggest barrier to the rational achievement of purpose is uncertainty... The organization wants to control as many sources of uncertainty as possible in order to protect its ability to act." In this way, uncertainty is the enemy of organization.

How do organizations minimize uncertainty? In general, they avail themselves of two strategies. First, organizations can increase the level of autonomy they have over their tasks. Since outsourcing requires that organizations relinquish control over the management, budget, and timeframe of production, they are often reluctant to share responsibility for a given task or product. Instead, organizations almost always prefer to have the high levels of clarity, insight, and control that are enabled by keeping their core activities in-house. As a result, the preservation of autonomy is high on the list of


13 Posen, "Foreword," 3.

14 Posen, The Sources of Military Doctrine; Morton H. Halperin, Priscilla Clapp, and Arnold Kanter, Bureaucratic Politics and Foreign Policy, 2nd ed (Washington, D.C: Brookings Institution Press, 2006); Wilson, Bureaucracy.

15 Perhaps more than anything, the colloquialism, "if you want it done right, you have to do it yourself" most accurately summarizes this organizational tendency toward the preservation of autonomy.
organizational priorities. Second, in order to undertake their tasks autonomously, organizations must increase the resources at their disposal. Doing so ensures that the organization has the material and personnel necessary to execute their tasks without relinquishing control and introducing uncertainty. Thus, in order to preserve stability and certainty on which their success relies, organizations have an interest in increasing their resources and autonomy. Militaries in general—as well as their individual services—are no exception to this rule.

The second-order effect of these tendencies, however, is that organizations tend to detest change, both because it inherently introduces uncertainty and because it often requires concessions of autonomy or resources. The organizational behavior literature agrees that organizations are prone to resist change mightily—and the bigger the change, the more mightily the organization is likely to resist it. In this respect, the military is again no exception. Just like any other large organization, the military is hesitant to adopt new concepts or ideas, as these changes inherently introduce significant uncertainty into their organizational machinery. Instead, they often resist the incorporation of novel concepts.

2.2 Learning in War and Peace

Given that militaries are, fundamentally, organizations, many scholars have applied the insights above in the military context. In general, however, where such analysis has occurred

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16 Wilson, Bureaucracy; Halperin, Clapp, and Kanter, Bureaucratic Politics and Foreign Policy.
17 Wilson, Bureaucracy, 222–31.
18 The notion that organizations (and, for that matter, individuals) are resistant to learning and change has been widely discussed and supported in the literature on organizational learning and knowledge management. See, for example, Vincent E. Cangelosi and William R. Dill, “Organizational Learning: Observations Toward a Theory,” Administrative Science Quarterly 10, no. 2 (1965): 175–203, https://doi.org/10.2307/2391412; Christopher Argyris and Donald A. Schön, “Organizational Learning: A Theory of Action Perspective,” Reis, no. 77/78 (1997): 345–348; Mark Easterby-Smith and Marjorie A. Lyles, eds., Handbook of Organizational Learning and Knowledge Management, 2nd ed (Chichester, West Sussex: Wiley, 2011), 12.
it is concerned with explaining military resistance to change and its remedies during peacetime. There are two good reasons for this emphasis on peacetime resistance to change. First, the peacetime environment should serve to exacerbate organizational tendencies toward stagnation, insofar as it lacks three important catalysts for change: clear and immediate security threats, civilian attention, and good feedback. Thus, when we see military organizations overcome their organizational pathologies during peace, they present an important empirical aberration worth further study. Second, many of the most consequential military innovations (e.g. air defense, carrier operations, missile development) have been developed—against the odds—during peacetime. It should come as little surprise then that peacetime innovation in the military has been the focus of much of the scholarly literature on military change.

But the wartime environment also presents some unique and puzzling dynamics for military change. Unlike the peacetime environment where there is both a clear theoretical argument and empirical record to support the view that change is unlikely, in the wartime environment it is less clear whether change should be embraced or rejected. After all, there are arguments that point in both directions. On one hand, wartime has several advantages for learning. First, there is usually a big, clear threat toward which the military is directing their energy. The presence of this threat reveals helpful information to the military about the strengths and weaknesses of their operational concepts, which can help surface both problems and solutions. In addition, the high costs of failure in the wartime environment can serve to catalyze learning in the military. Indeed, nowhere is the platitude, “adapt or

19 Clausewitz, On War; Posen, The Sources of Military Doctrine; Rosen, Winning the next War; Sapolsky, The Polaris System Development Bureaucratic and Programmatic Success in Government; Cote, “The Politics of Innovative Military Doctrine: The U.S. Navy and Fleet Ballistic Missiles.”


21 Murray, Military Adaptation in War, 7–12; Rosen, Winning the next War.
die" applied more literally than on the battlefield, where militaries that fail to learn the
right lessons risk casualties and death as a result. Similarly, the high cost of war often leads
to an abundance of resources, both financial and material, that can lower the costs of
experimentation and change. Finally, the time-pressures of war may lead militaries to adapt
and change more quickly than they would otherwise. Developments on the battlefield that
demand changes from the military occur in minutes or hours during wartime, whereas the
timelines during peace are often much longer. Empirically, the record of wartime change
could also support the argument that wartime dynamics induce adaptation in militaries
since, in some cases, we see militaries making rapid changes for all of the reasons identified
above. Take, for example, the development of counterinsurgency (COIN) doctrine by the
British military in Malaysia or the deployment of the Mine Resistant Ambush Protected
(MRAP) vehicles in Iraq and Afghanistan during the past decade, both of which illustrate
that militaries can make significant changes at both the tactical and strategic level in
response to the pressures of war.

However, there are also good theoretical and empirical reasons to believe that the
wartime environment might not induce learning in the military. Perhaps most significantly,
as Clausewitz identified nearly three centuries ago, the fog and friction of war can make
identifying both problems and solutions exceedingly difficult. Despite, or perhaps because
of the abundance of information available to the military during combat, it is often difficult
to distill what information is accurate and actionable, leading Clausewitz to the conclusion
that “many intelligence reports in war are contradictory; even more are false, and most are

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22 Clausewitz, On War, 108; Murray, Military Adaptation in War.
23 Nina Kollars, “Military Innovation’s Dialectic: Gun Trucks and Rapid Acquisition,” Security Studies 23,
no. 4 (October 2, 2014): 787–813, https://doi.org/10.1080/09636412.2014.965000; Farrell, Osinga, and
Russell, Military Adaptation in Afghanistan; John A. Nagl and Peter J. Schoomaker, Learning to Eat Soup
with a Knife: Counterinsurgency Lessons from Malaya and Vietnam, 1st edition (Chicago: The University
24 Clausewitz, On War; Murray, Military Adaptation in War; Rosen, Winning the next War.
uncertain.” This view is echoed by Stephen Rosen, who notes: “The lessons of combat are by no means unambiguous even when viewed first hand.” Accordingly, the abundance of information supplied in the wartime environment can sometimes serve to undermine learning by flooding the engine with too much or inaccurate information. In short, the mere presence of information does not necessarily guarantee that it will be useful or used by a military to make changes.

In addition to the inherent challenges of fog and friction, it is not entirely clear that many of the variables often touted as inducing change—threat, costs, resources, and time-pressure—will always catalyze change in the right direction or at all. Threats can be misinterpreted, high costs can lead to indecisiveness, abundant resources can lead to waste, and time-pressure can lead to rashness. Moreover, the empirical record is also littered with examples of militaries that failed to learn during wartime, despite the demand signals of the battlefield suggesting they should. Take, for example, the persistence of the strategic bombing doctrine in both the United States and the United Kingdom throughout much of the 21st century, despite wartime evidence repeatedly suggesting its ineffectiveness. Thus, when it comes learning there is good theoretical and empirical reason to believe that the wartime environment in and of itself is insufficient to induce or impede military change.

But the fact remains that militaries all over the world regularly learn, adapt, and innovate effectively during both war and peace. Moreover, scholars in political science and military history have spent much intellectual energy comparing instances of military change.

25 Clausewitz, On War, 117.
26 Rosen, Winning the next War, 25.
27 Rosen, 24.
with those of stagnancy in both environments. What conclusions have they reached? The
next section derives several of the themes and schools of thought that emerge from the
existing literature on military innovation and learning in war and peace.

2.3 Existing Literature
As noted previously, most scholars of military behavior embrace the notion that military
organizations are resistant to change. Despite acknowledging this fundamental premise,
however, scholars of military innovation and change diverge in their views on how this
resistance to change can best be overcome when adaptation is necessary. This section
identifies several arguments that appear in the extant literature on military learning and
change. While many of these existing explanations are complementary and consistent with
my argument, this section also illustrates where these theories fail to explain the more
nuanced elements of learning during war.²⁹ For the purposes of clarity, I have separated
these explanations into two broad categories. The first set of theories argues that the nature
war itself should incentivize learning in combat organizations. In line with the logic briefly
outlined above, these the theories argue that there are certain fundamental elements of the
wartime environment that should make military learning more likely. While these theories
point to different elements of the wartime context, each argues that wartime should, in and
of itself, catalyze learning within militaries. The second set of explanations acknowledges
that wartime introduces unique incentives for military learning, but also takes note of the
empirical reality that not all militaries learning during war. Thus, this second family of
theories argue that variation in learning during war is best understood not by examining

²⁹ For the purposes of this chapter, I provide a more general overview of each of these alternative
explanations. Within the cases themselves, I provide more tailored assessments of their strengths and
weaknesses relative to my own theory.
the nature of war, but by examining variables external to the organization or having to do with the structure of the organization itself.

### 2.3.1 Nature of War

Within the core scholarship on military behavior and change, there is widespread agreement that the dynamics of war present different challenges than those of peace. Further, some students of military learning believe that these unique dynamics can singularly catalyze learning. In this section, I discuss the core logic underlying the three predominant variants, distill the predictions of these approaches, and then identify some of their limitations. I begin with a discussion of the broad logic shared by theorists of organizational behavior and realist international relations that increased threat activates several reinforcing mechanisms to encourage learning in wartime. From there, I discuss a related explanation of wartime learning that focuses on the unique incentives created in the theater of combat operations. Finally, I review a less widely studied, but analytically significant view that wartime creates opportunities for emulation that catalyze learning.

#### Threat and Failure

In nearly all studies of organizational change—military or otherwise—there is a widespread view that threats to the survival of an organization can act as enablers of significant change. The logic is simple and best summed up by the platitude “necessity is the mother
of invention". And, indeed, the underlying premise appeals to a basic human impulse: when we are under threat, we are forced to consider new and creative ways to ensure our survival. But even beyond the organizational behavior literature, scholars of international relations, and especially those belonging to the realist school of thought, are strong proponents of the explanatory power of threat. At the most basic level, these scholars argue that a perceived increase in the threat to a state's survival can trigger a cascade of changes in behavior ranging from balancing, bandwagoning, spiral behavior, deterrence behavior, innovation, and aggression, among others. Following this logic, a state's entry into a war (or an imminent sense that war is near) serves to increase threat perception within the state and, therefore, should induce learning and change at several levels, including within the military.

In addition to this generalized feeling of threat that war can induce, the prospect or reality of failure on the battlefield can also serve to acutely heighten a state's sense of threat and, accordingly, its openness to learning and change. Repeated failures on the battlefield—and the associated costs of those failures—can create larger concerns of defeat within military organizations, incentivizing them to look for and make changes that they were previously unwilling to consider. Thus, the central proposition motivating this school of thought is that an increased perception of threat—often emerging from battlefield failure or defeat—can lead to significant behavioral modifications in military organizations.

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32 Posen, The Sources of Military Doctrine, 57; Christensen, The Innovator's Dilemma.
34 Posen, The Sources of Military Doctrine, 57, 75; Murray, Military Adaptation in War, 7-12.
That being said, the there are several different mechanisms underlying this impulse. For the purposes of clarity, I will briefly review each mechanism here. The primary mechanism by which an increase in threat can induce military learning and change is through its focusing effect. The logic of this argument is widely trumpeted by scholars in the field of military learning and change: when war is imminent or ongoing the enemy is inherently clearer than in peace. As a result of this clarity, political leaders can devise more precise strategies to meet this threat and will direct their resources and attention addressing the specific needs of the conflict at hand. Thus, threat induces strategic changes that can focus the military’s attention on specific issues related to an imminent or ongoing war.

In addition, several subsidiary mechanisms can also be activated by an increase in threat. Take, for instance, the increase in information that emerges in high threat environments. As noted in the previous section, the wartime environment—and the inherent threats associated with it—creates a deluge of information. Not only does active fighting reveal new information about military capabilities, but this information is witnessed firsthand by large swaths of the organization. Given the abundance of information that emerges from high threat environments, the argument goes, combat organizations should be better able to recognize both problems and solutions on the battlefield. Similarly, the presence of clear threats raises the stakes. Consequences in high threat environments are grave: first, military organizations that fail to learn risk organizational death—i.e. dissolution based on poor performance or irrelevance; and second, military organizations that fail to adapt to the realities of the battlefield risk significant bodily harm. Accordingly, scholars have argued that fear of both of these types of consequences should induce a willingness to learn and change on the battlefield. Finally, as noted above, the time


pressures of high threat environments mean that adaptations must be made quickly. Proponents of this view argue that time pressures force senior leaders to grapple with issues that might otherwise be avoided because they require hard or uncomfortable choices. Put simply, there is no time for delay when the threat is immediate. Changes must be made swiftly and decisively. Taken together, the logic of these mechanisms all point to a similar conclusion: the heightened threat environment of wartime should make learning more likely. Whether it be a result of more information, steeper consequences, or time-pressure, the decision to change course can and must be made quickly and so, proponents argue, it will.

As noted above, however, there are significant limitations to this logic. The main challenge to this school is a simple reality: wartime does not uniformly cause learning among militaries engaged in battle. As noted previously, it is not theoretically clear that increased threats, and the informational, consequential, and time pressures they induce, will lead to change rather than stagnancy. Indeed, we have good reasons to believe that organizations—and the people within them—are as equally likely to succumb to paralysis when faced with these circumstances. When individuals are forced to make decisions with life-and-death consequences, under incredible time-constraints, and with an overload of available information, it is hard to believe that they will always make the best choice possible, and instead may choose to sustain the status-quo, or make changes that are counterproductive. Indeed, history is replete with examples of even the best politicians and commanders choosing to persist when change was necessary, or to change course when persistence was required.37 While there may be more incentives for learning on the battlefield, there is no guarantee that these incentives will be heeded or that, if they are, the right lessons will be learned. Thus, threat alone, which places similar pressures on all militaries, does not help

us understand why some militaries respond by making the right changes while others do not.

Theater Necessity

A close corollary to the threat argument outlined above, the theater necessity argument relies on a similar logic. This logic, widely held by practitioners of conflict, suggests that combat organizations are more innovative and collaborative in the field than they are at home, since their proximity to the battlefield and distance from the organizational pathologies at home that make for a potent mix of freedom and urgency that is absent elsewhere.\textsuperscript{38} The view that the theater creates an openness to change relies on several subsidiary mechanisms. First, the harsh realities of combat are difficult to escape for those who are deployed, creating an incentive to address problems with whatever solution is most likely to work. Frontline operators, when faced with the day-to-day horrors of combat, are thus more likely to shed organizational and individual biases in order to solve the problems that they can. Second, the theater can also act as an incubator for new and collaborative thinking.\textsuperscript{39} Deployed forces often engage with their peers from other services more frequently than when they are at home. This exposure to new capabilities and ways of thinking can lead to novel operational approaches, collaborative enterprises, and openness to new ideas. Finally, distance from the bureaucracies at home—and the enforcers of their orthodoxies—provides room for creative thinking in the field. Absent these enforcers, good ideas and talented operators are more likely to be rewarded based on merit rather than on hierarchy, loyalty, or bureaucratic interests. As a result of both of these forces, practitioners of conflict


and scholars of wartime adaptation argue that the theater itself can induce learning and change in real-time.

As with the threat argument above, however, this view is limited by the empirical reality that not all militaries engaged in combat are uniform in their learning, even in the theater. Indeed, as we will see in the cases that follow, the British were capable of learning new operational concepts in the theater, whereas American forces did most of their learning stateside. Similarly, the Germans did very little of their actual learning in the theater of operations. In other words, although the theater necessity argument may have significant explanatory power in some cases, it is limited in many others. Accordingly, the theater necessity argument does not provide sufficient precision to explain much of the observed variation in the down-range experiences of different states.

Emulation

A less widely considered, but still analytically powerful argument that predicts an increase in learning during wartime emphasizes the role of imitation or, more accurately, emulation.\textsuperscript{40} The logic supporting this argument is straightforward: states (and their militaries) need not experience combat firsthand to learn its lessons, they can observe others engaged in combat and distill lessons from their experience. Accordingly, the wartime environment can make all states—including those not actively involved in combat—more likely to learn. As I will illustrate in Chapters 3 and 4, the logic of this argument can, to a certain extent, be seen in the British and American experience with tactical airpower during World War II, where the British were aware of German tactical airpower systems and the American forces were actively seeking out similar information from the British and German operations.

\textsuperscript{40} Paul Johnston, “The Question of British Influence on U.S. Tactical Air Power in World War II,” \textit{Air Power History} 52, no. 1 (Spring 2005); Posen, \textit{The Sources of Military Doctrine}. 

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There are two primary means by which states can engage in emulation. First, states can observe allies or clients in their experience during active fighting. We should expect the information gleaned from allies and clients to be relatively good, if sometimes incomplete. On the other hand, states may also imitate successful concepts that they observe from enemy militaries. Take, for example, the proliferation of low-tech drones among terror groups in the Middle East—having been on the receiving end of this technology for a decade, these groups appear to have learned how to employ them for their own ends. Although the information on enemy operational concepts may be far more limited, it can still serve as a powerful source of new information and subsequent learning, since the effects are clear to those who have been on the receiving end of such tactics and operations.

However, similar problems beset emulation hypotheses as do the threat and theater necessity arguments. This theory assumes that the influx of information—whether from allies, clients, or enemies—will be good information that is accurate, actionable, and easily parsed. Rarely is this the case. First, there is the simple problem that information gleaned secondhand adds an additional layer of opacity that can complicate the process of understanding what, in fact, happened on the battlefield. This becomes even more problematic when interstate relations are tense or cool. In addition to the complications of getting good information secondhand, there is the larger problem that even if good information does exist, there is also reason to believe that the receiving state might misinterpret or suppress this information. Scholars of war, with the benefit of hindsight, often attribute a degree of clarity to the deliberations and debates of the time but, in reality,

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41 Posen, The Sources of Military Doctrine, 54-59.
we know that cognitive and organizational biases can impede the distillation of the objective lessons from the combat operations of others. Indeed, as we will see in the British and American cases, reports from abroad on the successes and failures of both allies and enemies were often distorted to support organizationally motivated arguments. Thus, although battlefield imitation may very well occur in some instances, the predictions of this theory rely on an all-too-rosy picture of information processing in organizations.

Taken together, all three of these variants of the argument that wartime should induce learning rely on basically the same premise: the exigencies of war should catalyze learning. Thus, organizations involved in combat should be more likely to learn than they would be in peace. And, broadly, this point is accurate. Militaries around the world often display remarkable creativity and innovativeness when engaged in combat. However, these theories cannot explain variation between and within militaries when it comes to whether and why some military organizations are better able to identify and absorb the lessons of combat than others. For answers to this more nuanced question, we need to look to a second school of thought, which emphasizes how actors and structures within and around military can intervene to ensure changes are made.

2.3.2 External and Organizational Forces

For those scholars who do not rely on wartime alone, or at all, to explain patterns of military change, the arguments generally fall into one of two schools. The first identifies the sources of military change outside of the organization. Within this school, the two most robust explanations emphasize civilian intervention and material resources. Although I find much merit in elements of these explanations and adopt some of their insights into my own theory, I focus here on the ways in which they are limited as independent explanations of military

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43 Jackson, "Defeat in Victory: Organizational Learning Dysfunction in Counterinsurgency."
learning in war. The second school of thought I discuss here attributes military change to forces within the organization. One variant of this school highlights the importance of the internal leadership structure of the military, while another variant focuses on the dissemination infrastructure within the organization. However, as I discuss below, these internal theories fall flat in explaining wartime learning.

**Civilian Intervention**

Some scholars of military innovation have pointed to the role of actors external to the military in inducing the organization to change. More specifically, many of these scholars identify civilian elites as performing critical interventions into the military in order to force change. These scholars believe this theory is especially powerful during wartime, since civilians are more attuned to military matters when threats are high. In this environment of heightened threats, civilians become fearful of defeat or failure and, as a result, are more likely to intervene in military affairs to ensure that they are aligned with political goals. The high costs of war also serve to encourage civilians into a stronger oversight role during conflict.

Broadly, there are two variants of this view. At the most general level, some scholars argue that civilian strategic changes are likely to trickle down into military strategy and resourcing. In the context of learning, these scholars would argue that civilian grand strategy dictates the problems that a military is incentivized to consider and the

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44 See, for example, Posen, *The Sources of Military Doctrine*; and Jackson, “Defeat in Victory: Organizational Learning Dysfunction in Counterinsurgency.”

45 Posen, *The Sources of Military Doctrine*, 79. As Posen notes, “In general anything that increases the perceived threat to state security is a cause of civilian intervention in military matters and hence a possible cause of integration and innovation.”

46 A close corollary to this argument is that threat also makes military leaders more open to new ideas and concepts for all of the reasons described in the previous section.
solutions it chooses deploy. Though scholars admit there are exceptions to this rule, particularly in peacetime when civilian grand strategy and military planning are more prone to disintegration, they argue that link between civilian and military planning at the strategic level tends to tighten as war approaches. Not only does civilian strategy direct military preparations for war, but these civilians may also concentrate resources in the services that they believe are most likely to serve their strategic goals. The result, according to this view, is that civilian grand strategy should influence military learning considerably during wartime.

The second variant of the civilian intervention school, however, argues that civilians are more likely to affect change in the military through direct involvement at the operational and tactical levels. The argument goes that it is only by intervening in the minutiae of military planning that civilians can incentivize learning. Specifically, proponents of this second variant argue that civilians can support and protect the operational and tactical programs that align with their preferences through the distribution of positive and negative inducements like personnel changes and resource provision. As a result, this variant of the theory would argue that civilian involvement in the details of military operations is best suited to incentivizing the military to learn and change.

In some ways, the predictions of the civilian intervention school are borne out in the cases considered in this dissertation. This is especially true with regard to the first variant of the civilian intervention school, which is in near-complete alignment with the predictions of my own theory and the empirical record presented in Chapters 3-5. Indeed, grand strategic changes throughout the war, on all sides of the conflict, were a perennial and significant catalyst for change. The strategic guidance provided by civilian leaders helped focus military planning and concentrated resources in the services that civilians believed would best serve their strategic ends. However, it is important to note that
although these strategic interventions often influence military learning, their effects on military planning and resourcing are often broad and diffuse. Put another way, grand strategy often influences the boundaries of military planning, but less frequently influences its details. Thus, even as I acknowledge the influence of civilian grand strategy on military learning, I am also aware of the theory’s limits in practice.

On the other hand, the more targeted interventions prescribed by the second variant of the civilian intervention school have more considerable conceptual problems. The primary challenge facing proponents of this school is that military leaders often prove talented at flouting the direction of civilians at the operational and tactical levels. Indeed, when civilian leaders make requests—or demands—of the military which contradict the preferred approach of military leaders, those leaders can simply pay lip-service to those requests, develop superficial responses, or slow-roll their implementation in practice. This is true even when considerable resources are attached to civilian demands regarding specific programs at the operational and tactical levels. While there are some important exceptions to this rule, unless and until civilian leaders can convince senior military officers of the wisdom or necessity of their views, their interventions in the minutiae of military operations are likely to be evaded. Thus, the ability of senior military leaders to impede or avoid the specific changes demanded by civilians casts some doubt on the power of this second variant of the civilian intervention school in explaining cases of military learning.

Accordingly, we should be cautious about applying the insights of both of these variants wholesale. With regard to the second variant, we should expect civilian interventions into the minutiae of military planning to be met with little success for the reasons described above. After all, even the most powerful civilian leaders must rely on the military to execute their demands, and this division of labor often acts as a powerful break on their influence at the operational and tactical levels. As a result, I largely reject the
observations of this second variant of the civilian intervention school. However, with regard to the first variant, I readily acknowledge that civilian grand strategy may influence military learning in important ways. In particular, it can help direct and align military learning with the political and strategic goals of the state. But it is equally important to note that these strategic interventions tend to act as relatively broad stimuli for learning. Accordingly, my theory builds on the insights of this variant in order to refine and improve our understanding of the specific mechanisms linking civilian strategy and military learning during wartime. In this way, my theory is best understood as complimentary to the first variant of the civilian intervention school.

**Resources**

A close corollary to the argument that civilian intervention can induce learning within the military is the argument that resources have a role to play in catalyzing changes in military behavior. As noted in the previous section, all organizations are, by virtue of their organizational-DNA, concerned with maintaining or growing their material resources because it allows them to protect their autonomy and minimize uncertainty. Therefore, it should come as little surprise that scholars of military behavior have argued that directing resources can be an important source of leverage for leaders who aim to adjust or change military thinking on a particular issue during war. In general, the argument for resources as dictating military behavior takes one of two forms. On one hand, some scholars argue that resource abundance, or “slack” can encourage innovation and change, since it lowers the costs of experimentation. Where resources are flush, the argument goes, militaries are more likely to take risks. They need not worry about waste when money and personnel are


48 Feaver, *Armed Servants.*

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plentiful, and can instead try new things and invest in long-term capabilities.\textsuperscript{49} On the other hand, there are scholars who argue that resource constraints serve to induce innovation.\textsuperscript{50} In this view, tight resources require militaries to get creative and collaborative. It forces the military to use what they have wisely, and can even lead to a healthy competition between different subunits of the organization.\textsuperscript{51} In either case, however, proponents of the resource school argue that militaries are likely to change for the better when resources are at stake.

This argument does find considerable support in this dissertation. Indeed, in the next section, I argue that resource endowments have a critical role to play in my own theory of military learning, particularly in the implementation phase of learning. However, as expressed in the existing literature, resource arguments have significant limitations. First, it is worth noting that the indeterminacy of this theory is problematic. It is not enough to say that resources—abundant or scarce—affect whether militaries learn. Scholars and practitioners need to know the conditions under which abundance and scarcity matter, and how they measure up against each other. But putting aside the question of indeterminacy, each of these variants is also limited in important ways. The resource abundance school has been criticized for its overemphasis on material resources by scholars who note that quantitative advantages on the battlefield are rarely determinative of the outcome.\textsuperscript{52} After all, just as important as the resources available are a military’s choices about what to do with them. The resource scarcity school, on the other hand, is open to the critique that limited resources can also make militaries conservative in their approach to warfare, placing limits on the extent to which they are willing to adapt their warfighting approach in creative and novel ways. Thus, it is only with significant refinements to the existing explanations

\textsuperscript{49} Feaver.
\textsuperscript{50} Jackson, “Defeat in Victory: Organizational Learning Dysfunction in Counterinsurgency.”
\textsuperscript{51} Cote, “The Politics of Innovative Military Doctrine: The U.S. Navy and Fleet Ballistic Missiles.”
\textsuperscript{52} Biddle, \textit{Military Power}. 

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emphasizing resources, that I am able to explain variation in learning outcomes. It is to this task that I turn in developing my own theory in the next section.

Internal Bargaining
Other scholars of military behavior have proven skeptical of arguments that emphasize variables external to the military organization itself. Instead, they point to forces within the organization as being the critical variables driving learning and change in the military. The most prominent of these schools emphasizes the ability of different actors within the military to navigate its intraservice bureaucracy and drive change in the military.

Broadly, this argument has two variants. The first emphasizes the importance of senior military leaders in successfully manipulating the process of internal political bargaining. These scholars argue that through an internal political bargaining process, senior military officers are able to leverage three key resources in service of promoting a change in the organization: (1) control of promotion pathways, (2) influence over training, and (3) attitudinal leverage. First, control over promotion pathways of the officer corps acts as a critical organizational lever that senior military leaders can pull in order to induce change. By creating and endorsing a community of young leaders committed to their vision, these military leaders can over time generate the surge of support necessary to change doctrine. But promotion pathways are not the only mechanism by which senior leaders can control the internal response to change. Equally as important is their ability to modify and emphasize new tactics and doctrine during training and preparation exercises. Indoctrinating and socializing members of the military to novel doctrinal concepts begins during these exercises. Finally, these leaders are also able to use their personal status and

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53 The arguments delineated in this section are drawn primarily from: Rosen, *Winning the next War*; Murray, *Military Adaptation in War*; Nagl and Schoomaker, *Learning to Eat Soup with a Knife*. 
prestige to lend support to otherwise unpopular doctrines. For example, the fervor that
grew up around army General David Petraeus and counterinsurgency (COIN) doctrine in
the second part of the Iraq War is suggestive of this cache. The loyalty that surrounds
 certain leaders and their approach to warfare can create new and powerful norms of behavior
 and thinking. Whether this loyalty emerges because officers see personal opportunities for
 promotion or are motivated by the vision and personality of the leader may vary, but
 regardless of their motives this logic places military leaders at the center of the process of
 change. Accordingly, adherents to this view argue that if a savvy military leader feels a new
 operational concept should be adopted, they can reach deep within their service to affect
 leaders, training, and attitudes to support such a change.

The second variant of the internal politicking argument emerges from scholars that
take issue with the tendency to view wartime learning as a “top-down” phenomenon. Thus,
more recent work by Theo Farrell, Frans Osinga, James Russell, and Nina Kollars have
emphasized the importance of “bottom-up” innovation and adaptation that emerge directly
from the warfighter. These authors have argued that tactical and operational changes
identified by the frontline operators to address immediate battlefield needs can sometimes
catalyze much larger changes throughout military organizations. Indeed, they have
identified several instances of this phenomenon in the American and British experiences as
far back as World War II and as recently as in the U.S. wars in Iraq and Afghanistan.

Although it is probably true that military leaders—both at the top and bottom of
the organization—have a role to play in inducing change in their organizations, there are
some limitations to this approach. Two in particular stand out. First, there is the issue
that this approach presumes that there is an ongoing debate between leaders within the

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54 Murray, *Military Adaptation in War*; Farrell, “Improving in War”; Kollars, “By the Seat of Their Pants:
Military Technological Adaptation in War”; Michael D Doubler, *Closing with the Enemy: How GIs Fought
military, and particularly within the individual services. As we will see, however, there are issues for which intraservice attitudes are generally uniform. Indeed, with very few exceptions, air force officers in the United States and Britain supported the primacy of long-range bombing during the interwar period; and although there was some limited debate about the role of fighter aircraft in future wars, attack and ground support aviation was uniformly considered a secondary priority. Thus, in the absence of debate over service priorities, intraservice theories provide little insight regarding the sources of change. Second, bottom-up theories of military change ignore the powerful incentives and resources that can be deployed to silence lower-ranking individuals with unorthodox views. Absent the intervention of outsiders, there is reason to believe that these lower-ranking voices can and will be silenced. Accordingly, the influence of military leaders at all echelons is necessarily limited with regard to cases where intraservice debate is nonexistent or easily suppressed.

Dissemination Infrastructure

In addition to those scholars who emphasize the internal bargaining within the military, some students of military behavior have focused on other elements on the military’s internal structure to explain differential learning outcomes. In particular, recent work by Benjamin Jensen, Eric Heginbotham, Frank Hoffman, and Nina Kollars have emphasized how the dissemination networks, i.e. the channels of communication that exist within the military for developing and transmitting new knowledge, can influence the patterns of learning that we observe in militaries. The critical elements of this infrastructure vary from author to

author. For Jensen, the critical element is informal “advocacy networks,” in which coalitions of senior military and civilian elites can act as entrepreneurs, peddling the novel concepts identified in the incubators to their peers, infusing them with legitimacy, and protecting them from powerful naysayers. For Hoffman and Heginbotham, the critical feature of the infrastructure includes both the formal and informal dissemination mechanisms—from doctrine to magazines to bar-room conversations—that allow for new knowledge to make its way throughout the military organization. In general, all of these scholars tend to emphasize that the source of these dissemination and information processing structures are contingent on the institutional cultures of a given military. Thus, where dialogue and debate are embraced, they suggest we should see more robust dissemination structures, and where debate is suppressed, there should be fewer forums for information to flow freely.

To a certain extent, these theories provide significant traction on the variation we observe across countries when it comes to learning the lessons of war. As we shall see, in the British case the absence of robust dissemination infrastructures was partly to blame for the delays in implementing new methods for executing tactical airpower operations. However, these infrastructures are only partly to blame. Indeed, the British did have many of the dissemination mechanisms necessary to transmit new knowledge, but they chose to funnel old, ineffective concepts through those mechanisms, while suppressing or ignoring good information. Put another way, dissemination networks are only as good as the information that passes through them. Accordingly, additional theorizing is necessary to understand why some states are better able than others to both create and transmit good information coming from the battlefield.


Jensen, *Forging the Sword*, 20.

While all of the theories outlined above predict that military learning should occur during wartime, they each identify different causal pathways to this outcome. For some theories, it is the nature of the conflict itself that causes militaries to learn, for others changes that come from without are critical, and still others argue that learning is a product of the structure of the organization. But whatever the source, all of these theories argue that learning should happen during war. It is difficult to argue with this logic, given that there is good theoretical reason to believe that militaries at war are often experimental, innovative, and adaptive. Indeed, at this general level, my theory of wartime learning is perfectly aligned with the existing literature. I do not doubt that threat, shock, failure, imitation, civilian intervention, resources, internal bargaining, or learning infrastructure all have a role to play in explaining whether and what militaries learn during war.

What all of these theories fail to explain is how militaries learn during wartime. When one looks at the cases of British, American, and German learning about tactical airpower operations during World War II, it is clear that all three of these militaries were able to learn successfully. And we can see some strands of existing theories in those outcomes. In all three cases, wartime dynamics were at play. In all three cases, civilian leaders were both aware of and intervening on behalf of the appropriate solution. In all three cases, resources were manipulated. In all three cases, intraservice politics were similar. In all three cases, several elements of robust learning infrastructures existed. And yet, in all three cases, the process of learning was unique, presenting different challenges at different times for each state. Thus, what existing theory cannot explain are the very different processes through which each of these militaries learned to successfully execute tactical airpower operations. And, as the next section will lay out, process matters a great deal in the context of military learning. Accordingly, we need a theory of wartime learning that can account for the differential processes through which militaries learn during war.
address this need by developing a theory of learning, Military Filtration Theory, that while rooted the extant literature, adapts its core insights to generate more theoretical precision about the process of military learning in different states.

3 Military Filtration Theory

3.1 Learning Defined

As noted previously, I conceive of wartime learning as a process of change. This section further explains my theoretical proposition. I begin by explaining the component phases of the learning process. From there, I discuss how conceiving of learning as a process allows us to more accurately capture learning outcomes—it allows us to assess not just whether learning has occurred, but to better understand how lessons were learned. In the next section, I offer an explanation of my theory, Military Filtration Theory (MFT), which emphasizes two key variables in explaining learning outcomes: (a) a state's national military strategy and (b) the resource endowments of a state's military.

Learning as Process

At first glance, defining learning does not seem like a particularly difficult enterprise. After all, learning is something that comes naturally to all human beings from our earliest days: learning to speak, walk, read, write, and think, are all parts of the human experience. Nonetheless, understanding and explaining how this very human process occurs in an organization without anthropomorphizing or otherwise distorting reality has proven to be a difficult enterprise for scholars. Theorists of organizational behavior have spent decades debating different definitions of what precisely constitutes organizational learning, and have
developed a litany of different conceptions of the term. Often, these discourses have taken on a philosophical quality, leading to difficulty in applying organizational learning definitions in practice. As Daniel Garvin, a leading scholar in the field of organizational behavior, puts it, these “discussions of learning organizations have often been reverential and utopian, filled with near mystical terminology.”

Fortunately, recent work by scholars of both organizational learning and wartime adaptation have developed more precise and operationalizable conceptions of learning that can be adapted to the cases examined in this dissertation. Specifically, the insights of Daniel Garvin, Anthony DiBella, and Frank Hoffman offer an excellent starting point for discussions of military learning, and my approach to defining learning combines the central insights of these scholars. First, from Garvin, I argue that learning must result in some change or modification to mindsets and behaviors. Second, from DiBella and Hoffman, I argue that learning is best understood as a process consisting of several phases. Combining the insights of these scholars, I define learning as the phased process of identifying a problem and implementing a solution, through which organizations modify their behavior to reflect the acquisition of new information. Although there has been significant debate over the application of the components of the definition supplied here, this definition of learning as

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59 For brief but comprehensive summary of these competing definitions see: Garvin, “Building a Learning Organization,” 3–4.
60 Garvin, 2.
64 This definition combines language from several theorists of organizational learning, including: Garvin, “Building a Learning Organization,” 3; Dibella, Nevis, and Gould, “Understanding Organizational Learning Capability”; and Hoffman, “Learning While Under Fire: Military Change in Wartime.”
a process-based enterprise resulting in behavioral modifications is generally agreed on by scholars of military change.\textsuperscript{65}

Although the significance of behavioral modifications should not be underestimated, the central premise of my definition of wartime military learning is the notion that learning occurs in two phases, which are distinct but often overlapping: identification of problems; and implementation of a solution.\textsuperscript{66} In the first phase, militaries must identify that a problem exists and simultaneously develop a range of potential solutions to the identified problem. In the second phase, militaries must agree on a solution at the most senior levels and implement it throughout the organization. Both of these phases present important and unique challenges for military organizations, and I review them in greater detail below.

**Identifying the Problem & Potential Solutions**

The first phase of learning requires that a military identify the existence of a problem and begin to develop potential solutions to that problem. This identification phase is critical to the overall process of learning. First and foremost, it requires that militaries effectively interpret information and data emerging from the battlefield itself. It is not enough to simply have information about existing problems, an organization must process that information to make meaning of it. As DiBella notes:

> It is important to distinguish between information and knowledge. We generate knowledge when we give meaning to information or experience. For the learning cycle to be engaged, it

\textsuperscript{65} For a comprehensive review of the trajectory of these debates in both the organizational behavior and military learning scholarship, see Hoffman, “Learning While Under Fire: Military Change in Wartime,” 31–37. Hoffman provides an especially detailed account of the various process models applied in other theories of wartime learning.

\textsuperscript{66} These two phases are a streamlined version of DiBella’s three phases of learning: knowledge creation, sharing, and use.
is not sufficient to have the information in the system; organizational members must have a shared basis for interpreting that information and giving it meaning.\textsuperscript{67}

In this way information serves as the ore of learning—it only becomes valuable once it is processed by individuals.\textsuperscript{68} To do so, individuals engage in iterated dialogue about observed performance gaps at various places within the military organization.\textsuperscript{69} Specifically, in this phase, individuals do two things: first, they recognize that there is a problem with performance based on their experiences and, second, they begin to devise solutions to that problem. Thus, by taking new information from their experience in the field and developing candidate solutions to identified gaps, individuals give meaning to that information and, therefore, initiate the process of learning.

Having identified that a performance gap exists, the organization must then begin to create and test possible solutions to the problem at hand. In order to do so, individuals must surface tacit, individual, knowledge with a wider audience, and provide an opportunity to evaluate, test, and engage in dialogue about the new knowledge and solutions that have been surfaced.\textsuperscript{70} In this phase, potential solutions can be disseminated and evaluated through both formal (magazines, memos, training circulars, exercises, etc.) and informal (word-of-mouth, letters, observation, etc.) mechanisms, thereby allowing the organization to probe the utility and effectiveness of possible remedies. By making explicit and communicating this knowledge about the extant problem and its potential solutions throughout the organization, militaries can engage in iterated testing and dialogue in different venues. It is this record of record of debate and dialogue that senior leaders rely on to inform their

\textsuperscript{67} DiBella and Nevis, \textit{How Organizations Learn}, 30.

\textsuperscript{68} Kollars, Muller, and Santora, “Learning to Fight and Fighting to Learn,” 1048; Easterby-Smith and Lyles, \textit{Handbook of Organizational Learning and Knowledge Management}.

\textsuperscript{69} Kollars, Muller, and Santora, “Learning to Fight and Fighting to Learn,” 1049; Hoffman, “Learning While Under Fire: Military Change in Wartime.”

\textsuperscript{70} Kollars, Muller, and Santora, “Learning to Fight and Fighting to Learn”; Easterby-Smith and Lyles, \textit{Handbook of Organizational Learning and Knowledge Management}. 

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discussions about solutions in the next phase of learning. Accordingly, during the identification stage of the learning process we should see an open, iterated dialogue about the problem and its potential solutions, taking place in multiple places in the organization, both formally and informally.

**Selecting & Implementing the Solution**

Having identified that a problem exists, tested and debated possible fixes to that problem, and arrived at some conclusions about the best solution, the second phase of learning requires that a military then implement an agreed upon solution uniformly throughout the organization. This phase of implementation is critical: “knowledge may be generated and disseminated throughout an organization, but unless it is used to alter our decisions, our behavior, or our culture then the learning cycle remains incomplete.” In the military learning context, this requires that militaries take existing information about a problem, select a solution, and ensure that changes are implemented in the field.

For a solution to be implemented, it first needs to be selected from the range of potential fixes that were proposed and tested in the first phase of learning. In this respect, the participation and assent of senior military leaders is critical. Indeed, no solution is likely to be implemented in the field without the support of several key commanders in positions of considerable authority. In making their determination about which solution to select for implementation these leaders may consider a range of factors, including but not limited to: demonstrated battlefield performance, testing and evaluation reports, organizational interests, personal motivations and interpersonal disputes, and available resources. Ideally, we would want these leaders to ignore myopic personal or organizational interests and instead employ some sort of rational-legal decision-making process when selecting a solution.

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Of course, this is not always the case. But whatever the decision-making process employed by senior leaders, the implementation of solutions requires their participation, since they are endowed with the authority and expertise to ensure widespread adoption of a given solution. Thus, it is senior military leaders who must decide which of the available solutions will be employed in practice, and the learning process will not often proceed to widespread implementation absent their assent.

Once agreed on by senior leaders, the implementation of the solution requires that the organization as a whole is made aware of the change, and that enforcement mechanisms are in place to ensure widespread adoption of the solution. Leaders can use both negative and positive inducements to ensure compliance. On the negative side of the ledger, leaders can threaten to remove subordinates, or actually remove them, if they do not adopt the change. They can also constrain resources available to units who do not comply with the new concepts. On the positive side of the ledger, leaders can develop marketing and public relations campaigns featuring prominent and well-respected leaders promoting the change, or they can provide additional resources to units and individuals who embrace the changes. Either way, these inducements should result in the widespread adoption of changes decided on at the more senior levels of the military organization. Thus, in this phase, we should observe, first, discussion among senior leaders about the appropriate solution to an identified problem, and then widespread adoption of the new concept (i.e. behavioral modifications) in the relevant places on the battlefield.

In summary, I define learning as a two-stage process of first, recognizing a problem and developing potential solutions, and second, choosing and implementing the preferred solution in a way that modifies military behavior uniformly. If the first phase of learning has been initiated, we should see iterated dialogue about specific military problems (i.e. actual or anticipated performance gaps) in both formal and informal venues, and initial
testing of potential solutions to the problems identified. In the second phase of learning, we should see decision makers discussing and endorsing a solution, and then ensuring that the solution is adopted uniformly throughout the organization with the tools at their disposal.

**Learning Process versus Outcomes**

Generally, when scholars talk about learning they are concerned with whether or not an organization has learned the *right* lessons. And, indeed, engaging in the process of learning does not inherently mean that one learns the right lessons. Militaries can and do inaccurately learn the lessons of war all the time—too frequently fog and friction cloud judgement and lead to militaries adopting solutions and making behavioral modifications that result in perverse or counterproductive outcomes. Thus, engaging in the process of learning does not, in and of itself, lead organizations to arrive at desirable outcomes. As a result, scholars of wartime learning have focused on the dyadic question of whether or not the military learned the right lesson. In answering this question, scholars often compare cases where one military learns the right lesson during war, and another learns the wrong lesson during war.

While there is much insight to be gleaned from these comparisons, this is not the end of the learning story; indeed, it may just be the beginning. I pick up where these theories leave off, by asking whether or not there is variation in the learning process even among those states that learn the right lessons of war, and I find that there is a great deal. As a

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72 Indeed, this problem is not unique to military organizations. As DiBella and Nevis note firms are also capable of learning the wrong thing: “While claiming that organizations have processes to acquire, disseminate, and use knowledge, we need to be aware that these processes may be used for outcomes other than those desired by an organization’s leadership.” DiBella and Nevis, 37.


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result, this dissertation is focused on understanding why different militaries move through the learning process in differential ways, even if they arrive at the same conclusion.

But why should we care about the learning process as opposed to learning outcomes? After all, if a military eventually learns the right lessons, why does it matter how they learned them? The answer to this question is simple: poor learning processes are costly. Militaries who stumble through the learning process waste both time and resources, and success in the competitive wartime environment demands that militaries minimize this sort of waste relative to their adversaries. Thus, militaries with faster, leaner, learning processes have a competitive advantage in war. Not only will they be able to employ new operational concepts against their adversary’s outdated ones, but those militaries can then reallocate the personnel and material resources that had been devoted to the learning process back in to the field. On the other hand, militaries whose learning processes are slower and more wasteful than their adversary will get bogged down and will pay a price in terms of casualties and losses on the battlefield. In an environment where there are no trophies for second place, learning the right lesson is not enough; instead, militaries must learn the right lesson before their enemies. Thus, from a purely operational perspective, we should be very interested in uncovering not just whether but how different militaries make their way through learning processes on the battlefield because it helps us better understand who has an important competitive advantage in the war.

However, this approach raises a second question: what constitutes a “good” or “bad” learning process? One can imagine several ways in which a military that eventually learns the right lessons might still struggle during the learning process. First, military organizations can learn the right lessons, but these lessons can be fleeting. In other words, learning can be short-term and superficial, as militaries can backslide into old habits even after lessons have been ostensibly learned; the result being that some militaries have to
relearn the same lessons throughout the war. Second, militaries may learn the right lessons, but they may do so inconsistently throughout the organization, with some parts of the organization successfully learning and other parts persisting with outdated behaviors. Finally, and most relevant to the cases examined in this dissertation, militaries can learn the right lessons, but they may learn them slowly. Although there is no objective metric for “fast” or “slow” learning, we can get a sense of the pace of learning within a given military by comparing its progress to its peers, adversaries, and other parts of its own organization. In all of these ways, we can thus conceive of a military organization moving through the learning process differentially. Accordingly, I consider learning processes that are resilient, systematic, and fast to be stronger than those that are lacking one or more of these attributes.

As we will see in the British, American, and German cases, all three militaries eventually implemented the right solution to the problems presented by tactical airpower operations. This would lead many scholars to conclude that each were successful learners. But what this framing masks is that the British and American militaries struggled at certain points in the learning process, while the Germans were quick to solve the problems of tactical airpower operations. And, indeed, the British and American delays in this respect proved to be very costly in terms of both territory, resources, and time. Accordingly, my dissertationunpacks how and why the process of successful wartime learning looked very different in practice between these militaries. In doing so, I demonstrate the importance of getting both the learning process and its outcome right.

In summary, I conceive of learning as a phased process, during which a military recognizes a problem and implements an agreed upon solution. In order to understand how militaries may move through this process differently, I examine cases where several militaries learn the right lesson, but in unique ways. In taking this approach, I am able to
develop a more nuanced understanding of what successful learning looks like in practice. I acknowledge that even among states that successfully learn the lessons of war, many still experience delay, inconsistency, or ephemerality. In doing so, I am better able to capture the nuanced nature of learning than other scholars in the field.

3.2 Military Filtration Theory: National Military Strategy and Resource Endowments

Given the approach to learning described above, the central question of this dissertation is: what explains variation in the successful learning processes of different states? Or, more simply, why is that successful learning looks so different between states? As noted previously, the existing explanations of wartime learning are primarily concerned with explaining whether or not successful learning occurs at all. Moreover, most of these theories make the same prediction with regard to learning about tactical airpower operations in World War II: all of the militaries engaged in combat should have learned to successfully employ tactical airpower aviation assets. Not only were the threat-based incentives of war apparent to all of the parties, but civilian intervention was rampant, resources were manipulated, commanders were astute in the politics of their services, and all of the militaries were endowed with robust dissemination networks. And, indeed, the British, American, and German militaries did eventually learn to successfully execute tactical airpower operations.

But what these theories cannot explain is the differential learning processes observed in each of these states. Both the British and American militaries were quick to identify the problem of tactical airpower once the war began, but slow to implement a solution; while the Germans were quick to both recognize the problem and implement a solution well before the war began in earnest. What accounts for these differences? I argue that these different
learning processes can be best explained by examining the interaction of two key variables: (a) the state’s national military strategy and (b) the resource endowments of the state’s military. These two variables act as a filter on the information that is taken in, processed, and implemented by military organizations. More precisely, my theory argues that a state’s national military strategy will dictate which problems a given military identifies; and its resource endowments will dictate whether and how these solutions are implemented. Below, I define each of these variables. In addition, I briefly outline how the values on each variable explain the differential learning outcomes observed in each case to familiarize the reader with the architecture of my argument. In each of the empirical chapters, I provide a detailed account of these variables and their operation in the prelude to and early phases of World War II.

3.2.1 Explanatory Variables: National Military Strategy and Interservice Relationships

National Military Strategy

Military Filtration Theory argues that a state’s national military strategy will influence the first phase of the learning process: problem identification. Specifically, MFT argues that national military strategy will act as a filter on the types of problems that state and its military are likely to acknowledge. But what is a state’s national military strategy? Officially, a state’s national military strategy is its plan for “distributing and applying military power to attain national security.” Put more colloquially, however, a state’s national military strategy is its shared set of beliefs about the type of war it is prepared to fight.

74 “DOD Dictionary of Military and Associated Terms” (United States Department of Defense, August 2017).
A state's view about its national military strategy is dictated to considerable extent by its grand strategy, i.e. the “theory or logic that guides leaders seeking security in a complex world.” These overarching security goals serve to guide, focus, and constrain national military strategy. But what specific components of a state's grand strategy serve to dictate the contours of its military strategy? Two features of a state's grand strategy are central to the development of the national military strategy: (1) its geography and (2) its beliefs about offense and defense. These two considerations will structure its national military strategy, influence its military preparations, and determine which types of military problems its sees as worthy of deeper study.

First, a state will consider its geography when developing its national military strategy. The reason for this is simple: a state's geography will bear on what the primary domain of combat is likely to be in a future war. Depending on where the state is situated in the world, it will determine whether future conflicts are likely to be fought primarily on land, sea, or air and, as a result, the state will have to make choices about the overall balance of its military capabilities. Countries surrounded by large expanses of water know that future wars will require crossing that water by sea or air, so investing in air and naval power is generally a safe bet. On the other hand, landlocked countries are more likely to invest heavily in ground capabilities since future wars will necessitate fighting on land. Thus, states will take account of their geography in determining the primary domain of future conflict, which will dictate the relative balance of forces in their military.

In addition to assessing the primary domain of conflict based on their geography, states will also consider whether their overall warfighting posture will be offensive or defensive. For states that emphasize a defensive fighting posture, we should expect

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investments in capabilities that will allow for the defense of their homeland—particularly at the coasts or borders—and deterrent capabilities in the form of long-range air and naval capabilities. For states that believe in the benefits of an offensive military strategy, they will place their bets on capabilities that allow for rapid and sustained attacks on enemy territory. Thus, taken together with the geographic disposition of the state, national preferences for offensive or defensive strategies will determine the core elements of a state’s military strategy at any given moment in time.

For example, the national military strategy of an island nation with a strong belief in the primacy of defense would likely include significant investments in the naval and air services, focused on defense of the coasts and long-range deterrent capabilities. Where such a state does invest in land capabilities, we would expect those investments to be primarily oriented toward defense of the coasts and population security. Indeed, this is the sort of national military strategy we see in both the United States and Britain during the interwar period. On the other hand, island nations with a commitment to offense will likely invest in long range air and naval forces, but they will also be forced to make investments in

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capabilities necessary for rapid ground advance along with the transit and support of those forces from the air and sea.

Contrastingly, landlocked states with a belief in the primacy of the offensive will invest mainly in landpower, but they will likely do so with an emphasis on capabilities that will allow for rapid attack on enemy territory. Where they invest in naval and air capabilities the primary concern will likely be support of such offensive ground operations. This is precisely the military strategy we observe in Germany during the late interwar period. On the other hand, landlocked states with commitment to the defense are more likely to invest in ground capabilities that shore up natural defenses and bolster capabilities for defense in depth. Where these states do invest in naval and air forces, they will likely focus on developing short-range capabilities that can support of ground operations. We see this national military strategy taking root in French interwar thinking. Thus, by examining the interaction between national beliefs about the primacy of particular domains, as well as the benefits of offense versus those of defense, it becomes clear that different states may have different beliefs about the type of war they expect to fight or, as the case may be, are currently fighting.

Military Filtration Theory argues this national military strategy will dictate the types of problems that a military is likely to identify as worthy of further study, and it argues that changes in this military strategy will initiate changes in the problems that a military identifies. But what does this mean in the context of tactical airpower operations? Broadly, the link between national military strategy and tactical airpower operations is simple: national military strategies that prioritize offensive ground operations are more likely to encourage military leaders to attend to the problem of tactical airpower operations. After all, as the next chapter shows in greater detail, air support of ground forces becomes paramount when undertaking offensives on land. Tactical airpower operations, when done
well, allow for the rapid advance of ground forces, and can be especially useful in supporting a breakthrough of enemy frontlines. Accordingly, in states where ground offensives are at the center of the national military strategy, MFT predicts that solving the problems of tactical airpower operations should be high on its list of priorities; whereas in states that do not place ground warfare at the center of military strategy, we should expect tactical airpower operations to be largely ignored.

As we shall see in Chapters 3 through 5, the national military strategy of the United States, Britain, and Germany dictated when and how they acknowledged the tactical airpower problem. Initially, the defensive, air- and seapower orientation of the United States and Britain meant that tactical airpower operations were largely ignored. Since tactical airpower operations would primarily be useful in an offensive ground campaigns, and such campaigns were not initially central to the national military strategy of either the United States or the United Kingdom, MFT predicts that military leaders would be uninterested in tactical airpower. However, after the German offensive blitz in Poland and France, the American and British national military strategy shifted toward the view that the next war would be fought on land and that the offense would have the advantage in the war to come. Recognizing that a war was on the horizon and that winning such a war would require rapidly taking and holding ground, both states updated their national military strategies and began to consider problems associated with offensive ground operations in the early 1940s. Among the many military operations that rose to prominence when this shift took place was the role that air forces could play in supporting armies engaged in ground combat. Accordingly, it was after this shift in the American and British national military strategies that tactical airpower emerged as a problem worth further study.

The Germans, on the other hand, were landlocked; and, as a result, they had been concerned primarily with problems related to landpower for decades. Moreover, as the
German national strategy became increasingly offensive in nature during the interwar period; they became even more focused on problems related to taking and holding territory. Accordingly, it should come as little surprise that the Germans were primarily interested in air and sea power only insofar as it would support offensive ground operations. As a result, tactical airpower operations had long been understood as a crucial part of future campaigns and had been studied in great depth by the Germans before the war began. Thus, MFT accurately predicts that the German, American, and British national military strategies influenced whether and when each of these states identified the problem of tactical airpower.

Resource Endowments
But identifying a problem is not the same as solving it; and for the implementation phase of the learning process we must look to a different explanatory variable in determining why some states were better able to implement solutions to the tactical airpower problem: resource endowments. By resource endowments, I am referring broadly to materiel and personnel; and, in the context of tactical airpower operations, I am referring to pilots and planes. MFT argues that the distribution of resources within a given military are primarily responsible for the success or failure a state has in implementing an identified solution. In the context of tactical airpower operations, MFT argues that resource endowments will determine the level of competition or cooperation between the air and ground forces, which will in turn affect their ability to adopt joint solutions to the tactical airpower problem. Specifically, MFT posits that states with abundant resources are more likely to have services inclined toward cooperation, whereas states facing resource scarcity are likely to be more inclined toward competition. In the former case, we should expect tactical airpower solutions to be implemented effectively, and in the latter case should expect implementation to face significant hurdles. Below, I detail the logic behind these propositions in greater detail.
The mechanisms behind each of these predictions are relatively straightforward. Where resources are abundant we should expect cooperation between the services. The key mechanism here is that significant resources eliminate the need to make singular bets. With unlimited resources, a service is able to implement several different solutions at once, since resource abundance removes the need to make difficult choices about prioritizing among competing missions. Instead, militaries endowed with significant resources can, effectively, do it all. When resources are flush, a service can pursue joint or cooperative enterprises at little or no cost to their preferred, autonomous missions. Thus, where there are abundant resources we are likely to see militaries implementing cooperative solutions because doing so comes at little cost to other preferred missions.

The biggest problem for the implementation of solutions that require interservice cooperation comes under conditions of resource scarcity. Services that do not have quite enough assets to pursue multiple solutions to a given problem are in a difficult position: they need to make hard choices about which solution they will choose to implement. Without the freedom ushered in by resource abundance, the services are likely to revert to the tendencies predicted by organizational theory: absent the ability to pursue multiple solutions at once, the services will turn inward. The services should see resources and autonomy as zero-sum, and gains made by one service will be viewed as losses to another. Information and resources will be hoarded, and suspicion and antagonism between the services will remain high. Under these circumstances, it should come as little surprise that when the services are asked to cooperate in implementing a solution on the battlefield, they will have neither the inclination nor experience to work together. Instead, they will resort to the suspicion and slow-rolling that they have employed in preserving their resources up until that point. Further, we should not expect this interservice antagonism to be resolved—
and cooperative solutions fully implemented in the field—unless and until the infusion of resources relieves the decision-making pressure that they face.

At this point, however, an important caveat about resources is necessary: in all of the cases under consideration here, the promise of resources is not the fact of resources; and, in the context of implementation, the latter does all of the work. Put another way, resources have significant explanatory power only insofar as they exist in the theaters of operation. This is an especially important caveat in the context of resource abundance. As we shall see, in all three cases, civilian leaders were quick to make promises about future aviation assets and to allocate funding toward that end, but these guarantees took some time to be translated into actual planes. For instance, President Franklin Roosevelt's calls for additional American planes in the wake of early German aggression on the continent were of little help to commanders undertaking training and operations in the early forties, since Roosevelt's plans would take time to be realized in fact. Thus, it is not until aircraft—and combat ready aircraft at that—are actually delivered that we should expect the pressure of meeting competing demands on the battlefield to be eased, and conciliation between the services to begin. In short, the resources that are impactful vis-a-vis implementation are the resources that have arrived.

But why does cooperation matter for the implementation of tactical airpower operations? In the context of this dissertation, the selection and implementation of effective systems related to tactical airpower requires a cooperative relationship between in the air force and the army. As we shall see in Chapter 2 tactical airpower operations require close coordination between the air and ground forces, and concessions on both side of the issue. Thus, we should expect that where airpower resources are abundant, there should be cooperation between the army and air force in implementing collaborative solutions like those related to tactical airpower operations. On the other hand, where resources are scarce,
we should expect that little progress will be made in implementing cooperative solutions to
the problems raised by tactical airpower operations, even when the services are well aware
of the problem at hand.

Given all this, in examining the German, British, and American experience with
tactical airpower, I examine the level of resources available to the air forces of each military
at several points before and during World War II.77 In the German case, I find that resource
abundance ensured implementation of systems for effective tactical airpower operations as
the prospect of war grew more certain. From 1933 to 1939, the profusion of aviation
resources provided to the Luftwaffe under Adolf Hitler served to ensure that cooperative
implementation of tactical airpower solutions was sustained. However, as resource
constraints began to reemerge over the skies of the Eastern Front, the robust cooperation
between the Luftwaffe and Heer began to crumble. Both the British and American air forces,
on the other hand, were faced with significant resource scarcity in the run up to the war,
which meant that they would have to make hard choices about what airpower missions to
prioritize. As a result, in both cases, the air force maintained an antagonistic relationship

77 Reliable figures on the available first-line aircraft and production output of the combatants are difficult to
come by and often inconsistent. With that important caveat in mind, I have collected these figures from
several sources in each case; where discrepancies exist, I have generally relied on the more widely embraced
number. The sources include: David E. Johnson, Fast Tanks and Heavy Bombers: Innovation in the U.S.
with its sister services for a significant part of the period under consideration here. It was not until the Allied production and delivery of air power resources to the theater spiked in 1942 and 1943 that air and ground forces began to cooperate more fully to implement solutions to the problems of tactical airpower operations.

Thus, MFT accurately predicts that implementation of tactical airpower solutions in the United States and Britain should be halting and slow until the delivery of considerable resources in the theater eases interservice tension. On the other hand, implementation should be much smoother in the German case where abundance kept interservice tension low during the prewar years, but should falter as resource constraints emerged later in the war.

**Predictions**

Taken together, MFT’s two explanatory variables—national military strategy and resource endowments—are capable of predicting the differential processes by which militaries are likely to learn in the immediate prelude to war and during war itself. The problems which a state is able to identify will be influenced by its national military strategy; while the implementation of a given solution will be influenced by the resource endowments of its military.

In the context of tactical airpower operations, MFT predicts that states with a national military strategy favoring offensive operations on land should be most likely to identify and invest in studying the challenges presented by tactical airpower operations. Accordingly, we should expect Germany to be concerned with the tactical airpower problem set for the duration of the interwar period, but especially as it prepared to launch its offensive, land campaign on the European continent after 1933. On the other hand, we should not expect the American or British militaries to be concerned with tactical airpower
until their national military strategy shifted from a defensive air and naval approach to an offensive air, naval, and ground approach in the early 1940s.

But MFT also predicts that the process of deciding on and implementing a solution to the problems presented by tactical airpower operations will be influenced by the state’s resource endowments. Since tactical airpower operations require the participation of both the air force and army, it predicts that where resources are abundant there should be incentives to cooperate in implementation; but where resources are scarce, there will be incentives for competition and, therefore, cooperative implementation of solutions will be fraught. Accordingly, in the U.S. and United Kingdom, MFT predicts that scarce airpower resources in the prewar and early years of the conflict would make implementation of effective tactical airpower systems a tense and slow enterprise until abundance emerged in the operational theaters; whereas in Germany, abundance before the war meant that cooperative solutions faced fewer setbacks, but diminished when scarcity reemerged later in the war.

In general, the empirical record on American, British, and German learning about tactical airpower during World War II supports the predictions of MFT. However, as I discuss in the next section, elements of the British and American cases do not align perfectly with the predictions of the theory, particularly related to the influence of resources on the implementation phase of learning. Although these observations are not fatal to the theory, they highlight meaningful limits to its reach. In the following three sections, I preview the findings of these three cases. In Chapters 3-5, I examine the predictions and evidence for each case in greater detail.
3.2.2 United Kingdom & United States

In the British and American cases, the halting process of learning about tactical airpower operations is best understood primarily as a problem of implementation. Indeed, the historical record is clear that both the United States and United Kingdom knew about the problems of tactical airpower operations before the war began. As many scholars have argued elsewhere, both states became attuned to this problem as they redirected their focus toward land operations in the late 1930s. However, when it came to implementing those solutions, interservice tension over resources served to undermine progress.

As I illustrate in Chapters 3 and 4 both the United States and Britain’s national military strategies immediately after World War I emphasized defending territory by air and sea. Where issues of land power came up, they were generally centered on homeland security or imperial policing. Thus, during the early prewar period, the problem of tactical airpower operations was largely ignored or superficially addressed by both countries. However, once hostilities broke out in France, the British and American national military strategy shifted. As the Germans had demonstrated in France, the next war would be fought and won by the state with the strongest ground forces. Thus, both the British and American militaries began to consider a litany of new military operations related to ground conquest that had previously been ignored, and became aware that tactical airpower operations would need improvement. Within months of that realization, both the U.S. and Britain had

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developed the basic architecture of an effective tactical airpower command structure through testing and experimentation. But despite this quick diagnosis of both the problem and the remedy, however, it took both the British and the Americans nearly three years to agree on and implement these changes in the North African theater.

What accounts for this delay in implementation of a solution? For the vast majority of the prewar period, the American and British air forces did not have enough resources to invest in multiple airpower strategies at once. Instead, they needed to choose between several competing priorities to direct their limited investments in training, personnel, and materiel. At the same time, both air forces during this period were eager to demonstrate their organizational and operational independence from the other military services, to whom they had been previously or were currently attached. Facing these circumstances, both air forces were reluctant to risk conceding any additional assets to the ground forces, and instead chose to invest their limited resources in strategic bombing, which emphasized the


80 In the British case, the RAF was successful in securing its independence after World War I. The American Air Force, however, was still subordinate to the Army. This difference is an important one, but in terms of interservice relationships the level of competition between the Army and Air Force in the US and Britain was comparable nonetheless.

independent effect of airpower and required virtually no coordination with the other services. By choosing to invest in strategic bombing, however, this meant that the tactical airpower system that both militaries had identified as effective during the prewar period would be sidelined in favor of developing and deploying strategic bombing capabilities. At the same time, the ground forces of both militaries were strapped for resources, and were unwilling to accept the elements of the tactical airpower system that would require concessions on their part. The result in both cases was that despite the emergence of compelling evidence in favor of a new system for tactical airpower operations before the war began and in its earliest stages, neither the air nor ground forces in the United Kingdom or the United States were willing to make the organizational concessions necessary to select and adopt such a system in the early phases of the conflict.

The inclinations of the services—and especially the air forces—changed, however, as a result of shifting resource endowments. As the production and delivery of air assets into the Allied theaters of operation began to surge in 1942 and 1943, the air forces were able to attend to both the strategic and tactical demands of the battlefield. Accordingly, when the two militaries converged in the North African theater in late 1942 it soon became clear that their combined combat ready air force strength would allow for the implementation of a new tactical airpower system at little cost to their service priorities. Thus, the pooled and growing resources available to the Allies starting in late 1942 and continuing for the remainder of the war made implementation of the already-identified system for effective tactical airpower operations a low-cost enterprise.

As we shall see in Chapters 3 and 4, however, the link between resources and implementation is not perfect in the British and American cases. Indeed, despite having

82 Meilinger, "Trenchard and 'Morale Bombing'"; Murray, "British and German Air Doctrine Between the Wars."
plentiful aviation resources at the end of 1942 and being well-aware of the core elements of effective tactical airpower operations, the Allies chose not to apply this system during the invasion of North Africa in November 1942. Instead, it was only after the failures of Operation Torch that the new system for tactical airpower operations was fully implemented. Since MFT cannot fully account for this aberration, it is suggestive of an important constraint on the theory: the operationally freeing effect of additional resources is not always immediately recognized and, moreover, it can take additional catalysts, like failure, to spur this process into motion.

But even if we concede that additional catalysts may be necessary in some contexts to trigger the implementation process, the successful completion of this phase of learning is still tightly linked to available resources. As we shall see, American and British forces had experienced considerable failures before Operation Torch when resources were still constrained, and none had spurred the successful implementation of tactical airpower changes. Indeed, it was not until resource endowments in the theater were sufficiently abundant that the reckoning of failure led to the widespread and sustained implementation of a new tactical airpower system in the theater. As I make clear in the next two chapters, it was only with an abundance of resources that British and American leaders were able to leverage the immediate frustrations of Operation Torch’s failures into the implementation of the new tactical airpower system without debilitating resistance from the services.

3.2.3 Germany

Unlike the British and American cases, the German experience with tactical airpower operations faced very few setbacks both in the prelude to and during the early phases of the war. Indeed, the Luftwaffe is remarkable for the relative ease with which it was able to develop and employ sound doctrine for tactical airpower operations at the onset of
hostilities. It was not until resources became constrained on the Eastern Front that challenges for tactical airpower began to meaningfully emerge. Again, German military strategy, as well as the unique resource endowments of their armed forces converged to elicit such an outcome.

German thinking about future wars during the prewar period was dominated by geography. The simple fact that Germany lay in the middle of the European continent meant that any future war would require they defend or expand their territorial assets on land. Moreover, German military strategy also had a distinctly offensive flavor for much of the late nineteenth and early twentieth centuries. The offensive land strategy of the early prewar period was only reinforced by the ascension of Adolf Hitler, believed that a continental campaign would be the centerpiece of his expansionist vision. Thus, from the end of World War I to the start of World War II, German national military strategy directed military attention to the problems of offensive ground campaigns and, as a result, to those of tactical airpower operations. The result was an awareness among the air force and army that cooperation regarding tactical airpower would be necessary in any war to come.

Knowing that tactical airpower operations would be critical to future wars, however, did not guarantee that it would be embraced by the military. Moreover, the airpower restrictions of the Treaty of Versailles ensured that little operational testing and progress could occur in the early part of the prewar period. As the prospect of war drew nearer, however, and resources began to return to the Luftwaffe in the mid-1930s, cooperation between the air and ground forces only grew. As I note in Chapter 5, the key turning point for the implementation of tactical airpower operations in Germany came in 1933, when Hitler officially revealed the Luftwaffe’s existence to the world, and infused it with such

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84 Murray, *Strategy for Defeat the Luftwaffe*; Murray, “British and German Air Doctrine Between the Wars.”
considerable resources that its leaders could invest simultaneously in tactical airpower operations while also pursuing other, independent operational capabilities. Thus, at virtually no cost to their tactical airpower capability, the Luftwaffe was able to expand their mandate during this period. The overall result was that effective systems for tactical airpower operations—even with all of their organizational compromises—were both identified and implemented by the Germans well before the onset of hostilities.

Once the war began, the Germans continued to refine and build their tactical airpower capabilities based on their initial experiences in western Europe. Critically, however, even this cooperative relationship proved fragile. As German ambitions and operations continued to expand, the resources available to the Luftwaffe were increasingly spread thin. As I will explain in Chapter 5, the sudden resource constraints that expansion to the eastern theater imposed on the Germans caused a reversion to the organizational pathologies of competition and interservice antagonism, and those pathologies began to undermine their tactical airpower performance in the Soviet Union.

Taken together, the combined result of the German strategy of fighting an offensive land war, along with the resource endowments during the prewar period meant that the air forces were not just willing to collaborate in developing and implementing a robust doctrine for tactical airpower operations during the war itself, but that the Wehrmacht began the war with a force that had a significant tactical airpower advantage. The Luftwaffe would continue to refine this system based on the early lessons of the war, when resources continued to be flush and cooperation was still cheap. Once resources began to tighten, however, we see the reemergence of organizational pathologies that made continued improvement of tactical airpower operations challenging.

This brief summary illustrates that the differential processes by which the British, American, and German militaries learned to successfully execute tactical airpower operations...
operations are well explained by MFT, albeit with some important constraints. In the following case chapters, I provide much greater empirical detail to support each of these arguments. But, for the time being, it is sufficient to note that British and American delays in adopting effective tactical airpower systems are best explained by a combination of the defensive military strategies and constrained resources. Contrastingly, the cooperative spirit that animated German learning about tactical airpower operations was the product of the strategic imperative to prepare for a land war as well as the resources available to the Luftwaffe. Only after this changed, did problems emerge. As the following case chapters will illustrate these two forces acted as a powerful filter on the information available to the militaries themselves, civilian interventions, internal bargaining, and dissemination networks.

4 Empirical Strategy

This dissertation tests my theory of wartime learning against the competing explanations above with a structured case comparison of the British, American, and German experiences learning to successfully perform tactical airpower operations during World War II. The remainder of this section explains why and how I utilize these cases to illustrate the explanatory value of my theory. I begin by spelling out why examining joint tasks offers an compelling test of theories of wartime military learning both methodologically and substantively. In doing so, I also describe why tactical airpower is a particularly demanding subset of joint tasks in the context of wartime learning. In addition, I discuss my use of structured, focused case analysis to test MFT against competing explanations. Finally, I conclude with a summary of the remainder of the dissertation.

4.1 High Bars: Joint Tasks & Tactical Airpower
4.1.1 Joint Tasks

With some notable exceptions, the approach of the existing work on wartime military learning has been to focus on learning in single-service, single-country, and single-theater cases. There is much value to this approach, particularly in the early stages of theory development, since it allows for significant methodological control and analytical precision. However, my empirical strategy takes a different approach, demanding more of theories of wartime learning by applying a “high bar” for these explanations. To do so, I ask whether theories of wartime learning, including my own, can explain differential learning processes with regard to joint tasks, i.e. those tasks which involve two or more services of the military.

Joint tasks offer a more demanding test of wartime learning than single service tests that have been applied in previous studies. Joint tasks present a high bar for wartime learning because, in addition to the many difficulties of learning in war (fog, friction, life-and-death consequences) that accompany in single-service learning processes, there are several organizational reasons that we should expect militaries to be especially resistant to joint learning. Indeed, the particular challenges of sharing knowledge within a given community have long been understood by theorists of organizational behavior. Cooperation between subunits of an organization is best understood as a collective action problem, in which individuals and subunits of the organization have strong vested interests in not sharing new knowledge:

Were it not for the variation in individual interest throughout an organization, knowledge sharing would be a straightforward activity, without much shirking, guile, or resistance. In an organization populated only by altruists, who are interested beyond all else in helping others to learn, knowledge sharing would not represent a major issue to researchers concerned with organizational efficiency and innovation...However, empirical studies in many fields... show that there are diverse and distributed interests behind knowledge production, barriers to knowledge sharing and people who and ways to teach less than they learn from others.

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85 Easterby-Smith and Lyles, Handbook of Organizational Learning and Knowledge Management.
86 Easterby-Smith and Lyles, 407.
Put another way, individuals and communities within an organization are not altruists, instead, they have unique interests, and those interests can sometimes be in competition with each other. Thus, when their preferences conflict with others in the organization, individuals may be unwilling to share or cooperate with others. In the context of military operations, for example, subunits of the organization may sometimes suppress or ignore information that does not align well with their organizational interests, particularly when this information threatens their access to resources and autonomy. One scholar makes this point well when he states: “Each service—army, navy, air force—fights for its own interests...No service willingly accepts second priority, with an inferior claim on resources...Because each service is concerned for its autonomy, a group of services is not likely to produce an agreed multi-service strategy or doctrine that does anything more than combine their independent service doctrines.” In short, the particular interests of subunits within an organization can serve as powerful breaks on cooperative learning and change.

In addition, sharing knowledge comes with a whole host of transaction costs, which increase as the cultural and social distance between subunits increases. The foundation of this argument rests on the view that different services of the military have different cultures, essences, and views of the world. Thus, as Posen argues, “individuals in sub-organizations are trained, rewarded, and promoted according to a particular way of doing business.” Where these “ways of doing business” align, we should expect little friction; but where they diverge, we can expect miscommunication and tension. Accordingly, successful

87 Posen, The Sources of Military Doctrine, 226.
88 Easterby-Smith and Lyles, Handbook of Organizational Learning and Knowledge Management, 414.
90 Posen, The Sources of Military Doctrine, 44.
communication with other elements of an organization that have different norms, patterns of behavior, attitudes, regulations, etc. can be a taxing exercise—sometimes requiring repeated interactions to minimize trade-offs, compromises, and miscommunication. This is not to say that different military services do not share an underlying culture, but we often underestimate how different service orientations can lead to different perspectives and, therefore, increase the costs of sharing new knowledge across communities.\(^91\)

Taken together, individual interest and high transaction costs lead to a collective action problem in the joint learning context. Although it may be in the broader interest of the organization for subunits to learn together and to share knowledge freely, there can be strong incentives for the individual services not to do so. Some scholars have prescribed solutions to this dilemma including, but not limited to, the use of outside agencies, structural changes, and selective incentives. But we should not expect a high degree of communications between subunits of an organization absent some stimulus.\(^92\)

In the military context, this collective action problem as two critical implications. First, that the successful execution and adoption of joint doctrine should be a daunting task for militaries. Jointness adds a new layer of interest and cost to the already difficult problem of wartime learning. But, second, it tells us that we should be attuned to instances where joint tasks are efficiently and effectively adopted by militaries during wartime, since they suggest that something is going very right. We should pay attention to these outliers precisely because they are outliers—they may tell us something interesting about how the many organizational barriers to joint learning can be overcome. For these reasons, I focus my empirical inquiry on cases where militaries successfully learn to adopt joint doctrine

\(^{91}\) Indeed, the entire premise of “jointness” and the periodic reforms to encourage it in the United States implicitly acknowledge that information sharing between subunits is difficult.

during wartime, but I pay special attention to the unique nuances of how this process evolves in each case. In this way, joint tasks set a “high bar” for theories learning; if we can identify and understand the causes of successful learning in the complex joint environment, we should be able to extend these insights into “easier” cases as well.

4.1.2 Tactical Airpower

Why focus on tactical airpower as my test of joint learning as opposed to other seemingly difficult joint tasks? The choice of tactical airpower might be surprising to close observers of military operations, who would note that the doctrine for tactical airpower success is relatively straightforward. Indeed, he technical task of integrating air and ground forces on the battlefield has been well-understood and successfully employed in many wartime contexts. But there are several reasons that this subset of joint operations presents an especially difficult type of problem for even the most advanced militaries.

First, the employment of tactical airpower requires a level of integration that is unlike most others—it must go beyond the simple interoperability of air and land forces, and instead requires true unity of effort to achieve its battlefield aims. Tactical airpower operations involve a precisely choreographed dance of air assets, ground units, and their commanders. It necessitates extensive coordination and communication ahead of time but can also require a heavy dose of improvisation at the moment of execution. The result is that the slightest miscommunication or misstep can have significant effects that ripple throughout the operation: confusion or miscommunication about targets, bomb lines, sequencing, or authority can have immediate life-and-death consequences for both the pilots and their compatriots on the ground.

Moreover, tactical airpower operations also present a genuine organizational dilemma. As I will illustrate in greater detail in next chapter, the organizational interests
of the ground and air communities leads to very different preferences with regard to tactical airpower operations. Within the ground community, there are several good reasons to prefer a tactical airpower system that attaches specific air assets to specific ground units for their exclusive use. Ground commanders engaged in a high-intensity land battle are understandably concerned with massing as much firepower on immediate, frontline, targets as is possible. Accordingly, it makes good sense that a ground commander would prefer that tactical airpower assets are arranged in such a way that their firepower can be easily, effectively, and quickly directed toward targets in their immediate battle area.

For the air force community, however, the incentives are different. Unlike ground commanders, air commanders tend to think of the battlefield in much larger terms than the fighting that occurs in a specific sector of the frontline.93 Instead, air officers are encouraged to think about the battlespace as having multiple dimensions, which cover a much more expansive area than just the frontlines.94 Given that the battlefield is conceived of so expansively and air assets are limited, it makes good sense for air commanders to prefer that all air assets centralized under a senior commander, who can deploy those assets to converge on key nodes, often beyond the frontline of a specific engagement. The result is a that, instead of parceling out air assets to specific units as the army prefers, the air community tends to prefer a more centralized and flexible system of air support for ground operations.

The problem, of course, is that these are two very different systems, and sustaining both types simultaneously requires an abundance of resources that are rarely available. Thus, commanders are faced with a dilemma: the preferred system for tactical airpower

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94 Vermillion, *Understanding the Air Force Culture*. 
operations is perfectly rational given the incentives faced by each community, but they must choose one. Accordingly, the complex organizational dynamics that surround tactical airpower operations, as opposed to the difficulty of the operational concept itself, is what makes tactical airpower operations a good proving ground for theories of military learning. Not only is tactical airpower a joint operation, but it one of the most organizationally complex joint operations. In short, by using tactical airpower operations as my test of these theories, I place the empirical high bar on the top rung.

Skeptics might argue that tactical airpower operations are not the only joint operations to present these sorts of complex tradeoffs. For example, amphibious operations can require an equal amount of interdependence and results in similar amounts of tension, so why not focus on that type of joint operation? To this concern, my answer is an empirical and practical one: since the advent of airpower in World War II, tactical airpower has been employed in nearly every American military operation, large and small. Even today, American aviators are flying tactical airpower missions in support of ground forces in Iraq and Afghanistan. Indeed, tactical airpower operations seem to be a favored choice of political leaders in a variety of military contexts, whether it is being used as a “small footprint” solution to unconventional conflicts around the globe or in higher-end conventional engagements against peer competitors in the form of “AirLand Battle” or, more recently, “Multi-Domain Battle.” Moreover, tactical airpower operations, though fundamentally an army-air force operation, has close corollaries in other interservice operations, including carrier support of ground operations that have become so popular in the post-Cold War era. Put simply, few other joint operations can claim such consistent versatility and popularity in the modern era as tactical airpower operations. Thus, understanding the process by which

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militaries learn to successfully undertake tactical airpower operations has a very real practical impact even today that other joint tasks do not. For all of these reasons, I chose to focus my attention the how and why learning about tactical airpower was met with very different responses between the British, American, and German cases.

4.2 Controlled Case Comparisons

In order to test competing theories of wartime learning, I employ a structured, controlled qualitative case comparison, along with Mill's "method of difference". Doing so allows me to control for several confounding variables, while offering a detailed, nuanced explanation of the cases under study. Here, I discuss three of the main features of this methodological strategy.

First, comparing the British, American, and German experiences with tactical airpower operations in World War II provides a good laboratory to interrogate wartime learning because it allows me to apply Mill's "method of difference". As described by Van Evera, "in the method of difference the investigator chooses cases with similar general characteristics and different values on the study variable (the variable whose causes or effects we seek to establish)." Thus, I chose to study the experiences of the British, American, and German militaries during World War II precisely because, on the face of it, their experiences with tactical airpower operations should be very similar. They are composed of similar men, fighting in the same theaters, against each other, with similar equipment, and under similar strategic conditions. Moreover, all three of these militaries arrive at a very similar conclusion about the best system of tactical airpower operations. Nevertheless, these cases differ when it comes to the process of learning during wartime. In

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the British and American cases, it took nearly three years to effectively develop and implement successful tactical airpower doctrine, while the German effort to do the same was much faster and smoother. These differences in the learning process emerge despite the fact that these three modern, Western militaries are otherwise quite similar. Thus, this approach allows me to observe and explain variation on the dependent variable, while also preserving methodological control on several potentially confounding variables.

In addition to employing the method of difference, I also chose to use the case study method to interrogate the American, British, and German experiences with learning about tactical airpower. And, indeed, there is a long history of using cases to test theories of war and conflict. As Steven Van Evera notes, “Most theories of war are best tested by case-study methods because the international historical record of prewar politics and diplomacy, which serves as our data, usually lends itself better to deep study of a few cases than to exploration of many cases.”97 The case study approach allows me to excavate the specific process by which learning occurs. As a result, I am able to uncover how the process of learning during can be undertaken more or less productively, and my findings are therefore more nuanced and practically useful than those studies that apply other empirical strategies.

Finally, I apply the structured, focused method to guide my analysis of each case. As described by Alexander George and Andrew Bennett, the structured, focused method requires that the researchers ask same questions “of each case under study to guide and standardize data collection, thereby making systematic comparison and cumulation of the findings of the cases possible.”98 To do so, I do two things. First, in each case, I make predictions about the type of evidence that would confirm the logic of my theory, and the evidence that would support alternative theories. Being explicit about these predictions

97 Van Evera, 30.
allows the reader to understand what precisely I am asking of each case, and the type of
data that I will need to support my argument. Second, I apply a standardized set of metrics
for measuring both components of independent variable, MFT (national military strategy
and resource endowments) and the dependent variable (learning process). As I discuss in
each case, I measure the two components of the independent variable by examining a
standardized set of indicators. In measuring national military strategy, I examine the public
and private speeches, letters, and plans undertaken by senior leaders in each case. In
measuring resource endowments, I examine acquisitions, production, training, and
deployment records in each state, along with internal correspondence and long-term
planning documents. In assessing the dependent variable, the learning process, I take
periodic measurements of each states’ progress in developing and adopting the ideal system
of tactical airpower operations by assessing doctrine, training, and operations records. As I
illustrate in the next chapter, there are a clear set of metrics available to assess what the
ideal tactical airpower system includes and, therefore, where a given state may be in process
of learning to employ this system. Thus, in all three cases, I am looking for evidence that
meets very specific metrics for both the independent variable and dependent variable.

Although the structured, controlled, case comparison method works well for my
purposes, there remain limitations to taking this approach. Among the most problematic
are concerns about the generalizability of my theory. In particular, there are real questions
about the generalizability of my findings outside of the Western, joint, conventional military
context and perhaps outside tactical airpower operations. Indeed, these questions are
significant and require more extensive research to remedy in full. However, I address some
of these concerns in my concluding chapter to demonstrate that the plausibility of my theory
extends beyond the context interrogated in great detail here. However, more work needs to
be done to further probe the specific applicability of these findings outside of the Western, large-scale, conventional wartime context.

In summary, my dissertation offers a unique and challenge methodological test for theories of military learning. By approaching the question from a joint perspective, my dissertation sets a high empirical bar for theories of military learning. As a result, my finding should extend to other contexts as well. In addition, my decisions to employ a structured, controlled case comparison adds to the methodological rigor of my dissertation.

4.3 Plan of the Dissertation
The remainder of this dissertation proceeds in five additional chapters. The next chapter examines the concept of tactical airpower and its significance to battlefield outcomes in great detail. The third chapter examines the early British experience with tactical airpower starting at the conclusion of World War I through operations in North Africa in 1943. In the fourth chapter, I examine the American experience over the same period, and in the fifth chapter I assess the German learning process vis-à-vis tactical airpower operations. The final chapter concludes.
Chapter 2: Understanding Tactical Airpower

1 Introduction

This dissertation is concerned with explaining the differential processes of learning that we observe in military organizations during wartime. To do so, I have asserted that I will examine the process of learning about a complex and difficult subset of joint military tasks—tactical airpower operations—in great empirical detail, in order to distill some broader insights into wartime military learning. Despite (or perhaps because of) its perennial use in conflicts around the globe, however, some readers may wonder what precisely I mean by tactical airpower operations and how I go about determining when and how a state has successfully learned to employ them. Accordingly, in the first part of this chapter I provide the reader with both a definition of tactical airpower operations and a set of metrics for measuring a state’s progress in learning to perform this task.

In the second part of this chapter, I address another concern that many readers may have about my decision to focus on tactical airpower operations: their impact. In order to alleviate any concerns about the impact of tactical airpower operations on battlefield outcomes, I provide three separate accounts of instances during World War II where tactical airpower operations had a significant, if not decisive, influence on the battlefield. In particular, I offer stylized narratives of the role that tactical airpower played in securing victory for the Germans during the Battle of France in 1940, for the Allies in the Battle of Mareth Line in 1943, and again for the Allies during the Battle of Mortain and Falaise-Argentan in 1944. In doing so, this chapter will illustrate that among the most compelling reasons for close study of tactical airpower is that when these operations are done well, they can—and did—have a significant influence on the battlefield. The final section of this
chapter will place these successful battles in the broader context of tactical airpower operations in the British, American, and German cases.

2  Defining and Measuring Tactical Airpower Performance

Before diving in to the empirics of tactical airpower, there remain two important questions concerning definition and measurement. First, there is the simple question of what I mean when I say tactical airpower operations. Below, I acquaint readers with my definition of tactical airpower operations, which aligns closely with modern conceptions of the employment of tactical aviation assets in support of ground operations. Second, and just as important, there is the question of how we know when a given military has learned to perform tactical airpower operations successfully. In this section, I argue that there is a clear standard for effective tactical airpower operations that can be applied uniformly to different militaries during the World War II. States that have adopted all the components of this standard and deploy it in the theater can be said to have successfully learned to execute tactical airpower operations; whereas states that fall short on some or all of the components of this standard can be said to be in the process of learning. States which deploy no elements of this standard can be said to have not begun the learning process. Below, I identify the set of core principles that make up this standard. Together these principles form a picture of how tactical airpower ought to be employed for maximum effect on the battlefield in high intensity conventional warfare. Having established this standard, I then use it in each case as a yardstick to measure progress within militaries at different points during the war.

2.1  Defining Tactical Airpower
Before delving into measurement, it is important to understand precisely what we are talking about when we say tactical airpower operations. Tactical airpower is broadly understood as those airpower missions which are used in direct support of ground forces. Within this category, there are two core missions: close air support (CAS) and battlefield air interdiction (BAI).¹ CAS and BAI missions are closely related, but distinct, concepts.² Close air support is understood as referring to “air attacks against hostile targets which are in close proximity to friendly forces, and which require detailed integration with the fire and movement of those forces.”³ These targets often require engaging enemy forces, armor formations, and artillery positions at or near the frontline. Critically, CAS requires very detailed integration with the ground commander given that the targets of the air assets are extremely close to friendly ground forces. This integration and communication between air forces and the ground commander is conducted through one or several liaisons (Joint Fires Observers, Joint Terminal Attack Controllers, and/or Forward Air Controllers), often with specialized training in both air and ground operations. In contemporary use, there are numerous different types of CAS involving different levels of coordination between the air and ground forces and related to their ability to verify enemy positions.⁴ But the underlying principle of CAS is the use of aviation to support ground forces engaged in active fighting at the frontlines.

¹ During World War II the naming conventions for these operations were different—instead of CAS and BAI, aviators referred to direct and indirect bombing respectively. However, such terms are not used here for two reasons: first, there remained a great deal of confusion over the appropriate names for different types of air support during WWII, sometimes leading to inconsistencies in the empirical record; and, second, CAS and BAI are more familiar terms for most readers and capture effectively the same concepts.
² Although the term BAI has fallen out of favor in recent Air Force doctrine, the concept has frequently been applied—in practice if not in name—during tactical airpower operations since the middle of the twentieth century. For more on the distinguishing elements and evolution of BAI see Richard Hallion, Strike from the Sky: The History of Battlefield Air Attack, 1911-1945, Smithsonian History of Aviation Series (Washington: Smithsonian Institution Press, 1989).
³ Ibid., 2; Joint Publication 3-09.3: Close Air Support (Joint Chiefs of Staff Publication, 2014).
⁴ Joint Pub 3-09.3.
Battlefield Air Interdiction, on the other hand, still requires integration between the air and ground commander but occurs deeper within enemy territory and therefore may be less tightly integrated with ground forces than CAS. BAI targets, in general, include the enemy's fielded forces and reserves, lines of communication, supplies, and airfields in the rear of the battle area. Here, air action may be less tightly integrated with the immediate battlefield targets, but it still aims to influence battlefield outcomes insofar as it attempts to isolate engaged enemy forces from their logistical infrastructure and reserves.

Taken together, tactical airpower operations consist of aviation employed in support of ground forces that is intended to destroy, suppress, and isolate engaged enemy ground forces. Its primary targets are the immediate battle area or directly in the rear of engaged forces and, as a result, requires close coordination with the ground force commander to avoid friendly casualties and maximize effect.

2.2 Measuring Tactical Airpower

The successful performance of tactical airpower operations during World War II required each state's air force and army adhere to several key principles. These principles were largely developed during the prewar years based on the lessons of World War I and several of the colonial conflicts and, in some important respects, this standard for tactical airpower operations is a product of its time. However, many of the underlying concepts that form the core of this standard can still be found in contemporary doctrine for tactical airpower operations. Accordingly, I use these collective principles as a standard for effective tactical airpower operations—against which I measure each state's progress in the remaining chapters. There are five core components of this standard: (a) centralized command, (b)

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6 Joint Pub 3-09.3.
command integration, (c) target selection and prioritization, (d) signal and liaison and (e) resources and training. It is the combined effects of all five principles that ensures tactical airpower operations are employed to great effect on the battlefield. Below, I summarize each of these components.

Before doing so, however, a caveat is necessary. The standard outlined here is an ideal type and, in practice, a state may not be able to achieve all five parts of the standard due to conditions outside of its control. For example, the absence of air superiority on the battlefield—as a result, say, of poor weather conditions—does not mean that tactical airpower operations cannot contribute to success, it simply means that tactical airpower operations will be much costlier and likely less effective than they would be had air superiority been achieved. Accordingly, when I examine the cases in the following chapters my concern is less with whether or not all five of the core components are achieved in practice, but instead whether those principles were acknowledged, embraced, and meaningfully attempted by a state’s air force. As a result, it is plausible that a tactical airpower system meets the standard below even if many air assets were grounded for the duration of the campaign due to forces outside the control of soldiers and aviators, as long

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as these combined principles are recognized, adopted, and earnestly attempted. Thus, although the absence of one of the components in practice may mean that tactical airpower operations are not as effective as they could be, it does not mean that the state did not meet the standard of effective tactical airpower operations.

With this caveat in mind, the remainder of this section outlines the five key components of effective tactical airpower operations during World War II: (a) centralized command, (b) command integration and collocation, (c) target selection and prioritization, (d) signal and liaison and (e) resources and training.

**Centralized Command:** At the most senior levels, the command relationship between the ground and air commanders needs to allow for two things for the effective execution of tactical airpower operations: (1) massing/concentration of fire, and (2) flexible allocation of air assets. In order to ensure that the air assets can concentrate fire at precisely the right place on the battlefield, command should be streamlined directly from the senior joint or ground force commander to a single air force commander in charge of all air assets at the theater level. Doing so ensures that rather than parceling out firepower, air assets can be directed in mass to critical nodes in the theater, forcing enemy ground forces to take cover, disperse, or retreat. But only an air commander endowed with a view of the entire theater of operations can allocate air assets in the quantities necessary and where they are most needed for the overall campaign. Under this arrangement, requests for support and targeting may still come from ground units at the corps or division level, but the theater air commander and his immediate subordinates will retain oversight of asset allocation in the theater. Thus, rather than permanently attaching small air packages to a given ground unit, centralizing control of air assets under a separate air commander, subordinate to and
collocated with the ground force commander, allows for both the flexibility and timely concentration of fire at key moments during the ground campaign.

**Command Integration and Collocation:** The command and control relationship in support of effective tactical airpower operations requires detailed integration between the ground and air forces. As noted above, all CAS and BAI missions must be coordinated with the ground commander and, therefore, there is an extensive communications burden in these sorts of missions. To meet the extensive coordination requirements of tactical airpower operations, senior ground and air commanders should have collocated headquarters at several levels, but most importantly at the army level, so that integration and deconfliction can happen in real-time.

**Target Selection and Prioritization:** The proper execution of tactical airpower operations occurs in two main phases, focusing on different target sets. First, and most importantly, friendly air forces should attempt to establish localized air superiority. In the context of World War II, this generally meant preventing enemy air forces from significantly interfering with friendly air and ground operations. In order to achieve air superiority, air forces were tasked with targeting enemy airfields, communications links, and supplies in order to keep enemy air forces on the ground, engaging with any enemy aircraft that managed to make it up in the air, and suppressing enemy air defenses that might harass follow-on air assets. Although the air superiority mission is arguably distinct from tactical airpower operations, it acts as a critical enabler: unless and until air superiority is achieved, friendly air forces will be so burdened with avoiding or defeating enemy airpower and air defense assets that effective support of ground forces will be difficult. All that being said,

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however, air superiority is not a prerequisite for the provision of CAS or BAI. Though air superiority is helpful in diminishing the costs of such operations, strong air forces can and should be able to provide such support in a contested air environment. Even so, where the attainment of air superiority is possible at a reasonable cost, air forces should concern themselves first with this mission, given that it is a force multiplier for other types of operations.

Having established air superiority where possible, effective tactical airpower systems will then apply air assets to the most decisive sector in either in the rear of the battle area (BAI) or at the front lines (CAS). In the former case, this means targeting reserves, supplies, equipment, and communications, in the immediate rear of the battlefield; and in the latter case, it means targeting enemy armor, infantry, and artillery directly engaged in battle with friendly forces. Thus, effective tactical airpower operations have a clear set of targeting priorities: first, establish air superiority; and second, exploit that superiority to mass fire on critical battlefield targets wherever they reside.

**Signal and Liaison:** Executing tactical airpower well also entails some communicative elements: (1) liaisons and (2) reliable signaling and communications equipment. Without well trained air-ground liaisons (JFOs, JTACs, FAC-As, etc.) both the air and ground commanders may not be able fully exploit air assets because they lack reliable reporting on the placement of high-priority targets. This is especially challenging during CAS missions, where the fluidity of operations makes distinguishing friend from foe a difficult enterprise.

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9 In general, the Air Force view during World War II was that interdiction targets should be given priority over direct support, in order to strangle and isolate the enemy frontline forces. The logic of this approach is similar to that of underlying the strategic bombing offensive—isolating the battlefield will impact the enemy’s ability to marshal fighting forces over the long-term, while direct targets on the frontlines will have short term effects. For more on the prioritization of interdiction over close support see: Elwood “Pete” Quesada, “Tactical Air Power,” *Air University Quarterly Review* 1, no. 4 (Spring 1948).
Thus, air-ground liaisons are a critical communication node between the two communities, since they have access to real-time information about target location and are trained to understand which aircraft and weapons can be best applied in a given operational environment.\textsuperscript{10} In addition, successful application of tactical airpower requires working communications equipment in order to relay information between ground forces and the air component. This capability serves two primary functions: first, it ensures that the real-time accuracy of targeting information, and second it diminishes the likelihood of friendly fire incidents.

**Training:** Finally, access to pilots that are trained to perform the CAS and BAI missions is a critical element of effective tactical airpower. Planes are only useful if you have pilots trained to fly them in support of ground operations. Accordingly, a related component of successful tactical airpower is the necessity of training aviators (and soldiers) to understand the appropriate role and capabilities supplied by tactical airpower assets. This training can take many forms, but is best when experienced in the field or in field-like simulations. Close and continuing dialogue about tactical airpower between aviators and soldiers at all levels of the organization will help facilitate mutual understanding, positive relationships, and informal communications channels that can ensure that the resources available are used to maximum effect.

In summary, this section has aimed to provide the reader with a basic understanding of both the components of tactical airpower—CAS and BAI—as well as the doctrinal, command and control, logistics, and training components that together set the standard for effective tactical airpower operations in high intensity conventional conflict. These aspects of tactical airpower are summarized in Table 1. As we will see in the next section, when

\textsuperscript{10} Spires, *Patton’s Air Force.*
tactical airpower operations meet this standard, they can also have a decisive effect on battlefield outcomes.

Table 1: Key Components of Effective Tactical Airpower Operations

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralization</td>
<td>Tactical airpower assets in the theater should be formally centralized under the command of a joint ground commander, who sits directly above a single air commander at the theater level. This structure provides the theater commanders flexibility to concentrate air assets at key nodes in the ground battle.</td>
</tr>
<tr>
<td>Command Integration and Collocation</td>
<td>The ground and air commanders at the theater level should have a tightly integrated working relationship of mutual respect and informal co-equality. Planned and impromptu air support requests should be decided jointly. Both commanders should be collocated at the theater headquarters.</td>
</tr>
<tr>
<td>Target Selection and Prioritization</td>
<td>Air support assets should prioritize missions and related targets in the following way: (a) air superiority (b) indirect support and close/direct support. Air superiority allows for the freedom of action necessary to take on direct support targets.</td>
</tr>
<tr>
<td>Signal and Liaison</td>
<td>Ground units should employ effective means for air assets to distinguish friendly forces. Direct communications links between engaged forces and command centers allow for more accurate and effective targeting.</td>
</tr>
</tbody>
</table>
Pilots capable of undertaking both interdiction and close support missions will lead to smoother execution of operations. Collaboration between air and ground forces must be practiced extensively at all levels both before and during deployment.

3 The Importance of Tactical Airpower Operations

Having defined the core components of tactical airpower operations, the question remains: does tactical airpower actually matter? After all, it is difficult to justify studying this subset of military operations if tactical airpower has—or had—little influence on battlefield outcomes. The question is a fair one. Fortunately, the answer is also relatively simple: when done well, tactical airpower operations can have a critical—if not decisive—influence on battlefield outcomes. This is especially, although not exclusively, the case when it comes to offensive, set-piece, battles of the type that occurred in World War II. However, when done poorly, tactical airpower is not likely to advance battlefield objectives at all. In order to illustrate this point in the context of World War II, the remainder of this section recounts a stylized narrative of three key battles during World War II to illustrate the crucial role that tactical airpower operations played in the outcome. Specifically, I detail the role of tactical airpower operations in the German blitzkrieg operations France in May 1940, with a special focus on the crossing of the Meuse River; the Allied success at the Battle of Mareth Line in the North African Theater in March 1943; and, briefly, the successful Allied operations in France during the summer of 1944, with a focus on the Battle of Mortain and Falaise-Argentan. I then conclude the chapter with a brief discussion of battles where

tactical airpower operations failed to have any discernable effect on the outcome or actively expedited the demise of the fighting forces.

Several themes emerge from the accounts I provide below. First, in all three battles, the five components of effective tactical airpower operations identified in the previous section were on full display. The successful employment of tactical airpower in these three battles required a centralized command structure that placed all aviation assets under a single set of air leaders, who were co-equal and coordinating with their ground force counterparts. Additionally, in all three operations, the rapid acquisition of air superiority through preparatory, offensive action against airfields, logistics, and supply targets in the rear of the battle area played a crucial role in the success of the victorious side. In all three battles (and especially in the Battles of Mortain and Falaise-Argentan) air-ground liaisons, where they existed, proved essential to the success of initial breakthroughs. Finally, in all three cases, the most successful aircrews and air leaders had significant training and operational experience working with their counterparts on the ground. Taken together, the use of centralized command with co-equal air and ground leadership, the prioritization of targets required for air superiority and suppression, and interservice familiarity gleaned

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through joint experience, would have a significant, if not decisive, influence on the battlefield.\textsuperscript{13}

But the lessons of these battles were not all positive. Each of these operations demonstrated the many limitations that can and did curb the influence of tactical airpower operations. First, in two of the three battles—at the Meuse River and the Mareth Line—the challenges of air support for mobile operations were hampered by limitations in the communications and liaison structures, which made tactical airpower operations far more successful in offensive operations against static targets during breakthrough operations than they were in the follow-on exploitation phase.\textsuperscript{14} Indeed, tactical airpower operations during World War II often struggled to keep up with advancing ground forces during the exploitation of a breakthrough without incurring friendly casualties. Similarly, these rapid advances put pressure on the logistics, supply, and infrastructure necessary for continuous air operations, particularly when it came to airfields and fuel supplies. Eventually, these difficulties would be overcome, but all parties to the conflict would continue to struggle with these component of tactical airpower operations until the bitter end.

In addition, there were also problems plaguing tactical airpower operations in all of these conflicts that were unavoidable, but nonetheless acted as powerful breaks on the effectiveness of operations. Among the most persistent of these challenges was the weather, specifically clouds and rain, that diminished both the number and accuracy of bomb runs

\textsuperscript{13} It is perhaps important to note here that although tactical airpower operations were most significant in offensive, breakthrough battles during World War II, there are many other contexts in which tactical airpower operations can, and have, made a significant impact on the modern battlefield. For example, even in World War II, tactical airpower operations proved useful (though not decisive) during Rommel’s retreat from the Kasserine Pass. Similarly, tactical airpower operations have been uniquely powerful in small wars and COIN contexts against insurgent groups. However, for the purposes of this dissertation the focus remains on those offensive breakthrough battles where tactical airpower operations had an outsized influence during World War II.

\textsuperscript{14} In the latter Allied invasion of Normandy, many of these communications had been solved.
on both sides of the conflict. Although many of these problems would be solved in future wars, they remained limiting factors in even the most successful and decisive tactical airpower missions in World War II. The remainder of this section fleshes out these themes in the context of three key battles in which tactical airpower operations played a decisive role.

3.1 Blitzkrieg and Crossing the Meuse (May 1940)\textsuperscript{15}

By the end of the June 1940, Hitler's Wehrmacht was riding the high tide of victory. The campaigns in Poland, Norway, Denmark, Holland, Belgium, Luxemburg, and ultimately, France had all been more successful than even the most optimistic planners could have predicted. Although this celebration would be short-lived, brought to an end by the strong performance of the RAF during the Battle of Britain in July 1940, the spring and early summer of 1940 had demonstrated that the German war machine was a formidable one. For the Axis, the crowning achievement of this period was its speedy, stunning conquest of the Low Countries and France. Central to the success of this outcome was the application of the German doctrine of rapid, offensive, ground advance—later termed "blitzkrieg."\textsuperscript{16}


\textsuperscript{16} The term “blitzkrieg” was not used at the time, but it employed here for ease of reference.
doctrine—and, more specifically, it’s use by German ground forces to cross the river Meuse in a breakthrough operation in May 1940. Once the Meuse had been crossed, the German forces were able to encircle the Allies operating in the North, forcing the French into submission and the British off the continent. Among the many factors that helped to underwrite the success of this operation was the contribution of the Luftwaffe. As the remainder of this section will illustrate, nearly every account of the Luftwaffe’s role in the blitzkrieg in general, and the crossing of the Meuse in particular, points to its decisive impact on the victory achieved by the Germans.\(^{17}\) In the remainder of this section, I provide some basic background on the strategic context of the German invasion of France in spring 1940, and then detail the planning and execution of this operation, with a special focus on the role of the Luftwaffe in support of its ground forces.

### 3.1.1 Background

In the winter of 1940, Hitler was frustrated. Having successfully overrun Poland in the fall of 1939, he was eager to maintain his momentum and make his way into France. Many of his military advisors, however, were wary of executing a thrust into France in the cold, dreary, winter with its accompanying rain, mud, and low-visibility, but provided Hitler with a plan nonetheless. In its first iteration, the plan for invading France proposed a slightly modified version of the infamous Schlieffen plan, in which the bulk of the German forces would invade Holland and Belgium then make their way through northern France. This approach would avoid the Maginot Line defenses and the heavily wooded Ardennes region, which planners had thought would be difficult, if not impossible, to pass through quickly with armored formations.

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This initial plan was jettisoned, however, after bad luck and bad weather conspired to delay and undermine its execution. Thus, in early 1940 military planners were hard at work developing a viable alternative. In this period, Erich von Manstein, a visionary German ground commander, developed a war plan that would put the German doctrine of rapid, offensive, ground advance to good use. Instead of sending the bulk of German forces north through Holland and Belgium, Manstein proposed that only a small portion of the force would take the northern route. These forces would use blitzkrieg tactics and airborne units to make an outsized impact in the north, thus convincing the Allies that it was the main attack and drawing the bulk of the Allied defense into Holland and Belgium. With the Allies bogged down in the north the Germans would in fact send the bulk of their armored and motorized forces westward through the Ardennes and in to the open terrain of eastern France. The plan was that these armored and mobile formations, also applying the blitzkrieg doctrine, would move with such speed and effectiveness that they would complete a rapid breakthrough in northeastern France and then turn north to choke off and trap the Allied forces defending against the German feint in Holland and Belgium. Initially, few of Hitler’s advisers—and, early on, Hitler himself—believed the Manstein plan would work. However, when initial testing of the concept seemed to endorse the idea, the plan began to gather a small cadre of proponents and, eventually, Hitler was convinced that the plan could work.

The Manstein plan was unlikely to succeed, however, if blitzkrieg doctrine was not executed successfully by the Wehrmacht. Fortunately, the several streams of thought about the future of offensive armored warfare that would form the core of blitzkrieg doctrine had quickly and deeply permeated the German ground forces. There are several excellent

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18 In addition to the weather, German plans for the invasion were captured by Allied forces after pilots en route to a staff meeting and carrying a description of the plans were forced to crash land over Belgium and were captured by Belgian forces. The plans confirmed the Allied suspicion that the Germans would invade well-north of the Maginot Line and Ardennes. See Murray, *Strategy for Defeat the Luftwaffe*, 33–34; Mitcham Jr, *Eagles of the Third Reich*, 80–81.
accounts of what makes blitzkrieg doctrine unique and effective but, in general, there are a handful of key principles underlying the concept. First, the doctrine relies on generating a breakthrough in the enemy frontline and the penetration of its rear. To facilitate this, the doctrine prioritizes mobility and concentrated firepower. Above all else, blitzkrieg demands that the vast majority of units be fast and mobile. Whether they be armor, artillery, or infantry units, it is this rapid mobility that allows units to overwhelm and disorient the enemy, swamping its command and control with reports of enemy action. In response, the enemy will either be paralyzed by the deluge of reports, or ineffective in its attempts to meet the numerous demands for counterattacks. Meanwhile, the Germans, connected by redundant radio links and employing decentralized command authority would well equipped to navigate the chaos that they had created. Thus, for ground units, the vast majority of which were infantry, speed, mobility, and maneuver was their first priority. At the same time, the Germans also made good—albeit limited—use of massive, concentrated firepower from dive-bombers, artillery, and the infamous Panzers. The combination of both of these tactics—rapid movement of the ground forces throughout the theater and concentrated attacks at key chokepoints proved to be highly effective in execution.

Under the Manstein plan, the Luftwaffe would have a major role to play in supporting the army’s thrust into France. Fortunately, the Luftwaffe had been preparing for close cooperation with the army in breakthrough operations for most of the interwar years. As I discuss in greater detail in Chapter 5, the Luftwaffe had found an ally in the army and had taken an active interest in training for and executing tactical airpower

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operations. Although there remained some tension between the two services, especially as the Luftwaffe saw air-ground operations as just one of several ways in which it could be successfully employed, the Luftwaffe took seriously tactical airpower training and devoted the personnel and material resources necessary to perfect it. They had understood and absorbed the lessons of the Spanish Civil War during the interwar years and, more recently, had studied closely the successes and pitfalls of the operations in support of the army’s advance in Poland, Norway, and Denmark. In addition, the Luftwaffe had prepared for more specific the role it was supposed to play in blitzkrieg operations. Indeed, significant investments had been made in both the dive-bomber force, which would be crucial in close support, and light and medium bombers, which would prove critical to the isolation of the battlefield through battlefield air interdiction strikes. The Luftwaffe’s broad understanding of tactical airpower operations, and its intensive training to perform this mission would make for an effective combination in the breakthrough at the Meuse.

3.1.2 The Plan

After several months of delay, it was therefore the Manstein plan that would be employed in May 1940, as Hitler tried to further extend his gains westward through France. As Manstein had proposed, the German effort would consist of a three-pronged attack. It would begin with the advance of Army Group B, consisting of both Panzer and airborne forces, who would invade Holland and Belgium. These ground forces would be supported by Albert Kesselring’s 2nd Air Fleet, who would be responsible for taking out any Allied air threats.

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21 Here again there are many historical accounts of the plan an execution of the German invasion of France. In the following sections, my account relies heavily on those histories with an emphasis on the role of airpower, including: Horne, To Lose a Battle; Hallion, Strike from the Sky; Mason, The Rise of The Luftwaffe, 1918-1940; Public Record Office, Rise and Fall of the German Air Force; Jacobsen and Rohwer, Decisive Battles of World War II; Mitcham Jr, Eagles of the Third Reich; Posen, The Sources of Military Doctrine.
and dispatching the airborne forces on the Low Countries. Once the Allied forces had rushed to defend Belgium and Holland in the face of Army Group B's attack, the Germans would begin the main effort in earnest. The primary axis of the attack would, in fact, be westward, through the Ardennes and into eastern France. This thrust would be undertaken by Army Group A, which consisted of both Panzer and motorized forces and was supported by Hugo Sperrle's 3rd Air Fleet. These forces would punch a hole through the limited French defenses in the area of Sedan and cross the river Meuse before the French knew what had hit them. Army Group A would rapidly encircle the Allied forces who, believing that the main attack was in the north, would still be trying to fend off Army Group B. All the while Army Group C would be south of the main effort, keeping any Allied reinforcements away from the main action. Thus, the success of the plan relied first on the Allied forces believing that the main attack was being lodged in the north and, accordingly, that Army Group B put on a compelling and outsized performance; and, second, on the secret movement of Army Group A through the Ardennes, their rapid breakthrough at Sedan, and an even speedier encirclement of Allied forces while they were still distracted by the events in the north. The plan was risky and vulnerable, but if it worked, it would be an astounding display of German mobility, flexibility, and power.

The Luftwaffe would have two primary missions in support of the attack. First, both the 2nd and 3rd Air Fleets were explicitly responsible for gaining air superiority in the initial phase of the attack in the north and the main effort at Sedan. Superiority would beget several advantages, but first among them was suppression of enemy air attacks, which would be critical to ensuring the freedom of movement for the ground forces and would allow for the rapid advance required by blitzkrieg doctrine. In addition, superiority would keep Allied planes away from the advancing forces in the Ardennes, preventing them from getting a good look at the armored formation moving through what they thought would be
a quiet part of the front. Thus, the Luftwaffe had planned for the suppression and blinding of the enemy during these preparatory phases, and had supplied the frontlines with several hundred light and medium bombers (notably, the Dornier Do 17s and Heinkel He 111s) as well as a fighter contingent consisting primarily of formidable Messerschmitt Bf 109s and 110s.

But the air space that was secured by the Luftwaffe would also be put to use offensively insofar as it allowed the infamous German dive-bombers to operate at will against Allied ground targets. Thus, in addition to the 2nd and 3rd Air Fleets, Wolfram von Richthofen’s VIII Air Corps, primarily consisting of Junkers Ju 87s—the famed Stukas—would support the effort of Army Group B in the first phase with punishing dive-bombing attacks, and then shift to support the breakthrough of Army Group A once the main attack had begun. Thus, the combination of air superiority and follow-on dive-bombing was envisioned as a critical enabler of the campaign—it would blind the enemy, prevent harassing attacks on ground forces, and enable an uninterrupted onslaught of dive-bombing runs against enemy positions.

3.1.3 The Battle\textsuperscript{22}

In execution, the German invasion of France was one of the most impressive military feats of the modern era. The plan was executed with skill and acumen at all levels, and few—even among the German leadership—could have imagined a more successful campaign. For its part, the Luftwaffe played its role supporting of all three Army Groups well: fighter-

bomber teams rapidly secured air superiority by attacking airfields, communications, and supply targets; fighters kept any stray Allied aircraft from observing the armored advance through the Ardennes; and, when the time came, the Stukas terrorized Allied ground units everywhere. In this way, the air units deployed in the north kept the Allied forces distracted and suppressed, and the units supporting the main advance proved to be a key enabler for the breakthrough at the Meuse. Over five days in May 1940, the Luftwaffe thus enabled one of the most stunning and effective military operations in history.

The battle began, as planned, with a diversionary invasion of Holland and Belgium by Army Group B on May 10, 1940. As the ground forces advanced, and airborne troops loaded their transports, the Luftwaffe’s bombers, escorted by able fighter pilots, were busy taking out airfields, roads, railways, communications hubs, and fuel depots in Belgium, Holland, and northern France. The primary target of the Luftwaffe were the bases in Holland, but none of the Allied airfields were spared—the RAF, the Armée de l’Air, the Belgian and Dutch air forces all suffered significant losses on the first and second day of fighting. Almost immediately, the Dutch and Belgian air forces crumbled under the incessant punishment of the Luftwaffe. The Armée de l’Air and the RAF were also “badly stung” by German attacks, with some reports indicating a loss of nearly 1,000 Anglo-French aircraft by the second day of the operations.23 Facing incessant attacks, outnumbered, and outgunned, the Allies could muster little by way of air defense against the incoming German attack.24 As a result, German ground forces were able to rapidly achieve their objectives and their airborne forces were successfully inserted into the region. From the German

23 Mitcham Jr, Eagles of the Third Reich, 87.
24 Although the specific numbers differ between historical accounts of the battle, there is widespread agreement that the Luftwaffe outnumbered the Allied air forces by at least three to two. Moreover, nearly all accounts agree that in terms of quality, the Armée de l’Air was far behind Germany in acquiring the latest fighter and bomber assets. The RAF was in the process of acquiring between ground attack aircraft, but still lagged behind the Germans in the fighter and bomber categories.
perspective, the first phase of the operation had gone just as planned—the air-ground campaign had almost immediately caused the Allies to rush their best units to defend the north, all while the main line of effort proceeded in secret and unopposed through the Ardennes.

Thus, by May 13, 1940, the main attack of Army Group A was poised to begin. Their first and primary objective would be to cross the Meuse River in order to initiate the encircling maneuver that would trap the Allied forces now clustered in the north. The second phase of the campaign thus began, much like the operations in the north, with a deluge of bomber attacks on nearby airfields, troop concentrations, railroads, and communications links. The bombers were ably escorted by Messerschmitt fighters who ensured the bombers relative operational freedom by deterring or defeating the old, slow, air forces of the Armée de l’Air. Shortly after this initial wave came the Stukas. Their strategy is described well by historian Alastair Horne:

The Stukas operated in three groups, each of about 40 planes; the first, coming at about 5,000 feet would attack with two or three planes at a time, while the second group hovered watchfully at 12,000 feet, looking for the targets missed by the first group and then—after that had expended its bombs—moving in in turn; the third group operated in isolation, picking out single or moving targets. After the Stuka waves, the Dorniers would resume their work; then more Stukas. Around them buzzed the Me-109s and the heavier Me-110 ‘destroyers’ pouncing on any slower French fighter that attempted to get at the vulnerable Stukas.25

Operations of this type continued in rolling waves for several hours on May 13, and the result was immediate: French artillery was virtually silent. The shock of the Stuka barrage served to destroy and disable some of the exposed French artillery positions, but mostly it just ensured that French gunners were running for cover rather than manning their guns. Indeed, the actual damage inflicted by the Stukas was far less than their reputation would

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suggest. In fact, as most close observers of this period know, Stukas are actually quite ineffective—not only was their accuracy poor, but they were so weakly armored that they could barely defend themselves. Nevertheless, in the early days of the war the sight and sound of an approaching Stuka was, quite simply, terrifying. Moreover, the Germans were well aware of the psychological terror that the dive-bomber could inflict—it was the primary reason that in early versions of the aircraft, they attached an actual siren to the wing to alert the enemy to their impending arrival. Thus, despite having a bark much bigger than its bite, the Stuka’s dampening effect on artillery was powerful. With the French artillery suppressed, the main ground effort was able to capture the bridgehead with remarkable efficiency.

By the next day, May 14, the RAF units consumed with the battle in northern France had finally been given notice of the far more serious breakthrough about to occur in to their immediate south. To their enormous credit, the tired and demoralized units operating in the north made their way down to the Meuse and attempted to put a kink in the otherwise smooth advance of German forces. Unfortunately, as the British had become acutely aware over the past three days, their air assets in the theater were both too few and ill-equipped for the task at hand. The RAF contingent sent to assist the French in stemming the impending breakthrough at the Meuse consisted of both Fairey Battle and Blenheim


27 There is some contemporary evidence that the French actually abandoned their artillery positions for a variety of reasons, only some of which had to do with the Luftwaffe. For example, the 55th Division appears to have abandoned their positions due to a rumor that the Germans had penetrated their rear. For more see, Robert A. Doughty, *The Breaking Point: Sedan and the Fall of France, 1940* (Mechanicsburg, PA: Stackpole Books, 2014), 200–206. Even so, most historians agree that the morale effects of the Luftwaffe bombing were considerable in the disintegration of the French army.
Bombers, despite the former proving highly susceptible to German flak.\textsuperscript{28} For their part, the French were able to cobble together a handful of bombers along with some outdated fighter aircraft. The result was disastrous. Under the command of Air Chief Marshal Sir Arthur Barratt, the bombers headed straight into the teeth of German fighter and anti-aircraft fire, leading to significant losses for the British. Thus, while May 14 would be known in Germany as the “Day of the Fighter Pilot” its reputation in England was quite different: “the Meuse that day was an unimaginable hell, a real Valley of Death from which few returned.”\textsuperscript{29} By the following day, the Meuse had been crossed and the Germans were well on their way to execute the encirclement that would trap the Allies.

Over the course of these five days, several things went right for the German ground forces and the Luftwaffe. Indeed, the Luftwaffe contributed significantly to both maintaining the feint in the north, and clearing the way for armored forces in the west. There is no doubt that the numerical advantaged enjoyed by the Luftwaffe over the combined air component of the British, French, Dutch and Belgian forces contributed to their success. The Luftwaffe’s clear prioritization of air superiority and the longstanding alliance between the air and ground forces ensured that the Luftwaffe was able to make good use of their numerical superiority with doctrine and tactics that enhanced the progress of the blitzkrieg on the ground.

But the battle in France also exposed some cracks in the Luftwaffe architecture. In particular, the Luftwaffe struggled to maintain the forward logistical infrastructure necessary to keep up with the rapid advance of the ground forces. In addition, there were real issues of coordination and identification of friendly troops during the advance, as limited access to advanced radios and good real-time information about forward engagements

\textsuperscript{28} Mason, \textit{The Rise of The Luftwaffe, 1918-1940}, 352; Horne, \textit{To Lose a Battle}, 227; Mitcham Jr, \textit{Eagles of the Third Reich}, 91.

\textsuperscript{29} Horne, \textit{To Lose a Battle}, 332; Mitcham Jr, \textit{Eagles of the Third Reich}, 93.
hampered Luftwaffe efforts. Thus, even with the remarkable success of these operations, there were signs of the many challenges that would prove fatal to the Luftwaffe in long run.

3.2 Battle of Mareth Line (March 1943)\textsuperscript{30}

The Battle of Mareth Line in March 1943 is considered a major turning point in World War II. It was there that the Allied forces were finally, after nearly two and a half years of defeat and delay, able to force the combined German and Italian forces into a retreat from which they could not recover. Less widely known, however, is the critical role that Allied air forces played in reversing the fortunes of the British and American forces during this critical battle. Indeed, as this section will illustrate, it was only through the effective employment of tactical airpower assets that the Allies were able to end the deadlock that had characterized early fighting at the Mareth Line and create a breakthrough in the Axis frontline. Thus, despite the many advantages that the Allies enjoyed at this stage in the North African theater, most close observers of this period are quick to note the decisive impact that tactical airpower operations had on the happy outcome for the Allies. The

remainder of this section will provide a broad overview of the months preceding the battle in order to situate the reader within the larger context and identify key players. From there, I will review both the planning for and execution of the battle, with a special emphasis on the critical role that tactical airpower played in securing a victory for the Allies.

3.2.1 Background

The year 1943 started ominously for the Allies in the Mediterranean. Despite the influx of men and equipment that had come with the American invasion of North Africa during Operation Torch in November 1942, the winter had resulted in marginal gains for the Allies. The Allied forces had proven ill-prepared for the rainy winter to come, and had solved few of the supply and maintenance issues that had plagued them for over a year. The limited progress of the winter months was compounded in early February 1943 when Erwin Rommel, commander of the Axis forces in North Africa, seized an opportunity to launch an attack against Allied forces at Kasserine Pass. The Allied performance at Kasserine Pass was considered a failure, and according to General Omar Bradley “was probably the worst performance of the U.S. Army troops in their whole proud history.” Fortunately for the Allies, Rommel failed to capitalize on his initial successes at Kasserine Pass, a fatal mistake that allowed the Allies time to reinforce their positions and prevent exploitation of the Axis

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gains. This pause in operations provided an opportunity for the Allies to recoup their losses and develop a plan for an offensive that would push the Axis out of the region for good.

Despite the failings of the Allied forces at Kasserine Pass, however, in early 1943 British and American leaders had also begun to implement many crucial changes. From an airpower perspective, a critical change came just before the Kasserine debacle in late January 1943 when Dwight Eisenhower, supreme Allied commander of the forces in North Africa, along with President Roosevelt, Prime Minister Churchill, and the Combined Chiefs of Staff, agreed to revise the command and control system for aviation assets being employed in North Africa. As I detail in following two chapters, the key reform undertaken at the Casablanca conference was to centralize all air assets under a single chain of command. In addition, the Casablanca reforms infused forces in North Africa with a cadre of battle-hardened leaders with a deep and abiding respect for the independence and co-equality of air and ground forces on the battlefield. Although few of the command and leadership changes decided on at Casablanca had been implemented during the Battle of Kasserine Pass, by the time hostilities commenced at the Mareth Line in March 1943 these reforms had been fully realized in the theater.

Moreover, the news for the Germans in the wake of Kasserine Pass was not all good. In the early part of 1943, several major issues had emerged for Axis forces in North Africa, but four in particular stand out. First, under the command of Bernard Montgomery, the Allies had slowly begun to reverse their fortunes in the theater. The recent victory of the British Eighth Army at El Alamein had been especially heartening for the Allied forces and disappointing for the Axis. In the aftermath of the battle, Rommel himself remarked “Our chance of overrunning the remainder of the Eighth Army and occupying Eastern Egypt at

33 “SYMBOL: Record of a Conference Held at Casablanca in January 1943” CAB99/24, National Archives of the United Kingdom.
one stroke was irretrievably gone"34 and further that “with the failure of our offensive against the British at Alamein line, a new phase opened which was eventually to lead to the final collapse of our North African front.”35 In early fall 1942, Rommel was also becoming wary of the Allied air forces, who had shown continuous improvement over the duration of the conflict, noting that “the possibilities of ground action, operational and tactical, become very limited if one’s adversary commands the air with a powerful force and can fly mass raids by heavy bomber formations unconcerned for their own safety.”36 Moreover, new men and materiel were funneling in to the theater in preparation for the Allied invasion of Sicily and Italy, while the Axis supply chain was beginning to sputter. These improvements in the theater had infused the Allied leadership with a new optimism and confidence.37 Second, Rommel had lost the momentum in the wake of his gains at Kasserine. In failing to exploit his early gains, Rommel had given the Allies time to recuperate and reform. Thus, despite his best efforts to harass Allied forces and distract from their planning of a renewed offensive, Rommel was unable to divert Allied attention away from their effort to rebuild in the weeks after Kasserine Pass. Third, Rommel was sick. So sick, in fact, that he would leave North Africa in early March on a health leave. Although the Allies were unaware of his absence, Rommel had been a lynchpin of Axis forces in the region and his successor Hans-Jürgen von Arnim was left to execute the remainder of operations in the region. Finally, there were fissures in the Italian-German alliance that led to second-guessing and indecisiveness in Axis strategy, and Rommel was chaffing at the oversight: “I’m dictated to by Rome in every single thing, yet full

34 Rommel and Liddell Hart, The Rommel Papers, 245.
35 Ibid., 287.
36 Ibid., 284.
37 As Patton remarked in the wake of El Alamein “I feel well...and am radiating with confidence” Patton and Blumenson, The Patton Papers, 191. Although this sentiment was not unusual for the self-assured Patton, spirits were high after the victory at El Alamein.
responsibility is mine. That I find intolerable.” The combined result of each of these individual setbacks was that the Germans were in a far more precarious position than they had been up until that point in the North African theater. Nonetheless, it was up to the Allies to capitalize on this position of weakness, a task for which the new commander of the British Eighth Army, Bernard Montgomery, was well prepared.

3.2.2 The Plan

The plan for taking Northeastern Tunisia and, in doing so, driving the Axis out of North Africa was primarily a British effort. Harold Alexander, commander of the 18th Army Group, along with Montgomery had used the month of March to craft a three-phased plan to defeat Axis forces in Tunisia. The central dilemma for the commanders was one of geography: Axis forces had retreated behind the famed Mareth Line—a combination of natural and man-made defenses—that had proven to be a “hard nut to crack.” The Mareth Line, like the Maginot Line, was the product of the French view of the defensive advantage during the interwar years. The French, fearing an Italian invasion of Tunisia, had emplaced a series of defensive positions in the narrow band of land between the Matmata mountain range and the east coast of Tunisia. The impassable mountain range on one side and the sea coast on the other, as well as the muddy, marshy area in between would make tank

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38 Rommel and Liddell Hart, The Rommel Papers, 412; Howe, United States Army in World War II: Mediterranean Theater of Operations, Northwest Africa: Seizing the Initiative in the West, 512–14. There were also fissures within the German military leadership—Rommel, for one, appears to be at his wits end with Goering and highly skeptical of his intentions. For Rommel’s thoughts on the matter, see Rommel and Liddell Hart, The Rommel Papers, 420–22.

39 There are several detailed accounts of the planning for this operation, among the most highly regarded are: Hargreaves, Rose, and Ford, Allied Fighting Effectiveness in North Africa and Italy, 1942-1945; Cooling, Case Studies in the Development of Close Air Support, 174–75; Craven and Cate, The Army Air Force in World War II: Europe, TORCH to POINTBLANK; Howe, United States Army in World War II: Mediterranean Theater of Operations, Northwest Africa: Seizing the Initiative in the West; Playfair, Molony, and Jackson, History of the Second World War: The Mediterranean and the Middle East.

40 Craven and Cate, The Army Air Force in World War II: Europe, TORCH to POINTBLANK, 2:172.
transit across the Mareth Line difficult, if not impossible, on a clear day; but the addition of man-made defensive positions and robust armaments all but and ensured that defenders could pick off forces attempting to cross this threshold. When the Axis forces arrived in the region, they worked quickly to fortify the outdated system of man-made barriers and defensive positions, as well as reinforce the weak points that Rommel had identified early on. Thus, by 1943 German forces had settled in to their defenses on the Mareth Line quite comfortably.
Figure 1: Geography of the Mareth Line
Montgomery knew that the strongpoints in the Mareth Line would be difficult to surmount, even with the growing material advantage that the Allies had gained over Axis forces by March 1943. Nevertheless, Montgomery’s plan rested on the belief that the German forces could not withstand two simultaneous attacks on the Mareth Line. Accordingly, the plan that Montgomery developed relied on a series of diversionary attacks intended to draw Axis forces away from the Mareth Line, thus enabling a breakthrough. To achieve this end, Montgomery’s plan had three phases. In the first phase, the British First Army and U.S. II Corps, under the new leadership of General George Patton, would advance northwest in order to pull Axis reserves from their stronghold at the Mareth Line on the east coast. In addition, these units would take airfields and supply depots west and north of the Axis position, which could then be utilized by the Allied forces. Their ultimate objective would be to arrive at Maknassy, north of the Mareth Line, establishing airfields and a main supply depot at Gafsa en route. During the second and primary phase, Montgomery planned a two-pronged assault on Axis forces. The primary attack would be waged by the XXX Corps of the Eighth Army, who would push northward up the coast and attempt to break through the Mareth Line defenses. Simultaneously from the west, the 2nd New Zealand Corps (2nd NZ) would execute a flanking maneuver in an attempt to breach the Tebaga Gap, thus necessitating Axis reserves to move from the Mareth Gap and weakening their main line of defense against the XXX Corps. Having drawn Axis reserves westward toward the 2nd NZ, Montgomery expected he would then be in a position to puncture the Mareth Line. In the third phase, Montgomery intended to exploit his breakthrough and push the Axis forces Northeast and, eventually, out the country entirely.

For their part, the Allied air forces intended to wage a very different type of operation than they had previously in North Africa. With the new command structure approved at Casablanca in place, the air forces responsible for the entire Mediterranean all
fell under the direct command Arthur Tedder, and all air assets operating in North Africa were overseen by Lieutenant General Carl Spaatz, commander of the Northwest African Air Forces (NAAF).

Figure 2: Revised Allied Command Structure

Beneath Spaatz, Air Vice Marshal Arthur "Mary" Coningham was the commander of the Northwest African Tactical Air Force (NATAF) and Major General James Doolittle was responsible for the Northwest African Strategic Air Force (NASAF). From the outset, Alexander, Montgomery, Spaatz and Coningham agreed that the NATAF would be responsible for providing the bulk of support for the ground forces in both the first and second phases of the battle. In this effort, the three subsidiary commands of the NATAF—the U.S. XII Air Support Command (ASC), the British 242 Group, and the British Western Desert Air Forces (WDAF)—would be responsible for working with the U.S. II Corps, the British Eighth Army and 2nd New Zealand Corps. Where necessary, the NASAF was willing to provide bombers in support of the ground campaign, along with units from the Tactical Bomber Force (TBF).

What was remarkable about the planning for the Battle of Mareth Line, however, was that the joint plan for tactical airpower operations proved to be robust and comprehensive in ways that previous operations had struggled to achieve. Indeed, the
prioritization and division of labor devised by Coningham and his colleagues produced a
tightly choreographed and highly effective airpower dance that would prove central to Allied
success. In both the first and second phases of the operation, the division of labor between
the subsidiary units of the NATAF was clear:

NATAF's No. 242 Group, RAF and the USAAF XII Air Support Command would focus on
neutralizing enemy air units and diverting their attention away from the Eighth Army's
front. Such a move would thereby enable the WDAF to focus upon attaining local air
superiority over the front which, in turn, would facilitate the second phase of operations: the
WDAF's direct support of the Eighth Army offensive.\(^4^1\)

Thus, the 242 Group and XII ASC focused on the air superiority and battlefield interdiction
missions of suppressing Luftwaffe attacks on air and ground units by attacking airfields and
otherwise harassing their air forces. Where necessary and possible, the NASAF and TBF
would provide additional bombing support for BAI operations, focusing on enemy supply
depots, lines of communication, and transportation. With the Luftwaffe preoccupied in this
way, the WDAF would then be free to provide close air support to ground units to help
facilitate a breakthrough. Finally, all of these reinforcing operations would be overseen by
Spaatz and Coningham, who were tightly integrating operations with their ground
counterparts. Thus, the changes to both the command structure, as well as the priority of
objectives and the subsequent division of labor between commands, would prove central to
the Allies eventual success at the Mareth Line.

3.2.3 The Battle\(^4^2\)

\(^4^2\) Again, there are several excellent accounts of the execution of these operations in the historical record. In
this section, I summarize the major points of agreement among several of these historiographies, including:
Support Operations: World War II Close Air Support North Africa*, 83–84; Hargreaves, Rose, and Ford,
With their plan in place, the Allies were ready to begin the first phase of operations midway through March. Thus, by March 17, 1943 Patton’s II Corps was en route to Gafsa and Maknassy. Although inclement weather prevented the use of air support, Patton was able to make a rapid advance to Maknassy, establishing several waypoints for Montgomery’s subsequent advance on his way North. Though Patton chaffed at his limited objectives, the initial phase of operations was considered a resounding success.\(^4\)

The second phase of the campaign, Montgomery’s dual assault, began on March 20. As planned, the bulk of the force concentrated at the coast was to attempt a breakthrough at the Mareth Line, and a second, smaller contingent of the 2nd NZ undertook a flanking maneuver west of the Matmata mountains. The initial results of Montgomery’s thrust toward the Mareth Line were disappointing. Within days, it was clear that despite the Allies numerical advantage over the Axis defenders, German and Italian units were dug in and unrelenting, bolstered by the strongholds embedded in the Mareth Line. Matters were not helped by the persistent rain, which flooded the area surrounding the Mareth Line and further bogged down the Allied tanks, which were already struggling to advance over the steep, muddy terrain.\(^4\) Moreover, the intermittent rain prevented the WDAF from providing the strafing and bombing runs that had been promised in support of the advance. Realizing that the two sides were deadlocked and a breakthrough was unlikely at the Mareth Line, Montgomery was forced to reevaluate his plan.

Progress for the 2nd New Zealand Corps, who had been charged with flanking the Axis forces and drawing out their reserves from the Mareth Line, was off to a more auspicious start. The 2nd NZ had made exceptional time in advancing westward to the

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\(^4\) Patton and Blumenson, The Patton Papers, 191–95.

\(^4\) Craven and Cate, The Army Air Force in World War II: Europe, TORCH to POINTBLANK, 2:178–79.
Tebaga gap. Montgomery, seeing their rapid advance as a boon and recognizing that the bulk of the Eighth Army was bogged down at the Mareth Line, quickly moved to reinforce the 2nd NZ with his 1st Armored Division at the Tebaga Gap. But even with these reinforcements, there remained a significant problem geography: the Tebaga Gap was the only route through which the 2nd NZ would be able to flank the Axis forces, but it was situated between two mountain ranges—high ground which was occupied by German artillery and Panzer units. Accordingly, it would be virtually impossible for the 2nd NZ and their reinforcements in the 1st Armored Division to cross this threshold without incurring significant casualties or potentially fatal delays.

The solution to this problem, however, lay in airpower. Indeed, it was Harry Broadhurst, commander of the WDAF, who proposed to Montgomery and Coningham the solution to the problematic topography of the Tebaga Gap. Broadhurst suggested that the WDAF, which was all but guaranteed local air superiority by the enterprising efforts of the XII ASC, 242 Group, and TBF engage in a series of low-level, daylight attacks on the German positions in the hills flanking the Tebaga. He further suggested that this initial “air blitz” be followed by an artillery barrage, and finally an infantry advance through the gap. At a minimum, Broadhurst expected the combined air and artillery operations to suppress enemy fire for enough time to allow the infantry to advance. Although Coningham was initially skeptical of the proposal, Broadhurst proceeded with the plan.

Thus at 1530 on March 26, Operation Supercharge II, as it had been named, began with a sortie of light and medium bomber squadrons “launching pattern bombing attacks against predetermined targets to disorganize the Axis position in preparation for the main attack.” Soon after, a second wave of fighter-bombers, composed of the new Hurricane IID ‘tank busters’ and P-40 Kittybombers “were fed in every quarter hour to bomb selected

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targets and strafe gun positions.” By 1600, the follow-on artillery barrage had begun, and behind them the tanks and infantry followed. In this second phase, the artillery barrage was used to mark a bomb-line which, along with the use of colored smoke signals by artillery and infantry units and Forward Air Controllers (FACs), helped guide strikes by the WDAF. Simultaneously, Spitfire units roamed the battlefield to help maintain air superiority against any stray Luftwaffe pilots who had escaped harassment by the XII ASC and 242 Group.

The effect was a near immediate success: “by nightfall, the New Zealanders, followed by the 1st Armored Division, had broken into Axis positions and the armor passed straight through in a moonlight operation. The next day the enemy fought desperately in a confused mêlée but the Mareth position had been turned.” After nearly a week of deadlock, the Allies had finally broken through at the Tebaga Gap. The Allies would go on to exploit this successful breakthrough and complete its flanking maneuver, thus forcing the Axis into a retreat that would ultimately force it off the continent. For close observers of this battle, the central lesson is clear: tactical airpower operations were decisive in the Allied victory. Only with airpower could the 2nd NZ successfully overcome the geographical advantages of the Axis forces.

There were many component parts to the successful execution of tactical airpower operations during the Battle of Mareth Line. However, three in particular, stand out. First, there was the development of a centralized, co-equal command structure that gave a single senior air force commander (Spaatz) control over all air assets in the theater. Spaatz, with the support of Coningham, was able to reorganize and direct forces as needed to the most critical points on the battlefield. Thus, when it became clear that a breakthrough would be more likely at Tebaga than at the Mareth Line, Spaatz and Coningham were able to direct

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most of the tactical airpower apparatus toward that objective. Second, the choice of senior commanders to prioritize air supremacy and interdiction over direct bombing, despite the vocal objections of their counterparts in the ground forces was critical to the successful outcome.

In addition, the use of smoke signals, liaisons, and the high-levels of experience of the operating aircrews all served to influence the successful outcome of the battle for the Allies. Finally, Allied materiel resources outnumbered those of the Axis, Rommel had recently departed the field, and fissures within the Axis alliance all conspired against Axis forces. The combined result of these advantages was a critical success for the Allies. But without the enterprising use of tactical aviation assets against the German positions at the Tebaga Gap, it is unlikely that the Allies would have succeeded with such rapidity and with so few casualties; and thus, tactical airpower operations had a significant role to play in turning the tide against the Germans in Tunisia, and ultimately turning the tide of the war itself.

3.3 Battle of Mortain and Falaise-Argentan (August 1944)48

By the time the Allies invaded Normandy, several issues that had plagued Allied tactical airpower operations in the early part of the war had been solved. First, the dual issues of command centralization and prioritization had been resolved. Although tactical air forces,

48 There are several excellent histories of the role of airpower during the Allied invasion, breakthrough, and breakout in France which, for the sake of brevity will not be recounted here. The description provided here relies primarily on the following sources: Thomas Alexander Hughes, Overlord: General Pete Quesada and the Triumph of Tactical Air Power in World War II, 1 edition (Free Press, 2002); Wesley Frank Craven and James Lea Cate, The Army Air Forces In World War II: Europe - Argument To V-E Day, January 1944 To May 1945, vol. 3 (Washington D.C.: Office of Air Force History, 1983); Hallion, Strike from the Sky; Spires, Patton’s Air Force. In addition, shorter but still useful accounts of this period are found in: John Terraine, The Right of the Line: The Role of the RAF in World War Two (Barnsley: Pen & Sword Military, 2010); Jacobsen and Rohwer, Decisive Battles of World War II; Public Record Office, Rise and Fall of the German Air Force.
who had been specially trained for and experienced in support of ground operations were linked to specific army groups, the attachments were at sufficiently high levels of command that the air forces could continue to mass against critical targets in the theater. Moreover, among all senior leaders, it was well-understood that the first priority of air units would be gaining air superiority and battlefield air interdiction. If and when those two missions had been satisfactorily achieved, would they send up ground attack assets to provide direct support for ground forces engaged at the frontlines. As Richard Hallion notes:

> Overall, the Allied air campaign for the invasion of Europe followed the dictates of FM 100-20; the campaign consisted of attacks aimed at destroying the Luftwaffe, followed by attacks aimed at isolating the battlefield via interdiction, and, finally, once forces were engaged in close combat with the enemy and the requirements of Phase 1 and Phase 2 operations had been fulfilled, Phase 3 attacks—battlefield air interdiction and close air support strikes—would become increasingly predominant.⁶

For the most part, ground commanders understood that direct support of the invasion itself would come last, and this prioritization would persist throughout the duration of the Allied thrust through Europe. This was certainly the case on the American side, where air and ground leaders at the Army level fostered strong relationships through the summer of 1944.

Second, and just as important, air resources—including those that would prove very capable in tactical airpower operations—were flooding in to the theater. The highly effective P-47 Thunderbolts, for example, were arriving for the campaign in droves. Meanwhile, the losses of air assets on the German side through combat attrition and diversions to the eastern front were significant, and the Axis went in to D-Day with a paltry force relative to their display four years earlier at the Meuse.

But perhaps the most important new development for tactical airpower operations that proved successful during the invasion of France was the system of signaling and

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⁶ Hallion, Strike from the Sky, 190.
support. This new system, developed in Sicily and scaled up by Major General Pete Quesada in advance of the Normandy operations, would allow tactical air assets to better support ground forces during mobile operations. As noted earlier, prior to Normandy nearly all air forces—Axis and Allied alike—struggled to maintain continuous, close support of armored units on the move without incurring friendly casualties. Limitations in radio technology served to exacerbate this issue, but by June 1944 the Allies had created a work around, which would become known as “armored column cover”. Quesada developed and rolled out—with the enthusiastic support of General Omar Bradley—the concept of a “contact car” or what we now would liken to a Joint Terminal Attack Controller. Put simply, armored vehicles functioning as mobile air-ground control posts would be embedded with the leading armor formation. The result was that “tactical air units would know precisely and at all times the location of friendly and enemy forces. The contact cars functioned in close cooperation with tactical reconnaissance aircraft, and reduced the time necessary to set up immediate support strikes.” Thus, Quesada and his peers had developed a system of signal and liaison that would ensure requests from the leading edge of the battlefield were met quickly, and with a diminished risk of friendly casualties. Taken together then, by the start of the operations in Normandy, the Allies, and especially the United States, had developed a system for tactical airpower operations that would prove efficient, effective, and devastating to the shoe-string German forces attempting to halt the Allied advance.

50 Hallion, 199.

51 Although the system of close air support developed by Quesada was a notable improvement in tactical airpower operations during the final phases of the war, the significance of this change is often overstated in the existing literature on the breakthrough in France. As Jacobs aptly summarizes, “The system of air support developed and employed in the European theater in the last year of the war did not alter the fundamental priorities established in existing doctrine. Close air support did not supplant either air superiority or interdiction; it did, however, become an important, regular, and integral component of all ground operations in the theater after the invasion of Normandy” (48). For more see, William A. Jacobs, “Tactical Air Doctrine and AAF Close Air Support in the European Theater, 1944-1945,” Aerospace Historian, March 1980, 40-48.
Thus, it was at the Battle of Mortain, and days later at the Battle of Falaise-Argentan, that tactical airpower operations would become the stuff of legend.

### 3.3.1 The Background and Plan

Although the war would continue for several months, many historians cite August 1944 as the beginning of the end for the Wehrmacht. Of course, Hitler would continue to surprise and frustrate the Allies on the battlefield until the bitter end of the war, but the summer of 1944 marked an important turning point for the Allies. Below, I provide a broad overview of two of the most critical engagements during this period—the Battle of Mortain and, days later, the Battle of Falaise-Argentan—in which Allied tactical airpower operations were performed with extraordinary acumen.

The summer of 1944, which began infamously in June on the beaches of Normandy, had reached a tipping point by late July. Omar Bradley’s First Army had engineered a breakthrough at St. Lô during Operation COBRA, and the Allies were now making their way through France. Despite his many competing priorities to the east, Hitler had taken notice of the ominous breakthrough. In an effort to halt the Allied advance, Hitler ordered his commander in the West, Gunther von Kluge, to mass an armored striking force under the German Seventh Army—basically a patchwork of incomplete Panzer divisions—in a counterattack in the vicinity of Mortain and Avranches.

There was good reason to target this area, which sat at the seam of the American First and Third Armies making their way south, and was known even to the Allied

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leadership as the weakest point in their line. But despite the obliging geography of Hitler’s proposed offensive, German military leaders still had significant reservations about the plan. Indeed, von Kluge himself suggested to Hitler that the assembled units instead focus on an orderly retreat to shore up a stronger defensive position, rather than lashing out on an ill-conceived offensive thrust. Hitler, however, deeply paranoid about the motives of his most senior officers after the failed assassination attempt of July 20, 1944, insisted on an offensive drive through Mortain towards Avranches, and von Kluge was forced to comply. Thus, in the first week of August 1944, von Kluge went to work assembling what strength was left in existing Panzer divisions to prepare for an attack early in the month. Hitler, for his part, personally guaranteed that 300 Luftwaffe assets would be there to support the invasion when the time came.53 This promise would prove empty. But, more importantly, what Hitler failed to realize, was that if (and when) this offensive maneuver failed, the entire German Seventh Army would be stuck between the teeth of the Allied forces to the north and south.

The Allies were well aware of their weak point at Mortain. In fact, Bradley and several of his senior advisors had remarked among themselves about their fears of an offensive counterattack at Mortain much like the one that Hitler was planning. Though there was little Bradley could do to reinforce his position on such a wide front, he did order that the battle-worn First Division be replaced by the fresh 30th Division. Moreover, in a renowned moment of good fortune, Bradley received an Ultra intelligence report on the day before the German counterattack that such an offensive was coming.54 With this forewarning, Bradley was able to shore up Allied airpower to help support the 30th in their defense of the region.

53 Public Record Office, Rise and Fall of the German Air Force, 335; Terraine, The Right of the Line, 660. 54 There is some controversy over the role that this forewarning played in Allied planning for the operation. For more see, Hallion, Strike from the Sky, 217; Terraine, The Right of the Line, 660–61.
The tactical airpower system in the European Theater had also just undergone a fortuitous reorganization on the first of the month. Much like the system developed in North Africa, both the British and American air forces had allocated specific units for tactical airpower operations in the theater. For the Americans, all of the tactical airpower assets were arranged under the Ninth Air Force, under the command of Hoyt Vandenberg. Within the Ninth Air Force, Pete Quesada’s IX TAC would support Bradley’s First Army and Otto Weyland’s XIX TAC would support Patton’s Third Army. On the British side of the ledger, Arthur Coningham’s Second Tactical Air Force (TAF) would support Montgomery’s 21st Army Group. Moreover, the leaders allocated to each of these commands—both ground and air—had a deep appreciation of the realities of tactical airpower operations and were well-aligned on the issues of command co-equality, centralization, mission prioritization, and signaling that had previously been points of tension between ground and air commanders. Moreover, all of these units were bursting with a potent mix of fighters, fighter-bombers, and light and medium bombers that were necessary for the task at hand.

Thus, by early August, the German Seventh Army was poised to launch a scrappy attempt at halting the American advance through France. The Allies, however, knew that such an attack was imminent. Though they could do little to shore up their ground forces at Mortain since such little notice gave them virtually no time to acquire the necessary reinforcements, they were able to generate an experienced, competent, and well-resourced air contingent. The result for the Germans was a disaster: not only would the Allies halt their counterattack, but American and British forces in the region would force the Germans into a deadly retreat and second engagement at the Falaise-Argentan pocket that would prove calamitous.
3.3.3 The Battle\textsuperscript{55}

Contrary to the outcome, the Battle of Mortain started well for the Germans. Von Kluge, realizing that time was of the essence, launched his offensive with a thrust through Mortain late in the evening of August 6, 1944. Foregoing a preparatory artillery barrage to retain the element of surprise, von Kluge made use of the Luftwaffe's night fighters and several Panzer divisions to begin his attack against the 30th division, who had only just arrived to replace the 1st Division. Catching the 30th in transition, and aided by foggy weather in the early morning of August 7, von Kluge was initially quite successful, quickly capturing Mortain and forcing the 30th to retreat from several key positions in the area. By midday, however, the fog cleared. With clear skies, Bradley and Quesada ordered the IX TAC into action. The result was speedy and decisive. Within hours, the light and medium bombers, along with their fighter escorts of the IX TAC had wrested air superiority from the paltry contingent of Luftwaffe fighters in the area. Meanwhile, the 2nd TAF along with the remaining assets from the IX TAC (and two units borrowed from XIX TAC) began a relentless series of attacks against the German armored forces. Making superb use of Quesada's system of forward air control, units in the 30th were able to quickly and accurately call in strikes against the German Panzers, and with no threat from the Luftwaffe above Mortain, the Allied air assets were free target German armor with an intensity and accuracy seldom witnessed up until that point in the war. By the end of the day, all but one of the Panzer divisions had been stopped in their tracks. Although the Germans would continue to pour reserves into the region in attempt to regain the brief tactical advantage they had acquired on the morning of August 7, it was clear that the Allies, by marshalling

significant air assets in support of a modest ground force, had fatally wounded the German Seventh Army. The fighting at Mortain would not be fully contained until August 10, 1944, but the damage had been done.

But worse than the defeat itself was that the German Seventh Army was now caught in a very precarious position. Von Kluge’s armored forces, now attempting to retreat east, were trapped between three Allied armies. The Germans were facing the prospect of a double envelopment: at Mortain, Bradley’s First Army, supported by the IX TAC, was putting pressure on the Seventh Army; to the south, Patton’s Third Army, supported by the XIX was waiting not-so-patiently; and to the northeast, Montgomery’s Second Army, accompanied by the 2nd TAF, was preparing to advance. Realizing their superior position, Bradley and Montgomery ordered Patton to shift his advance north in the direction of Argentan, while the Canadian First Army would advance south toward Falaise. Following this tack, the two Armies would eventually converge to meet between Falaise and Argentan, trapping the Seventh Army in the center of the two-pronged Allied attack.

In support of the operations, the combined tactical air forces of the IX TAC, XIX TAC, and 2nd TAF played a central role. Having successfully secured and retained air superiority in the Falaise-Argentan pocket, the IX TAC along with the British 2nd TAF were responsible for attacking targets inside the pocket. Meanwhile, the XIX TAC was responsible for supporting Patton’s enveloping drive by protecting his flank against any German incursions as his forces pressed northward. In the event, each of the tactical air forces performed their tasks with remarkable efficiency. Though there are few verifiable estimates of the damage done by each of these air forces, both the Allies and the Germans knew that the damage was significant—according to von Kluge’s chief of staff, less than 150 tanks (of over 2000) made it back across the Seine River. This estimate is almost certainly

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an exaggeration of the damage, but many historians have suggested that it was significant. Thomas Hughes, for example, notes that in just two days the Ninth Air Force was responsible for destroying sixty-three tanks and seventy-five armored vehicles.\textsuperscript{57} But regardless of the specific numbers, all observers of the Allied envelopment of the German Seventh Army share the view that the persistent and precise attacks from tactical air forces was “an outstanding triumph of airpower.”\textsuperscript{58}

The Allied advance, however, was far from perfect. As they had earlier in the summer, heavy bombers proved to be largely incapable of providing air support to ground units without incurring significant friendly casualties. In addition, in a controversial decision, Bradley ordered Patton’s rapidly advancing forces to stop on August 13, fearing that Patton’s thin line would be overrun by the retreating Germans or, worse, that the British and American forces would collide and incur significant friendly casualties before either commander realized what was happening. The result of Bradley’s order, however, was a fifteen-mile gap between the British forces at Falaise and the tip of Third Army’s spear at Argentan that allowed thousands of German troops to stream through the opening. But even with these shortcomings, the Allied forces proceeded to make significant gains as August wore on, and the tactical air forces continued to tear apart German armor as the ground forces advanced to close off the pocket.

To his credit, Von Kluge quickly realized that the battle was lost, and ordered a retreat on August 16. But it was too late. Without virtually no air cover from the Luftwaffe, whose limited attempts to get off the ground were being kept at bay by the Allied fighters and light/medium bombers, German armor was an easy target for the Allies from both the ground and, especially, the air. By August 20, the gap had been closed and the fighting was

\textsuperscript{57} Hughes, \textit{Overlord}, 243.

\textsuperscript{58} Terraine, \textit{The Right of the Line}, 662.
dwindling, but the unencumbered, effective tactical air operations of the previous two weeks resulted in a level of destruction that was disturbing even by the standards of an already bloody war. As one historian notes, "The image of the utter destruction of men and machines that [the tactical air forces] caused on the ground with rockets, cannons, and bombs, is one of the most familiar pictures of the air war...No one who saw it would ever forget it."59

4 Conventional Wisdons and Tactical Airpower

Read in sequence, the tactical airpower successes of World War II on both sides of the ledger might give the impression that these operations were easily arrived at and executed by both the Allies and the Axis forces. But the story of tactical airpower during World War II is far more nuanced than it is often given credit for in contemporary lore. In each case, the air forces struggled to arrive at and sustain effective systems for tactical airpower operations. In the British and American cases, arriving at an effective system was a struggle that persisted for nearly three years. For the Germans, on the other hand, the challenge was not arriving at the best system, but sustaining it in the face of increasingly strained resources during the latter part of the war. Thus, the battles of France, Mareth Line, Mortain, and Falaise-Argentan are all examples of the how tactical airpower operations can be done well, but these pinnacles were hard to reach and equally as difficult to sustain.

Take, for example, the British experience with tactical airpower during Battle of France in 1940, which put on display an extraordinary lack of preparation for air support of ground operations, as problems with command and control, prioritization, signaling, and resource constraints plagued the RAF throughout the campaign. As one historian of these early failings notes "From September 1939 to August 1941, the [British] Army rarely won

59 Ibid.
a battle and lost every campaign. One aspect common to all of these early defeats was the lack of adequate air support for the Army.\textsuperscript{60} This is not an exaggeration. As Chapter 3 shows, before the Battle of Mareth Line, the British execution of tactical airpower operations was at best, ineffective, and at worst, harmful to the overall outcome of the campaign.

Similarly, the early days of the American experience with tactical airpower operations—both during the preparatory training phases in Louisiana and Carolina and once they had arrived in North Africa—put into harsh relief that problems of command, prioritization, and signaling existed when it came to executing tactical airpower operations. The United States became aware of the limitations of their existing system for tactical airpower operations during the massive armored training exercises during the mobilization phase that preceded the American entry into the war, and were reminded of these limits during their first battles in North Africa.

And even the Germans, who began the war with a refined and functional system for conducting tactical airpower operations, struggled to maintain sufficient resources to ensure that the core functions of tactical airpower operations could be achieved across several fronts. Thus, by the end of the war, German pilots and planes were stretched so thin throughout various different theaters ensuring tactical airpower was supplied was nearly impossible. The result was that air support for ground operations proved to be a very costly enterprise for the Germans, and was difficult to sustain in the face of the steadily improving and better resourced Allied air campaigns.

In all three cases then, the successes recounted in this chapter prove to be the exception rather than the rule. For the Allies, reaching the pinnacle of performance witnessed at the Battle of Mareth Line and again in the skies over Mortain and Falaise-

\textsuperscript{60} Hall, \textit{Strategy for Victory}, xi.
Argentan was an arduous process with several failings along the way. For the Germans, the challenge was sustaining operations to the exceptional standard set during the Battle of France, when resources were steadily dwindling in every theater of operations. The remainder of this dissertation illustrates how and why each state faced its own peculiar challenges when it came to learning how to successfully employ tactical airpower operations.
Chapter 3: British Tactical Airpower

1 Introduction

Among historians of World War II, there is widespread agreement that British diplomatic and military behavior during the prewar period was, at best, misguided and, at worst, reckless.\(^1\) As the argument goes, British economic, military, and diplomatic policy in the wake of World War I was so consumed with rebuilding British power and, therefore, preventing or avoiding another global conflict, that they were blinded to the increasingly obvious realities of the growing German threat.\(^2\) In focusing on conciliation abroad, and nonmilitary economic growth at home, historians have argued that the British allowed the Germans to rebuild and rearm, while letting their own military defenses languish.\(^3\) Thus, according to some, British wishful thinking during the prewar years allowed the German military to grow unabated, as their own military became ensnared in a strategy that proved inadequate for meeting the German threat.

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At the same time, many scholars of British behavior in the years preceding World War II also note that the British turn inward was a predictable and understandable response to the horrors of the First World War. In the wake of this bewilderingly violent and economically devastating conflict, they argue it should come as little surprise that many of the participants in World War I retreated back into their own borders and focused on rebuilding what had been lost. As a result, many scholars do not fault the British for their initial impulse toward isolationism and appeasement in the immediate aftermath of World War I, and instead find fault in the persistence of their diplomatic and military illusions in the face of mounting evidence of Germany’s global aggression. As one historian puts it: “In the 1920s, in a world in which most great powers... did not possess the economic or military power to disturb the status quo, the British people and leaders could afford such views without harmful consequences to national security. In the harder world of the 1930s, such views came close to destroying Great Britain.”

But regardless of the wisdom of British choices during the prewar period, the impact of their strategic decisions had a pernicious effect on their warfighting capabilities once the war began. Indeed, if there is one thing that most historians can agree on, it is that British prewar strategy left them unprepared to actually fight World War II. This was especially the case when it came to air support of ground operations. During the prewar period, the convergence of civilian diplomatic and economic calculations along with well-intentioned but flawed military theorizing about future wars meant that the Royal Air Force (RAF) was allowed—and, in the 1930s, encouraged—to develop counterproductive doctrine.

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throughout this period. Specifically, the single-minded pursuit of strategic bombing doctrine, which advocated for the use of long-range bombing to destroy the enemy’s morale and economy, came at the expense of a more balanced approach to air warfare. The result was that when the time came for the British to enter the fray their air forces were ill-equipped to perform many of the tasks required of them.

The consequences of this doctrinal disparity for the performance of tactical airpower operations were immediate and undeniable: from the start, the RAF simply could not marshal the forces or capabilities necessary to successfully support ground units engaged with the enemy. Years of thinking about and investments in strategic bombing doctrine had left little room for developing a robust system for tactical airpower operations in the RAF. As a result, when the British Expeditionary Forces (BEF) and the French army attempted to rebuff the German thrust into France in May 1940, the British Air Forces in France (BAFF) proved incapable of providing assistance to their counterparts on the ground. But if there was a silver-lining to the debacle in France it was that the failure would administer an important strategic and military jolt to the British, causing them to reconsider their reliance on a hollow air deterrent and begin further investment in forces

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that could fight an offensive ground war against the German military. As a result, among the many problems that quickly emerged on the RAF’s radar was the problem of air support for ground forces.

But even with this acknowledgement that tactical airpower operations would need to be improved in the wake of the Battle of France, it still took the RAF nearly three years to successfully adopt the system for tactical airpower operations detailed in the previous chapter. It was not until March 1943, over the skies of North Africa, that the British were able to consistently and uniformly employ this system for effective tactical airpower operations. Thus, as we shall see in more detail in Chapter 5, when compared to the Germans, who had identified and solved the problems of tactical airpower operations well before 1940, the British were far behind their primary competitor in acknowledging, identifying, and adopting an effective system of tactical airpower operations. In this way, despite eventually learning the right lessons, the British had lost the tactical airpower race to their main adversary. Accordingly, the remainder of this chapter will trace the sources of the RAF’s lethargy in acknowledging, studying, and resourcing tactical airpower operations during the prewar period and in the early stages of World War II.

As we shall see, it is only by examining closely the evolution of British national military strategy and resource endowments—the two variables at the center of Military Filtration Theory (MFT)—that we can fully account for the empirical trajectory we observe in this case. Indeed, more than any other case in this dissertation, British thinking on tactical airpower operations adheres most closely to the predictions of MFT. Specifically,

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MFT helps us understand the nature and timing of British learning about tactical airpower operations: first, it explains why the British ignored the problems presented by tactical airpower operations in the prewar period; second, explains what caused the British to finally acknowledge the issue; and, lastly, it explains how interservice tension over resources prevented the implementation of identified solutions for almost three years.

The remainder of this chapter proceeds as follows. In the next section, I review and discuss how I operationalize the three key variables—national military strategy, resource endowments, and learning vis-à-vis tactical airpower operations—in the British case. In addition, I distill specific predictions from MFT with regard to the British case, and preview my findings. In the following section, I examine the prewar British experience with tactical airpower operations—or, more accurately, the lack thereof—from 1920 to 1939. In the fourth section, I discuss how the British failures in France catalyzed important changes in its national military strategy that made the RAF attuned to and willing to study the unique challenges presented by tactical airpower operations. In the fifth section, I examine how the dividends of this attention only became widespread after the infusion of significant resources into the North African theater of operations. Finally, I conclude with a consideration of several alternative explanations to the theory presented here, and I argue that although these alternatives do help fill-out the picture of British learning about tactical airpower, MFT provides a more comprehensive explanation than those in the extant literature.

2 Measurement and Predictions

Before going in to greater detail regarding the empirical record of the British experience with tactical airpower operations during this period, this section reviews the some of the key methodological and theoretical nuances of applying Military Filtration Theory to this
case. To do so, I begin by considering two issues of methodology: first, I discuss when in the period under consideration (1920 – 1943) I take samples of the in this case; and, second, I explain what type of evidence I seek out in the empirical record with regard to my three key variables—national military strategy, resource endowments, and learning about tactical airpower operations. Doing so allows me to clarify for the reader what I am measuring and how I am measuring it throughout the case and, therefore, helps to address any concerns about reliability and validity. In addition to clarifying these issues of measurement, I also use this section to distill the specific predictions of Military Filtration Theory in the context of British airpower during this period, and preview my core findings vis-à-vis these predictions. In doing so, I am able to familiarize readers with what we should expect to see if the logic of MFT is borne out in this case. In general, I find that the British experience with tactical airpower operations is well explained by MFT. However, in being explicit about the methodological and theoretical operationalization of my theory, I also allow the reader to make an informed assessment of the validity of my approach.

2.1 Measurement

Military Filtration Theory argues that the interaction of country’s national military strategy and resource endowments will have a significant impact on their ability to learn lessons about the conduct of military operations, especially though not exclusively in the joint environment. In the context of the following empirical chapters, it specifically argues that variation in these two variables should correspond with different phases of military learning about tactical airpower operations. Accordingly, in all three of the following cases, I will need to take measurements of three key variables: (1) national military strategy; (2) resource endowments; and (3) learning about tactical airpower operations. This raises two methodological concerns: first, when in the period under consideration should I take measurements of these three variables? And, second, what types of evidence should I
examine in measuring each one? Below, I discuss both of these concerns in the context of the British case.

In examining the evidence in the British case, I have chosen to periodize my inquiry into three eras: (a) 1920-1939; (b) 1940-1942; and (c) 1942-1943. Why have I segmented my evidence into three distinct periods? I have chosen these three periods because they roughly correspond with major shifts in the values on my dependent variable, British learning about tactical airpower. For the vast majority of the prewar period (1920-1939) the British had not initiated the learning process about tactical airpower. However, in the wake of the Battle of France, the British entered the first phase of learning—identification—when they acknowledged and extensively studied the issue of tactical airpower operations (1940-1942). Finally, in the latter part of the North Africa campaign, the British demonstrated that they were in the second phase of learning—implementation—when they began widespread deployment of the new system for tactical airpower operations successfully (1942-1943). In short, each of the periods under consideration here correspond with a major phase of British learning about tactical airpower: absence of learning (1920-1939); problem identification (1940-1942); and implementation of a solution (1942-1943). By examining tactical airpower operations during each of these distinct periods, I am able to demonstrate for the reader precisely when and how the British moved through the process of learning about tactical airpower operations.

However, it is not just the dependent variable that I am measuring during these distinct periods; in addition, I am also measuring values on the two independent variables central to MFT—national military strategy and resource endowments—to see if variation in these variables corresponds with variation in the dependent variable. As I discuss at length below, if MFT is correct, movement through different phases of the learning process should be tightly linked to these two variables: changes in national military strategy should
be temporally linked to the identification of the tactical airpower problem, and changes in British resources endowments should be similarly associated with to the implementation of a solution to that problem. Accordingly, by segmenting the period under consideration in this way, I am able to determine whether and how changes in dependent variable are temporally linked to the independent variables prioritized by MFT.

Having established when in this period I will take samples of evidence in the British case, there remains the question of what type of evidence I employ to measure the values on each of the three key variables at the center of this case. For all three variables, I rely on a wide array of different qualitative measurements to construct a robust picture of each variable during the periods identified above. As is the case in all of the empirical chapters of this dissertation, my approach to measuring my dependent variable—the process of learning about tactical airpower—relies on several sources of information to triangulate among sometimes-competing reports about the issue. Specifically, in measuring the process of learning about tactical airpower operations in the British case, I examine the thinking about and practice of tactical airpower in three venues: doctrine, training, and operational performance. In measuring progress in each of these domains, I rely on a wide array of sources, including, but not limited to: official reporting and publications, and unofficial exchanges like memoranda, meeting notes, personal letters, internal performance reviews and reports. In general, I use a combination of both primary source accounts (archival documents, memoirs, etc.) as well as secondary historical accounts to construct my measurement of tactical airpower learning in each of these domains.

When measuring the two independent variables at the center of MFT—national military strategy and resource endowments—I utilize a similar variety of primary and secondary sources. More specifically, when it comes to measuring national military strategy in the British case, I focus my attention primarily on the official statements and unofficial
correspondence of key political and military leaders during the period, in addition to the official reporting from the several commissions that were created to study questions of army and air force strategy during this period. Similarly, when measuring resource endowments, I rely on official accounts of both promised, planned, and executed aircraft acquisitions and pilot training programs, as well as private correspondence and memoirs from key leaders during this period. Taken together, these sources provide a comprehensive account of the British experience learning to successfully employ tactical airpower operations, while allowing me to tease out the corresponding values on the variables at the center of Military Filtration Theory.

As promising as this approach may seem, however, there are important limitations to my methodological strategy. In the British context, one in particular stands out. Specifically, there remains very little good secondary historical work on the subject of British tactical airpower during this period. Instead, the literature on British air doctrine and the RAF more generally before and during World War II is skewed toward examining and explaining the RAF’s strategic bombing doctrine. As a result, where the RAF’s approach to tactical airpower operations is noted, it is usually considered in the context of strategic bombing and, all too often, is relegated to a footnote or passing mention. Although recent work in the field of British airpower history has begun to remedy this imbalance, there remains a limited pool of detailed historical accounts of tactical airpower during this period.

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As a result, there are limited observations that can be made by relying only on secondary historical accounts. Fortunately, however, by surveying a wide swath of the existing historical literature on airpower and supplementing these accounts with archival research, I have still been able to develop a clear picture of tactical airpower during this period. That being said, there remains room in the marketplace of ideas regarding British tactical airpower operations for further expansion and study.

2.2 Predictions

As noted in the above, Military Filtration Theory identifies two independent variables in explaining the process of wartime learning: national military strategy, i.e. the type of war a state believes it will fight, and resource endowments, i.e. the material assets and personnel available to the state for warfighting. In all of the cases examined in this dissertation, Military Filtration Theory makes several broad predictions regarding how these two variables will influence the process of military learning.

First, MFT helps us to understand when the process of learning will begin or, put another way, when a state is likely to identify that a problem exists. Specifically, MFT argues that the character of a state’s military strategy will dictate what military problems it is likely to identify. In the context of tactical airpower operations, we should expect a state to ignore this set of issues until it adopts a national military strategy that prioritizes offensive land power.

Second, MFT acknowledges that the recognition of a problem and the implementation of a solution are distinct phases of the learning process. MFT argues that even if a state’s national military strategy makes it attuned to a particular problem, this focus does not guarantee that the decided-on solution will be implemented. In order for a solution to be implemented, MFT directs our attention to the resources available to the state in question. We should expect that where resources are constrained, there should be
significant interservice tension. Accordingly, for those problems that require a joint solution, we should expect implementation to be difficult under conditions of resource scarcity. On the other hand, where resources are abundant, we should expect interservice cooperation to predominate and problems which require the implementation of joint solutions to proceed more smoothly. Thus, in the context of tactical airpower operations, which requires a great deal of interservice cooperation to be executed well, we should expect states facing resource constraints to struggle with implementation unless and until resources become significantly more abundant.

But what does all this mean in the context of the British case? MFT makes three specific predictions about the British experience learning to successfully execute tactical airpower operations. First, it predicts that the British deterrent military strategy during the prewar period should have led it to ignore or suppress questions related to tactical airpower operations. Second, it predicts that once British national military strategy was reoriented toward fighting a land war in the wake of the Battle of France, the challenges presented by tactical airpower operations should have been acknowledged and studied further. Finally, however, it predicts that the identified solutions of such studies should not have been implemented throughout the military until resource endowments became less scarce. In the remainder of this section, I briefly review the logic underlying these propositions, and preview my findings in the British case.

MFT’s first prediction is that the deterrent British military strategy in the prewar years (1920-1939) should have led the military to largely ignore the problems presented by tactical airpower operations. Indeed, in the immediate aftermath of World War I and well into the thirties, Britain’s isolated geographic position along with its commitment to avoiding participation in future continental conflict conspired to ensure that its national
military strategy had a deterrent and defensive disposition.\textsuperscript{15} Rather than prepare for the potentiality of a ground war, the British preferred to reinvest their resources in rebuilding their economic base, and relied instead on a minimal deterrent military capability to prevent attacks on the nation itself.\textsuperscript{16} Although, in execution, the deterrent British national military strategy had several major flaws, the underlying logic was simple: by investing in deterrent capabilities—especially in the form of offensive, long-range, aircraft—the British believed they could dissuade aggressive states from attacking on their shores.\textsuperscript{17} As a result of this overwhelming emphasis on deterrence, MFT predicts that the British military in the prewar years should be unconcerned with the specific problems of land warfare, including tactical airpower operations. And, indeed, this is what we see in the empirical record: there is virtually no consideration of tactical airpower operations during the prewar period, and where such interest does exist, it is fleeting, isolated, and superficial.

The second prediction of MFT, however, is that changes to British military strategy that reorient it toward fighting an offensive land war should lead to an attendant shift in its consideration of tactical airpower operations. Thus, insofar as British military strategy shifts toward fighting and winning a war on land, we should expect the problem of tactical air support to emerge on the radar of the military. Again, this is what we see in the empirical record. In the wake of the stunning Allied defeat in France during the summer of 1940, the British were forced to revise their national military strategy toward halting the German


\textsuperscript{17} Murray, \textit{Strategy for Defeat the Luftwaffe}, 322–27; Overy, \textit{The Air War}, 11–13; Posen, \textit{The Sources of Military Doctrine}, 142–43; Murray, \textquotedblleft British and German Air Doctrine Between the Wars.\textquotedblright As we shall see, these aviation assets had the added benefit of being able to police British imperial holdings at a much lower cost than could be guaranteed by the navy or ground forces.
advance on land.\textsuperscript{18} Almost immediately, this shift in national military strategy led to corresponding changes in military’s approach to tactical airpower operations.\textsuperscript{19} The British military almost instantaneously began to direct its attention to developing a tactical airpower system that could effectively and efficiently support ground forces.\textsuperscript{20} Over the course of the next two years, the British would devote considerable attention to studying and developing solutions to the problem of tactical airpower operations.\textsuperscript{21} Thus, MFT accurately predicts that shifts in British national military strategy toward offensive ground operations lead to the initiation of the first phase of military learning, identification of the tactical airpower problem.

The third key prediction of MFT, however, argues that despite early insights into the best system of tactical airpower operations, the widespread implementation of changes will be delayed if there exist constrained resources in the theaters of operation. More specifically to the British case, MFT argues that in an environment of constrained resources, the RAF would need to prioritize some missions over others. Given its persistent proclivity toward independent strategic bombing operations, we should expect the RAF to first direct its limited resources toward that end. Insofar as there were resources remaining after the needs of the strategic bombing operations were met, we should expect the RAF to attend to the needs of tactical airpower operations, but only reluctantly and unevenly. Needless to say, MFT predicts that the lack of RAF attention to tactical airpower under conditions of scarcity is likely to generate significant resentment among army officers, whose air support needs will inconsistently be addressed. In this tense interservice environment, MFT predicts

\textsuperscript{18} Millett and Murray, \textit{Military Effectiveness}, 2010, 3:90–92; Overy, \textit{The Air War}, 46.
that cooperative solutions to the tactical airpower problem will not be implemented, regardless of their proven efficacy. Instead, MFT predicts that the only way to ease this interservice antagonism and allow for implementation of cooperative tactical airpower solutions is to provide more resources to the operational theaters. In doing so, MFT argues, the RAF will no longer be forced to prioritize some missions over others and, instead, can meet both its preferred strategic bombing demands and the army’s tactical needs simultaneously. As a result, interservice tension will be reduced and the implementation of new, cooperative solutions to the tactical airpower problem will no longer be held hostage to interservice politics.

Here again, we see the predictions of MFT borne out in the British case: it was not until that the British received a massive infusion of aviation assets and personnel in late 1942 and early 1943, that army and RAF commanders agreed to the widespread adoption of the new system of tactical airpower operations. For the RAF, the additional resources meant that tactical airpower needs could be met at little or no cost to their preferred strategic bombing missions; and, for the army, these resources meant that their calls for more direct support would be heeded. In short, the provision of additional resources in meant that all theater priorities could be met, not just the RAF’s preferred ones. With these larger guarantees in hand, the RAF and army were thus willing to make the smaller concessions necessary to adopt the new tactical airpower system. Thus, the evidence in the British case bears out MFT’s predictions that additional resources can ease interservice

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24 "Portal to Sir Alan Brooke, ‘Air Cooperation with the Army,’” February 27, 1943, AIR 8/984, The National Archives of the UK.
tension by allowing more needs to be met and, as a result, paves the way for the adoption of cooperative solutions.

Thus, the British experience learning to successfully perform tactical airpower operations adheres to the predictions of MFT. Not only does MFT explain British avoidance of the tactical airpower problem during the prewar years, but it also provides considerable insight into when and why the problem of tactical airpower operations was acknowledged in the summer of 1940 and implemented almost three years later in the North African theater of operations.

3 Prewar Years (1920 – 1939)

Modern militaries are often criticized for “fighting the last war” rather than adapting and updating their operational concepts to future threats. But when reviewing the failures of the British political and military leadership in preparing to fight World War II, the problem was not that they had prepared to fight the last war; it was that they had prepared to fight no war at all.25 Indeed, the First World War had left deep scars across Europe, and Britain was no exception. The result was that leaders and the general public in Britain were, by and large, unwilling to consider the prospect of fighting another major war, and arrived at a grand strategy after World War I that was deterrent and defensive in nature.26 The problem in taking this approach, however, is that the British had thrown the baby out with the bathwater—by rejecting altogether the possibility of fighting in another major war, the British failed to internalize many of the important lessons of the last one, especially in the

Instead of spending the years in between World War I and World War II studying the lessons of the former and anticipating the potentialities of the latter, this period in Britain was animated by the development of contradictory and counterproductive national military strategies and operational doctrines that were largely removed from the realities of warfighting at the time.

British military planning during this period was predicated on avoiding war altogether with a strong military deterrent, primarily in the form of adopting and implementing strategic airpower doctrine; and, if a war should come, relying on their allies to do the bulk of the ground fighting. Seeing this strategy as an opportunity to reinforce their claims to independence and resources, RAF leaders at the time began a campaign to illustrate to civilian leaders and their sister services that airpower could have an important role in influencing the outcome of a war. To do so, they developed and promoted strategic bombing doctrine, i.e. air attack of military and civilian infrastructure deep with enemy territory to undermine both the capability and will of the enemy to fight. Civilians, looking for a cheap, effective deterrent, were swayed by RAF proselytizing about strategic bombing. Unfortunately, however, this emphasis on airpower, and especially strategic bombing, would not only prove faulty in execution, but also came at the expense of developing other important operational capabilities. Thus, the remainder of this section

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traces how and why this deterrent strategy came to dominate British thinking in the prewar period, and its implications for tactical airpower operations.

3.1 National Military Strategy & Resource Endowments

Military Filtration Theory predicts that in order to understand why the British failed to acknowledge the problems presented tactical airpower operations in the prewar period, we need to look first at their national military strategy, which should act as a filter on the types of military problems that a state acknowledges and attempts to resolve. Since tactical airpower is associated primarily with ground operations, states which plan to engage in such operations are far more likely to be concerned with the nuances of developing and employing an effective tactical airpower capability than those with other military strategies. Thus, absent a military strategy that prioritizes offensive ground warfare, we should not expect the British to be concerned with the challenges of executing tactical airpower operations. Accordingly, in this section, I review the nature of British national military strategy in the prewar period (1920-1939) and its implications for airpower. Although resource endowments do not become central to the story of learning about tactical airpower operations until the implementation phase, I also briefly discuss the resource endowments in England during this period to provide the reader with background on this issue that will prove helpful in my later discussions of implementation.

To understand British military strategy during this period, it is critical to first understand the national mood in the wake of World War I. Overwhelmingly, British leaders and the general public were focused on two strategic priorities in the immediate aftermath of the war: first, avoiding participation in another continental conflict and, second, shrinking military budgets and reinvesting those funds into developing the national economy.33 The

view that England should not be involved in another major war was enshrined in strategic thinking during this period in the form of the "Ten Year Rule" which stated that military planners should assume that England would not be involved in another war for ten years. Adopted by the British government in 1919 and renewed in 1929, this policy was retained by the British until 1934, and reflected its commitment to avoiding participation in any major conflict. As we shall see, this policy would have significant ramifications for military strategy and planning throughout the prewar period. At the same time, British leaders were also committed to returning military spending to its prewar state, and reinvesting in the national economy. Accordingly, the public and their politicians were adamant that military spending be cut significantly during this period, and that the military make due with considerably less than was needed during combat operations in World War I. Taken together, these two overriding strategic priorities meant that the British government was in the midst of a significant inward turn and its main concerns for the foreseeable future would be the avoidance of future war and the reinvigoration of the British economy.

In addition to these two broad priorities, British leaders were also committed addressing to two less pressing, but still significant, strategic concerns: first, retaining and policing their global empire and, second, defending against aerial attack from adversaries on the continent. The first of these concerns—maintaining and policing the empire—was closely linked to the reinvigoration of British prestige around the world, which leaders

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thought would help in both expanding its global reach and deterring attack by potential adversaries.\textsuperscript{39} By maintaining its empire, the logic went, the British could project power around the globe, which would serve to intimidate would-be challengers.

Additionally, British strategy during this period was animated in part by a fear of aerial attack on the British homeland.\textsuperscript{40} Indeed, World War I had ushered a new weapon onto the international scene that undermined British security in a profound way: the airplane. No longer was the formidable moat around the British Isles and its impressive navy able to deter attack, since airplanes could now cross the English Channel in short order, bringing with them the prospect of terror and damage.\textsuperscript{41} Moreover, this capability had been put on vivid display at the end of World War I in a series of German air raids against British civilian targets in the summer of 1917.\textsuperscript{42} The effects of the attacks were immediate and striking. As one historian notes: “It is difficult to exaggerate the fear, bordering on panic, the [German] bombing strikes caused among the British population and its government—for the next two decades...The psychological effect of losing this shield was enormous.”\textsuperscript{43} Preventing aerial attack, together with policing its empire, avoiding another major war, and maintaining a small, inexpensive military establishment thus formed the core strategic priorities of the British in the years between World War I and II. As one scholar puts it, the British aimed to “reduce commitments and reduce enemies, but without conceding any part of the empire.”\textsuperscript{44}

\textsuperscript{40} Meilinger, \textit{The Paths of Heaven: The Evolution of Airpower Theory}, 43; Smith, \textit{British Air Strategy Between the Wars}, 8–9.
\textsuperscript{41} Murray, “British and German Air Doctrine Between the Wars”; Millett and Murray, \textit{Military Effectiveness}, 2010, 2:99.
\textsuperscript{42} Smith, \textit{British Air Strategy Between the Wars}, 18–19; Sims, \textit{Royal Air Force}, 17–18.
\textsuperscript{43} Meilinger, \textit{The Paths of Heaven: The Evolution of Airpower Theory}, 43.
\textsuperscript{44} Posen, \textit{The Sources of Military Doctrine}, 149.
But what did all of these priorities mean for British military strategy and planning? The bundle of these overarching priorities, though understandable given the national mood, would prove contradictory and, ultimately, quite dangerous when it came to military planning. The crux of the challenge was straightforward: the overriding priorities of avoiding involvement in another continental war, disincentivizing attack on the British homeland, and policing its imperial holdings meant that the British military would need to retain at least some of its capabilities; but, at the same time, the national mood would not support significant investments in defense. As a result, any military strategy during this period would have to thread a very fine needle—the military establishment would need to be sufficiently robust to deter attack and police the empire but not large enough to significantly raise costs. The result was a military strategy premised on deterrence and, secondarily, policing; underwritten not by the entirety of the British military establishment but primarily by the Royal Air Force. This approach, as the argument went, would allow the British to maintain an intimidating profile and keep its colonies in check, while also keeping costs low. Although the contours of this military strategy would evolve over the course of the interwar period—for example, as home defense increased in urgency in the late 1930s and imperial policing diminished in the late 1920s—the core tenets of this strategy remained the same through the duration of the prewar years.

The RAF was a major contributor to the development of this military strategy for two primary reasons. First, the strategy ensured the provision of significant funding for the

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air forces at a time when military budgets were sharply decreasing. But, just as important, this strategy offered a much-needed endorsement of an independent air force during the vitriolic debate that was occurring over air force independence in Britain.\textsuperscript{49} To understand fully the significance of this latter point, some context is necessary. Perhaps more so than any other state at this time, the British armed forces had been engaged in tense debate over whether or not the air force should be cleaved off from the ground and naval services. Starting with the formal creation of the Royal Air Force in April 1918 and continuing well into the 1920s, the debate over air force independence was fraught.\textsuperscript{50} On one hand, the navy and army had not taken kindly to the creation of a third service. Not only would this mean that they would have to split existing resources three ways (instead of the traditional two-way division) but they would no longer retain operational control of the air forces, which inevitably led to concerns about the provision of such support in combat.\textsuperscript{51} At the same time, British airmen had become enamored with the prospect of their own organization and administration. Not only would it give them access to new resources, but it would allow them to pursue what they believed to be a promising new concept of strategic bombing.\textsuperscript{52} The result was an antagonistic dispute between the air force and their counterparts in the army and navy during the prewar period.

In this context, it should come as little surprise that the air force was an active proponent of a national military strategy that emphasized imperial policing and deterrence by air. After all, such a strategy would help reinforce their argument for independence in

two ways. First, the policing mission would allow the RAF to demonstrate its ability to subsume the missions of their ground and naval peers at a much lower cost. Thus, in the early prewar era, the RAF regularly demonstrated their willingness and ability to undertake the role of imperial policing more cheaply than their army counterparts. And, to their credit, the RAF did so brilliantly. As noted later in this chapter, the RAF was able to successfully suppress uprisings throughout the empire during the early interwar period, at significantly less cost to the nation than the corresponding ground effort.

At the same time, the RAF was also an avid booster of deterrence by air. The variant of deterrence that was promoted by the RAF—and adopted by their all-too-eager civilian superiors—was tightly linked to the doctrine of strategic bombing. At the most basic level, the RAF believed that the best way to avoid a catastrophic aerial attack—or as they often referred to it a “knock-out blow”—on the British homeland was to invest in airpower capabilities that could reach out and touch potential adversaries. By matching or exceeding the aerial capabilities of potential enemies, the RAF and civilian elites believed that they could credibly threaten to return more pain as they received. Though based on suspicious logic, the view that investments in long-range bombing that matched their nearest peer would successfully deter attack—often referred to as “parity” at the time—was peddled by the RAF and soon became the centerpiece of British military strategy for the majority of the prewar period.

57 Smith, British Air Strategy Between the Wars, 8–9; Posen, The Sources of Military Doctrine, 146.
58 Smith, British Air Strategy Between the Wars, 31–32; Powers, Strategy without Slide-Rule, 183.
For their part, the army was left in the lurch. The combined effect of the embrace of deterrence by air and the total aversion to fighting a ground war meant that the ground forces would be underfunded during the prewar period. Most senior civilian leaders believed that preparing for a ground war would only serve to do one of two things: (a) allow their continental allies to free-ride based on the belief that the British would come to their rescue with a robust ground force; or (b) encourage other states to rearm their own ground forces to meet the British threat. Either way, it was believed that preparing the army to fight a ground war would prove to be a self-fulfilling prophecy. Instead, during the prewar period, military and civilian leaders refused to endow the British ground forces with any of the resources that would prove vital once the war broke out.

In principle, the military strategy adopted by the British during this period seemed to have few flaws—investments in the air force would allow them to maintain peace, deter war, and police their global holdings at a relatively low cost. In practice, however, this proved to be a contradictory and dangerous policy. The crux of the issue lay with resources. Although British civilians had agreed in theory to fund investments in the RAF’s deterrent capability, the manner in which they went about doing so was problematic. Fundamentally, British politicians during this period remained unwilling to fight a war—in the air or otherwise—during this period. As a result, they were satisfied with creating the illusion of a robust air deterrent without creating one in fact. Thus, in an effort to keep

62 Smith, *British Air Strategy Between the Wars*, 89; Murray, “British and German Air Doctrine Between the Wars.”
costs low, the British civilian leadership failed to provide adequate resources to develop real air strength and instead British leaders were satisfied with “the image of military power.”

In practice, the result of these choices was that the RAF during this period was focused on developing a doctrine of strategic bombing with few of the necessary planes or resources to actually conduct such operations. This tendency is exemplified in the British decision to invest almost entirely in “first-line” aircraft, rather than directing some of this investment toward building the reserve forces that would be key to actually fighting a war should it arrive. The product was a fleet that superficially matched the German and French capabilities but would have little staying power in the event of an actual war. As a result, the British were left with a military during the prewar period that all of the trappings of a strong deterrent but with almost none of the actual capability. The results would prove disasterous in the skies over France.

In light of all this, it should come as little surprise that tactical airpower operations were virtually ignored for the duration of the prewar period. With a military strategy focused on deterrence, an air force focused on developing strategic bombing doctrine, and an army that was all but gutted, there was no reason to raise, let alone consider, the problems presented by air support of ground forces. Not only would such an operation admit the possibility of a ground war, which British leaders were unwilling to do, but it would draw constrained resources from already strapped services. Thus, while other airpower concepts, for example Fighter Defense, would gain some traction as the specter of German aggression rose in the late 1930s, tactical airpower was too aligned with exactly the

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64 Posen, *The Sources of Military Doctrine*, 152.
type of operation that the British had disavowed to gain any real support during the prewar period. Just as important, the RAF was unwilling to concede any cooperative ground to the army given its longstanding fight to retain its independence in the face of army and navy objections. By their very nature, tactical airpower operations would grant credence to the army and navy position that some portion of the air forces should and would be needed to support their operations and, therefore, could undermine the RAF's case for independence. Thus, as I will illustrate in greater detail in the following section, the British national military strategy meant that tactical airpower was virtually ignored for the duration of the prewar era.

Before moving on to the empirical record of tactical airpower learning in this period, however, I will close this section with a brief discussion of resource endowments in the prewar era. As noted in Chapter 1, resource endowments generally do not directly affect the learning process until the implementation phase. However, the interservice tension over resources that would prove so powerful in the implementation phase in the British case had its roots in the prewar era. Indeed, during this period in the British case, the constrained resources available to the military served to reinforce preexisting interservice tension in ways that would prove problematic in later years. As noted above, the tension between the British air forces and their ground and naval counterparts had already reached a fever pitch in the immediate aftermath of World War I. The root of the issue was, in fact, organizational: neither the army nor the navy was eager to concede its control over its supportive air forces to a service that might not be willing to meet their requests for

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69 Smith, British Air Strategy Between the Wars, 25-26; Powell, The Development of British Tactical Air Power, 1940-1943, 6-9.

support. Once the war was over, however, and resource constraints on each of the services were fully felt, the issue of organizational autonomy was further compounded over an impassioned competition for funding. With the creation of the independent air force the army and navy would be forced to share their shrinking slice of the resource pie with a third, and notoriously irreverent, service. Moreover, as it became increasingly clear as the 1920s wore on that the RAF would be the primary beneficiary of resources in this constrained environment, interservice tension only heightened. By the early 1930s then, the interservice antagonism that had emerged over the independence of the RAF had reached its height, regularly spilling into public view. Although this competition for resources was certainly concerning during the prewar period, it was not until the war actually began that the legacy of this antagonism would begin to have real and deadly consequences.

3.2 Tactical Airpower: Doctrine, Exercises & Operations

As noted above, the nature of British military strategy during the prewar period meant that very little attention was paid to the potential problems of tactical airpower operations. Both the army and air force were preoccupied with concerns that had nothing to do with fighting an offensive ground war, and were therefore largely unconcerned with the problems of air support in such operations. Moreover, even as the possibility of war neared toward the end of this period and some priorities emerged with new urgency (like, for example, home defense), tactical airpower remained at the very bottom of the RAF’s priorities. Not only

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was it peripheral to their main concern of strategic bombing and, later, home defense, but such operations would inextricably link them to support of the army and could undermine their decades-long effort to secure independence.

But perhaps even more telling than the absence of thinking about tactical airpower operations, is the way in which the issue was approached on the few occasions where it was forced to surface. Accordingly, I briefly recount the three areas where tactical airpower operations were considered during the prewar period to illustrate just how isolated, superficial, and, in the end, fruitless these limited attempts to address the problem proved to be. Specifically, I will review the ways in which tactical airpower operations were considered in the context of doctrine, exercises, and imperial policing operations.

Doctrinally, the RAF is notable in this period for its overall lack of codification schemes. There was little prioritization of publishing official doctrine, and instead officers and airmen generally relied on informal publications, conferences, and speeches for the most up-to-date information. Nevertheless, there were at least four doctrinal publications that were released during the prewar period that give some insight into the evolution of RAF thinking about airpower. In some of the first iterations of RAF doctrine, including: Operations (1922), Manual of Combined Naval, Military, and Air Operations (1925), and Royal Air Force Manual AP 1300 (1928), there were some concessions to the importance of collaboration with the army. Indeed, given that air force officers were fresh off of the victories of World War I, in which air support of ground forces was used to good effect, this

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should come as a little surprise. Even Sir Hugh Trenchard, the British prophet of strategic bombing, was willing to concede at this time that air power could and should be employed in concert with the other services for maximum effect. Furthermore, in policing operations throughout the empire, airmen were working with ground forces to good effect.

Accordingly, RAF doctrine in this early period was willing to admit the potentiality of cooperation with ground forces but, critically, only in a limited way. Indeed, in the first iteration of AP 1300, only one chapter was devoted to cooperation with the army. Moreover, such concessions were never made at the expense of underlining the independent effect of airpower when employed in strategic bombing missions. Thus, despite some formal recognition of tactical airpower operations in the early prewar period, it remained a secondary priority to independent missions.

Moreover, as the prewar period continued, the already-limited writing on tactical airpower was overshadowed by discussions about inherently independent, offensive character of air warfare. Although some references to army support were retained in future iterations of RAF doctrine, the balance of formal and informal writing on the role of airpower in future wars was focused on strategic bombing doctrine. For instance, John Slessor’s *Air Power and Armies* (1936), which was considered the gospel of contemporary RAF thinking on air war, did note that air power could be used in extenuating circumstances to support ground operations, but overwhelmingly focused its attention on

the use of air assets in independent missions. In general, air officers shared Slessor’s priorities in the prewar period: they were far more interested in discussing the topic of strategic bombing than they were with understanding tactical airpower operations. Thus, with its focus elsewhere, it should come as little surprise that the final RAF doctrine on the issue of cooperation with the army before the war broke out, *Manual of Army Cooperation* (1937), offers a litany of potential uses of airpower in support of ground forces but little practical guidance on how and when that support can best be implemented.

But even more revealing than what RAF leaders were saying publically about tactical airpower operations, was the astounding willingness of airmen to ignore or contradict formal prescriptions on army cooperation in informal discussions about the use of air power. Indeed, a review of the popular airpower journals during this period reflects a widespread and deep skepticism of tactical airpower and a clear preference for strategic bombing among airmen. Thus, even when the RAF did acknowledge in their theorizing about air warfare that they might need to support ground forces, these documents were long on insincerity, short on details, and widely rejected by many air officers.

In a similar way, RAF exercises and operations policing the empire reflected a general disregard for tactical airpower operations. Perhaps more so than any other metric, the manner in which airmen were willing to dismiss or ignore the few exercises and operational reports about tactical airpower operations is illustrative of the disinterest in this mission throughout the RAF. First, despite conducting annual exercises with the army regarding cooperation—which is, admittedly, somewhat remarkable given the prewar attitudes toward

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84 Powers, for example, provides a comprehensive overview of the thinking in major airpower journals during this period. For more see, Powers, *Strategy without Slide-Rule*, 192–97.
such collaboration—the reports of these exercises reveal that over the course of almost a
decade virtually none of the recommendations made on the basis of the exercises were
adopted in future iterations. 85 Thus, despite one such exercise report in 1927 endorsing the
collocation of army and air force headquarters, neither exercises in 1934 nor the defense of
France in 1940 implemented this simple recommendation. 86 Whether this dismissal was the
result of heavy turnover among RAF leaders in the cooperation billets or if it had a more
malicious motive remains unclear, but either way it reflects a remarkable disregard for the
close study and improvement of tactical airpower operations during the prewar period. 87 In
short, despite clear evidence from actual cooperative exercises suggesting the need for
changes, the RAF and army proved unwilling to integrate such insights into their
operational practice.

Furthermore, the RAF proved equally willing to dismiss even the most credible
reports on how to employ and improve tactical airpower operations that were coming from
“air control” operations in the British colonies as early as 1922. 88 Indeed, despite consistent
and clear reporting on the limits of RAF cooperation with ground forces in imperial policing
operations in Somaliland, Afghanistan, Iraq, and Spain, the RAF was contemptuous of such
reports. 89 Rather than take them on their merits, RAF leaders dismissed the findings of
forces engaged around the world as not comparable to the challenges that would be posed
in operations during a major conventional war. 90 Though there may be some merit to this

85 Powell, *The Development of British Tactical Air Power, 1940-1943*, 12-16; Murray, *Strategy for Defeat
the Luftwaffe*, 329.
17-18.
Development of British Tactical Air Power, 1940-1943*, 17-27.
view, this trend prevented senior RAF officers from acknowledging and incorporating the operational reporting of their own officers deployed in policing missions during the prewar period.

Taken together, the RAF’s disregard for tactical airpower operations, even when it was forced to surface in doctrine, exercises, and operations during the prewar period reflects a deep and abiding commitment to avoiding the problems of tactical airpower. Thus, despite being presented with opportunities to meaningfully improve tactical airpower operations, the RAF’s view of future military operations—which was based squarely in deterrent British military strategy—colored their response to this information. The result was that even where consideration of tactical airpower operations existed in the RAF, these observations were distorted, ignored, or suppressed.

4 Fall of France & the Aftermath (1940 – 1942)

As the specter of war on the continent grew, however, even the British were forced to reckon with the possibility that another ground war might be on the horizon. Thus, despite their best efforts to avoid thinking about or preparing for ground contingencies, the British were forced to make some concessions to the prospect of such an outcome by the late 1930s. From an airpower perspective, two critical changes occurred as a result of this shift: first, the British began to invest more heavily in capabilities that would assist in home defense, resulting in a surge of fighter production; and, second, the British agreed to supply the French with limited ground and air forces to assist with their defense, called the British Expeditionary Force (BEF) and the British Air Forces in France (BAFF), respectively. The results of these two investments could not have been more different in practice: while

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improvements in the British home defense capability halted the German air attack during the Battle of Britain in the summer and fall of 1940, the BEF and BAFF proved strikingly inadequate during the Battle of France. Thus, these investments in the late 1930s were met with mixed results.

After the German invasion of France in 1940 put the failings of the British military on full display, however, British leaders became resolved to address their weaknesses more comprehensively. As Prime Minister Winston Churchill himself put it in the days after the Dunkirk evacuation, “our thankfulness at the escape of our Army and so many men, whose loved ones have passed through an agonizing week, must not blind us to the fact that what has happened in France and Belgium is a colossal military disaster.” As a result, significant changes to British military strategy began to emerge in full force. The Battle of France would induce British civilian and military leaders to take seriously the prospect of offensive ground warfare and, as a result, would make them attuned to the unique military problems associated with this type of conflict. Among the many issues that this brought to the attention of British military leaders was the challenge presented by tactical airpower operations. Thus, it was in the summer of 1940 that the British finally came to terms with a war on the land and their role in it and, in doing so, gained an interest in tactical airpower operations.


93 “National Churchill Museum | Winston Churchill We Shall Fight on the Beaches Speech.”


The remainder of this section will discuss the changes in British military strategy and resource endowments that were ushered in by the fall of France. As I will demonstrate, the results of this failure for British strategy and military preparation were immediate. Although the British would continue to pursue the development of a robust home defense and strategic bombing capability, they now added an additional military priority to their list: forcing back the German forces now occupying France and threatening British holdings abroad. As a result, issues like tactical airpower were thrust into the spotlight for further study and experimentation. But the picture of British preparation was not all rosy. Despite the British government recognizing the need for improved tactical airpower operations, interservice tension over the issue would remain largely unresolved for two more years. As we shall see below, the maintenance of this tension came directly as a result of continued resource scarcity—although the British had approved a massive rearmament program in 1940 that, unlike its prewar predecessors, would eventually infuse the military with a meaningful increase in materiel, the delays in deploying such assets into the theater meant that interservice tension would remain.

4.1 National Military Strategy and Resource Endowments

In May 1940, the British were dealt a considerable shock. Not only had their military strategy failed to deter German rearmament, but they soon found that their choice not to invest in ground forces had left them at a considerable disadvantage. Not only was the

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British army itself practically hollow, but neither the army nor the RAF had given much thought to working together in a combined operation. Thus, British prewar policy that had kept their ground capabilities small to prevent allied shirking had proven ill-advised—when British reinforcement was truly needed, it did not exist.

Adding insult to injury, the strategic bombing doctrine that the British had adopted, and that the RAF had touted so loudly during the prewar years, also proved hollow once the fighting began. Years of indecisiveness over British rearmament schemes during the late thirties (of which there were at least six in the course of four years), accompanied by civilian unwillingness to allocate the necessary funding to develop meaningful capabilities, meant there was little for the RAF to show beyond doctrine for strategic bombing in 1940.

In other words, strategic bombing was almost entirely theoretical—the long-range bombers did not exist in the numbers necessary to undertake this mission. Thus, British military planning during the prewar years had proven flawed: they could neither perform the strategic bombing operations that they had planned to undertake, nor could they perform the ground campaign that would be required to fend off the Germans.

The British needed a new strategy. Fortunately, the Germans had made it clear to what end that strategy would be directed. The German advance on the continent had made the British Isles the last frontier in Europe, and the British would need to marshal all of their available resources to meet German aggression. This meant that the British would need to be prepared to do two things: first, repel an attempted German aerial or naval invasion on its shores; and, second, to defend their allies and global holdings by meeting

101 Hall, “From Khaki and Light Blue to Purple: The Long and Troubled Development of Army/Air Co-Operation in Britain, 1914-1945,” 78–80; Murray, “British and German Air Doctrine Between the Wars.”
102 Murray, Strategy for Defeat the Luftwaffe, 326; Posen, The Sources of Military Doctrine, 153.
the Germans on land. The first of these changes had been initiated in 1938, when British concerns about home defense had reached their pinnacle. And, indeed, it is fortunate that they did—without the prioritization of home defense it is unlikely that British Fighter Command would have had sufficient resources to repel the Germans during the Battle of Britain in the summer and fall of 1940. However, the prospect of waging a ground campaign against the Axis forces was a new addition to British military strategy, and would require some adaptations on their part. With the appointment of Winston Churchill as Prime Minister in May 1940, the British changed tack to meet these new strategic demands.

Critically, however, the intensification of this military priority—combating the German menace at home and abroad—did little to diminish the fervor for strategic bombing. Although the deterrent element of long-range bombing capabilities had failed, this did not mean that British military leaders were willing to jettison the doctrine altogether. Instead, there remained a deeply held view that offensive strikes in the heart of Germany would still act as a critical lever with which to weaken the German military. Thus, although there were elements of the British military strategy that changed noticeably in the wake of the Battle of France, by-and-large these were additions to existing priorities rather than replacements of them.

As British military priorities grew, however, there would also need to be a change in resources. In this respect, the new government wasted little time in funneling money to the

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106 Smith, British Air Strategy Between the Wars, 180–201; Overy, The Air War, 15–17.
111 Frankland, Bomber Offensive, 20–52; Terraine, The Right of the Line, 251–300.
military.\textsuperscript{112} By the best estimate, between 1939 and 1940, British expenditure on defense tripled and, in the following year, increased five-fold.\textsuperscript{113} The RAF received a considerable share of that funding, and the vast majority of it was directed toward fighter and bomber acquisitions.\textsuperscript{114} Critically, however, the promise of additional resources was not the fact of additional resources. Particularly in the air force, there remained the problem of actually producing these now-earmarked aviation assets; and production would take time: not only was the British aviation industry still recovering from downsizing during the interwar period but, simply as a matter of fact, planes take a relatively long time to build.\textsuperscript{115} Even the most robust aviation industries during this period would struggle to meet the demands of the battlefield and, early in the war, Britain did not have a robust industry to support such an enterprise.\textsuperscript{116} As a result, although home defense concerns had bolstered fighter production in the late 1930s, British industrial bomber production was still warming up in 1940.\textsuperscript{117} Thus, despite directing funding toward British aviation, progress in delivering those planes was initially slow, particularly in the critical category of medium bombers.\textsuperscript{118}

Beyond overall production, however, the picture was even more dire. Indeed, combat ready “first-line” aircraft, which could be immediately deployed into the theater, made up only a small proportion of overall aircraft production in this period. For instance, by some estimates, British combat ready aircraft from 1938 to 1941 had gone from approximately

\textsuperscript{113} Office, \textit{Fighting With Figures}, 222.
\textsuperscript{115} Millett and Murray, \textit{Military Effectiveness}, 2010, 3:96–98; Smith, \textit{British Air Strategy Between the Wars}, 110–11.
\textsuperscript{117} Overy, \textit{The Air War}, 27–28, 42; Office, \textit{Fighting With Figures}, 170.
2,000 first line planes to only 4,500 aircraft. Though, by the end of 1942, that number would double again, it is important to recognize that the faucet of aviation resources took some time to turn on.

Furthermore, there was the issue of getting pilots and maintainers to man and maintain the growing air fleet. Here again, the British would eventually deploy an effective intake and training system, but in the early days there were considerable growing pains. As we shall see in the following section, it was not until early 1942 than many of the manpower holes were filled in the RAF. Similarly, the maintenance of aircraft in the operational theaters—and especially in North Africa—faced major problems well into 1941. Together, the result of these industrial, training, and maintenance realities meant that the promise of these aviation resources took some time to be realized in British operations. In their absence, the interservice tension between the RAF and British army remained high throughout the early part of the war. In the context of tactical airpower operations, this meant that, despite awareness of both the problem and possible solutions to the challenges of tactical airpower operations, implementation of these fixes would be fraught. As we shall see in the next section, it was not until aviation resource abundance was manifested in the theater in late 1942 and early 1943 that interservice antagonism could be overridden, and tactical airpower solutions implemented.

4.2 Tactical Airpower Operations

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120 Overy, The Air War, 77.
In the early part of the war, the actual execution of tactical airpower operations in France and in subsequent campaigns in Greece, the Middle East, and North Africa were, for the most part, deeply flawed. Although there were pockets of success—most notably in the Western Desert Air Forces (WDAF) under the command of Air Vice-Marshal Arthur "Mary" Coningham—nearly every ground engagement in which the British were involved before the end of 1942 was plagued by ineffective air support. But this is not to say that the British were unaware of the problem. Indeed, the failure of air support in France was not easily ignored. British military strategy was now resigned to meeting Axis forces on land, and there were real concerns about the performance of tactical airpower operations in theaters around the globe. After all, if the RAF could not support the French or its other allies on the ground, there was reason to be concerned that such support would be found wanting in a future attacks against German forces around the world. As a result, in the wake of the French defeat, the RAF and army were tasked with devoting considerable resources to studying the problem of tactical airpower operations and developing new solutions. Although these solutions would languish in the climate of deep interservice tension over the provision of resources that persisted well into 1942, the close study of the

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127 Few historians have devoted attention to the development of tactical airpower operations after the fall of France. In general, three authors—and their several published accounts of this period—provide the most comprehensive accounting of tactical airpower development in the early war, and are relied on here along with documents from The National Archives of the United Kingdom (TNA). For more on the historical accounts, see: Hall, *Learning How to Fight Together: The British Experience with Joint Air-Land Warfare*; Hall, “From Khaki and Light Blue to Purple: The Long and Troubled Development of Army/Air Co-Operation in Britain, 1914-1945”; Hall, *Strategy for Victory*; Powell, “‘The RAF Must Fly the Flag’: The British Army’s Interpretation of Tactical Air Power during the Battle of France, 1940”; Powell, *The Development of British Tactical Air Power, 1940-1943*; Powell, “Re-Discovering the Operational Level”; Carrington, *Army Air Cooperation, 1939-1943*; Charles Carrington, *Soldier at Bomber Command*, First edition (London: L. Cooper, 1987).
tactical airpower operations in the wake of the French defeat marks the initiation of lengthy but, eventually, successful learning process.

The remainder of this section examines the British experience in this first phase of learning about tactical airpower operations. First, it reviews the performance of the BAFF in France, after which the British military recognized the many problems that tactical airpower operations would pose for future ground campaigns. Second, it discusses the process by which the British military began to study this challenge, focusing on the early experiments with air-ground communication undertaken by the Wann-Woodall committee, the establishment and work of the RAF's Army Cooperation Command, and the initial piloting of the new tactical airpower operations system by the Western Desert Air Forces. Significantly, however, despite considerable progress in all three of these venues, the widespread implementation of their findings remained elusive.

4.2.1 BAFF & the French Collapse

When the British began operations in France, the army and air force agreed on a system of support for ground operations that centralized control under one air command, the British Air Forces in France (BAFF), lead by the Air Officer Commanding-in-Chief, Air Marshal Sir Arthur Barratt. Under Barratt would be two subordinate commands, the Advanced Air Striking Force (AASF) and the RAF Air Component. The AASF, which would be responsible primarily for interdiction strikes, consisted of eight squadrons of Fairey Battle light bombers, two squadrons of Bristol Blenheim bombers and two squadrons of Hurricane

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fighter aircraft. The Air Component, on the other hand, would be employed in direct support of the army in a reconnaissance role, and consisted of five Lysander squadrons, four Blenheim squadrons and four Hurricane squadrons. Regardless of their intended missions, however, both RAF and army leaders agreed that, in certain circumstances, the entirety of the BAFF could be employed in support of the ground forces: “the BAFF [was] responsible at all times for the air support of the ground forces. Accordingly, the BAFF’s bomber squadrons could be placed at the C-in-C BEF’s disposal whenever necessary.” In other words, the air assets supporting the ground campaign in France were organized under the immediate authority of an RAF officer, but ultimately responsible to the ground commander—a compromise that both the army and RAF could live with at the time. However, this agreement proved problematic in execution, and ultimately was short-lived.

Much has been made of the quantitative disadvantages of the BAFF relative to the Luftwaffe in the skies over France and, indeed, it appears that the BAFF did have considerably fewer planes engaged in support of the BEF during operations on the continent. However, it is important to note that the quantitative disadvantages suffered by the BAFF, where they existed, were a product of inadequate resourcing on the part of the RAF and not a result of the limits of available British assets at the time. Beyond the numbers, however, there were more meaningful disparities between the RAF and Luftwaffe

133 Hall, 49.
in France, most noticeably in terms of bombers available. The British Fairey Battle and Blenheim bombers, for example, were too slow and too cumbersome to be of much use to the RAF aircrews since they were vulnerable to German flak.\textsuperscript{136} Thus, as one historian points out, “while the quality of the RAF aircrew was excellent, and fully the equal of the best the Luftwaffe had to offer, the same could not be said of its aircraft.”\textsuperscript{137} Accordingly, even if the BAFF had been outfitted more robustly, there were significant flaws in the technical elements of their aircraft that would impede effective operations.

The quantitative and technical disadvantages, however, were no doubt exacerbated by the doctrinal and operational failings of the ineffective tactical airpower system employed by the BAFF. Several problems emerged. Not only was the BAFF flying bombers that could not keep up with German air assets or evade their artillery, but the lack of headquarters collocation and delays in transmitting calls for support meant that there was considerable confusion about the provision of real-time air support.\textsuperscript{138} Additionally, despite some initial improvements to the system for impromptu air support, the mechanisms employed in France remained slow and inconsistent.\textsuperscript{139} And while attempts to centralize command under Barratt helped, the calls for persistent air cover from ground units demonstrated a misunderstanding about what targets could most productively be attacked by the available aviation.\textsuperscript{140} Since the BAFF was ultimately responsible to the ground forces, there was little Barratt could do to prevent these calls from leading to the counterproductive dispersion of air assets over the front. But more than anything else, the biggest problem for the BAFF was that they neither had the resources nor the experience to wrest air superiority from the

\textsuperscript{137} Hallion, \textit{Strike from the Sky}, 142.
\textsuperscript{139} Powell, \textit{The Development of British Tactical Air Power, 1940-1943}, 55–58.
better outfitted and organized Luftwaffe, and conceded it almost immediately. The result was that the available aviation assets, dispersed across the front without any semblance of local air superiority, were easily picked off by Luftwaffe pilots. 141

The product of these vulnerabilities was striking: according to one estimate, in the first three days of the fighting the Battle bombers were consistently taking over 40 percent losses, and by the second day the available Battles and Blenheims had dropped from 135 to 72. 142 Although German operations over Sedan and the Ardennes were far from perfect, their efforts to secure local air superiority followed by continuous attacks against French ground forces played an significant role in causing the collapse of the French ground force. 143 For its part, the BAFF could do little to keep the Germans from harassing the BEF or French forces, let alone conduct the interdiction strikes that it had hoped it would employ. 144 Thus, the combination of limited assets, ineffective platforms, disrupted communications networks, lost airfields, and, most importantly, lack of air superiority, meant that there was little the BAFF could offer by way of support against the German advance.

But it was not just the BAFF that had failed in France, the entirety of the British Expeditionary Force had also crumbled under German pressure, along with their French allies, and the failure was too obvious to ignore. Thus, as noted previously, the result was a strategic shift that demanded the British military better prepare for ground operations. When it came to tactical airpower operations, there was much work to be done.

142 Hallion, Strike from the Sky, 140–42.
4.2.2 Army Cooperation Command, Wann-Woodall & the Western Desert Air Forces

By the time British forces had evacuated France in June 1940, it was clear that tactical airpower was a problem. In the wake of these failings, there were two main complaints coming from both the army and RAF. First, both services agreed that there had been insufficient resources supplied to the defense of France.\(^{145}\) Furthermore, both services also agreed that the command structure for air support had proven inadequate.\(^{146}\) The problem, however, was that the RAF and army disagreed on what the appropriate fix to the command problem should be. In after action reviews undertaken by the army, ground commanders raised concerns over the effectiveness of the centralized system of command for air support.\(^{147}\) Indeed, the army was quick to revert to their pre-1940 argument that “sufficient aircraft—both fighters and bombers—[should be] under the direct command of the Army commander.”\(^{148}\) The RAF, on the other hand, reviewed the command structure more favorably, and remained “convinced that the events in France illustrated a prima facie case for regarding the initial [centralized] air plans as entirely successful.”\(^{149}\) RAF leaders argued that more aircraft, improvements in reconnaissance, and the implementation of a more RAF authority would solve many of the problems observed in French operations.\(^{150}\) Thus, looking at the same set of facts and acknowledging the same set of underlying issues, air and ground commanders found themselves in stark disagreement on about how to remedy these problems. In the remainder of this section, I discuss the three forums which were

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\(^{149}\) Hall, 53.

\(^{150}\) Hall, 53–63.
subsequently developed to help resolve some of these disputes about tactical airpower operations: (a) Wann-Woodall experiments; (b) the Army Cooperation Command (ACC) and (c) the Western Desert Air Forces (WDAF).

**Wann-Woodall & Army Cooperation Command**

Although the after-action reports from France would leave the services at odds with each other, the grievances aired in its wake did force the RAF to think more seriously about how to deal with army dissatisfaction.\(^{151}\) As a result, the RAF invested in two new resources to find a better solution to the problem of air support: (a) the Wann-Woodall experiments and (b) Army Cooperation Command, both of which served as critical incubators for the generation of new knowledge about the tactical airpower problem set.

The RAF, facing renewed pressure to provide evidence that its proposed system for centralized RAF command of air assets was superior to the army's proposal to make these assets organic to smaller ground units, invested in a series of experiments in Northern Ireland aimed at providing precisely this sort of evidence.\(^{152}\) Starting in August 1940, the RAF tasked Lieutenant-Colonel JD Woodall, who had worked closely with Air Marshall Barratt, and Group Captain AH Wann to work on solving the technical and tactical problems of air support for ground forces.\(^{153}\) In particular, the exercises conducted during the Wann-Woodall experiments were aimed at identifying the best system of communication and liaison between the ground forces and their air assets in order to provide efficient impromptu air support to ground units engaged in active fighting.\(^{154}\) After several months

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of testing and experimentation, the joint exercises had developed a clear solution to the problem of liaison. Best said by C.E. Carrington, who bore witness to the experiments firsthand:

The essence of this system was a mobile operations room, called at first a Close Support Bomber Control, under an army officer but located at a combined headquarters. From the control, officers were sent forward in light cars to signal back battle information and calls for air support, by direct wireless links. In addition to these forward 'tentacles', the controller had backward 'tentacles' to the airfields. He monitored the messages, backwards and forwards, passing requests to the R.A.F. Group Commander, who at this stage of the war was presumed to be under military command.

Thus, as Carrington describes, the key contribution of the Wann-Woodall experiments was to develop a system of communications that would provide the RAF with to-the-minute reporting on how and where their air attack could be best executed in the battlefield. The response to this system was generally positive, and its findings were circulated within a small cadre of army and air force leaders interested in the topic. However, despite the clear progress inherent in this system, the RAF stopped short of distributing the findings more widely to the commands in theater. Although the reasons for this limited distribution are opaque, this choice may have been a result of RAF distrust of theoretical and experimental solutions—instead, the RAF was waiting for empirical proof that such a system could work from commanders in the field. Thus, despite the clear improvement in communication that was identified by the Wann-Woodall experiments in August 1940 the wholesale adoption of these changes proved to be a bridge too far for the RAF and army.

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159 Powell, "Re-Discovering the Operational Level," 74.
In addition to the Wann-Woodall experiments, the RAF also invested in the development of the Army Cooperation Command (ACC) in the winter of 1940. The ACC, under the leadership of Air Marshall Barratt, who had just returned from commanding the BAFF, was tasked with aligning army and air force thinking on the issue of tactical airpower. Although Army Cooperation Command was plagued with resource difficulties throughout its operation, its key contribution to the debate over the role of air power in the ground fight was “to educate the Army in Britain about the ability of tactical air power to have a wider influence at the operational level.” Though subject to near-constant complaints from both the RAF and the army, by 1941, the ACC had held some small training exercises that demonstrated that the RAF—if properly trained and outfitted—was capable of providing sufficient support to the ground forces. Critically, this experimentation validated several of the core components of effective tactical airpower systems discussed in the previous chapter, including the importance of a centralized command structure under an air commander that could filter immediate requests from the frontline through a series of vetting procedures to ensure that airpower was being leveraged at the most critical nodes on the battlefield. But despite the best efforts of the ACC leadership, the impact of these events was limited, in part because senior civilian and military leaders (including Churchill himself) were unwilling to divert resources for these sorts of training exercises. In this environment of constrained resources, the diversion of air assets away from the RAF’s preferred strategic bombing mission, along with army’s

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162 Powell, “Re-Discovering the Operational Level,” 73.
admittedly excessive demands for more support units, the limited the effects of the goodwill that had started to emerge between the two services in the aftermath of the fall of France.\(^\text{166}\)

Thus, despite the identification of some of the critical tenets of tactical airpower at Wann-Woodall and the ACC from 1940-1941, the impact of their findings was limited. Not only had these incubators developed a robust system for real-time joint communications, but they had also validated the need for centralized control of air assets under the air commander. Unfortunately, these insights would go unheeded. Not only did senior commanders want more field testing of these concepts, but their interservice antipathy made them skeptical of any information that contradicted their preferred system for air support.

**Western Desert Air Forces**

Fortunately for proponents of a new tactical airpower system that incorporated the centralization and communications components identified at the ACC and during the Wann-Woodall experiments, the RAF’s operations in North Africa would offer an operational proving ground to validate some of their insights. Although the early stages of the campaign were plagued by many of the same issues facing the BAFF in France, by late 1941 initial combat testing of the new system by the WDAF had validated many of its core tenets.

The war in North Africa began in earnest in September 1940—just months after the debacle in France—when Italian dictator Benito Mussolini invaded Egypt in an effort to secure territory in the region. For the British, this affront was not easily ignored: “Egypt was the crux of British security in the Middle East as well as a main link in the chain of imperial communications.”\(^\text{167}\)

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\(^{167}\) Hall, *Strategy for Victory*, 68.
the British, but it was an important military base for the Royal Navy, and offered a resupply route for the army and air force.\textsuperscript{168} Accordingly, unlike the planning for France, the British had directed significant attention to the potentiality of fighting in this theater before the war began.\textsuperscript{169} Realizing that they could not afford another repeat of the tactical airpower debacle that occurred in France, some limited improvements were made to the tactical airpower system at the start of North African operation: first, the RAF was explicitly charged with direct support of ground forces; second, the RAF commander was collocated with the ground commander; and third, the liaisons and signaling infrastructure between the field and headquarters had been improved.\textsuperscript{170}

But these relatively minor changes would prove insufficient. After the arrival of the German Afrika Corps under Field Marshal Erwin Rommel to reinforce the Italians, the tide turned against the British and their fortunes reversed in the spring of 1941.\textsuperscript{171} On arrival, the Afrika Corps immediately launched a counterattack against the British, laying siege to Tobruk and forcing a British retreat to Sollum at the Egyptian-Libyan border.\textsuperscript{172} For the remainder of the spring, Tobruk would remain contested, despite two British efforts to dislodge the German forces.\textsuperscript{173} First, in May 1941, the British began Operation Brevity, which attempted to make gains in Egypt and set the stage for an offensive that would retake Tobruk.\textsuperscript{174} Quickly, however, the operation proved a failure, and the British forces were pushed deeper into Egypt.\textsuperscript{175} A month later, the British launched Operation Battleaxe,
another attempt to lift the siege on Tobruk and retake the city, which also ended in the British being driven back by the German forces.\textsuperscript{176}

In both of these operations, air support was a point of significant tension between the air and ground commanders. In Operation Brevity, Lieutenant General William Gott and Air Vice Marshal Raymond Collishaw fought repeatedly over where RAF attacks would better serve the ground force: Gott argued that RAF attacks should be concentrated on German tanks, while RAF commander Collishaw argued that tanks were notoriously difficult to target from the air and, accordingly, suggested that air assets would be better used attacking indirect targets in the enemy rear, including communications and lines of supply.\textsuperscript{177} Ultimately, Gott's argument won the day and RAF air support was dispersed ineffectively across the front, with air assets trying and failing to hit German tanks from above.\textsuperscript{178} Similarly, Operation Battleaxe was marked by disagreements over the appropriate employment of air support. Like Gott, the new ground commander, General Archibald Wavell, thought air assets would be most useful covering the ground force advance and responding to impromptu calls for support.\textsuperscript{179} For the sake of interservice harmony, Air Marshal Tedder, then in charge of RAF air assets, chose to go along with Wavell's preference, despite his concerns that the employment of air assets in this way was overly rigid.\textsuperscript{180} In both operations, ground officers had insisted on violating several precepts of effective tactical airpower operations: they prevented the centralization necessary for aircraft to mass on critical battlefield targets, and they prioritized close air support over air

\textsuperscript{177} Terraine, \textit{The Right of the Line}, 344.
\textsuperscript{178} Terraine, 344.
\textsuperscript{179} Terraine, 344--46; Hall, \textit{Strategy for Victory}, 82--83.
\textsuperscript{180} Terraine, \textit{The Right of the Line}, 345--56.
superiority and battlefield interdiction. Thus, in the first year of the North African campaign tactical airpower remained poorly employed.

By the fall of 1941, it was apparent to all those involved that more changes would be necessary if tactical airpower operations were to be successfully undertaken in North Africa. Indeed, even Prime Minister Churchill was forced to weigh in on the issue on the issue of prioritization, leading to the publication and distribution of a revised training document, *Army Training Instruction No. 6*. But doctrine is easily ignored, and it was therefore up to the theater commanders to ensure that tactical airpower remedies were implemented. Fortunately, the introduction of several new commanders into the theater ensured that meaningful changes would be made, albeit on a relatively small scale. First, General Archibald Wavell was replaced by General Claude Auchinleck, who developed a much stronger working relationship Tedder. Almost immediately on taking command, Auchinleck made clear to Tedder that he took the integration of air support seriously and was eager to repair the strained relationship that had existed under Wavell’s command. Accordingly, Tedder and Auchinleck instructed their subordinates to create an interservice committee that would deal with the question of how air support should be organized, coupled with a series of field exercises that would test out their prescriptions.

Although far from perfect and still subject to many of the similar tensions that had plagued discussions of air support before, the joint committee was instrumental in developing a command and communications structure, the Air Support Control (ASC), that allowed for improved air-ground integration. The ASC was effectively a joint, mobile,
integration unit, provided to each corps and armored division that would process requests for air support from the field. Similar to the conclusions of the Wann-Woodall experiments, the committee proposed that the ASC would be linked to each brigade in the field by radio and would act as an intermediary between these field units and air headquarters. As a result, “forward troops could make air support requests that would be considered immediately and, if granted, met promptly...[at the same time] each request was evaluated by the ASC in accordance with the overall picture of each battle, the suitability of each target, and the availability of appropriate aircraft.” In other words, the joint committee had developed a system that was capable of providing meaningful, prompt air support to individual ground units while allowing the RAF to retain control of its assets and ensure they were being used optimally from a theater-operational perspective.

The ASC system, along with Auchinleck’s willingness to allow air commanders full control over air assets in the theater, finally adhered to the core tenets of effective tactical airpower. Auchinleck and Tedder’s improved working relationship meant that Tedder and his RAF subordinates could retain more centralized control of air assets and, as a result, could prioritize air superiority before dispersing air assets for ground support. In addition, the ASC system would be adopted to ensure speedy allocation of impromptu ground support where it was most necessary. But the success of this system was yet to be demonstrated in combat. For this task, it was up to the Western Desert Air Forces, under the command of the newly appointed Air Vice-Marshal Arthur Coningham to demonstrate just how successful this system could be under fire. Fortunately, Coningham and Tedder had a remarkable intuition for air support, and were willing partners in executing the insights

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that had emerged at the end of 1941.\textsuperscript{189} Thus, when Operation Crusader—a major offensive intended to relieve Tobruk—began in November 1941, the WDAF was given its first opportunity to prove the new system’s mettle.\textsuperscript{190} Although the operation itself was met with limited success, from the standpoint of air support, it offered the first proving ground for the new arrangements of air support that had been developed over the summer.

In execution, the operation acted as a proof-of-concept for the precepts of effective tactical airpower operations that had been identified at Wann-Woodall and the ACC. Under the centralized command of Coningham, the WDAF first met air superiority needs over the front, followed closely by BAI and CAS operations, all while employing real-time communications through the ASC and collocated army-air headquarters.\textsuperscript{191} Within days of launching the attack, it was clear to those involved that the new tactical airpower strategy was working. As one historian recounts, “the RAF’s air superiority was quickly established, and the German offensive air action during the first three days of battle was, in Tedder’s words ‘almost negligible’. ‘It was clear’ [Tedder] remarks, somewhat tartly, ‘that the Army, for once, was pleased with the RAF’.”\textsuperscript{192}

In particular, two elements of the operation stood out from an air power perspective. First, the ground and air commanders had both agreed centralization of the theater air assets under RAF command was paramount. As a result, air superiority would be the first priority of the RAF and “provision of direct support should never jeopardize this essential


\textsuperscript{192} Terraine, \textit{The Right of the Line}, 357.
requirement.” Second, the ASCs that had been developed and integrated into the force in the early fall were implemented with some slight modifications, including the further centralization of command over air assets at the theater headquarters (rather than at the corps level). The combined effect of these changes was a marked improvement in tactical airpower operations: while air assets were centralized under Coningham, the ASC system still allowed incredible flexibility and responsiveness to the impromptu needs of the individual ground units. Together, prioritization and centralization had led to significant improvements, just as the Wann-Woodall and ACC experiments had predicted. As one historian puts it, “The two services had at last constructed not only a theoretically sound but also a practical, working partnership.”

Of course, even with the improvements that Crusader ushered in, there remained several issues that still needed to be sorted out. In particular, time lags for impromptu support plagued the RAF, and identification of friend and enemy forces continued to be a problem. These shortcomings would need to be rectified over the next several months, and Coningham was committed to doing so. Indeed, Coningham and the RAF theater commander would continue to refine the air support system that had finally achieved a satisfactory balance for both services. Thus, although British combined operations in North Africa over the next year would be met with middling levels of success—in large part because of the disastrous ground organization that existed in North Africa from 1941 to 1942—the WDAF under Coningham would remain a light in an otherwise dark period of British performance.

But just as the findings of Wann-Woodall and the ACC were aired but not resolved, this narrow band of success in the Western Desert did not mean that the rest of the British ground and air organizations were willing to shift wholesale to the new system. Indeed, there remained significant disagreement occurring at the highest levels of the army and RAF over tactical airpower operations. Senior commanders in the War Department and Air Staff remained engaged in a heated, and personal, dispute over whether the army would be better served by an organic air force attached to individual ground units or the type of flexible centralized system that was being slowly implemented in the Western Desert and validated by the ACC and Wann-Woodall experiments.\textsuperscript{199} For example, as one historian points out, there was a particularly unpleasant debate going on between Chief of the Air Staff, Air Marshal Sir Charles Portal and Chief of the Imperial General Staff, General Sir Alan Brooke, whose “poor relations did not mean that the subject of air support for the army was not heatedly discussed between the two but little progress was made on the major issues such as the wider organization of air support, where the Services were extremely far apart in their thinking.”\textsuperscript{200} Thus, despite the initial success of air support system that had been developed and implemented during Operation Crusader, which were well-aligned with the insights of the ACC and Wann-Woodall there was still much work to be done to get the entire British military to accept that such a system should be adopted wholesale.

5 Improvement in North Africa (1942 – 1943)

The isolated, but important successes of the Western Desert Air Forces, along with the insights provided by the ACC and Wann-Woodall experiments were beginning to gain a reputation—indeed, by the start of 1942, several senior leaders had been exposed to the


\textsuperscript{200} Powell, “Re-Discovering the Operational Level,” 79.
core ideas of the new system for tactical airpower operations, including the need for
centralization under a single air commander, along with the importance of prioritization,
collocation, and training. Thus, in several places throughout the RAF, there was good
evidence that elements of the tactical airpower system described in the previous chapter
would be necessary in future air-ground campaigns. Moreover, the insights of all of these
incubators of tactical airpower knowledge were quite similar despite limited known overlap
between them. And this should not be surprising; as one historian notes, one is “struck both
by the similarities...of the Wann/Woodall system being preached in England, and the
solutions which were being simultaneously evolved in the fire of the battle in East Africa
and the Desert. There is no need to wonder at parallel development taking place; the
fundamentals of the subject, on examination, are common sense.”

But even with growing support for this new, common-sense system there remained
entrenched antagonism between the army and RAF over many of these changes. As noted
above, the army was unhappy with the prospect of an air commander determining when
and how air assets would be deployed over the battlefield. They preferred to have continuous
air coverage over each sector of the battlefield and were, quite rightly, doubtful that the
RAF would be willing to deploy their resources in this way. On the other hand, the RAF
was unwilling to make some concessions to the army—while they did agree to undertake
the air superiority and battlefield air interdiction components of tactical airpower
operations, they were far less eager to deploy assets to perform close air support of ground
forces on the frontlines. It was this fundamental disagreement over the control and
prioritization of air assets over the battlefield that would delay the implementation of the
new tactical airpower system for over a year from its first successful testing with the WDAF
and over two years from the first acknowledgement of the issue after the fall of France.

201 Terraine, The Right of the Line, 352.
Thus, despite good evidence emerging about the nature of the tactical airpower problem and the content of the solution, air and ground force leaders in the United Kingdom remained unwilling to implement this solution throughout the force. As a result, it was not until the start of 1943 that the new tactical airpower system was adopted by the British wholesale.

The question thus becomes, what occurred in 1943 that allowed this interservice antagonism to be overridden and caused widespread implementation to finally occur? As the remainder of this section will argue, the widespread adoption of the new system occurred due to the resolution of interservice tension that was enabled by the surge of airpower resources that flooded British forces at the end of 1942 and the start of 1943. The increase of Britain’s own aviation assets, along with the addition of significant American resources in the fall of 1942 meant that there were finally enough aircraft and pilots in the primary theater operations—North Africa—for the RAF to perform the full spectrum of tactical airpower operations at little cost to its preferred tasks. In short, by 1943, the infusion of air assets into the theater meant that the RAF could finally attend to all of its competing priorities, no matter how far down the list they were ranked. Thus, with the assurance that all of their needs would be met, RAF and army commanders were willing to adopt the new system for tactical airpower operations. After all, it mattered less to army commanders who was in charge of air assets if aviation arrived on the frontlines when it was requested. Similarly, RAF commanders were finally willing to countenance meeting close air support requests when all of their other priorities were already being attended to. In this way, the increased resources that arrived in late 1942 and early 1943 eased

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202 Terraine, 378–84; Office, Fighting With Figures, 170–72; Overy, The Air War, 65.
interservice tension and paved the way for the implementation of an effective form of air support for ground operations, as opposed to an organizationally expedient one.

To illustrate this point, the remainder of this section will provide a sketch of the resources that became available to the British in late 1942 and early 1943, and then discuss how these resources enabled the widespread implementation of an improved tactical airpower operations system in the North African theater.

5.1 National Military Strategy & Resource Endowments (1942 – 1943)

Although precise and accurate figures on available aircraft in World War II are hard to come by—especially, though certainly not exclusively, in the British case—the general trends during this period are illustrative. At first glance, British production figures would seem to suggest that aircraft production began surging in 1940 since, in 1939, estimates place production at almost 8,000 aircraft. But production tells only one part of the resource story. Indeed, few of those assets were deployed for operational use in the defense of France, and even fewer were actually undertook that mission. Accordingly, more telling than British production figures, is the critical category of combat-ready “first-line” aircraft, i.e. those planes that could immediately be put to use in their intended function. In this category, available aviation for the British in the early part of the war is less impressive: under 3,000 first-line aircraft were available to the RAF at the end of 1940. In fact, it is only at the end of 1942 that we begin to see a spike in available resources. By one estimate,

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205 The best estimates of production and first-line strength are found by triangulating between several different sources. Here, I rely on the accounts in: Overy, The Air War; Richards and Saunders, The Royal Air Force, 1939-1945: The Fight Avails; Office, Fighting With Figures; M. M. Postan, British War Production (HMSO, 2013).

206 Office, Fighting With Figures, 170; Postan, British War Production, 484-85.


the first-line aircraft available to the British almost doubled from just over 4,000 aircraft at the end of 1941 to almost 8,000 at the end of 1942. Critically, then, although the RAF had been promised resources in the form of considerable funding the wake of the fall of France, those guarantees were not translated into actual deployed planes until well into the war itself. Thus, it was at the end of 1942 that the British began to reap the benefits of earlier investments in new aircraft.

At the same time, it was at the end of 1942 that the Americans meaningfully joined the British in their fight against Germany. Indeed, it was with the invasion of North Africa in the fall of 1942 that the British came to see the sheer expansiveness of the American war machine. As I detail more extensively in the next chapter, the provision of American aviation in North Africa coincided with a considerable jump in their production rates and available first-line aircraft—between 1940 and 1943, U.S. production grew by at least double every year, and by one estimate, in 1943 they had reached over 85,000 planes, of which over 20,000 were combat ready. Moreover, when the Americans arrived in North Africa to aid the British in fall 1942 under the auspices of Operational Torch, they brought with them many of these newly minted aircraft. By one estimate, in mid-1943 the United States’ contributions to the North African theater in just one sector of the battlefield had reached 72 squadrons. The result was that Allied aircraft in the region had reached a total to

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209 Richards and Saunders, The Royal Air Force, 1939-1945: The Fight at Odds, 1:410; Richards and Saunders, The Royal Air Force, 1939-1945: The Fight Avails, 2:372. Even accounting for aircraft aid delivered by the United States, the early war totals were relatively small. In 1940, for example, the US had delivered only about 1,000 planes to the United Kingdom. For more, see Office, Fighting With Figures, 175-76.


211 Wesley Frank Craven and James Lea Cate, The Army Air Forces In World War II: Men and Planes, vol. 6 (Washington D.C.: Office of Air Force History, 1983), 350; Overy, The Air War, 77. More conservative estimates place production at 64,000 of which 25,000 were combat ready; but, by either metric, the American contribution to aviation readiness by 1943 was significant.

212 Playfair, Molony, and Jackson, History of the Second World War: The Mediterranean and the Middle East, 1:494.

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6,000 aircraft, of which more than half were operational (as opposed to support, communications, and transport aircraft). This is especially striking given that before the infusion of American air assets that came along with Operation Torch, the majority of American aviation assets in the theater were non-operational and, just a few months earlier, the Americans had contributed only 13 squadrons to the fight in North Africa. Thus, when the American arrived in the North African theater ahead of Operation Torch, the British felt the effects almost immediately.

But what did the provision of these additional resources mean for tactical airpower operations specifically? After all, couldn’t all of these additional assets been directed toward strategic bombing or reconnaissance operations rather than tactical airpower? Perhaps counterintuitively, the answer to this question is yes—many of the additional resources flooding in to the North African theater appear to have been allocated to operations that had little to do with tactical airpower, including strategic bombing, reconnaissance, support, and transport, among others. For example, a considerable amount of U.S. bombers (primarily in the form of the heavy Fortresses and medium Mitchells, Marauders, and Lightnings) were placed in the North African Strategic Air Forces (NASAF).

So how did this affect tactical airpower operations in North Africa? Although reliable data on the movement of specific aircraft during this period is difficult to come by, it seems plausible that the provision of new strategic bombing resources in North Africa actually had a displacing effect—when these new assets arrived, existing aircraft in the theater could be consolidated and directed toward tactical airpower operations. Indeed, according to the available orders of battle, few of the units that were involved in the implementation of the

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213 Playfair, Molony, and Jackson, 1:488.
new tactical airpower system were new to the theater; instead, they appear to have been
drawn from existing deployments in North Africa that had been previously employed in
different capacities.\textsuperscript{217} Thus, the provision of additional aviation resources into the North
African theater seems to have had an indirect effect on the assets available for tactical
airpower: rather than contributing directly to the tactical airpower mission, the flood of
aircraft coming in to the theater appears to have displaced older units into tactical airpower
tasks. But regardless of its source, the RAF’s available resources for tactical airpower
operations increased considerably in late 1942 and early 1943.

In addition to the displacement effects created by the acquisition of new aircraft
fresh off the production lines in Britain and the United States, there was also new interest
in allocating existing resources from other theaters toward tactical airpower operations in
North Africa. In particular, over the course of 1942, leaders at Fighter Command took an
interest in the tactical airpower mission, and began devoting more of their training and
material resources toward assisting with these operations.\textsuperscript{218} Despite successes at the Battle
of Britain, several Fighter Command leaders were coming to the conclusion that the home
defense mission was no longer sufficient to sustain their claim to resources. But with positive
reports on the fighters’ utility coming out of early operations in the Western Desert, some
Fighter Command leaders thought their mandate ought to be supplemented with a tactical
airpower role.\textsuperscript{219} Thus, as one scholar of this period points out, “After the crisis in air defense
passed, it became clear that if Fighter Command were to keep its high place, another mission

\textsuperscript{217} Playfair, Molony, and Jackson, \textit{History of the Second World War: The Mediterranean and the Middle
\textsuperscript{218} “Sholto Douglas, Air Chief Marshal, AOC-in-C, Fighter Command to Air Chief Marshal Sir Charles
Portal, Air Ministry, ‘Air Cooperation with the Army,’” September 11, 1942, AIR 8/984, The National
Archives of the UK; “Portal to Douglas, ‘Army Air Support: Role and Training of Fighter Squadrons
Policy,’” March 6, 1942, Air 16/776, The National Archives of the UK.
would have to be found, preferably an offensive one."\textsuperscript{220} As a result, key Fighter Command leaders, most notably Air Marshal Trafford Leigh-Mallory and Air Marshal William Sholto Douglas, instructed their subordinates to begin experimenting with adding bombing capacity to fighter aircraft in order to expand the reach and utility of fighter operations.\textsuperscript{221} Thus, by the spring of 1942, Fighter Command had linked their need for a new mission with the provision of air support: such a mission would provide Fighter Command with the sort of offensive utility and relevance to the war effort that home defense could no longer supply.\textsuperscript{222} By the fall, under the new leadership of Leigh-Mallory, who was known to have a strong cooperative relationship with the army, Fighter Command had made a strong case that they should have a role to play in the provision of air support in the theater.\textsuperscript{223}

With Fighter Command’s new interest in tactical airpower operations, however, there also came trained pilots and additional squadrons. Indeed, by September 1942, Douglas reported to the Air Ministry that Fighter Command had trained all 75 day squadrons in tactical airpower operations.\textsuperscript{224} In addition, over 14 of the cooperative exercises undertaken by Fighter Command in the summer of 1942 had included a squadron or more, along with 65 more minor exercises.\textsuperscript{225} Thus, by the fall of 1942 Fighter Command had not just a declared interest in tactical airpower operations but had trained their operators to that end.

Finally, in addition to the considerable material that arrived in the theater at the end of 1942, many of the maintenance problems that had plagued the British forces in North Africa had slowly been fixed over the course of the early fighting. Initially, maintenance

\textsuperscript{220} Jacobs, “Air Support for the British Army, 1939-1943,” 177.
\textsuperscript{221} “TNA AIR 8/984,” September 11, 1942; “TNA Air 16/776.”
\textsuperscript{222} “TNA AIR 8/984,” September 11, 1942; “TNA Air 16/776.”
\textsuperscript{224} “TNA AIR 8/984,” September 11, 1942.
\textsuperscript{225} “TNA AIR 8/984.”
had been a major problem for the RAF in North Africa, leading to frustration at the most senior levels—including Churchill himself—as “aircraft somehow – inexplicably – [were] ‘vanishing without trace’ between England and Egypt.”226 The problem, however, was not of vanishing aircraft, but of maintenance. In the rush to defend North Africa, the RAF had failed to outfit a robust maintenance command in the theater, leaving air assets on the sidelines of the fight.227 Over the course of 1941, however, several command changes, and especially the appointment of Air Vice-Marshal GG Dawson, to improve the maintenance system started to show dividends.228 Although these challenges would persist throughout the course of operations in North Africa—and would surge again with the entry of U.S. forces—early British attention to these issues meant that the resources which arrived in the theater in 1942 would be put to good use.

The results of these simultaneous changes converged in North Africa at the end of 1942. Within months, the theater had received an influx of planes, pilots, and interest that had been unequalled previously. Thus, by one estimate, the North African Air Forces alone had over 2,000 operational aircraft in the theater, of which almost half were allocated exclusively to tactical airpower operations.229 As the next section will illustrate, this influx of resources meant that the hard choices about theater priorities would ebb considerably, and grievances from both air and ground commanders would diminish—the RAF could finally satisfy the ground commanders’ demands for more close support, while also undertaking the elements of tactical airpower operations that they preferred, and at no cost to their strategic bombing capabilities. The result was that air and ground commanders no longer needed to use tactical airpower operations as a tool to litigate interservice

228 Terraine, The Right of the Line, 341.
disagreements, and were finally willing to allow for the widespread implementation of a more effective system.

5.2 Tactical Airpower Operations (1942-1943)

The arrival of these resources, along with the pilots and supportive infrastructure to ensure their effective use, was a boon for the widespread implementation of the new tactical airpower system. It was the provision of these resources that allowed the RAF—and as we will see in the following chapter, the U.S. Army Air Forces (USAAF)—to fully implement the system of tactical airpower operations that had been validated by the Wann-Woodall experiments, the Army Cooperation Command, and the Western Desert Air Force over the course of the previous two years. Thus, by the early spring of 1943, both the RAF and USAAF were employing a system of tactical airpower operations that had all five of the core elements of effective tactical airpower outlined in the previous chapter. Moreover, buy-in from almost all senior air and ground commanders meant that this system would continue to be the basis for air-ground cooperation for the remainder of the war.

As noted above, the convergence of several different sources of additional airpower resources served to ease tensions between the RAF and army in North Africa considerably. Not only had British production reached a steady clip, but American assets were also flowing into the theater. Moreover, Fighter Command had taken an interest tactical airpower operations and began to prepare pilots to assist in this sort of operation. Finally, many of the maintenance issues that had posed a problem for the availability of aviation had been resolved. Critically, with these new resources available, the RAF was no longer forced to

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choose between focusing on strategic or tactical operations in the North African theater, since they could supply both. Moreover, even within tactical airpower operations, the RAF had sufficient resources to supply not just air superiority and battlefield air interdiction priorities, but it could also attend to the close support needs of the army. As a result, army leaders, who now saw that the centralization of air assets under an air force commander need not deprive them of close air support, were willing to make some concessions in their fight to preserve control of air assets over the battlefield. Thus, in providing more resources to the theater, the British were able to ease the tension that existed within the RAF regarding the conduct of strategic versus tactical operations, and between the RAF and army over the prioritization of close air support. In this context, where the prior grievances of each service had been addressed at virtually no cost to their individual service priorities, senior leaders no longer needed to hold tactical airpower operations hostage to service politics. Instead, the new system of tactical airpower operations that had been studied closely for two years could finally be deployed throughout the theater without eliciting protests from the army or RAF.

All that being said, the combined British and American operations in North Africa that began in 1942 did not get off to an auspicious start. For reasons that remain opaque, the Allied powers chose to use a system for tactical airpower during Operation Torch that reflected virtually none of the improvements that had emerged from both British experience and, as we will see in the next chapter, from American experimentation at home. Indeed, when the Allied forces invaded North Africa in the fall of 1942, they chose to divide the coast into three sectors—the Western Task Force (WTF), the Central Task Force (CTF),

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and the Eastern Task Force (ETF)—with the former two sectors under American control, and the latter under British control. 236 Assigned to each of these task forces were elements of the theater air forces, with Twelfth Air Support Command designated to support the WTF, the Twelfth Bomber and Fighter Commands supporting the CTF, and the RAF Eastern Air Command supporting the ETF. 237 Although these air assets were ostensibly under the command of Major General James Doolittle, in practice, it soon became clear that the dispersion of air assets to support the regional task forces prevented them from concentrating fire, gaining air superiority, and providing support for their counterparts on the ground. 238 These issues of command were further reinforced by problems with Allied communications and logistics throughout the early operations, as both militaries had not operated on such an enormous frontage with such significant numbers of troops since the First World War. 239 Thus, it soon became clear to all those involved that changes would need to be made.

Fortunately, by late 1942, the Allied commanders in North Africa had access to both the operational knowledge necessary to improve tactical airpower operations, as well as the resources to ensure that interservice antagonism in both the U.S. and Britain did not present an insurmountable challenge for implementation of such a system. Thus, in the winter of 1942-1943, Allied commanders began the widespread reorganization of their air forces that would bring it into alignment with the new system developed in Britain over the course of the previous two years. Approved and codified at the end of January 1943 during the Casablanca Conference, the new command arrangement would place Tedder in command of the Allied Mediterranean Air Command, under which there would be three regional commands. Of those three, there would be one centralized air force for North Africa, the Northwest Africa Air Force, commanded by Lieutenant General Carl Spaatz. 240 Directly under Spaatz the Allied air assets in the theater would be divided into functional commands with separate strategic forces, the Northwest African Strategic Air Forces (NASAF), under the command of Doolittle, and tactical forces, the Northwest African Tactical Air Force (NATAF), under the command of Coningham. 241 Furthermore, the latter would be endowed with considerable resources to perform its tactical airpower tasks—not only would it have access to the Western Desert Air Forces, but the British No. 242 Group and No. 211 Group along with the U.S. Tactical Bomber Force and XII Air Support Command would all be at Coningham’s disposal. 242 With all of this aviation at his fingertips, Coningham would find that he could provision all three of the central priorities of tactical airpower operations: superiority, battlefield interdiction, and close air support. As a result, with the exception of some instances of bad timing and bad luck, Coningham’s counterparts on the ground would

not want for close air support, even as Coningham also undertook air superiority or deeper battlefield interdiction missions.\textsuperscript{243} Furthermore, undertaking these tactical operations would not require Coningham to plunder the strategic bombing forces in the theater. Instead, the NASAF had been endowed with significant resources as well, including the U.S. 5th Heavy Bombardment and 47th Medium Bombardment Wings, together consisting of well over 500 operational aircraft.\textsuperscript{244} Given the limited strategic targets available to the Allies in North Africa, the NASAF outfit would prove more than sufficient for the remainder of the campaign.\textsuperscript{245} Thus, it was in early 1943 that the British were finally able to codify the changes that had long been understood in pockets of the RAF, largely as a result of the massive amount of resources that were now at their disposal. With RAF and army commanders both satisfied that their operational demands were being met, the concessions required by the new tactical airpower system raised few eyebrows.

Indeed, the dividends of the formalization of this system in the theater would take only two months to be realized by the entire organization, and by the spring of 1943 the new tactical airpower doctrine had proven its effectiveness. As noted in the previous chapter, Allied success in finally rebuffing Rommel is, in no small part, the result of the close working relationship between the NATAF and the ground forces engaged with Axis in Tunisia, culminating in the resounding success during the Battle of Mareth Line. By May 1943, this system was codified for future use in the form of pamphlet “Air Power in the Land Battle,” which Chief of Air Staff Charles Portal insisted was distributed to all RAF


\textsuperscript{244} Playfair, Molony, and Jackson, \textit{History of the Second World War: The Mediterranean and the Middle East}, 1:496–97.

\textsuperscript{245} Millett and Murray, \textit{Military Effectiveness}, 2010, 3:107; Overy, \textit{The Air War}, 73–74.
personnel of squadron leader rank and above. Put best by Ross Mahoney, a historian of this period, "In many respects the air operations during the Battle of Mareth Line exemplify the long and difficult learning curve that had been gradually surmounted over preceding years. The effective employment of tactical airpower in this battle was the culmination of three years of hard-earned lessons and bitter fights both with the enemy and between the services." Thus, by the spring of 1943, after countless experiments, disputes, command changes, isolated successes and remarkable failures, the British had finally succeeded in solving the problem of tactical airpower operations and implementing an effective system throughout their ground and air forces.

6 Alternative Explanations

Thus far, this chapter has demonstrated how the combination of national military strategy and resource endowments—the two variables at the center of Military Filtration Theory (MFT)—explain the British learning process with regard to tactical airpower operations before and during World War II. In general, the evidence provides robust support for these two variables in explaining both the identification and implementation of the effective tactical airpower operations system. Without considering the evidence in favor of alternative explanations, however, it is difficult to assess how powerful MFT is relative to the existing approaches in the literature on military learning. Accordingly, the remainder of this chapter briefly reviews the logic underlying several of the explanations of military learning in the extant literature and provides an assessment of their tenability in the British case. Specifically, I review below six alternative explanations: (a) threat/failure; (b) theater necessity; (c) emulation; (d) civilian intervention; (e) internal bargaining; and (f)

246 "Portal to Brooke ‘Air Cooperation with the Army,’” May 6, 1943, AIR 8/984, The National Archives of the UK.
dissemination networks. As this section will illustrate, although there is some merit to these explanations, none alone can explain the full process of learning in the British case as robustly as MFT.

6.1 Threat/Failure & Theater Necessity

Perhaps more so than any other alternative explanations, the theories that emphasize the unique dynamics of the wartime environment, and especially those that focus on the influence of heightened threat environments and theater dynamics, fall short in the British case. They are considered together here, since the refutation of these arguments relies on the same empirical reality: the British were aware that the existing system of tactical airpower operations needed to be improved as early as spring 1940, and were aware of the appropriate solutions to this problem very soon after; and yet, it still took them almost three years of war to identify and implement the core elements of this solution. I will briefly review the logic of the wartime theories here to remind the reader of their core tenets, before discussing how these arguments fail to explain the evidence in the British case.

The underlying logic of the threat/failure and theater necessity arguments is that the unique dynamics introduced by war and, in the case of the latter, operations in the field present warfighters with new incentives to learn and innovate. Unlike the peacetime environment, the argument goes, the pressures of war and severe consequences of failure induce warfighters to learn and change based on empirical realities rather than embedded institutional or individual biases. Moreover, in the context of the theater necessity argument, free from the oversight and prejudices of commanders' politicking at home, the theater can offer operational commanders with a laboratory for experimentation and change based on the needs and gaps observed on the battlefield. As a result, these theories argue,
wartime should allow for learning that would otherwise be suppressed in the peacetime environment.

To a certain extent, the British experience learning about tactical airpower operations coheres with some of the predictions of this school of thought. After all, it was the shock of failure in the Battle of France that finally incentivized RAF and army leaders to take the problem of tactical airpower operations more seriously. And, furthermore, it was in the Western Desert Air Force, where Air Vice-Marshal Coningham was free from the oversight of the Air Ministry and War Office zealots, that an effective system for tactical airpower operations was developed and deployed to great effect. Accordingly, one would be hard-pressed to argue that the heightened threat environment, along with the experience of inexcusable failures and theater freedoms, did not have some influence on the development of an effective tactical airpower operations system in the British case.

However, there are two main limitations to this approach. First, although the wartime environment can help us understand that changes may occur when wars begin, it can tell us very little about the directionality of that change. Put another way, in the wake of the fall of France, it is not at all clear a priori what lessons or changes the British would have been extracted from their experience. In short, although wartime can tell us that change should happen, it fails to provide specific clues about the nature and content of those changes. Thus, it is only by examining the alteration in national military strategy, based on both the geographic position of the state and its beliefs about future warfare, that we can come to clear understanding of the directionality of the changes that wartime failures induce. We must look to variables other than war for additional predictive precision about the nature of change.

Second, even if one concedes that the wartime environment catalyzed the first phase of learning—the identification of a problem and potential solutions—it can tell us very little
about why the British failed implement this new and effective tactical airpower system. Indeed, as I have noted several times above, it took the British nearly three years of war to implement the tactical airpower system that they had been well aware of in the immediate aftermath of the fall of France. Little about theories of threat/failure and theater necessity can explain why three years of war passed before the problems identified by wartime failures were adopted across the force. For this explanation, we must also look to other variables. Accordingly, even the most generous interpretations of wartime theories of military learning cannot explain the entirety of the learning process in the British case.

6.2 Emulation

As we shall see in all of the cases in this dissertation, alternative theories that point emulation as the central motivator for learning underestimate the ways in which commanders’ observations of the empirical realities of the battlefield were tainted by their organizational and service-specific biases. This was especially the case in the British and American contexts where army and air force leaders were quick to impose their own preferences on the observed successes of the German system for tactical airpower operations.

According to proponents of emulation, British learning about tactical airpower operations is attributable to senior commanders’ observations of successful systems operating on the battlefield, and their subsequent attempts to recreate those systems in their own organizations. If this theory were true, we would expect to see British discussions of effective tactical airpower systems, and attempts to replicate such systems in the field. Moreover, any delays we observe in the implementation of these systems should be attributable to the difficulties of imitation, particularly if and when the British were attempting to emulate enemy operations.

Like the previous alternative explanation, there is some limited evidence available that coheres with the predictions of emulation theories. Indeed, British leaders were aware
that the Luftwaffe was outpacing them in the tactical airpower realm after the Battle of France, as senior civilian, RAF, and army leaders made note of the German success in support their ground operations.\textsuperscript{248} Thus, the available evidence suggests that British leaders were aware of the more effective German system for tactical airpower operations as early as 1940.

Critically, however, awareness of this system does not mean that British leaders understood the core components of this system. In fact, a closer examination of the empirical record suggests that that British leaders were prone to distort their observations about the German system to cohere with their services’ preferred approach to tactical airpower operations. Thus, RAF leaders argued that the German tactical airpower successes were attributable to centralization of air assets under a single air commander, while the army leadership contended that Luftwaffe success was a result of the air force conceding control of aircraft to ground officers. The result was that the “German example” was used to serve the ends of both services’ in the debate over tactical airpower and did little to alter preexisting views on the matter. Accordingly, while there was awareness of more effective systems in other states, the institutional biases of British observers prevented a clear-eyed emulation of existing examples of tactical airpower effectiveness.

6.3 Civilian Intervention

There is some strong evidence in the British case that supports the argument that increased civilian attention to military matters can direct commanders’ attention to issues of importance that their organizational biases might otherwise cause them to overlook. This is especially the case when it comes to reorienting military strategy toward new problems that have previously been ignored, like tactical airpower operations. That being said, there

are some significant limitations to this approach in explaining the arc of British learning about tactical airpower operations. In particular, the British case demonstrates that civilian power can be far more constrained in the second phase of learning, as even the most powerful civilians in the British government proved incapable of forcing the military to adopt the proven system of tactical airpower operations.

The logic underpinning theories of civilian intervention in explaining wartime learning is straightforward: when civilians are attuned to military matters, most frequently due to increased threats on the horizon, they can use institutional and material resources at their disposal to incentivize military leaders to consider and solve operational problems that might otherwise be ignored. In the case of British learning about tactical airpower, these theorists would thus predict that civilian interventions should have influenced the development and implementation of the new tactical airpower system.

In the first phase of learning, theories of civilian intervention find considerable support in the British case and, for the most part, align with the predictions of MFT. After all, the shifts in national military strategy that MFT argues are critical for the identification of new operational problems often come from the strategic interventions of senior civilians. As a result, it would be disingenuous to argue that civilian intervention and MFT are not tightly linked theories of military learning and change especially in this first phase. The complementarity of these theories is certainly put on display in the British case. The influence of Prime Minster Churchill’s interventions to alter British grand strategy and, accordingly, military strategy were at the root of the military’s reorientation toward offensive ground operations. Without such changes at the senior most levels, it is unlikely that military leaders, particularly in the RAF, would have revised their preferences to incorporate tactical airpower operations on their list of priorities (or, at least, not until
much later in the war). In this way, MFT and theories of civilian intervention are closely aligned.

However, the explanatory value of civilian intervention theories diminishes somewhat when we consider the second phase of wartime learning in the British case: implementation. In fact, what is most remarkable about the case here (and in the American case as well) is how successful military leaders were in flouting the interventions of civilian leaders—and even the direct prescriptions of Churchill himself—when civilians directed their commanders to adopt the new system of tactical airpower operations. Churchill was forced to personally intervene on the matter of tactical airpower operations on at least two occasions early in the war, exhorting his commanders to adopt elements of the system outlined in the previous chapter on both occasions, and went to great lengths to attach the promise of material resources to these demands. But his interventions on both occasions went, by and large, unheeded. Though RAF leaders made some superficial concessions to his demands, including the publication of new training manuals, in practice few changes were made to meet Churchill’s requests. Furthermore, even the attached promise of future resources was insufficient to induce implementation of Churchill’s demands. Instead, it was not until an influx resources—which, it should be recalled, were not attached specifically to tactical airpower operations—were actually realized in the theater that military leaders were willing to make the changes that Churchill had been advocating for several years. In this way, the British case should make us quite wary of the manner in which military leaders are able to flout the explicit demands of their most senior civilian superiors at the operational level. Instead, as MFT suggests, we must look to the actual deployment of additional resources to the theater to understand when and why implementation of controversial new ideas occurs on the battlefield.

6.4 Internal Bargaining
As in the American and German cases, the British case provides little compelling evidence for arguments that attribute their experience with tactical airpower to the resolution of internal disputes in the RAF. That being said, I review here the core components of this logic in order to demonstrate the ways in which MFT proves to be a more compelling explanation of British learning than intraservice competition.

Proponents of the internal bargaining school see the intraservice politicking of a state’s military as the central factor in whether and how a state learns to adopt new operational concepts. It argues that internal disputes over the dominant operational way of war within a service will, over time, result in winners and losers. The operational concepts (and their attached operators) who win these internal disputes will then induce the service organization to prioritize their preferred operational concepts ahead of competing ones. Accordingly, these proponents would argue that an effective system for tactical airpower operations would only be adopted if and when senior RAF commanders who were proponents and operators of such a system rose to the top of their organization.

To a limited extent, there is some evidence of this being the case. Indeed, the appointments of Air Marshals Arthur Tedder and Sholto Douglas, who were both supporters of improving tactical airpower operations, to senior positions in the RAF coincided with the adoption of more effective tactical airpower systems under their supervision. In this way, proponents of the internal bargaining school would argue that the ascension of these leaders lead to the adoption of new systems as they began to gain increased credibility within the organization, and began to use their positions to make changes first within their commands and then outside of it.

The problem with this explanation, however, is that it ignores the many powerful air leaders who acted as counterweights to Douglas and Tedder. Air leaders like Slessor, who continued to oppose the prioritization of tactical airpower throughout the war, were
equally successful in slow-rolling and blocking the implementation of these systems when resources were scarce. Indeed, most of the Air Ministry leadership, along with the Air Staff, and several operational commanders were vocal about their opposition to the use of aircraft in the tactical role outside of some extenuating circumstances. Moreover, even after the adoption of the Casablanca reforms this opposition continued to be vocal and active. Thus, although there was a debate between senior RAF commanders about the merits of improving and executing tactical airpower operations, it would be inaccurate to suggest that this debate was ever resolved squarely in favor of those who supported tactical airpower operations. Indeed, by some accounts, the interservice politicking that existed in World War II over tactical airpower still exists today in the RAF. Thus, although the provision of additional resources may have temporarily quieted the debate over tactical airpower operations, the notion that any longer-term resolution of these disputes resulted in the eventual ascendancy of this concept to the top of the RAF’s list of priorities would be to misunderstand the perennial, embedded nature of these disputes.

6.5 Dissemination Networks

Finally, some scholars of military learning point to the importance of dissemination and communications networks in the adoption of new operational concepts. As with many of the previously discussed alternatives, although these explanations find some limited support in the British case, the weight of the evidence suggests that this approach is, overall, inadequate to explain the full arc of British learning about tactical airpower operations.

Theories that emphasize the role of dissemination networks rely on the argument that differences in the learning process can be attributed to the strength of the systems by which different military organizations communicate new knowledge. Where these networks are overlapping and robust, we should expect speedy implementation of new ideas, but where they are limited or nonexistent, we should expect implementation to be more difficult.
In the context of the British case, proponents of this school would argue that the lack of British dissemination infrastructure was the core source of delay in implementation of new tactical airpower systems. They would therefore expect to see an absence of interunit and interservice communication related to tactical airpower operations, bottlenecks in the flow of new information, and, more generally, ineffective or nonexistent dissemination networks for the codification and communication of new ideas. Only after these dissemination holes had been plugged would they expect to see implementation of the new system.

To a certain extent, the evidence in the British case supports the view that the RAF’s dissemination structure resulted in delays in communicating knowledge from Wann-Woodall, the Army Cooperation Command, and the Western Desert Air Force about new and effective systems of tactical airpower operations. Indeed, on several metrics, the British are notoriously ineffective at communicating with and between units. First, the British military has a long tradition of shirking formal doctrine in favor of more informal and flexible systems of establishing standard operational practices. Although this flexible approach to codifying operational schemes has been lauded in some contexts, particularly as it relates to rapid adaptation and the early stages of innovation, the absence of clear codification can be a significant liability in the context of information sharing and implementation. Indeed, the absence of clear codification in the British case proved to be a significant liability early in the war, as it allowed commanders who were unaware of or unwilling to embrace the new doctrine to plead ignorance to the new practices. Second, the absence of inter-unit communication was a less explicit but still powerful impediment to the successful sharing and use of new tactical airpower doctrine in the British case. The British legacies of the independent, decentralized, regimental system inhibited the creation of cross-cutting infrastructure, communications, and training networks, ultimately leading to underperformance. As a result, regimental units were inclined to look inward, creating
bottlenecks for information sharing and overall cohesion. Together, these impediments to coherent and consistent communication about new operational concepts may have served to undermine the transmission of good information about tactical airpower operations coming out of different incubators in the RAF.

But even with evidence of challenges in disseminating new information about tactical airpower operations, there remain two significant conceptual problems that face this theoretical approach. First, there is the simple issue that proponents of the new tactical airpower system found effective work-arounds to the problems presented by the lack of robust dissemination networks. Indeed, Tedder, Coningham, and Montgomery acted as tactical airpower entrepreneurs, disseminating their observations through speeches, pamphlets, and other informal avenues. But even more important that the work arounds that were found by entrepreneurial commanders, there is the more fundamental issue that this explanation, like many of those discussed previously, is effective in explaining only one phase of the learning process: implementation. Indeed, dissemination networks can tell us very little about when, why, and how the knowledge that is fed into these networks is created. Instead, we must look to other variables to determine how and why the British were able to generate the new thinking on tactical airpower operations that would eventually be implemented in the field.

7 Conclusion

In summary, this chapter has traced the evolution of British learning about tactical airpower operations during the prewar period and in the early stages of the war itself. It has shown that the two phases of learning—identification and implementation—are tightly linked with the two variables at the center of MFT—national military strategy and resource endowments—in this case. Specifically, it has shown that shifts in British national military
strategy after the fall of France attuned military leaders to the tactical airpower issue. But this chapter has also shown that despite knowing about solutions to this problem, it was not until the RAF's resources surged in late 1942 and early 1943 that an effective system was meaningfully implemented. Finally, it has demonstrated that alternative explanations, although they help explain some features of the British experiences, cannot explain tactical airpower learning in this case as comprehensively as MFT.
Chapter 4: American Tactical Airpower

1 Introduction

As illustrated in Chapter 2, there was much to be celebrated about American tactical airpower operations in 1944. Variously referred to as “genius” and “the best in the world,” the employment of airpower in support of ground forces under the leadership of General Elwood ‘Pete’ Quesada, commander of the IX Tactical Air Command in the European Theater of Operations (ETO), during the breakout in France in the summer of 1944 was central to the eventual success of American forces. But while the system for tactical airpower operations employed in the ETO is notable for its effectiveness in aiding the ground force advance, it is the conclusion of a much longer story of experimentation, debate, frustration, and compromise, that began during the prewar years and culminated in the deserts of North Africa during 1943. Long before Quesada’s widely-heralded system of air support was employed in France, its core principles were implemented to great effect in North Africa. This chapter tells the first, and arguably most important, half of the protracted story of how American aviators learned to successfully perform the tactical airpower operations whose effects were demonstrated so vividly later in the war.


In stark contrast to the heralded tactical airpower operations in the ETO, the early U.S. experience with tactical airpower was less encouraging. During the early prewar years, the challenges presented by tactical airpower operations were generally ignored, and even where they were considered they were often downplayed and solutions were superficial. As the prospect of a land war grew, however, issues of tactical airpower operations increasingly came to the foreground, and the U.S. Army Air Forces (USAAF) began to acknowledge and study the problem more closely. But the resource constraints of the prewar period—particularly in combat-ready aviation—meant that the implementation of an effective system for tactical airpower operations would remain a second-tier priority during this period. As a result, when the United States invaded North Africa in November 1942, air support operations were being conducted on the basis of vague, ill-conceived doctrine, which was distorted or ignored by ground commanders in practice. Despite knowing that tactical


4 During the period under consideration in this chapter, the American air forces were variously referred to as the US Army Air Service, US Army Air Corps, and Army Air Forces. For ease of reference I use the terms Air Force or US Army Air Forces (USAAF) throughout the chapter.


airpower operations would present real challenges, and having devised several elements of a system to address these issues, resource constraints in the prewar period prevented the USAAF and army from implementing meaningful changes on the battlefield.

As the war in North Africa continued, however, there was a noticeable change in American thinking about tactical airpower operations, ultimately leading to the widespread adoption of a new tactical airpower system in January 1943. Above all else, this change was a product of additional resources. The combined aviation resources of the U.S. and United Kingdom by late 1942 meant that there were enough pilots and planes to meet several operational needs at once, including provisioning both a robust tactical airpower capability and an impressive strategic bombing arm. With plenty of planes to go around, and facing the harsh realities of war in the North African theater, air force and army leaders finally implemented the tactical airpower system that they had long known was effective, and did so at little cost to their pursuing their organizational interests.7

Thus, it was in the North African theater in early 1943 that the system employed in the ETO was first operationalized with elements of all five of the core principles of effective tactical airpower outlined in Chapter 2. All tactical air assets were unified under a single chain of air force commanders, who coordinated with, but were not subordinate to, their ground counterparts. Air superiority was understood by both ground and air officers to be the first priority, followed by targets in the rear of the battlefield and, last, close air support. Radio communications, smoke signals, and liaisons, though far from perfect, were being

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employed to good effect. And, finally, units trained specifically in the art of air support were being deployed to the front lines.⁸

The remainder of this chapter will review the development of this system for tactical airpower operations, focusing on three primary phases of the learning process sketched above: (a) the prewar debates over the appropriate role for airpower (1920-1940); (b) American preparation for war and early airpower operations in North Africa (1940-1942); and, finally, (c) the victory in North Africa (1943). In doing so, I will illustrate that the process by which the U.S. learned to effectively employ tactical airpower during this period is best explained by tracing changes in two key variables at the heart of Military Filtration Theory: the United States’ national military strategy and the military’s resource endowments. Specifically, I argue that it was not until the United States’ military strategy shifted from emphasizing defense via air and sea to emphasizing offense in all three domains that there was widespread recognition of the tactical airpower issue. But despite acknowledging the tactical airpower problem, I argue that the tense interservice relationships and disagreements that resulted from tight resources during this period meant that solutions to the challenges presented by tactical airpower operations were slow to be agreed on and implemented. It was not until additional resources were delivered to the theater of operations that the USAAF could provide air support of ground forces without making significant sacrifices in their preferred strategic mission that this tactical airpower system was fully implemented on the battlefield. Taken together, tracing these two variables—national military strategy and resource endowments—in the American story of

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tactical airpower operations provides a clear picture of how and why the United States learned to employ tactical airpower assets in a drawn out, but ultimately successful, way.

2 Measurement and Predictions

As in the British case, I dispense here with several questions of methodology. Specifically, I discuss in this section both when in the period under consideration I take samples of evidence in the American case, as well as type of evidence that I have sought out. In addition, this section reviews the three key predictions made by Military Filtration Theory with regard to the American case and previews my core findings in this case. Although the major predictions of MFT are confirmed, there are elements of several alternative explanations that are also borne out in the case evidence. As I note at the end of this chapter, this leads me to conclude that MFT has a relatively high explanatory power, but we cannot fully discount the catalyzing effect of several other variables—most notably, failure—in the explaining the learning process observed in the American case.

2.1 Measurement

There are two main measurement concerns in this case: first, at what point(s) in time should I take measurements of the independent and dependent variables and, second, how do I go about measuring these variables? First, as in the previous case, I choose to measure my three variables of interest at points in time that roughly correspond to the different phases of the learning process. Thus, in the American case I capture evidence at three waypoints during the learning process: the period before learning begins; the early phases of identifying the problem and beginning to craft solutions; and, finally, the implementation of the solution. In the context of the American experience, these periods roughly correspond with (a) the prewar period (1920-1940), (b) the preparatory and early phase of U.S. entry into the North African theater (1940-1942), and (c) the American victory in North Africa (1943).
Thus, I measure each of the three key variables—national military strategy, resource endowments, and learning about tactical airpower operations—during each of these periods. In doing so, I am able to capture the evolution of each variable in distinct phases of the learning process.

In addition to taking measurements at these times, it is important that my measurements are reliable and valid throughout the American case. Accordingly, I seek out evidence for both my dependent variable and independent variables that captures the stated and actual practices of the American military during this period. In measuring the dependent variable—the tactical airpower learning process—I look to public and private statements of senior leaders, planning documents, and actual training and operations reports and behaviors. More specifically, before the war begins, I rely primarily on published training regulations, reporting from training exercises, and memoirs from key leaders involved in the debates over tactical air power to measure whether the components of this system have been adopted. Once the war begins, my primary pieces of evidence are doctrine employed by the USAAF during operations, as well as battlefield reporting from engaged units, and, occasionally, reports from senior leaders. In applying several overlapping but distinct accounts of both the theory and practice of tactical airpower operations in the United States during this period, I am thus able to triangulate between different sources and reconstruct a robust picture of tactical airpower operations both before and during the war.

I take a similar approach in measuring my two independent variables, national military strategy and resource endowments. In the context of the American case, I rely primarily on three sources of evidence in measuring both of these variables. First, to measure national military strategy, I focus my attention on the strategic guidance being provided by senior civilian leaders (most commonly the President and Secretary of Defense), the war
plans and preparations they direct, and the stated views of senior military commanders about combat planning. Second, to measure resources—and their effect of interservice cooperation—I focus on the formal reports and planning documents related to both available and planned materiel endowments, and debates over how those resources should allocated. In this respect, several sources are especially helpful, including the airpower Board and Committee reports ordered by Congress to study the future role of airpower, publications from the doctrinal and operational hubs for the air force during this period, including reports from the Air Corps Tactical School (ACTS), official training documents and doctrinal publications, and after-action memos on training exercises. In addition, I rely on informal memos between senior leaders, as well as personal recollections in memoirs and unofficial correspondence. Together, these sources provide a comprehensive account of both the stated and implicit military strategy in the United States, as well as the way in which resource endowments influenced the debates over air force missions during this period.

2.2 Predictions

As the remainder of this chapter will demonstrate, the process of American learning about tactical airpower is best explained by tracing changes in national military strategy and resource endowments. More specifically, I argue that national military strategy is linked to the first phase of military learning—problem identification; and resource endowments are linked to the second phase of military learning—implementation of solutions. It is only by examining both variables that we can make sense of the full learning process in the American case.

The first variable, national military strategy, is linked to problem identification because it acts as a filter on the types of problems that a military is likely to see and acknowledge. National military strategy—the type of war that a state believes it is fighting or will fight—dictates the planning and preparations for war. Since states can rarely prepare
for every combat contingency, their national military strategy will act as a heuristic device to help them allocate resources. In the context of tactical airpower operations, national military strategies that prioritize offensive ground warfare are more likely to cue thinking about air support of ground operations than national military strategies focus on defense by air or sea.

But even if a state's national military strategy allows them to identify the right problems, there is still the issue of solving those problems, and learning is not complete until solutions are implemented throughout the force. Moreover, as decades of research on organizations and militaries will attest, a shift in national military strategy at the most senior levels of the civilian and military leadership is unlikely to lead to immediate implementation of the appropriate solution. Instead, as I argue here, resource endowments can either heighten or diminish the organizational pathologies that impede the cooperative implementation of controversial solutions, particularly in the joint environment. Where resource abundance exists, interservice relationships are likely to be cooperative and, therefore, we should expect the implementation of solutions to joint problems proceed smoothly and quickly. But where resource endowments are scarce, we should expect interservice relationships to be competitive and antagonistic, and the implementation of joint concepts and doctrine to be debated, delayed, and halting.

But what, exactly, does my theory predict we should see in the American case? Based on the logic outlined above, MFT makes three major predictions about the American experience adopting an effective system of tactical airpower doctrine. First, during the early prewar period, MFT predicts that the problem of tactical airpower was unlikely to be considered by senior leaders of the U.S. military. For the vast majority of this timeframe, the U.S. national military strategy was defensive and deterrent in nature. Flanked by two oceans, and consumed with an isolationist fervor, the U.S. placed its military emphasis on
two main priorities during the prewar period: (a) continental and hemispheric defense and (b) investing in deterrent naval and air capabilities to ensure that, should a war arise, it would be fought far away. With this national military strategy, there was little interest in the U.S. military—and especially in the air force and army—in acknowledging and studying the problems related to air support of ground operations, which were most likely to be necessary in an offensive land war. Since the United States was not oriented to fight such a war during the early prewar years, it was not concerned with the challenges of supporting mobile ground units from the air. Thus, MFT predicts that we should observe the tactical airpower mission being largely ignored for the majority of the prewar period, and where it was considered, such debates and exercises should exist primarily on the periphery.

As the specter of war loomed in the late 1930s, however, a shift in American national military strategy occurred: while the U.S. was still concerned with deterring any attacks on the continent or invasions in the hemisphere, senior civilian and military leaders were coming to terms with the possibility that they might have to engage in offensive ground operations on the European continent. As a result of this shift in national military strategy, MFT would predict that a slew of new problems came into view for the U.S. military. As the U.S. came to terms with the prospect of an offensive ground war, the problem of developing an effective system of tactical airpower operations moved from the periphery to a matter of significant concern, particularly among U.S. Army officers.

Although the U.S. military had identified the problem, however, there was still the matter of implementing an effective solution. In this respect, MFT argues the nature of the resource endowments—and their influence on interservice relationships—will be critical. More specifically, MFT argues that resource constraints, particularly vis-à-vis combat ready aviation, would make the USAAF reluctant to concede training, materiel, and personnel resources to tasks outside their preferred mission of strategic bombing. Similarly, MFT
predicts that even if the USAAF did perform tactical airpower operations it would be especially reluctant to concede resources to the costly CAS missions that the army was so eager to employ, and would instead prefer the lower cost, more independent elements of tactical airpower operations (i.e. air superiority and battlefield air interdiction). Taken together, MFT predicts that despite acknowledging the issues of tactical airpower before the war began, the air forces would be unwilling to make the material concessions necessary to ensure a better system implemented.

Further, MFT accurately predicts that it was not until these constraints began to lift in the North African theater in late 1942 and early 1943 that implementation of an effective system began in earnest. It was the flood of combined Allied resources arriving in the Mediterranean theater that allowed USAAF commanders to meet the needs of the ground forces at little cost to their preferred missions. When combined with several months of disconcerting failure, these circumstances eased tension and allowed for the deployment of the new system. After nearly two years of debate about the issue, the army and air force were able to reconcile their differences and implement a system of effective air support for ground units, but only as a result of the diminished costs of doing so.

In summary, MFT predicts that different elements of the learning process are linked to different explanatory variables. At the outset of the learning process, national military strategy dictates what problems a military sees, but when the time comes to implement solutions to those problems resource endowments became critical. Thus, MFT predicts that the American national military strategy of the prewar years toward defensive, deterrent capabilities would lead questions of tactical airpower to be ignored. But even after that orientation shifted toward offensive land campaigns in the early 1940s, MFT would predict that the competitive interservice dynamics between the air force and army as a result of the limited resources meant that the implementation of a solution would be disputed and
delayed. Accordingly, MFT accurately predicts that it was not until the army and air force had sufficient aviation assets in the theater to provide air support of ground units without diminishing its ability to simultaneously meet the strategic demands of the theater that an effective system for tactical airpower operations would be likely to emerge.

In general, the empirical record below confirms each of the predictions of MFT. In some important respects, however, the empirical record also demonstrates that other variables beyond those identified by MFT have a significant role to play in certain stages of the process of American learning. For example, significant battlefield failures were critical in implementing this solution. Thus, although the empirical record illustrates that MFT performs well in the American case, I conclude this chapter with a consideration of how other, secondary, variables also contributed to the process of American learning about tactical airpower.

3 Prewar Years (1920 – 1940)

The empirical record from the majority of the prewar period supports the conclusion that concerns about tactical airpower operations were a second-tier priority for the United States military. This is not to say that there was no consideration of the tactical airpower issue during this period; indeed, the need for this type of operation in an eventual conflict was

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well-understood by both the army and the air force, particularly in the immediate aftermath of World War I, where such a capability had been put on display. However, where discussions of tactical airpower operations did exist during the prewar years, they were theoretical in nature and vague on the details, with few organizational and material resources devoted to preparing or training for these operations. Such a lack of investment is notable in-and-of-itself, but becomes particularly pronounced when one compares it to the extensive preparation that the air force undertook in support of continental defense and strategic bombing during the same period. Although tactical airpower operations were not entirely ignored during this period, the U.S. national military strategy made other priorities paramount.

Among the reasons that other missions were prioritized over preparing for tactical airpower operations, the national military strategy and the grand strategy of which it was an integral part during this period was primary among them. During the prewar years, American military strategy was geared toward defense of the continent and deterring any potential attack. As a result, the U.S. military was not explicitly preparing to fight an offensive ground war and the role of aviation in support of such operations was not of primary concern. Instead, the army and air force had other priorities. The army, despite protesting against the drawdown after World War I, reluctantly accepted a significantly scaled down standing force and was largely preoccupied with maintaining readiness and

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10 Lester, Mosquitoes to Wolves The Evolution of the Airborne Forward Air Controller, 6–7; Boyne, Silver Wings, 90; Finney, History of the Air Corps Tactical School, 1920-1940, 14–16.
satisfying the requirements of continental and coastal defense with a shoestring force.\textsuperscript{13} For the air force, most of the organizational and training resources were invested in making the case for their independence, while maintaining army support of such an endeavor.\textsuperscript{14} The result was that the air force spent much of this period developing the operational capabilities that would support their case for independence (i.e. long-range bombers) but cloaking these investments under the guise of continental and hemisphere defense.\textsuperscript{15} The remainder of this section demonstrates that despite paying lip-service to the issue of tactical airpower operations, the air force spent the vast majority of the prewar years focused on other priorities and, further, that this singular emphasis grew significantly as time went on.

Below, I review the prewar period in two phases. First, I examine the early prewar period (1920 – 1935) in order to establish a baseline understanding of trends with regard to my two independent variables, national military strategy and resource endowments, as well as my dependent variable, learning about tactical airpower operations. In the second part of this section, I examine these same variables during the late prewar period (1935 – 1940), in order to illustrate how these early trends crystallized at the close of the thirties.


It has been well-established that in the wake of World War I, the United States shifted rapidly and dramatically toward an isolationist posture, with a renewed emphasis on shrinking the peacetime military establishment, investing in a defensive military posture


and focusing its resources toward domestic concerns. In a sharp break with the internationalist impulses that had animated the conclusion of the Great War, senate leaders had rejected the Treaty of Versailles and ushered in an era of American retrenchment. The horrors of World War I had soured the American public and their representatives on the notion of collective security, and the result was “the emergence of a new and strident type of isolationism which called not only for the traditional avoidance of alliances and military involvements abroad but for a set of positive rules and practices designed to insulate the United States from the contagion of foreign wars.” But even as the memories of World War I began to fade, the necessity of economic and fiscal stringency ushered in by the Great Depression further reinforced the view that investments in the American military should be kept to the bare minimum. From a purely material perspective, these two forces meant that the United States defense establishment was dismantled in the wake of World War I.

For the senior leaders of the army and air force, the defensive strategy toward defense and the associated scarcity of resources meant that they would need to align their missions, capabilities, and investments with this new approach to world affairs. Thus, despite early support for a moderately sized standing army and a related emphasis on mobilization, the onset of an isolationist public mood and the attendant defensive strategy meant that the army would primarily be responsible for continental defense and, later in this period,

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18 Millett and Murray, Military Effectiveness, 2:71.
19 Doenecke and Wilz, From Isolation to War, 11; Johnson, Fast Tanks and Heavy Bombers.
hemisphere defense. Although the army chaffed as the continental limitations of this posture—and certainly made some investments in developing elements of an expeditionary, rapidly mobilized ground force—it nonetheless undertook a drawdown and attempted to fulfill their mandate to defend the continent.

For the air service, which accounted for about ten percent of overall army strength during this period, this defensive orientation and limited resources meant that they would need to find a way to justify the development of an air force on defensive grounds and investments in new, experimental technologies would have to be kept to a minimum. Simultaneously, however, the air force was growing convinced during this period that it needed independence from the army in order to realize its true operational potential as an autonomous, war-winning service. But pursuing the goal of independence complicated the air force case in the prewar years: they would need to convince legislators to invest in an experimental suite of capabilities in a way that was palatable to a war-weary government and public that wanted a small, defensive, military establishment. The result was that the air force would spend most of the early prewar period using the guise of continental defense to justify the procurement of the long-range bombing assets that it felt would be central to demonstrating its independent, war-winning capabilities. Thus, the defensive national military strategy of the United States in the early prewar period meant that the army

22 Millett and Murray, Military Effectiveness; Johnson, Fast Tanks and Heavy Bombers, 107–8.
24 Spires, Patton’s Air Force, 1; Greer, The Development of Air Doctrine in the Army Air Arm 1917-1945, 15–20; McClendon, Autonomy of the Air Arm, 47–52.
25 Craven and Cate, The Army Air Forces In World War II: Plans and Early Operations, January 1939 to August 1942, 1:13–71; Millett and Murray, Military Effectiveness, 2:85; Johnson, Fast Tanks and Heavy Bombers, 153–60. Although the Army was initially supportive of these efforts, it would grow increasingly skeptical of Air Force goals as the prewar period went on. See Futrell, Ideas, Concepts, Doctrine, 69–70; McClendon, Autonomy of the Air Arm, 74–75; Boyne, Silver Wings, 110.
became focused on preparing for continental defense missions, while the air force lobbied for growth under the pretense of defending the homeland and deterring attack.

In addition to a national military strategy that emphasized the defense, American military planning during this period was equally a product of constrained material resources. In this respect, the air force was in a difficult position: investments in air power during this period were inherently costly and experimental in nature. Thus, technical progress in the air force was likely to be expensive, small-scale, or both. The result was the emergence of a tense debate over the future of airpower.26 On one hand, were air force leaders and civilian proponents of airpower who felt not just that aviation should get its fair share of the military budget, but that its independent, war-winning capabilities entitled it to independence from the army. On the other hand, army, navy, and more conservative civilian leaders argued that the air force was only entitled to what the army was willing to give it, unless and until new data emerged confirming the airmen’s claims.

There is no lack of evidence supporting the proposition that this debate was ongoing during the prewar period. Beginning in 1920 with the Army Reorganization Act, which established the air force as a combat arm of the army, there were several official studies on the future of airpower in the United States, many of which arrived at opposite conclusions about the necessity of investing in the air force as well as its claims to independence.27 For example, the reports of the Morrow Board and the Lampert Committee, released within weeks of each other in 1925, arrived at starkly different conclusions regarding air force independence, with the former advocating that the air force remain subordinate to the army


27 According to one of the authoritative accounts of this period, “no less than 14 principal boards considered the problems of national defense, the chief one being: how was the air weapon to be fitted into the overall structure of national defense” Finney, “The Development of Tactical Air Doctrine in the U.S. Air Force, 1917-1951,” 12.
while the later recommended independence. Indeed, there was good reason for debate about the future of the air force—airplanes were, after all, a new technology and many of the arguments being made at the time were hypothetical in nature. Arguments in favor of investing in an independent air force at the time emphasized that future wars could and would be won and lost by air forces, who were sufficiently unique to require their own organization and resources. Critics, however, were skeptical of airmen’s claims about the war-altering nature of airpower, and highlighted that the air force was used to great effect during World War I primarily in support of ground forces.\textsuperscript{28}

As time went on, however, several important institutions were created within the air force that helped to amplify its claims to additional—or at the very least, equal—resources. Among the most important of these developments was passage of the Air Corps Act of 1926, which established an Assistant Secretary of War for Air and created an air section on the General Staff.\textsuperscript{29} In addition, this designation lead to the redesignation of the Air Corps Tactical Schools (ACTS), which would become a major hub of doctrinal thinking and practical training during the prewar period.\textsuperscript{30} In just over a decade, the air force’s lobbying had proven effective: the air force was authorized to expand to just over 16,000 men and 1800 aircraft and had made several significant institutional strides toward formal recognition of its independence. But this campaign had also left a trail of skeptics in its wake. Both the army and navy were growing wary of the airmen’s claims of superiority,

\textsuperscript{28} For an account of the competing logics of these reports see: Greer, \textit{The Development of Air Doctrine in the Army Air Arm 1917-1945}, 26-30; Futrell, \textit{Ideas, Concepts, Doctrine}, 42-50; Wolk, \textit{The Struggle for Air Force Independence, 1943-1947}, 9-10; Craven and Cate, \textit{The Army Air Forces In World War II: Plans and Early Operations, January 1939 to August 1942}, 1:28-30.


and especially what those boasts would mean for their own bottom lines. Thus, the air force’s campaign for independence—and the access to resources that came along with it—had also initiated an organizational confrontation with the other services, who saw the air force’s claims as diminishing their own resources. This competitive spirit would prove resilient.

3.2 Early Prewar (1920 – 1935): Tactical Airpower Training & Operations

At the same time as the air force was lobbying for its independence and the additional resources that would come along with it, it was developing a suite of operational capabilities that would reinforce its organizational claims. Specifically, it was during this period that the air force began to develop long range strategic bombing doctrine in earnest. American aviators had become convinced that aviation assets, when loaded with enough bombs and aimed at the critical infrastructure of an enemy, could in-and-of-themselves cause enough damage to undermine the will of the enemy to fight. In this way, these airmen believed that long-range bombing could avoid altogether the bloody ground battles that the world had seen for so long, while having the added effect of deterring attacks on the American continent.

Realizing, however, that such a capability was linked to the sort of campaign that the defensive U.S. national military strategy sought to avoid, air force doctrine during this period was careful to couch long-range capabilities in terms of the continental and coastal

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32 There are several accounts of the development of strategic bombing doctrine in the United States. Some of the most widely cited and comprehensive histories of this doctrine include: Johnson, *Fast Tanks and Heavy Bombers*; Craven and Cate, *The Army Air Forces In World War II: Plans and Early Operations, January 1939 to August 1942*; Futrell, *Ideas, Concepts, Doctrine*; Greer, *The Development of Air Doctrine in the Army Air Arm 1917-1945*. 

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defense missions. The air force argued that in order for aviation assets to effectively establish a defensive perimeter around the United States and her allies in the region, it would need to invest in improving the range, speed, and firepower of existing aviation assets. The army, realizing that such a capability would improve its ability to both defend against and deter altogether enemy action in the hemisphere was initially supportive of investing in long-range bomber experiments and trials. After all, the United States is large, and any air force responsible for helping secure the continent would need to cover significant swaths of it without delay. Thus, it made some sense that a long-range bomber could be sold as a weapon for continental and hemispheric defense. Indeed, General Douglas MacArthur, then-Chief of Staff of the army, was among the most vocal supporters of such experimentation, especially since he had wrested the coastal defense mission from the Navy in 1926.

In this way, the air force was able to give the impression of cooperation with the army, while simultaneously reinforcing the operational capabilities that could help underwrite independence from the ground forces. The air force’s investments in long-range aviation kept army skeptics at bay in the short-term while contributing to the air force’s case for independence in the long-term.

Although the air force was careful to endorse the defensive mission of their growing capabilities, there was nonetheless an increasingly vocal cadre of air officers who supported investments in bombers on the merits of their offensive capabilities alone. This growing component of the air force, had an ever-increasing belief in the primacy of the bomber over

34 Several historical accounts point to this disguising of long-range bombing capabilities, including: Millett and Murray, Military Effectiveness, 2:86-87; Finney, History of the Air Corps Tactical School, 1920-1940, 12; Goldberg, A History of the United States Air Force, 1907-1957, 31; Greer, The Development of Air Doctrine in the Army Air Arm 1917-1945, 30-31.

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other aircraft (pursuit, attack, observation, etc.) that was taking root in the training and doctrinal development institutions throughout the air force, including at ACTS. Here, the linked priorities of air superiority and long-range bombing had become "firmly established" in both the instruction and training provided at ACTS. Indeed, by the mid-thirties, ACTS had increased its instruction on air subjects, at the expense of ground subjects and general instruction. Moreover, in joint exercises with the army during annual War College maneuvers of 1931, senior airmen were beginning to complain of misuse of air assets by ground commanders, who by-and-large refused to release air assets to autonomously strike targets in the rear of the battle area. Thus, by the mid-thirties, a significant portion of the training undertaken by most officers in the air force was infused with a long-range strategic flavor.

To a great extent, the growing primacy of independence and the related strategic bombing capability was enabled by the technical developments during the early prewar period. After all, it was in the 1920s and early 1930s that many of the necessary technical hurdles to building such a capability were overcome through the efforts of enterprising, talented, and brave airmen. Despite the early limits placed on air force purchases of aircraft, considerable improvements in the range and speed of air assets were being made throughout the early prewar period, both through the efforts of military airmen and

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37 Finney, History of the Air Corps Tactical School, 1920-1940; Futrell, Ideas, Concepts, Doctrine.
38 Between 1930 and 1935, instruction on air subjects had increased from 43% to 53% of instruction at ACTS, taking equally from ground subjects and general instruction. For more on this shift, see Finney, History of the Air Corps Tactical School, 1920-1940, 35.
40 Millett and Murray, Military Effectiveness, 2:83; Goldberg, A History of the United States Air Force, 1907-1957, 30-38; Craven and Cate, The Army Air Forces In World War II: Plans and Early Operations, January 1939 to August 1942.
investments in the private sector. Moreover, by the early 1930s, many of the manpower restrictions that had been placed on the armed forces in the wake of World War I had been loosened, and by 1932 the Air Corps had a strength of 16,000 men with 1700 planes. Thus, result was that by the mid-1930s the U.S. Army Air Corps had seen significant growth organizationally, made formal gains in establishing its independence from the army, and had laid the doctrinal and technical groundwork for long-range strategic bombing to become a core part of its mission. Critically, however, the air force had been able to do all of this while maintaining the veneer of supporting the army in its continental and coastal defense missions.

But this preoccupation with strategic bombing came at a cost. Specifically, it meant that preparation and thinking about air support of ground operations was overlooked or superficially considered. The overwhelming intellectual and material investments in strategic bombing meant that less of the resource-pie was being devoted to training and instruction for air support, and with few airmen advocating for improving this capability its future prospects did not look good.

However, even with growing air force preoccupation with strategic bombing—and army preoccupation with continental defense—during this period, tactical airpower was not entirely ignored by either service. Indeed, in doctrine, public statements, and reports the War Department and elements of air force did recognize the importance of air support for ground forces in principle. For example, the Air Corps Tactical School (ACTS) training

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44 Jacobs, "Tactical Air Doctrine and AAF Close Air Support in the European Theater, 1944-1945"; Greer, The Development of Air Doctrine in the Army Air Arm 1917-1945, 66-70; Goldberg, A History of the
in the early prewar period conceded that support of ground forces was a core mission of the air forces, and independence skeptics on several congressionally devised boards and committees regularly and publically expressed their view that air assets were best employed in support of ground forces.\textsuperscript{45} Similarly, the Army General Staff was quick to remind the air force that it remained subordinate to the ground forces, especially in joint exercises and maneuvers during this period.\textsuperscript{46} Moreover, most training regulations and doctrine contained boilerplate language confirming the General Staff’s position that the air force was subordinate to the army in both war and peace, and would be expected to come to the aid of ground forces should a land conflict transpire.\textsuperscript{47} Given the fresh memories of World War I and the air force’s status as a part of the army, it should come as little surprise that some lip-service was paid to the tactical airpower mission in the early prewar period. But even with these periodic reminders from the army, the air force continued to marginalize and sideline the mission of air support for ground forces, and the early attention given to this mission during the start of the prewar period was being supplanted by efforts to secure air force independence and investments of limited resources in strategic bombing doctrine.


As the United States entered the mid-thirties, there were two shifts on the strategic landscape that presaged changes to U.S. foreign policy: first, Franklin Roosevelt was elected

President in 1932 and, second, across the ocean, Hitler was appointed Chancellor of Germany, ushering in a nationalistic and aggressive regime. Although the United States would maintain a formal national military strategy of defense and deterrence for several more years, Roosevelt was keenly aware of the troubling developments on the European continent.\textsuperscript{48} Moreover, Roosevelt came in to office with the strong conviction that the American deterrent could and should be bolstered with investments in aviation.\textsuperscript{49} Significantly, however, Roosevelt's support of the deterrent effect of the air force would not make itself manifest in practice for several years: throughout most of the late prewar years the United States was still pursuing a defensive strategy and Congress, in particular, was unwilling to budge on its defensive, neutral posture, enacting Neutrality Acts in 1935, 1936, and 1939.\textsuperscript{50} Nonetheless, the fissures between Roosevelt's concern with the looming threat of German aggression in Europe and continued Congressional endorsement of a defensive national military strategy were beginning to grow.\textsuperscript{51} While the American military strategy from 1935 to 1940 remained fundamentally defensive, cracks in the surface were beginning to appear.

During this period, the air force was able to capitalize on increasing support for airpower among senior civilian leaders but, still facing resource constraints, it needed to prioritize some missions over others. Facing these circumstances, the air force predictably privileged those capabilities and institutions that would help it make the organizational and


\textsuperscript{50} Johnson, \textit{Fast Tanks and Heavy Bombers}, 108; Goldberg, \textit{A History of the United States Air Force, 1907-1957}.

operational case for independence. The result was that, operationally, the air force directed the vast majority of their growing but still constrained resources toward strategic bombing. As noted above, the strategic bombing mission had become the central focus of air force leaders based both on their beliefs about its effectiveness and because it allowed the air force to retain full control over air operations. Organizationally, the air force also pushed for the establishment of the General Headquarters Air Force (GHQAF) in March 1935 on the basis of findings from the earlier “Drum Board” which was a major step forward for air force independence from the army.\(^5\) Although the GHQAF was not independent of the army, it was one of the first formal acknowledgements that the air force could be independently organized and, further, that its missions could include strategic bombing of enemy territory.\(^6\) Thus, in the late prewar period, the air force’s still limited resources meant that it would need to prioritize, and it did so by putting independence—and strategic bombing—at the top of its list. All that being said, however, the air force remained careful to continue to emphasize the defensive, deterrent components of its capabilities in order to give the impression that it was aligned with the expressed national military strategy.

But the army and navy were becoming suspicious of the air forces’ growing independence and commitment to strategic bombing doctrine. For the navy, there had been a longstanding frustration with the air forces’ claims to be a more affordable, effective, means for deterrence and coastal defense.\(^7\) This tension manifested itself on several occasions during the prewar period, and forced the air force and army into a close, albeit


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tenuous alliance.\textsuperscript{55} Even so, the army was also becoming skeptical of air force intentions. The replacement of MacArthur with General Malin Craig, who was far more doubtful of air force investments in long-range bombers meant that the air force lost one its primary army advocates for long-range capabilities.\textsuperscript{56} Accordingly, it was during this period that army support for experimentation and investment in strategic bombing forces dried up, as concerns about the cost of such efforts and their distraction from ground support operations surfaced more prominently in army leadership.\textsuperscript{57} Thus, whatever inclination toward close cooperation existed in the prewar period, it was shrinking as the air force became more brazen in its attempts to garner independence and the resources that came with it. Accordingly, despite a sustained formal commitment to the defense in the mid to late thirties, there was growing evidence that this strategy might soon be jettisoned; and, when that time came, the air force was ready to make the case for the prioritization of its offensive, strategic bombing capabilities over other demands.

3.4 Late Prewar (1935 - 1940): Tactical Airpower Operations & Training

The persistent air force fixation on strategic bombing as its main operational priority meant that tactical airpower would only be further sidelined during the late prewar period. The air force had devised a concept that would allow it to thread a fine needle: investments in long-range bombing could be sold as aligning with the defensive, deterrent elements of U.S. national military strategy, while enhancing its organizational claims to independence. Since tactical airpower operations did neither of those things, we see limited consideration of it in the late interwar period.

\textsuperscript{57} Futrell, \textit{Ideas, Concepts, Doctrine}, 84; Goldberg, \textit{A History of the United States Air Force, 1907-1957}, 42-44.
There were several shifts in training, doctrine, and acquisitions during this period that were indicative of the prioritization of long range bombing capabilities over tactical airpower. Official doctrine on airpower, along with unofficial statements illustrate that the air force’s preference for strategic bombing was becoming more widespread. For example, the air force update to Training Regulation (TR) 440-15, which hadn’t been revised since 1926 and was primarily concerned with air support of ground operations, was updated in 1935 to also include language that prescribed a strategic, independent role for the air force. Additionally, in 1936, it became clear that air force leaders were willing to take a strong stand against the then-common practice of attaching air assets directly to ground units during exercises, when the Air Corps Board—created to consider disputes related to the future of airpower—openly expressed misgivings about the practice. Moreover, even the lessons of the Spanish Civil War in 1939 that appeared to reinforce the importance of tactical airpower operations, were being discounted by proponents of strategic bombing, who argued that air support of ground forces had little impact on the outcome of the war. Similarly, the emphasis on long range bombing over tactical airpower manifested itself in early acquisitions priorities during this period. As the early investments in bomber aircraft began to bear fruit in the form of the B-9, B-10, and especially with the successful testing of the B-17 during army-navy maneuvers in the Pacific in 1937, it became clear that strategic bombing could move from the realm of theory to the realm of practice, and the

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60 Greer, The Development of Air Doctrine in the Army Air Arm 1917-1945, 103; Hallion, Strike from the Sky, 89–114.
air force was eager to put 15 years of nascent thinking to work. This enthusiasm was felt nowhere more strongly than at ACTS, which had become the hub of doctrinal thinking about strategic bombing, where airmen were eager to continue testing with the new long-range capabilities. Thus, by the late-thirties the operational push for a more independent role for the air force had begun to manifest itself both formally and informally.

But even with this widespread enthusiasm for strategic bombing, air force leadership was still careful to mask it under a defensive umbrella—although the President was favorably inclined toward airpower, neither the army nor the American public was eager to concede resources to an offensively minded air arm. The army, which was focused on meeting the need of continental and hemispheric defense during this period, continued to look to the air force for its long-range patrol and bombing coverage in the hemisphere. And the U.S. public and Congress remained committed to defense well into the late thirties. Although there remained real concerns about air force intentions within the General Staff, the army still relied on the air force for a critical piece of its defensive mandate, and was thus required to sustain its investments in long-range capabilities despite their misgivings. Accordingly, the strategic bombing missions remained veiled in the guise of defensive doctrine well into the thirties.

Accordingly, during this period tactical airpower operations remained an afterthought. The air force was preoccupied with developing strategic bombing capabilities and serving the continental and coastal defense missions, and the army was concerned with meeting the needs of continental and hemispheric defense. This left little room and few resources available for meaningful tactical airpower preparations. Despite occasionally

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paying lip-service to the concept in official doctrine during this period, both the army and air force were preoccupied with other concerns.

4 Preparing for War and Early Operations in North Africa (1940 – 1942)

In the years leading up to the outbreak of World War II, the U.S. foreign policy elite had become highly attuned to the situation in Europe. By late 1941, President Roosevelt, Secretary of War Henry Stimson, and Army Chief of Staff George Marshall knew that the United States could become embroiled in yet another European war, and they had resolved to be more prepared than they were last time. Despite their genuine intent to enter this war better prepared than 20 years earlier, however, the efforts of senior civilian and military leaders were hamstrung in significant ways that would become apparent during the combat in North Africa. But, at least in the case of tactical airpower operations, this was not for lack of trying. Shifting attitudes among the United States policymaking elite and public, particularly after the fall of France in spring 1940, lead to a markedly more offensive, ground-oriented national military strategy. As a result of this change, the American military elite had been studying the tactical airpower problem for nearly two years when they entered the war and had identified the contours of an improved system. Unfortunately, however, neither the air force nor the army was willing to concede the necessary resources demanded by the most effective solutions—the army was unwilling to give up its “flying artillery” and the air force was unwilling to strip resources from the strategic bombing capability and redirect them toward tactical airpower. The result was that despite their awareness of an improved system, the entrenched interservice politicking of the day meant that these efforts made little progress toward actual implementation. Instead, the U.S. went to war with an outdated and ineffective system for tactical airpower operations.

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According to the predictions of MFT, this should come as little surprise. The shift in the national military strategy of the United States toward a more offensive posture in late 1939 and early 1940 meant that the problems of offensive ground operations—including those presented in conducting air support of land campaigns—should have emerged with a new urgency. However, MFT predicts that this strategic urgency alone will not be enough to ensure implementation of identified solutions. Instead, it forecasts that, insofar as the services are locked in a competitive posture due to resource endowments, it is unlikely that joint problems will be quickly and easily solved. Rather, we are likely to see extended debate, with little resolution of core issues, and vague or incomplete formulations of the solution at best. Unless and until this competitive relationship is mitigated with the infusion of additional resources, we are unlikely to see much progress on implementing solutions throughout the force. And, indeed, this is what we see in the American case: despite shifting toward a more offensive strategy and acknowledging the need for improved air support of ground operations, implementation of these solutions was slow to gain ground. The result was that doctrine for tactical air support operations during this period was vague and, ultimately, the execution of these operations was ineffective during the early stages of the war.

The remainder of this chapter relates the empirical record of American tactical airpower thinking from 1940 to 1942. It begins with a discussion of the strategic shift in American thinking that began after the invasion of Poland in September 1939 and was solidified after the fall of France in the spring of 1940. It argues that this shift in military strategy introduced a series of new military problems to senior leaders, who acknowledged and began the process of studying those problems. It then discusses how, despite this change and earnest interest in the problem of tactical airpower among senior leaders, organizational pathologies unleashed by resource constraints served to filter the findings of tactical
airpower training and exercises on the eve of the war; and, ultimately, led to the production of vague and inconsistent doctrine for operations in North Africa. It concludes with an examination of the early failings of tactical airpower operations in this theater to illustrate just how problematic the failure to implement this new system for tactical airpower operations proved to be in execution.

4.1 National Military Strategy & Resource Endowments
The defensive, deterrent national military strategy that had characterized the United States’ approach to world affairs during the prewar years would come to an end at the close of the 1930s. It was during this period that the ominous nature of Hitler’s aggression was becoming difficult to ignore. Roosevelt and his advisors were cautiously, albeit seriously, aware of the prospect that American forces might become entangled in a conflict if and when it broke out in Europe. During this period, Roosevelt had found ways to circumvent Congressional feet-dragging in order to support British war preparations, and was equally talented in ensuring some investments were made in the United States’ own preparation for war.

More than any other event, the German invasion of Poland in September 1939 and the fall of France in the spring of 1940 served to shock the American public and, reluctantly, Congress into acknowledging that American participation in the European war—whether in the form of industrial support to its allies or in the entry of U.S. forces—was a possibility,

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if not a guarantee.\textsuperscript{68} In the wake of the German invasion of France, Roosevelt, with limited support from Congress, began a remarkable preparatory effort to improve the state of the American military and prepare Americans for a fight in Europe.\textsuperscript{69} Among the most significant changes induced by the events in Europe in late 1939 and early 1940, there are four which are especially reflective of the American reorientation toward offensive operations: (a) the development of the Rainbow war plans, which envisioned the United States fighting a multifront, global war; (b) the activation and training of the General Headquarters (GHQ) Army in July 1940; (c) the authorization of significant air force growth in 1940, epitomized by the projections of the First and Second Aviation Objectives; and (d) the massive industrial mobilization to redress the manufacturing deficiencies that emerged between the wars.

The first of these moves, the development of the Rainbow war plans, was the most explicit signal that American military strategy had changed. Indeed, in June 1939, the Joint Board (the predecessor to the Joint Chiefs of Staff) jettisoned their prior war plans that envisioned future confrontations as a single-front fight and instead began a concerted effort to plan for a multi-front, international war against Germany, Japan, and Italy. Had there been any doubt about American involvement in the next world war, the development of Rainbow plans served to correct that impression.

But the shift was not just a planning exercises: the U.S. also took meaningful steps to initiate preparation for such a conflict. Accordingly, the activation of the GHQ Army under the leadership of General George Marshall, and the ambitious and unrivaled training exercises overseen by Lieutenant General Lesley McNair, were the first indications that the


United States was preparing for the potentiality of an offensive ground campaign. Indeed, under the leadership of Marshall and McNair, the GHQ Army went from an ill-equipped 200,000-man force, to a trained, equipped (even if minimally), force of over one million in 1941. Thus, by the late thirties, the U.S. Army had begun meaningful preparations for fighting and ground war.

Similarly, Roosevelt’s authorization, with the eager support of Congress, of significant investments in aircraft, which leaders at the time thought would be critical in fighting a war on the continent, is suggestive of the changing American views about the prospect of fighting another European war. Initially, and somewhat absurdly, Roosevelt’s authorization was slated to reach 50,000 army and navy planes, but was subsequently approved by the War Department at a more reasonable level of 18,000 planes by 1942. This impulse toward investing in a robust air force was further codified in the First and Second Aviation Objectives, approved by Marshall in June 1940 and March 1941, respectively, which laid out a clear plan to increase the number of aircraft in produced in the United States. Though many of these planes would be given to the British to support their fight against the Germans, American investments in developing a robust air force made clear that it was no longer under the illusion that it could stay out of the European conflict altogether and, further, that if the Axis tried to bring war to the United States, the United States would be prepared to bring war right back.

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71 Johnson, Fast Tanks and Heavy Bombers, 188; Gabel, The U.S. Army GHQ Maneuvers of 1941.
72 Gabel, The U.S. Army GHQ Maneuvers of 1941, 5; Johnson, Fast Tanks and Heavy Bombers, 149–51.
But it was not just aircraft production that the U.S. began to surge after the fall of France. American industrial preparation for the war in all its forms began in earnest in 1940, suggesting that the fiscal and diplomatic concerns that had prevented the United States from making significant investments in warfighting machines had diminished. By 1940, the prospect of fighting a ground war in Europe as well as, potentially, fighting against a formidable foe in Japan had emerged as a very real possibility. As a result, senior civilian and military leaders began to make investments in the training and equipment that aligned the U.S. military with these new priorities.

Among the many new priorities that would emerge during this period, the challenge of air support for ground operations was one. As I discuss in great detail below, as the American national military strategy began to shift, there was widespread acknowledgement among senior military leaders that air support of ground operations would need to be studied closely. Despite this acknowledgement of the need for effective tactical airpower operations, however, the interservice disputes over the provision and distribution of limited airpower resources spilled over into the training, exercises, and doctrine related to tactical airpower operations during this period. Thus, throughout this period service pathologies acted as a filter for officers in both the army and air force who were tasked with identifying and implementing a system of tactical airpower operations that could successfully be deployed in support of ground offensive.

The interservice debate over tactical airpower operations in the United States was deeply rooted in the resource constraints of the day, and had all of the hallmarks of the classic tactical airpower dilemma outlined in Chapter 2. For the air force, the prewar years

had produced a commitment to operational and organizational independence that would be best served by directing the majority of its limited resources toward strategic bombing. And, for the most part, the strategy was working: in 1941, the Army Air Forces were established at the behest of Secretary Stimson and, in March 1942, a War Department Reorganization placed the USAAF on almost-equal organizational footing to their ground counterparts. Moreover, by 1939, army and navy air appropriations had increased considerably. With all these gains on the horizon, it was difficult for the USAAF leadership not to see preparation for tactical airpower operations as an unwelcome diversion of attention and materiel from their larger crusade for strategic bombing and organizational independence. In the late 1930s and early 1940s, the American industrial machine was humming, but not at a high enough volume to allow the USAAF to outfit both tactical airpower and strategic bombing units amply, particularly given with the concurrent demands for aviation assets coming from their British allies. In 1938, for example, the USAAF was producing—in total—under 2,000 planes annually and, by 1940, that number had only grown to just under 4,000. Even by 1941, the most generous appraisal of U.S. aviation strength only estimates first-line combat aircraft at 4,000 planes in the wake of the Pearl Harbor attack. Moreover, the British demands for aircraft—and especially heavy bombers—meant that aviation assets felt even more constrained than they may have appeared on paper: “more

79 Spires, Patton’s Air Force, 1; Hallion, Strike from the Sky, 53.
than half of the 1941 production of first-line combat planes went to [the United States’] potential allies, chiefly the British." Faced with the choice of where to invest their time, training, and resources, the USAAF preferred to spend on strategic bombing. According to one estimate, between 1941 and 1942, the USAAF’s medium bombers, light bombers, and fighters on-hand doubled in strength, while their heavy bombers on-hand grew ten-fold.

Though these numbers should be taken with a heaping spoonful of salt, given the difficulties of approximating production and first-line combat strength, they do align with the irrefutable doctrinal and operational emphasis on long-range strategic bombing during this period. Thus, although the air force was, reluctantly, willing to admit that tactical airpower operations could be necessary in extenuating circumstances during a ground operation, they were adamant that these operations would not be their primary focus. It should not be surprising then that the available resources were devoted first to their preferred tasks.

The army, on the other hand, was concerned with the immediate problems of the battlefield, and saw the air force as a critical but supportive element of an infantry or armor advance. Accordingly, many army commanders were convinced that air assets should be subordinate and tied to ground forces. Moreover, after over a decade of air force efforts to untie themselves from the army, there was considerable skepticism about how well the air force would and could support a ground advance. Thus, the army felt that only a ground

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82 Craven and Cate, 6:423.
83 Craven and Cate, 6:423.
84 Hallion, Strike from the Sky, 53; Greer, The Development of Air Doctrine in the Army Air Arm 1917-1945, 32–39.
88 Greer, The Development of Air Doctrine in the Army Air Arm 1917-1945, 95.
commander could control and direct air assets to adequately provide cover for advancing forces and was quick to object to any system that would diminish persistent air cover for advancing ground units. Just as the air force was reluctant to adopt a tactical airpower system that would diminish the resources available for strategic bombing, the army was unwilling to adopt a system that would lessen its access to continuous air cover resources.

These concerns, however understandable, colored nearly all discussions and testing related to tactical airpower from 1940 to 1942, resulting in serious doctrinal and operational problems during this period. Even with the shared understanding that tactical airpower operations would prove central to U.S. success in an eventual ground campaign, interservice interests based on the desire to protect organizational resources served to impede the resolution of several key issues related to air support for nearly two years.

4.2 Tactical Airpower Operations: Exercises, Doctrine, & Early Operations
The remainder of this section details how the pursuit of these interests infused various elements of the American experience developing and implementing solutions to the core challenges of tactical airpower operations. In particular, I focus on three areas where this interservice tension diluted and delayed the implementation of a robust standard for tactical airpower operations: (a) during the preparatory GHQ maneuvers, (b) in the development of doctrine for air support, and specifically, in the construction of FM 31-35, and finally (c) during early operations in North Africa.

4.2.1 Preparatory Exercises
In the three years that separated the German invasion of Poland and the American landings in North Africa, both the U.S. Army Air Forces and the army became increasingly concerned with preparing successfully undertake tactical airpower operations. During this period,

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several army-wide planning and training exercises took place that revealed conflicting views about the nature of air support for ground operations. Though these maneuvers revealed the need to adopt the standard of tactical airpower outlined in Chapter 2, the need for interservice compromises and concessions over resources meant that the wholesale adoption of this system was avoided for several more years.

Here, I review the experience of the army and USAAF with the tactical airpower mission during the largest set of maneuvers—the GHQ maneuvers in Louisiana and Carolina during the summer and fall of 1941. Although there were several additional maneuvers and training exercises (for example the Ft. Benning tests of the Air Support Control system in 1941 or the Desert Training Center exercises in 1942), the GHQ maneuvers reflect several of the major themes and disagreements that took place between the army and USAAF during all of the preparatory exercises during this period.  

Given the sheer scope and magnitude of the American prewar mobilization and GHQ maneuvers, as well as the amount of press and public attention given to these events at the time, surprisingly little historical work has been done on these exercises. Where such work does exist, it often takes the form of official military histories, many of which were written during or very shortly after the war. Nevertheless, taking together these accounts with some academic studies and original records from the period, the historical record sketches a relatively clear picture of how many of the interservice debates over tactical airpower operations remained major points of unresolved tension during the maneuvers. Although the GHQ maneuvers performed an important function in building on and refining knowledge

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90 For more on the other exercises conducted in and around this period, see: Sidney Meller, “The Desert Training Center and C-AMA, Study No. 15” (Historical Section, Army Ground Forces, 1946); Lester, Mosquitoes to Wolves The Evolution of the Airborne Forward Air Controller, 9.

related to the challenges of tactical air support, both the USAAF and army were disappointed with the outcome of the exercises and recognized that further training would be necessary to resolve many of the underlying issues. Unfortunately, however, neither service proved willing to relinquish the resources necessary to see these issues addressed in practice.

The GHQ maneuvers consisted of four key events over the summer and fall of 1941. The first two maneuvers—the Tennessee (June 1941) and Arkansas (August 1941) maneuvers—were preparatory and intended to get units up to speed on basic skills. As one historian notes, these “exercises were designed to lead these green divisions progressively through the principal types of field operations including a concentration, an advance to contact with an enemy, an attack, the organization of a defensive position, and finally a withdrawal.” In the fall, however, the Louisiana (September 1941) and Carolina (November 1941) maneuvers were intended to more closely mimic battlefield conditions that American soldiers were likely to face if and when the United States entered the war. Both sets of maneuvers would prove important to developing an American force that could compete with the European armies that had already been engaged in battle for over a year, but they would set off a debate over the appropriate role of airpower in a ground war whose echoes would also make their way into army doctrine.

Before turning to the outcome of these maneuvers, however, it is worth recounting important historical context regarding the purpose and challenges of these exercises. The GHQ maneuvers were the brain-child of the newly appointed Army Chief of Staff (COS),

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General George Marshall. Marshall, who had observed firsthand the pitfalls of sending an undertrained and ill-equipped force to fight in Europe during the First World War, was attuned to the need for extensive prewar preparation. Indeed, in the wake of World War I, Marshall remarked, “Today it is inconceivable that we should have found ourselves committed to a war while yet in such a complete state of unpreparedness.” But, as Christopher Gabel, an army historian and author of the most comprehensive official account of the maneuvers notes, the U.S. Army in 1939 had a great deal of work to do: “The day that Germany’s attack on Poland signaled the beginning of World War II, the U.S. Army ranked approximately seventeenth in effectiveness among the armies of the world, just behind that of Rumania. The Regular Army totaled less than 190,000 personnel, including the Philippine scouts and the Army Nurse Corps.”

Accordingly, when Marshall started as COS his first priority was to engage in a robust prewar preparation and training program that would enable the American forces to mobilize efficiently and effectively into a combat ready force when war came, and the GHQ maneuvers were to be the culmination of that prewar effort. Under the leadership of McNair, personally chosen by Marshall to spearhead this effort, the GHQ exercises were an opportunity for the ground forces to train at the corps and field army level in “free maneuvers” intended to simulate combat conditions. These exercises would come at the end of several weeks of progressively larger training efforts, moving incrementally from basic

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95 Greenfeld, Palmer, and Wiley, United States Army in World War II: The Army Ground Forces, The Organization of Ground Combat Troops, 10; Gabel, The U.S. Army GHQ Maneuvers of 1941; Hallion, Strike from the Sky, 150.
97 Marshall, 8.
98 Gabel, The U.S. Army GHQ Maneuvers of 1941, 8.
99 Gabel, 19; Greenfeld, Palmer, and Wiley, United States Army in World War II: The Army Ground Forces, The Organization of Ground Combat Troops, 6, 40–43.
training at the individual level to all the way to division-level combined training.\textsuperscript{100} Then, in the summer and fall of 1941 the GHQ maneuvers would force these units would face off in two teams at the corps and field army level.\textsuperscript{101}

However, the scope of these exercises meant that they were also plagued by challenges from the start. First, there was the simple issue of creating a training regimen that could meet the needs of troops with different levels of preparedness—not only was the overall training effort aimed at the 200,000 ground troops of the regular army, but it was also responsible for training the several thousand reserve and national guard forces who had far less exposure and proficiency in basic soldiering.\textsuperscript{102} Relatedly, there was the issue of the small and underprepared officer corps, which was coming out of twenty years of peacetime status.\textsuperscript{103} As a result, many of the officers in the regular army were ill-equipped to train their enlisted soldiers to adapt to the new structure and equipment of warfare that had been devised by higher command.\textsuperscript{104} Moreover, as American policymakers became attuned to the prospect of war, they began funnel more and more troops into the training apparatus, often leading to long delays and ill-used time, especially among the enlisted soldiers.\textsuperscript{105} The result of this combination of personnel and capabilities led to frustration and morale issues throughout both the enlisted and officer corps. Finally, there was the persistent issue of resources and equipment.\textsuperscript{106} Although policymakers had come around to the view that war

\textsuperscript{100} Greenfeld, Palmer, and Wiley, \textit{United States Army in World War II: The Army Ground Forces, The Organization of Ground Combat Troops}, 9–12.

\textsuperscript{101} Greenfeld, Palmer, and Wiley, 43–45.

\textsuperscript{102} Greenfeld, Palmer, and Wiley, 10; Gabel, \textit{The U.S. Army GHQ Maneuvers of 1941}, 15–17.


\textsuperscript{105} Gabel, \textit{The U.S. Army GHQ Maneuvers of 1941}, 16.

\textsuperscript{106} Johnson, \textit{Fast Tanks and Heavy Bombers}; Sherry, \textit{The Rise of American Air Power}. 

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was likely and had begun to allocate the necessary resources to increase and modernize the equipment available to the U.S. Army, these efforts were hamstrung by the simple fact of American industry would have to ramp-up to the production levels required, and that process would take time.\textsuperscript{107} The result was that the GHQ directed training effort failed to incorporate some of the more advanced equipment during the exercises.\textsuperscript{108} But even in the face of these significant challenges, the GHQ maneuvers were a remarkable feat of combined training and by start of hostilities in North Africa, the U.S. Army had quadrupled in size and had improved its overall readiness as a result.

In the process of directing these maneuvers, the army—and the nation—became acutely aware of many of the deficiencies of the American war machine. In this environment, there arose significant debate over the appropriate remedies to these challenges at several levels of command, often reaching the civilian leadership.\textsuperscript{109} Nowhere was the debate more divisive than when it came to the appropriate role of air power in an eventual ground campaign. U.S. Army officers were well aware that the USAAF preferred leveraging the strategic, independent effect of airpower, even if it came at the expense of ground support.\textsuperscript{110} And, indeed, they had good reason to believe this: as noted earlier, the USAAF has spent over a decade making the case for its independence, arguing that air assets were best leveraged by striking strategic targets deep in enemy territory, and that diversions of airpower to support ground forces would come at enormous cost.\textsuperscript{111} Thus, the dispute over

\begin{itemize}
\item \textsuperscript{107} Goldberg, \textit{A History of the United States Air Force, 1907-1957}, 43-44.
\item \textsuperscript{108} Gabel, \textit{The U.S. Army GHQ Maneuvers of 1941}, 17; Greenfeld, Palmer, and Wiley, \textit{United States Army in World War II: The Army Ground Forces, The Organization of Ground Combat Troops}, 6, 40-43.
\item \textsuperscript{109} For example, there was an extensive debate that emerged during and after the GHQ maneuvers over the appropriate role that mechanization and armor forces should play, command structure, and combined arms. For more see, Stephen D. Biddle, \textit{Military Power: Explaining Victory and Defeat in Modern Battle} (Princeton, NJ: Princeton Univ. Press, 2004); Johnson, \textit{Fast Tanks and Heavy Bombers}.
\item \textsuperscript{110} Lester, \textit{Mosquitoes to Wolves The Evolution of the Airborne Forward Air Controller}, 5.
\item \textsuperscript{111} Gabel, \textit{The U.S. Army GHQ Maneuvers of 1941}, 38; Greenfeld, Palmer, and Wiley, \textit{United States Army in World War II: The Army Ground Forces, The Organization of Ground Combat Troops}, 103.
\end{itemize}
airpower during the GHQ maneuvers was mired in longstanding interservice disputes about where the limited air force resources should be directed.

During the GHQ maneuvers, this tension would be a persistent feature of the many discussions had by army and air force officers about the role that air power would play in the exercises, and by proxy the role that it would play in the war. But views in the air force and army were not always uniform. On the army side of the debate, for example, Marshall and McNair had different opinions about how linked air power ought to be to ground units. For his part, McNair felt that the view outlined in the earliest airpower doctrine of the war, Field Manual 1-5 Employment of Aviation of the Army was correct in assigning “all aviation within a theater to the commander of field forces, who then assigned air units to specific corps and divisions for integration into the ground scheme of battle.”112 Marshall, on the other hand, was more inclined toward the air force view of the situation, and “advocated a system under which air units, controlled by air officers, roam the entire theater of war, striking at the most remunerative targets.”113

In the USAAF, leaders acknowledged that strategic bombing should be the priority, but there remained some debate just about how much of the remaining resources should be devoted to the ground support mission. For his part, General Hap Arnold, father of the American air force and staunch proponent of the strategic bombing mission (albeit in a limited capacity) was willing to admit that air forces would need to be employed in the ground fight.114 Moreover, he went on to put some organizational muscle behind the air support mission; as one historian notes, in 1941 “against the advice of staff members, Arnold designated, for the first time in air arm history, a formal advocate for air support. Col.

112 Gabel, The U.S. Army GHQ Maneuvers of 1941, 37.
William E. Lynd became the first head of the Air Support Section of the Air Force Combat Command (successor to the GHQ Air Force in June 1941). However, there remained a great deal of consternation among other senior air officers about diverting resources away from the basic pilot training to ground support exercises. In 1941, these concerns were well-founded: with already limited resources, air officers were concerned that putting pilots into ground support exercises with new equipment and relatively little training risked putting the cart before the horse. As a skeptical General Emmons, Head of Army Air Forces Combat Command, succinctly put it, “After considerable study of this [GHQ maneuver request] I feel it my duty to invite your attention to the price that our young and growing air force will have to pay and to the serious effect it will have on its future capabilities and readiness for defense.” To Arnold’s credit—and over the vehement objections of many of his senior commanders—the air force was directed to allot a small share of air assets to the GHQ maneuvers, offering the 17th Light Bombardment Group as early as February 1941, and in the early summer of 1941 allocating additional resources. Although some senior leaders were willing to concede some ground, even before the GHQ

118 “Increased Participation of Air Force Units in the 1941 Maneuvers,” June 2, 1941, General Headquarters of the US Army, 1940-1942, General Correspondence, United States National Archives and Records Administration.
maneuvers began there was considerable variation in views about the appropriate role of airpower in a future ground war, whether tactical airpower operations would be a primary focus in such a contingency, and how much of the limited air force resources should be devoted to the task.

The result of these competing viewpoints was that there was no consensus about the high concept underlying tactical airpower operations. Instead, there were two competing and non-overlapping views of what tactical airpower operations could and should do on the battlefield. For the army, tactical airpower was to function primarily as “flying artillery,” providing cover and suppression of enemy forces for advancing ground forces. Accordingly, airpower would need to be available to army commanders at very low-echelons, who could direct them to the most lucrative frontline targets to perform close air support tasks. For the air force, on the other hand, the tactical airpower high concept was quite different. On the rare occasion when such a capability was provided, air force officers were adamant that aviation be used to isolate the enemy forces and prevent harassing air attacks on friendly units. Accordingly, these air force commanders were very reluctant to commit the already small number of tactical airpower assets to close air support missions, and instead directed them toward battlefield air interdiction and air superiority tasks. As we shall see in the remainder of this section, the incompatibility of these two conceptions of tactical airpower operations—and both services’ unwillingness to compromise or concede resources—resulted in suboptimal outcomes during the early 1940s.

Absent a clear and unified concept for tactical airpower operations shared by the two services, disagreements and inconsistencies soon bled over into the procedural elements of war preparations. It was in this state of indecision that, in February 1941, the army and air force began to test several tactical airpower systems for use in the GHQ maneuvers with
17th Light Bombardment Wing. In the first phase of testing, air and ground units were engaged in dialogue and joint training about the potential opportunities and challenges afforded by air support. During this phase, the units developed an initial suite of best practices, which were then applied in combined training from April to June of 1941. Over this period, the 17th Light Bombardment Wing conducted several joint operations with the 4th Division and 2d Armored Division at Fort Benning, in order to test out alternative modes of air support. Quickly, the core findings of these initial experiments were identified. First, units observed that targeting was a significant issue and identified the need for robust signaling and liaison between the ground and air. Second, the exercises acknowledged that there should be a single, centralized command structure for air assets, with only the Task Force commander above a single air commander who was solely responsible for the “method of employment of his forces.” Finally, the after-action reporting on these preliminary exercises suggested that “preliminary directive for air support of ground troops should be published immediately and furnished to the service.” Thus, what these units discovered about tactical airpower in the winter and spring of 1941 was three-fold: command need to be centralized, liaison and signaling was essential, and more doctrine and training would be necessary.

In addition to the 17th Light Bombardment Wing tests, the army was also getting good reporting before the start of the GHQ maneuvers about tactical airpower from the

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120 The after-action reporting on these preparatory exercises can be found in: “17th Bomb Wing (L) Report: Combined Tests to Develop Doctrines and Methods for Aviation Support of Ground Forces”; See also: Greenfeld, Palmer, and Wiley, United States Army in World War II: The Army Ground Forces, The Organization of Ground Combat Troops, 102–6.

121 “17th Bomb Wing (L) Report: Combined Tests to Develop Doctrines and Methods for Aviation Support of Ground Forces.”

battlefields in the Western Desert in 1941. The observations of several air force officers that had been sent abroad to liaise with British officers—most notably, Lieutenant General Lewis Brereton—exhorted their fellow American officers to adopt the principle of centralization of command that was developing in the Western Desert. American officers also endorsed the experiments taking place with the Air Combat Command in Northern Ireland, which served to support a centralized system of air support. Together with the experiments taking place among the operators in the 17th Light Bombardment Wing, this first-hand reporting from the field offered preliminary support for a centralized system of tactical airpower operations preferred by the air force.

Against this backdrop, the GHQ maneuvers began in Louisiana and Carolina in the late summer and fall of 1941. By the time that the Louisiana maneuvers began in late August 1941, many of the issues related to tactical airpower that had been raised by the 17th Light Bombardment Wing and Brereton reports were beginning to crystalize into a significant debate between air and ground commanders around a handful of core principles. Not only was there a dispute over the overall concept of tactical airpower operations, and specifically whether to privilege the air forces' view that isolation of the

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123 Brereton's reflections are summarized here, though his full report on the British system is fascinating and can be found in the National Archives: “Letter of Instruction No. 1: Plan of Air Support Operations by Second Air Task Force: Second Army Maneuvers,” August 19, 1941, RG 337, Entry 57 General Headquarters of the US Army, 1940-1942, General Correspondence; “Report on 2nd Air Task Force Participation in Louisiana Maneuvers,” September 1941, RG 337, Entry 47 General Headquarters of the US Army, 1940-1942, General Correspondence., US National Archives and Records Administration.

battlefield should be prioritized over the ground forces’ view that air cover should be prioritized, but there were also several ancillary debates on matters of procedure and execution. Among the most contentious issues brought to the fore during the Louisiana and Carolina Maneuvers was the issue of command and control. The key challenge was that command and control in the air support context revealed very different views about how air forces should be controlled and who should be controlling them. As noted previously, air and ground views on the problem differed systematically. Ground commanders were eager to have air assets function, effectively, as very long range artillery, attacking enemy targets on the front lines. Accordingly, from the ground forces perspective, the army was eager to have all air assets under the command of the field army ground commander, who would then divvy up assets to the corps and division commanders. The argument of army commanders was that such a system would retain a unified command structure and ensure that all ground requests for air support were met. On the other hand, the air force officers felt that all air assets should come under the command of a single air force commander at the field army level who, while reporting to the senior ground commander, was able to vet air support requests coming from the field. In this way, USAAF officers argued the air support system would be best able to achieve concentration of effort, while still ensuring alignment with the senior ground commander’s goals.

When the time came for the Louisiana and Carolina maneuvers to begin, the system for tactical airpower operations was very much a compromise between the air and ground


127 Gabel, The U.S. Army GHQ Maneuvers of 1941, 57.

views, despite endorsements from the 17th Light Bombardment Wing and WDAF reports favoring centralization. The key component of this system was the Air Support Control (ASC), also referred to as an Air Task Force during the maneuvers (Figure 3).129 The ASC was manned by a senior air force commander who oversaw all air assets in the field army. In addition to the ASC, however, individual corps and divisions were manned with Air Support Demand Units (ASDUs) that were staffed jointly by ground and air force officers. These ASDUs would receive air support requests from the front lines, evaluate which requests should take priority, and relay them back to the ASC. The ASC would then evaluate the necessity and feasibility of the requests in light of the senior ground commanders’ goals, needs, and available assets. If a request from the field was approved by the ASC, an appropriate air unit would be assigned, and the request would be relayed to designated airfields. Once received by the airfield, who was on alert, they would rapidly deploy the requested air assets. All told, the average time for this process was estimated by one historian as taking nearly an hour and a half.130 This system was intended to ensure that frontline ground forces were able to quickly and easily request air support, but also that the support would be aligned with the overall goals and needs of the battle, as well as in line with the capabilities of the air assets in theater.131

129 The air support control system used in the maneuvers is comprehensively reviewed in the after action memos and can be found in the US National Archives: “Plan of Air Support of Second Army by Second Air Task Force”; “Letter of Instruction No. 1: Plan of Air Support Operations by Second Air Task Force: Second Army Maneuvers.” Also see, Greenfeld, Palmer, and Wiley, United States Army in World War II: The Army Ground Forces, The Organization of Ground Combat Troops, 113–14.

130 “Plan of Air Support of Second Army by Second Air Task Force.”

131 “Plan of Air Support of Second Army by Second Air Task Force.” This document includes a comprehensive discussion of the command structure and specific requirements used to evaluate air support requests by the ASDU and ASC.
In the actual event, the strikes called in by air support demand units were focused on both the close air support and battlefield air interdiction missions. In addition to “the first priority” of “support of the armored corps in its movement around the enemy” air units were also tasked with targeting “troop concentrations, communications, and vital installations.”\textsuperscript{132} In short, the GHQ maneuvers attempted to thread the needle of meeting both the air force and army preferences.

By the conclusion of the exercises, however, the verdict on tactical operations in general, and the ASC system in particular, was clear: despite a decent first showing, there was still much work to be done. Indeed, Marshall and Arnold both reported that they were satisfied with the ASC system, and even the field army commanders expressed their satisfaction with the air support provided, but almost all commanders were equally aware

\textsuperscript{132} “Report on 2nd Air Task Force Participation in Louisiana Maneuvers”; “Reports on Employment of Aviation in Close Support of Ground.”
that there was much work that needed to be done to improve the system.\textsuperscript{133} Thus, in after-action reporting, U.S. officers began a wide-ranging debate on all of the core doctrinal components of tactical airpower, including: (a) command and control, (b) command integration and collocation, (c) prioritization, and (d) signal and liaison.

Implicit in much of the after-action reporting on the maneuvers were echoes of the ground force view that many of the observed problems had to do with the over-centralization of the ASC system.\textsuperscript{134} Specifically, centralized vetting of air support requests by several air officers was highlighted as the source of two major issues. First, there was the problem of dismissed requests for support from frontline units based on air officers' hesitancy to deploy to frontline areas where they believed artillery could support ground forces.\textsuperscript{135} According to observers at the time and historians of this period, a second major issue was delays in getting assets deployed, likely a result of the two phases of deliberation and approval before any request could be met. As Colonel Jack Roberts reported in an after-action review, "Delays due to [time required for transmission of the request] were alarmingly large."\textsuperscript{136} Thus, while centralization in the ASC system offered a coherent and clear system of command to direct air support requests and allocate the appropriate forces, there remained real problems that would continue to plague American ground forces well into the war. Unfortunately, these initial indications that the system, while an improvement, would still present challenges down the road were left unexplored for the time being, since a mutually satisfactory solution was not available.

\textsuperscript{133} Gabel, \textit{The U.S. Army GHQ Maneuvers of 1941}, 120; "Memo to Commanding General, 3rd Air Task Force, Reports of Employment of Aviation in Support of Ground Troops."

\textsuperscript{134} "Report on 2nd Air Task Force Participation in Louisiana Maneuvers"; Gabel, \textit{The U.S. Army GHQ Maneuvers of 1941}.

\textsuperscript{135} Gabel, \textit{The U.S. Army GHQ Maneuvers of 1941}.

\textsuperscript{136} "Memo to Commanding General, 3rd Air Task Force, Reports of Employment of Aviation in Support of Ground Troops."
In reflecting on army-air force coordination at the highest levels in the field, after-actions reports also noted that collocation of the ASC with the field army headquarters would be essential moving forward.\textsuperscript{137} For example, in the Second Army, the ASC was located nearly 75 miles away from the army Headquarters, leaving much of the communication to ‘liaison officers’ via phone, teletype, or in person.\textsuperscript{138} This inefficiency was noted as something that should and could be easily remedied in the future via collocation, with the Second Air Task Force commander noting explicitly: “It is recommended that in the future the Air Support Command Headquarters be located at or very near to army Headquarters.”\textsuperscript{139} Although this was not controversial, the absence of collocation in the first place speaks to the operational divisions that existed between the air force and army.

In addition, one of the critical lessons of the exercises was the need to engender a better sense of appropriate target selection for air support among ground officers. In particular, air force commanders hoped that ground forces would have a better sense of which targets—i.e. targets in the rear of the battlefield including logistics, supply, and reserves—could most usefully be targeted by air assets.\textsuperscript{140} As Harmon emphasized in his reporting on the exercises, “\textsc{Combat Aviation in Support of Ground Forces Must Not Be Uselessly Expended Against Objectives Which are Not Profitable Targets},” by which the commander probably meant targets within range of friendly artillery.\textsuperscript{141} Indeed, as historians of this period have noted, during the maneuvers, air force officers were far more inclined to approve these sorts of interdiction targets than


\textsuperscript{138} “Report on 2nd Air Task Force Participation in Louisiana Maneuvers.”

\textsuperscript{139} “Report on 2nd Air Task Force Participation in Louisiana Maneuvers.”


\textsuperscript{141} “Plan of Air Support of Second Army by Second Air Task Force.” Emphasis in original.
they were to approve requests for targets close-in to the battle and "all but the most vital
direct support requests were screened out." From the air force perspective, focusing on
these interdiction targets would be most useful since air assets were uniquely capable of
accessing these targets and isolating the battlefield, while long-range artillery could suppress
enemy activity closer to the frontline. For the army, on the other hand, this emphasis was
difficult to square with the realities of taking fire on the frontline. Understandably, ground
units were often eager to have as much firepower concentrated on the immediate battle
frontage, rather than in the rear where they could neither see nor feel air support. Although
this issue would not be resolved during the Louisiana and Carolina exercises, reports coming
out of the maneuvers highlighted this problem from both perspectives.

Finally, one of the clearest of the lessons from the maneuvers was the need for
improved radio communications between the field, the ASDU, the ASU. On several
occasions, units reported difficulty and delays getting their requests to higher headquarters,
and once aircraft were deployed they had "no means of talking to the ground unit being
supported, or even of communicating with the corps air support demand unit that had
forwarded the request." Meanwhile, the ground units had limited means for identifying
themselves as friendly without effective radio communications. The issue was repeatedly
identified in after-action reports and was farmed out for further technical exploration.
Indeed, this was one of the few areas were the army and air force agreed on a clear technical
solution.

In summary, before and during the GHQ maneuvers the U.S. military became aware
of the problem of tactical airpower operations and the many facets of the task that would

142 Gabel, The U.S. Army GHQ Maneuvers of 1941, 120.
143 "Report on 2nd Air Task Force Participation in Louisiana Maneuvers"; "Letter of Instruction No. 1: Plan
of Air Support Operations by Second Air Task Force: Second Army Maneuvers".
144 Gabel, The U.S. Army GHQ Maneuvers of 1941, 120.
need to be resolved. Unfortunately, in the absence of ample resources, training undertaken
during the GHQ maneuvers had revealed more problems than they had solved. As Bechthold
notes, “A major gulf was exposed between theory and practice. Each side showed a lack of
understanding of the other’s needs and capabilities, compounded by other failings on both
sides.” Issues of command, communication, and targeting—though recognized as
challenges—were still mired in a longstanding interservice debate about the strategic and
operational independence of the air force. In this way, the maneuvers served as a critical
moment to both surface and begin to address these difficult issues related to tactical air
support. But this was not enough. Interservice disputes emerging from an improving but
still constrained resource environment meant that several of these problems—though they
were clear to all those involved—would remained unresolved as the United States made its
way to North Africa.

4.2.2 Doctrine

At the conclusion of the maneuvers, nearly all senior leaders who had observed or
participated in the exercises remarked that an updated doctrine for air support that reflected
changes and observations from the GHQ exercises was necessary. Although the existing
document, FM 1-5 Employment of Aviation of the Army and FM 1-10 Tactics and Techniques
of Air Attack, had been supplemented by additional Training Circulars, the existing
document was deemed unsatisfactory by both air and ground officers. Moreover, in the
wake of the GHQ maneuvers, there was a strong feeling among senior commanders that

145 B. Michael Bechthold, “A Question of Success: Tactical Air Doctrine and Practice in North Africa, 1942-
146 Jacobs, “Tactical Air Doctrine and AAF Close Air Support in the European Theater, 1944-1945,” 38;
Lester, Mosquitoes to Wolves The Evolution of the Airborne Forward Air Controller; Finney, “The
Development of Tactical Air Doctrine in the U.S. Air Force, 1917-1951”; Johnson, Fast Tanks and Heavy
Bombers, 100-101.
better doctrine and more training would be critical in improving air support for ground operations. Accordingly, in September 1941 McNair ordered from his senior commanders a series of reports on the success and failure of “Aviation in Close Support of Ground,” specifically requesting that:

In order to make appropriate recommendations to the War Department on the above subject for inclusion in field manuals, it is desired that reports based on participation in maneuvers be submitted by the commanders addressed [First Army, Governors Island, NY; Second Army, Cp Robinson, Arkansas; Third Army, Lake Charles, Louisiana; Air Force Combat Command, Bolling Field, DC] It is desired that comment be made on the following:— (a) methods of coordination between air and ground unit commanders; (b) methods by which delays in attacking ground targets can be avoided; (c) air-ground communication; (d) target designation and indication by ground units to supporting air units; (e) air target reconnaissance; (f) priority of air support missions; (g) organization and operation of advanced command posts; (h) methods of air approach to targets; (i) type of munitions in each type of attack; (j) continuity of support; (k) attack formation; (l) pertinent matters not covered above.

Although there was widespread agreement that a new doctrine was necessary, this did not mean that such doctrine would resolve any of the underlying disputes about how tactical airpower operations should be conducted in practice. For the air force, remained real concerns regarding the diversion of limited air assets to the tactical airpower mission. As one air force commander put it “We are fighting for an opportunity to develop Air Power but we are devoting four extremely important months to the creation of Ground Power... I find it very difficult to justify their participation when there are so many other forms of training that must be accomplished before we can hope to have an effective air force.”

But if the air force was going to provide this capability—even at the lowest levels possible—it would only do so if it could retain control of the allocated aviation and direct them toward missions and targets away from the frontline, a notoriously dangerous and resource-draining

147 “Training and Inspection Report of the 2nd Air Force.”
148 “Reports on Employment of Aviation in Close Support of Ground.”
149 “Increased Participation of Air Force Units in the 1941 Maneuvers.”
place for aircraft to be. Meanwhile, the army retained its concern about the need for additional air cover and the attachment of tactical airpower units to specific divisions and corps, and remained intransigent on the prospect of giving up CAS for BAI. Thus, at the most basic level, neither service was willing to make the necessary concessions to improve tactical airpower operations, a fact which would permeate both doctrine and practice in the early forties. Until these disputes were meaningfully addressed, doctrine and practice would continue to be inadequate.

But these disagreements did not stop the U.S. military from trying. In response to McNair's request, commanders from the 1st Army, 3rd Air Task Force, 2nd and 3rd Army, 2nd Air Force, Army War College, and Air Combat Command all replied with a litany of doctrinal conclusions to be drawn from the exercises. In general, the reports were factual in nature, providing an account of how air support was provided. However, as noted above, these reports did implicitly indicate some important conclusions and concerns about the existing system. Although some of this feedback from the units involved would make it in to future iterations of air support doctrine, some of the key points of dispute—most notably, the unwieldy relay and vetting system that accompanied the centralization of control under the ASC—would remain unresolved in subsequent doctrine, reflecting the ongoing debate between the air force and army on this issue.

In addition to soliciting feedback from officers about air support performance during the GHQ maneuvers, senior air and ground commanders were also eagerly and actively soliciting input from liaison officers who had observed—or in some cases, participated in—tactical airpower operations with the British in North Africa.\footnote{“Letter of Instruction No. 1: Plan of Air Support Operations by Second Air Task Force: Second Army Maneuvers”; “Letter from MG BK Yount. Commanding General 3rd Air Force to Commanding General, Air Force Combat Command,” n.d., RG 337, Entry 57 “General Headquarters of the US Army, 1940-1942, General Correspondence,” US National Archives and Records Administration; “Reports on Employment of Aviation in Close Support of Ground.”} Unfortunately, however, the
lessons that these observers were bringing back to the American army were also colored by service interests. On one hand, ground officers tended to report that the German system, which they erroneously thought attached air units directly to ground units, was having a devastating effect on Allied forces in North Africa. As Colonel A.F. Kingman reported back after the completion of the maneuvers:

The efforts of the R.A.F. in the Middle East to support the Army has resulted in a series of tragic failures. It failed in most cases largely because ‘it never got around to training with the army’ and because of its refusal to accept the principle of unity of command in task forces. General Devers is recommending the acceptance in a degree of the German method, which has proven successful, wherein air units are attached to subordinate ground units. His recommendation is considered sound.

Similarly, Colonel R.F. Ennis, who had just observed the British Armored Forces operating in North Africa, remarked:

One of the most decisive roles of aviation is the immediate support which it can give an army on the battlefield. Its effectiveness was evidenced by the support given by the German Air Force to the German Armored Army in France and Belgium. The German Air Force has succeeded where the R.A.F has failed largely because there was a super staff over the three services which attached air units to the Army for training and support, and thereby virtually a unified air-ground team. As a natural result, the German air units were trained to and did give effective air support on the battlefield.

Thus, according to many ground officers having observed the initial fighting in North Africa, the Germans were succeeding where the RAF was failing due to a command structure that attached airpower directly to armored ground units and was controlled by lower-echelon ground commanders.

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152 “Reports on Employment of Aviation in Close Support of Ground.”

153 “Reports on Employment of Aviation in Close Support of Ground.”
On the other hand, air officers tended to report that the burgeoning British system in the Western Desert, which closely resembled the centralized command and control and air independence they preferred, was performing well. As Brereton remarked at the time, success in the British case was emerging when and where (a) air superiority was the first priority of air support teams, (b) centralized command under an air force officer was implemented, and (c) continuous, two-way education and joint training had taken place. Indeed, Brereton, having observed the success of the Western Desert Air Force (WDAF) firsthand as the commander of the earliest American detachment to Egypt, the U.S. Army Middle East Air Force (USAMEAF), “quickly grasped the importance of drawing on [WDAF] experience. Ten days after his arrival in Cairo he was urging the War Department to dispatch qualified observers to study Coningham’s employment of fighters and light bombers.” Thus, senior airmen looking at the battlefield in Europe were taking away very different lessons from their ground counterparts examining the same set of facts in Europe. For air officers, air superiority, centralization, and autonomy were the characteristics of the developing British system that were the key takeaways from the theater, while ground officers saw the attached German units as the pinnacle of effectiveness.

After soliciting input on the basis of the GHQ maneuvers and liaisons in Europe and the Western Desert, McNair, Marshall, and Arnold believed that the lack of consensus on several challenges related to tactical airpower meant that the issue required further study. Shortly thereafter McNair and Arnold thus decided that an additional set of large-scale, joint air-ground exercises would be necessary in the coming months before any significant updates to doctrine were made. Unfortunately, however, these well-laid plans for further

155 Craven and Cate, The Army Air Force in World War II: Europe, TORCH to POINTBLANK, 2:28. See, for example, “Report on 2nd Air Task Force Participation in Louisiana Maneuvers.”
testing were disrupted by the attack on Pearl Harbor and the official American entry into
the war, distracting from the air support training enterprise. Thus, it was not until the
spring of 1942 that the U.S. returned to the issue of doctrine for tactical airpower operations;
and when the U.S. did get around to it, no progress had been made since the conclusions of
the GHQ maneuvers were transmitted to McNair. As a result, when the army published
Field Manual 31-35 Aviati0n in Support of Ground Forces in April 1942, most of its precepts
reflected the ongoing interservice debate that had hardened during and after the GHQ
maneuvers. Though an improvement on earlier versions, this doctrinal manual also left
many of the problems that had surfaced vaguely addressed or ignored entirely.

To its credit, FM 31-35 did make some important improvements on existing doctrine.
First, the manual did formally adopt a system of command and control that closely
resembled the centralized ASC system (Figure 4), which had been endorsed by air force
officers in the GHQ maneuvers, despite concerns from the army about over-centralization.
In addition, FM 31-35 emphasized the need for extensive planning and coordination between
air and ground teams, underscoring that both elements of the joint team would need to
know their equipment, doctrine, and capabilities as well as those of their partners in the
other domain. Similarly, the doctrine was clear that advanced planning and collaboration
could be used to mitigate confusion and delay on the battlefield. Finally, the manual

19.
Greenfeld, Palmer, and Wiley, United States Army in World War II: The Army Ground Forces, The
160 United States. War Department, FM 31-35 Basic Field Manual, Aviation In Support Of Ground Forces,
1942 (Washington, DC : US G.P.O., 1942), 2; Cooling, Case Studies in the Development of Close Air
Support, 156–57; Futrell, Ideas, Concepts, Doctrine, 133; Hallion, Strike from the Sky, 163.
161 United States. War Department, FM 31-35 Basic Field Manual, Aviation In Support Of Ground Forces,
1942, 1–6.
162 United States. War Department, 1–6.
emphasized a central role for both air- and ground-liaisons to fill the gaps that understandably emerged from rushed or inadequate training on both sides.  

But as useful as these updates were, there remained real issues with FM 31-35. Most problematically, despite including several concessions to the air force’s preferred system of support, the doctrine also included language that would allow ground commanders to override or ignore many of those precepts in practice. As a result, FM 31-35 was only partially resolved when it came to questions of centralization of command, target prioritization, and communications. This was especially true when it came to the core tenet of tactical airpower doctrine, the nature of the command and control system employed. Although FM 31-35 had included language institutionalizing the ASC system, it also included language that would appeal to ground officers, who preferred a responsive but far too decentralized system of attaching air assets to smaller units. Indeed, within the same paragraph as it articulated the need for air assets to be centralized under a single air commander, the manual goes on to note that, in exceptional circumstances, “aviation units may be attached to subordinate ground units” allowing ground commanders to bypass the ASC altogether. Thus, FM 31-35 effectively allowed for both the system preferred by the air force and the army to coexist within the manual.

In and of itself, this duality might not have been problematic. But in the context of a contentious debate over the merits and organization of tactical airpower operations, the hedging of this doctrine gave dissatisfied ground commanders a vehicle to undermine the centralized system codified in FM 31-35. And, as the operations in North Africa would

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163 United States. War Department, 5.
166 Wielhouwer, *Trial by Fire*, 31.
illustrate, this exception would prove to be a fatal flaw in practice: “this manual attempted to create a workable ground-air support system, but, in truth, it merely generated the appearances of such a system.”\textsuperscript{167} These exceptions left considerable room for manipulation by ground commanders at the corps and division level, who saw air assets as organic to their units and to be used at their discretion (rather than in concert with the overall theater goals).\textsuperscript{168} Despite preserving the centralized system of the ASC in principle, “the real power in the allocation of air support rested with the ground commander, while the air commander functioned primarily in an advisory and administrative function” as later operations in North Africa would demonstrate.\textsuperscript{169} Moreover, the system as authorized in the doctrine placed significant control in the hand of the corps commander, who “in effect had their own mini air force on call for their use.”\textsuperscript{170} The result was that enterprising ground commanders, most of whom were strong proponents of their institutional view that air should be attached to specific units, found justification in the doctrine to flout the more centralized system being advocated by the air force.

\textsuperscript{167} Hallion, \textit{Strike from the Sky}, 163.


\textsuperscript{169} Bechthold, “A Question of Success,” 830.

AirSupport Control System (ASC) in FM 31-35

Ground forces on this line may be brigades, regiments, or lower units.

NOTES:
- Solid lines: normal ground force command channels
- Broken line: air support control channels
- Dotted line: direct control channels
- Double line: coordination channels
- Square: air support parties
- Circle: air support control

Air support controls and air support parties will control directly thru aircraft-in-flight and/or aircrews not when aviation is in support of a particular ground unit. Control with photographic, mapping, and transport squadrons not shown on chart.

Figure 1.

Figure 4: ASC System in FM 31-35
In addition to the problem of command and control, FM 31-35 only presented a half-baked solution the question of prioritization of missions and targets. To its credit, manual was clear that air superiority was the first mission of any air force operation, tactical or otherwise.\textsuperscript{171} From there, however, the ordering of targets was convoluted. Although the manual was clear that air power should not duplicate the targets that could be reached by artillery assets, it left considerable maneuvering room for commanders in terms of choosing between battlefield interdiction targets (reserves, supplies, communications, etc. in the rear), which were generally the preferred targets of air force officers, and those frontline targets preferred by the ground forces.\textsuperscript{172} The exact phrasing was: "The most important target at a particular time will usually be that target which constitutes the most serious threat to the operations of the supported ground force. The final decision as to priority of targets rests with the commander of the supported unit."\textsuperscript{173} Not only did this caveat leave open the prioritization of targets, but it also placed target selection authority in the hands of the ground commander. In the context of the looming debate over target selection that was occurring between the army and air force, this phrasing would serve to confuse more than it would clarify.

Finally, from a technical standpoint, the system outlined in FM 31-35 would prove more effective among units that were equipped with state-of-the-art and abundant radio systems.\textsuperscript{174} Indeed, the system proposed in FM 31-35 required extensive and persistent

\textsuperscript{171} United States. War Department, \textit{FM 31-35 Basic Field Manual, Aviation In Support Of Ground Forces, 1942}, 5.


communications between ground and air forces, particularly at the frontline, and success in executing tactical airpower operations would prove contingent on these systems being in good supply.\textsuperscript{175} Unfortunately, however, many of the units that would be deployed in North Africa were not equipped with such systems or were poorly trained to use them.\textsuperscript{176} By endorsing a system that was so tied to this technical component, FM 31-35 linked its effective employment to an unreliable piece of equipment that was often in short supply during the early phases of the war.

In any other context, the opaque nature of FM 31-35 may not have presented so many issues in execution; after all, doctrine in the United States is considered a flexible guide for operations, rather than a rigid set of instructions. And, indeed, interpretation of and improvisation on existing doctrine can be effective on the battlefield. The problem with introducing the loosely worded FM 31-35 into this environment, however, was that it left considerable room for commanders to litigate interservice disagreements over tactical airpower operations on the battlefield. Moreover, the inconsistencies of the doctrine allowed the army, who had the organizational upper hand when the U.S. intervened in North Africa, to ignore important lessons from the GHQ maneuvers. In this way, FM 31-35 was as much a tool of interservice disputes as it was a reflection of the competing views.

Thus, there were many issues related to tactical airpower operations that were unresolved by FM 31-35, including failing to improve the speed of request approval in the ASC system, allowing ground commanders to reassign air assets, failing to provide guidance on target selection and mission priority, and relying on technology that was not yet reliable or widely available. The result was that the United States entered operations in North Africa after two years of debating, discussing, and testing systems for air support of ground

operations, with doctrine that was flawed and which most senior officers knew would be as ineffective in practice as it had been in testing. Despite being well aware that tactical airpower operations would be central to the success of ground operations and cognizant of the problems that remained, the interservice competition of the period was too entrenched for American officers to overcome without stronger inducements.

4.2.3 North Africa (1942)

When hostilities began in late fall 1942, General Dwight Eisenhower, Supreme Commander Allied Expeditionary Forces, directed his staff to issue the directive, “Combat Aviation in Direct Support of Ground Units,” that was taken almost wholesale from FM 31-35.\(^{177}\) The pitfalls of this doctrine quickly made themselves apparent. As noted above, the system effectively allowed the Allied commander to designate specific air units to task force commanders, who could then attach those air assets to ground units at the brigade, division, or corps level. This is precisely what occurred—in the absence of clear guidance on whether air assets should be under the control of a single air commander or divvied up among corps and division level ground units, enterprising ground commanders proceeded to attach air assets to units for their exclusive use. Thus, the core precepts of FM 31-35 that emphasized centralization and air force autonomy were “virtually discarded once actual operations began.”\(^{178}\)

The overall command organization for the invasion also reflected deference to the army view of air support. army planners decided that the ground invasion would be separated into three Task Forces—Western (WTF), Central (CTF), and Eastern (ETF)—and each would be supported by attached elements of the theater air forces (the Twelfth


\(^{178}\) Bechthold, “A Question of Success,” 837.
Air Force, under the command of Major General James Doolittle). Accordingly, the Twelfth Air Support Command was designated to support the WTF, the Twelfth Bomber and Fighter Commands supported the CTF, and the RAF Eastern Air Command supported the ETF. The result of this was that air assets had been divvied up for task force commanders to use at their discretion, with only limited oversight from the Twelfth Air Force commander, and “under the TORCH design, well formed by this time, the commander in chief had no overall air commander.”

At the start of the landings, USAAF participation in an air support capacity was limited. However, as operations began to expand eastward through the desert, cracks in the air support system began to emerge. The problem was straightforward: the dispersion of air assets to specific task forces meant that it was impossible for any of the individual air force units attached to establish localized air superiority or mass against critical targets. This inability of air forces to provide effective cover for ground units did not go unnoticed, and by the end of November, ground commanders were growing frustrated that they had been left exposed by the air forces. By December, the result was that both ground and

181 Craven and Cate, The Army Air Force in World War II: Europe, TORCH to POINTBLANK, 2:62.
182 Craven and Cate, 2:67–103; Spires, Patton’s Air Force, 7–9.
183 Spires, Patton’s Air Force, 7–9; Cooling, Case Studies in the Development of Close Air Support, 162.
air commanders were unsatisfied with the state of air support in North Africa.186 For their part, ground commanders felt that the air forces were leaving them exposed and under attack by the superior German Luftwaffe.187 On the other hand, air commanders were growing impatient with ground officers’ ill-advised orders to disperse air assets against immediate, frontline targets, rather than focusing on superiority and interdiction, which would free the ground forces from the Luftwaffe onslaught.188

In addition to the command issues that emerged early in Operation Torch, air support in the desert was also plagued by many of the same technical issues that had been flagged earlier, in addition to a slew of novel logistical challenges related to the airplanes themselves. As in Louisiana and Carolina, the air support structure relied on the persistent and widespread use of radio communications. However, after arriving in the desert, it became clear that the vast distances and logistics and supply challenges faced by the Allies made reliable communications equipment relatively rare, and instead the Allies were often forced to rely on outdated phone systems or liaisons on motorcycles.189

Compounding these communications challenges, the logistics of moving the existing air forces throughout the theater proved to be an unexpectedly difficult enterprise. Put simply “planners had not anticipated that in the early stages of the operation it would be a highly mobile air force, nor that it would be operating so far east.”190 This oversight, along with many logistical challenges of establishing airfields in the desert, meant that air assets

190 Craven and Cate, The Army Air Force in World War II: Europe, TORCH to POINTBLANK, 2:125.
were unable to reach and stay at the front lines.\textsuperscript{191} Finally, the dilapidated railway system and lack of motor vehicles served to exacerbate these transportation issues.\textsuperscript{192} The unfortunate result was that critical equipment and maintenance supplies were left playing catch up to the movement of the frontline forces throughout the winter months. These challenges only served to complicate the command and control issues related to tactical airpower.

Unsurprisingly, the air situation in North Africa had devolved into a mess by the start of 1943: “Airfields were few and inadequate, and no semblance of a combined headquarters existed. Communications were practically nonexistent, except for an archaic telephone system, and the political situation, even from the perspective afforded by half a century of hindsight, defies cogent summary.”\textsuperscript{193} Among the primary recipients of complaints from both ground and air commanders was Eisenhower. Indeed, on several occasions during the winter of 1942, Eisenhower showed a keen understanding of the challenges facing the American effort and was especially attuned to the problems with the tactical airpower system. For instance, in late December 1942 he summarized the situation well when he wrote to Marshall:

\begin{quote}
From the beginning of TORCH coordination in operations involving air units has not been completely satisfactory. In certain respects, this was an inescapable result of existing conditions and the rapid advance we were making, but other factors are involved. As opportunity has been given, I have studied the matter carefully and conferred with such
\end{quote}

\textsuperscript{191} As Eisenhower pointed out in early January, “To provide one landing strip in the forward area requires 2,000 tons of perforated plate. To transport this amount of materiel from Oran forward precludes the movement precludes to the movement of other critically needed supplies and material. We are not sufficiently protected with the light antiaircraft at our landing fields and the ground protection that we can give is, in many instances, useful only against light raids.” See Dwight D. Eisenhower et al., \textit{The Papers of Dwight David Eisenhower} (Baltimore: Johns Hopkins Press, 1970), 891.


persons as Admiral Cunningham, Air Chief Marshal Tedder, General Spaatz and others. Under initial TORCH conceptions it was assumed that the U.S. Air Force would be largely concentrated in the western end of the theater. It immediately became necessary, however, to employ both tactical and strategic elements of the U.S. Air Force in the east alongside British Air Forces. A certain confusion resulted which has been intensified by poor fields and inadequate supply lines and improvised methods of operation. With the postponement of our land offensive, the time has come when the matter must be straightened out. I have come to the conclusion that a single air commander is necessary.194

Recognizing that these failures were, in part, a product of the ineffective, compromised system developed on the basis of the GHQ maneuvers, Eisenhower worked to remedy the situation. Thus, in January 1943 he proposed to the Combined Chiefs of Staff that he designate the Allied Air Forces under the centralized command of General Spaatz, who would be collocated at the ground force headquarters.195 This reorganization was met with approval by key members of the Combined Chiefs, including Marshall and Arnold.196 Indeed, by the late winter of 1943, it had become clear to American commanders that the existing approach to tactical airpower was flawed in significant ways. The doctrine, reflecting interservice debates with roots well before the war began, was too opaque and manipulable to be a useful constraint on army preferences. Senior American commanders had come to recognize the shortcomings, and hearing that both ground and air officers were dissatisfied with some elements of the doctrine, came to recognize that further improvements would be necessary to address these complaints. But identifying the new system for tactical airpower operations at the senior-most levels of command was just the first step in completing the learning process—these commanders needed to ensure that the changes agreed on at the

194 Eisenhower et al., The Papers of Dwight David Eisenhower, 874.

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Casablanca conference were meaningfully implemented in North Africa. For that, they would need adequate resources.

5 Victory in North Africa (1943)

5.1 National Military Strategy & Resource Endowments

By early 1943, the U.S. military strategy was squarely geared toward offensive ground operations, and tactical airpower had long been acknowledged as a problem in need of fixing. But as the previous section had shown, the selection and implementation of a new tactical airpower system was slow to emerge. And, indeed, MFT predicts that the interservice disputes between the air force and army would need to be resolved before the U.S. could complete the implementation phase of learning.

As MFT predicts, the resolution of interservice disputes and wholesale adoption of this system had everything to do with the infusion of Allied aviation resources into the North African theater and the war more generally. As several historians attest, and as I lay out in the previous chapter, it was at the end of 1942 and early 1943 that Allied aviation finally hit its stride. According to one estimate, by the end of 1942, USAAF aircraft on-hand totaled over 47,000 planes, and almost 7,000 of these were combat ready.\(^{197}\) By the end of the following year, aircraft production had doubled, reaching well over 85,000 planes, of which over 20,000 were combat ready.\(^{198}\)

Moreover, the American and British air forces in the North African theater were receiving a significant infusion of material during this period, both due to the ongoing operations and in preparation for the eventual advance into Italy. Although the precise figures of front-line aircraft in North African theater are hard to come by, the most

\(^{197}\) Craven and Cate, *The Army Air Forces In World War II: Men and Planes*, 6:423.

conservative estimates of capabilities in 1943 puts the Allied assets devoted to strategic bombing at nearly 500 aircraft of primarily B-17s, B-25s, B-26s, P-38s, P-40s and RAF Wellingtons in the theater.\textsuperscript{199} At the same time, however, tactical airpower was equally well resourced by 1943. The most conservative estimates allocate at least 500 front-line aircraft deployed (primarily A-20s, B-25s, P-40s, A-36s, and Spitfires) for tactical airpower operations, while more generous accounts estimate the combined Allied strength at nearly 1,200 combat-ready aircraft devoted to tactical airpower.\textsuperscript{200} Though these figures are hard to verify, the general trend suggests that by 1943, the Allies had managed to outfit the North African theater with significant strategic and tactical airpower resources.\textsuperscript{201}

With all of these available resources, it became much less costly for the air force and army to make the concessions that the new tactical airpower system required. The air force could supply planes for tactical airpower operations while maintaining an equally robust strategic bombing capability in the theater, and could even dedicate a significant proportion of those assets to close air support missions. Thus, in addition to meeting the strategic and battlefield interdiction needs of the theater, the air force could simultaneously maintain a semblance of air cover for the army. In other words, the infusion of resources meant that implementing the new tactical airpower system no longer required much by way of concessions from the army or air force—the CAS, BAI, superiority, and strategic bombing needs could all be met in the theater. The result was that implementing the new tactical airpower system was unlikely to encounter much resistance.


\textsuperscript{200} Craven and Cate, 2:417; Playfair, Molony, and Jackson, \textit{History of the Second World War: The Mediterranean and the Middle East}, 1:496–97.

\textsuperscript{201} Craven and Cate, \textit{The Army Air Force in World War II: Europe, TORCH to POINTBLANK}, 2:417.
Furthermore, senior commanders could no longer ignore the obvious effects of poorly executed tactical airpower operations—there was clear evidence that the existing system was not working. Unlike the GHQ maneuvers or the liaison reporting, American officers were experiencing the catastrophic results of ineffective air support and they could see and feel that something was wrong. Among the most concerning of these failures was the American performance against Rommel’s surprise offensive at Kasserine Pass. The Allied forces were overrun by Rommel’s thrust through the center of the Allied line, costing the Allies many of their forward bases, fuel, supplies, tanks, half-tracks, artillery and, critically from an airpower perspective, forward airfields. But it was not just Kasserine. Nowhere in the theater were ground units reporting that they had been supplied with effective air support in the early phases of the American invasion of North Africa.

Thus, what became clear during the late winter of 1942 and early spring of 1943 was that tactical airpower was floundering. But what was different from previous attempts to remedy this problem was that an influx of aviation resources into the theater meant a new tactical airpower system could be adopted without generating significant costs to air force and army priorities. Between the combined resources of the RAF and USAAF, Eisenhower would be able to both meet the needs of the tactical airpower missions while still allowing the air force to continue its efforts deep in enemy territory. As we shall see in the next section, the USAAF would therefore be able to satisfy the demands of the ground forces by allocating units entirely to close support, while maintaining air superiority and a steady barrage against battlefield interdiction targets, and preserving several hundred bombers.


under the NASAF for strategic bombing. There was finally enough to go around, and the results were impressive.

5.2 Tactical Airpower Operations: Turnaround in Tunisia

By the Casablanca conference, a meeting of the Combined Chiefs of Staff and senior civilian leaders including Roosevelt and Churchill in January 1943, Eisenhower and others understood well that it was time to change the air support system. Unlike previously, however, this time senior officers would be clear on the issue command and control. Based on input from senior British and American military officers, Roosevelt and Churchill signed off on a new command structure for air power in the North African theater that would facilitate the sort of centralization necessary for effective air support.

In addition to consolidating each of the ground task forces under Eisenhower, the air units would also be consolidated. Specifically, rather than separating the Twelfth Air Force into functional commands (fighter, bomber, air support) all units would be consolidated under the Mediterranean Air Forces, commanded by Tedder, under which there would be the Northwest African Air Force (NAAF) commanded by Spaatz. Directly under Spaatz would be four air forces, distinguished based on mission: Strategic Air Force, Tactical Air Force, Coastal Air Force, and Troop Carrier Command. The Northwest African Tactical Air Force (NATAF) would be commanded by Coningham, who would oversee the XII Air Support Command, the Desert Air Force, the RAF 242 Group, and the Tactical Bomber Force, all units with significant familiarity with the core precepts of the tactical

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204 Eisenhower et al., The Papers of Dwight David Eisenhower, 902–3.
205 “SYMBOL: Record of a Conference Held at Casablanca in January 1943”; World War II Inter-Allied Conferences, 1–3.
207 Hallion, Strike from the Sky, 171; Cooling, Case Studies in the Development of Close Air Support, 172.
airpower mission. In addition, army and air force headquarters at several levels of command would be collocated. These reforms made for a far more streamlined and adaptive command structure.

Under this reorganization, the NATAF had one primary purpose: "either directly or indirectly, the forces were dedicated to further the advance of the land campaign. Along with the indirect interdiction missions, the tactical forces had a specific charge to provide close air support." Furthermore, the new cadre of air commanders made clear that this command would have an explicit set of priorities—air superiority, battlefield air interdiction, and close support, in that order. But, even so, given the amount of aviation in the theater, the ground forces were still all-but-guaranteed continuous close support from the WDAF. In other words, despite the new prioritization structure, the consolidation of Allied tactical airpower assets meant that the ground forces would feel like they were getting more resources. Along with the improved liaison structures and better trained pilots, the NATAF was a formidable ground support command. Few of the reforms that were adopted at Casablanca were new to American commanders—the exercises at Louisiana and Carolina and reporting from the American liaisons had both indicated that a more centralized system of command under a coequal partnership of senior air and ground commanders abiding by a shared set of priorities was necessary—but it was not until Casablanca that this vision found unequivocal support among all senior leaders.

Critically, however, the implementation of this centralized command structure for tactical airpower operations in North Africa came at virtually no cost to the strategic

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bombing capability in the theater. Indeed, running parallel to this centralized tactical airpower structure was an independent strategic bombing command structure with a separate and robust set of capabilities. Thus, not only did the establishment of a parallel tactical airpower system have little discernable effect on strategic bombing in the theater, it actually may have freed bombers from being siphoned off for ad hoc missions. In this way, the new system of tactical airpower operations was palatable not just because it was effective, but because it had both the appearance and fact of not detracting resources from the services’ main priorities.

That being said, the eventual ascendancy of this system did go entirely unopposed. Indeed, despite significant changes and improvements in coverage due to the novel system of command, there remained some tension between air and ground units over the issue of air support, and specifically air cover for frontline troops making their way through the desert.212 In one of the more famous exchanges of the early war, this tension came to a head in a heated dispute between General George Patton and Coningham during April 1943.213 As recounted by Patton, his critique of air coverage in March 1943—and his implication that failed air support was to blame for the loss of American life—was not well received by Coningham. According to Patton, Coningham “accused me of being a fool and lying. He said that our calls for air support were due to the fact that American troops were not battle worthy and use the cry wolf for lack of air support as a means of excusing our slow

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212 As Eisenhower himself acknowledged in a letter to Arnold, “Operationally [the new system] appears to us to offer the very best solution to a most complicated problem. Administratively a number of new problems are brought up of which the details will finally have to be settled by Tedder, Spaatz, and myself.” See Eisenhower et al., *The Papers of Dwight David Eisenhower*, 911.
advance." The unfortunate exchange lead to several follow-on discussions among senior commanders in the field, and threatened to undermine the delicate progress that had been made on air support. After careful maneuvering by both commanders the crisis ebbed, but the anecdote illustrates that tensions over air support still ran high in the spring of 1943. As Tedder wrote to British Chief of the Air Staff Charles Portal in March 1943:

[The Americans] are instinctively antagonistic to [the new structure] and find it difficult to understand that every General has not a divine right to command his own private air forces, and incidentally a divine inspiration by which he knows better than anyone else how those air forces should be employed. I think most of the Americans who have now seen our organization working admit that it is sound, and produces better results than their own, but at the back of their minds there is always the bitter feeling which exists amongst them regarding separate air forces.

Certainly, some of the ground commanders’ concerns were well-founded. Allied air operations were still plagued by communications issues, and clunkiness of the request system meant that there were significant delays when support was requested at the division, corps, and even army level. But even with these pockets of resistance among senior ground commanders, at the highest levels of command there was significant buy-in for the reorganization. In particular, three of the central figures in the Allied ground campaign—Generals Marshall, Eisenhower, and Alexander—were all in agreement that the new system was both needed and effective. Moreover, these leaders had the ability to remove those

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ground officers who refused to concede that changes would be necessary. Accordingly, despite the objections of some officers, the failures of late 1942, along with the infusion of resources into the theater, forced the services to take a harder look at the evidence suggesting a new system was necessary and allowed them to begin making the changes necessary to implement it.

Almost immediately, the adoption of the new system led to significant battlefield improvements. The formal command changes showed progress in adopting a more centralized system of command and settling once and for all the issues of dispersion of air assets. Similarly, the changes showed strong support for the core principles of mission prioritization and liaisons. Moreover, with the approval of Spaatz, Coningham enacted several informal changes to reinforce his role and the new structure of command, including: (a) insisting that air support missions would prioritize gaining air superiority through offensive missions that sought out Luftwaffe targets, rather than defensive air cover operations; (b) focusing second on vulnerable vehicles instead of heavily armored tanks; (c) requiring that all available aircraft be concentrated on key nodes of the battle, with none held in reserve for the exclusive use of a ground unit, and finally (d) that he would determine those key targets in consultation with the ground commander. These specific operational directives, when combined with the larger structural reforms approved at Casablanca and implemented in the immediate aftermath of Kasserine would prove to be a deadly

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219 Fredenhall was the most obvious casualty of the reorganization—his antipathy toward to the new system for air support was likely part of the reason for his dismissal. Arnold was also known to personally intervene in promotions, see Goldberg, A History of the United States Air Force, 1907-1957, 96–97.


combination.²²² By the end of February, the American forces had halted Rommel's advance, and the air support system under Spaatz and Coningham had proven to be a critical element of the reversal. As detailed extensively in Chapter 2, it was this system would go on to serve Allied ground forces well throughout the remainder of the North African campaign in the spring of 1943.

After the success of the new system had been proven in the desert, Eisenhower, with the support of his fellow commanders and the War Department, ordered the production of a new doctrine for air support during the summer of 1943.²²³ The result was FM 100-20, which unlike its predecessor FM 31-35, unequivocally stated several of the core principles that had been identified during the GHQ maneuvers, refined in North Africa, and proven effective in the wake of Kasserine.²²⁴ Among other things, FM 100-20 crystallized the key tenets of effective tactical airpower, including: (a) centralization of command under an air force commander;²²⁵ (b) co-equality between land and air forces;²²⁶ (c) prioritization of air superiority, followed by interdiction and then close air support;²²⁷ and (d) the necessity of liaison between ground and air forces at multiple levels.²²⁸ Moreover, unlike FM 31-35 there was no question about the primacy of precepts, and the doctrine left very little room for maneuvering or misinterpretation. In case there was any lingering doubt, the doctrine exclaimed in capital letters: “RELATIONSHIP OF FORCES.—LAND POWER AND AIR

²²⁵ United States. War Department, 1–4.
²²⁶ United States. War Department, 1.
²²⁷ United States. War Department, 9–10.
²²⁸ United States. War Department, 9.
POWER ARE CO-EQUAL AND INTERDEPENDENT FORCES; NEITHER IS AN AUXILIARY OF THE OTHER...DOCTRINE OF EMPLOYMENT.--AIR SUPERIORITY IS THE REQUIREMENT FOR THE SUCCESS OF ANY MAJOR LAND OPERATION...COMMAND OF AIR POWER.--THE INHERENT FLEXIBILITY OF AIR POWER, IS ITS GREATEST ASSET. THIS FLEXIBILITY MAKES IT POSSIBLE TO EMPLOY THE WHOLE WEIGHT OF THE AVAILABLE AIR POWER AGAINST SELECTED AREAS IN TURN; SUCH CONCENTRATED USE OF THE AIR STRIKING FORCE IS A BATTLE WINNING FACTOR OF THE FIRST IMPORTANCE. CONTROL OF AVAILABLE AIR POWER MUST BE CENTRALIZED AND COMMAND MUST BE EXERCISED THROUGH THE AIR FORCE COMMANDER.229

Thus, FM 100-20 formalized clearly and forcefully the principles of air independence, centralization, co-equality, prioritization, and liaison that had long been understood in pockets of the U.S. Army and USAAF, but were only now being endorsed by the organization wholesale. It had taken three years of concerted effort but, finally, the USAAF and army were able to put aside their organizational grievances, take a hard, clear look at the existing evidence, and implement at a new system for tactical airpower operations that would prove highly effective.

6 Alternative Explanations

The narrative presented here provides compelling confirming evidence for MFT. As noted in the introduction, MFT makes three predictions about the American case. First, while the American national military strategy was defensive and deterrent in nature, we should expect tactical airpower operations to be a secondary priority for both the air force and army. Second, as the American national military strategy shifted toward more a more offensive

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229 United States. War Department, *FM 100-20: Command and Employment of Air Power*. 284
posture, necessitating investments in landpower, we should expect that the challenges of tactical airpower should be identified and discussed more openly. However, given American resource constraints before 1942, MFT predicts that organizational pathologies should impede the implementation of this system. Critically, it was the infusion of considerable resources—along with the harsh realities of war—that served as a catalyst for resolving several of the key disputes over command, centralization, prioritization, and signaling. Thus, it is fair to say that national military strategy and resource endowments had a critical role in explaining the evolution of tactical airpower doctrine in the American case. This does not, however, mean that other variables did not have supporting roles in this play.

Accordingly, in this section, I review the six alternative explanations outlined in the theory section: (a) threat/failure; (b) theater necessity; (c) emulation; (d) civilian intervention; (e) internal bargaining; (f) dissemination infrastructure. In reviewing each of these explanations, I am able to illustrate how some of these variables interact with MFT to produce the outcomes observed in this case. As this section makes clear, to a certain extent, all of these theories find some support in the American case, though some (failure) more than others (internal bargaining). The main limitation of most of these theories is that they explain some parts of the learning process but not all of it. Thus, overall, MFT still provides a compelling framework to help scholars make sense of the precise influence of entire process of learning in the American case, whereas other explanations only help us understand parts of it.

6.1 Threat/Failure

Among the most compelling alternative explanations are those that emphasize the role of failure in inducing American learning about the tactical airpower problem. Adherents to this view would contend that American learning about tactical airpower was tied to the
battlefield failures that they experienced early in the North African campaign. This theory is rooted in decades of organizational theory research that suggests that failure induces significant fear in individuals and organizations, which forces them to consider and engage with ideas that would otherwise be anathema. Moreover, in the wartime context, failure takes on a whole new seriousness as the consequences are literally life-and-death. Accordingly, this theory would predict that American failures on the battlefield catalyzed the implementation of new tactical airpower doctrine in the North African theater as existing systems were costing the U.S. lives, resources, and potentially could cost them the war. Without these failures, it is not clear that the United States would have had sufficient inducements to select an alternative, not just in the case of tactical airpower, but vis-a-vis several different types of operations. Moreover, acknowledging the role of failure in triggering the implementation phase of learning does not require us to reject MFT. After all, failure may have spurred implementation, but resources were responsible for the successful completion of this phase. In this way, failure provides additional granularity to our understanding of the implementation phase in the U.S. case but does not undermine the central predictions of MFT.

But even if we concede the role of threat/failure in the implementation phase, it remains only a partial explanation of the learning process. Indeed, the failures of the early North African campaign forced the United States to select a new tactical airpower doctrine, but these failures cannot explain the process by which the U.S. identified the problem of tactical airpower operations in the first place. Indeed, the logical extension of this theory would suggest that in the absence of battlefield failures, the Americans would have been unlikely to know about or develop solutions to this problem, and yet, the Americans were well aware of this issue several years before the war began, and had been debating and discussing it throughout their preparation. Thus, while failure can help us understand what
ultimately catalyzed the resolution of interservice disputes and the subsequent implementation of new tactical airpower doctrine, it is at best a proximate explanation of learning and can tell us little about the earlier phases of learning in the American case. Accordingly, while the American case gives some credence to the role of failure in the learning process—and aligns well with the predictions of MFT—we must look to other variables to understand this process in its entirety.

6.2 Theater Necessity

Like explanations that emphasize failure in inducing learning, explanations that emphasize theater necessity as an inducement for learning are supported, to a certain extent, by the evidence in the American case. Like failure explanations, proponents of the theater necessity view would argue that there is a special sort of urgency that emerges in the theater of operations. Away from the distractions and oversight of their home organizations, exposed to members of other services and communities, and facing immediate issues with real consequences, militaries are more likely to work together on hard problems in the theater. Moreover, battlefield experience may embolden and empower combat commanders to push back against their bureaucratic peers at home.

In the American case we see some circumstantial evidence suggesting that this cooperative spirit may have been responsible for the implementation of the new tactical airpower system during the winter of 1943. Indeed, it was not just the American air and ground commanders who were both exposed to and receptive toward new thinking about tactical airpower in the theater, but the American commanders were also exposed to and engaged with their British counterparts in deciding on and implementing this new system. In addition, the observation of battlefield commanders on tactical airpower were taken very seriously at home. Accordingly, it would be disingenuous to suggest that the American case
does not provide some support for the theater necessity argument: had senior leaders not been forced to work together on hard problems in the theater it is unlikely that they would have resolved so quickly to make changes in the face of existing evidence.

Like the failure argument, however, the theater necessity argument only gets us so far in explaining the entire learning process. In particular, three problems stand out. First, there is the simple empirical fact that senior air and ground commanders were not only exposed to each other’s thinking on several occasions before American entry into the war but in these interactions, they were expressly aware of the necessity solving the issue. For both the air force and army leadership engaged in training and preparing ground forces, there was persistent and open discussion about the challenges of getting this type of operation right and the serious consequences that not doing so would have in the theater as early as 1941. Moreover, the relationship among senior air and ground leaders during this period was collegial—Hap Arnold and George Marshall were close friends and consistently expressed their admiration for each other—and just as important, the air force and army were still, in fact, a united service in persistent contact with each other. In other words, although the theater environment may have presented a new urgency to the officers involved with the tactical airpower problem, the years preceding the war had not been lacking in providing the airmen and soldiers with meaningful opportunities to exchange ideas in a collegial and cooperative way. Second, despite the credibility and power of the field commanders lobbying for better tactical airpower systems, there were several battlefield commanders who were opposed to such a system. Thus, while the balance of influence was views among senior commanders is difficult to discern, proponents on either side of the issue could have found field commanders willing to endorse their view.

Even if we were to accept, however, that there is some unique motivational or credibility mechanism operating in the theater—and, indeed, there may well be something
that cannot be observed in the history books which exists in the theater—this still leaves us with the problem of explaining the early stages of the learning process using this theory. Just as focusing on failure can at best tell us why a particular solution was finally implemented, but little about the process by which that solution and its associated problem were identified, theater necessity does a much better job of explaining implementation than it does in explaining why particular problems and solutions can be picked out of the noise that exists in the rapidly changing battlefield. Indeed, a significant part of the reason that American commanders were able to so quickly identify the problem of tactical airpower operations once they arrived in the theater is surely because they had been attuned to and engaged in a heated debate about it before they arrived. Thus, while theater necessity does provide some insight on the implementation side of the equation, does not offer a more comprehensive account of the learning process.

6.3 Emulation

For those who subscribe to the emulation school of thinking about wartime learning, the explanation of American tactical airpower learning is a simple one: the Americans saw the success of the system employed by the British WDAF and copied it. Until very recently, this view was embraced in some histories of American tactical airpower during World War II. Moreover, there is certainly evidence to suggest that the United States benefited from the hard-won lessons of the RAF supporting the Eighth Army before they arrived. Indeed, the system that was adopted by both the United States and the British in the winter of 1943 matched almost exactly the system that had been developed by the WDAF.

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That being said, however, a careful review of the historical record reveals that the story is more complicated than the emulation accounts admit for two reasons. First, there is the simple fact that the Americans had independently developed many of the core tenets of the WDAF system before they had significant exposure to the British system. During the prewar years, and especially as the Americans observed the lessons of the Spanish Civil War, there is a long record of American airmen and soldiers independently understanding many of the fundamental principles of centralized command, prioritization, signaling, and resources that would eventually be implemented in North Africa. Although these views were suppressed or ignored, they did exist. Thus, where tactical airpower was being discussed in the United States, the Americans were independently arriving at many of the same conclusions as the British.

Second, we should be careful about the benefits of hindsight in considering the role of emulation in the American experience with tactical airpower operations. Although it may seem clear now that the tactical airpower system being employed by the WDAF was the superior system, at the time, there were several competing and compelling alternatives being peddled to the Americans. Indeed, there is a long empirical record of reporting about the effectiveness of tactical airpower systems being deployed by the British, Germans, and even Japanese militaries. And, as have seen, reports on these systems were distorted based on service interests. Thus, we should not underestimate just how much noise there was in the American military regarding other states’ system of air support for ground operations. Accordingly, even if we concede that the Americans were able to identify and copy wholesale the WDAF system, this theory provides little explanation of why the U.S. was able to pluck this approach out of the many alternatives that were being presented at the time.

231 "Memorandums for the Chief of Staff: Independent Air Force," June 1941, RG 107, Entry 74A, Top Secret Correspondence of Secretary of War Stimson, July 1940 - September 1945, US National Archives and Records Administration.
6.4 Civilian Intervention

For advocates of the civilian intervention school, the American case also provides some confirming evidence, but falls short in some important respects. Indeed, as we saw in the account provided in this chapter, it was in large part President Roosevelt and Secretary of War Stimson who were responsible for both the change in military strategy and the flood of resources in the early 1940s. These civilians were uniquely able to direct resources and attention to this problem set, and promoted senior leaders who took seriously the challenges of preparing for ground operations in general, and air support of those operations in particular. Moreover, it is telling that the reforms approved at the Casablanca conference were authorized by both Roosevelt and Churchill, despite their military character. Thus, there is good reason to believe that civilian intervention was a central feature of both the identification of the tactical airpower problem and the implementation of its solution. Indeed, MFT aligns well with these theories of learning that privilege the role of civilians, and sees them as a critical enabler of change throughout the learning process.

There are, however, limits to the explanatory power the civilian intervention in the American case. First, as a definitional matter, these theories tend not to consider how multifaceted the notion of “civilian” can be in practice, which proves to complicate matters in the U.S. case. Instead, theories of civilian intervention tend to focus on the President at the expense of other powerful civilian institutions in the United States. Nowhere is this borne out more clearly than in the American case during World War II, where Roosevelt’s efforts to invest in and direct military preparations for war in the late 1930s were impeded by isolationist blocs in Congress. Though Roosevelt may have been a powerful civilian, he was not an all-powerful civilian, and his appeals on behalf of airpower were constrained in important ways.
Second, even if we concede that civilian—and especially Presidential—intervention had a significant role to play in the American experience with tactical airpower operations there remains the reality that despite the vigorous interventions of Roosevelt, the American military was still able to delay the selection and implementation of a new tactical airpower system for several years. If anything, the delay in implementation and the necessity of Roosevelt to intervene again in 1943 suggests that the forces of interservice pathologies acted as a powerful break on civilian influence. Thus, the story of American tactical airpower learning is as much a story of the strong influence of military and organizational obstructionism as it is a story of civilian influence. Accordingly, we cannot rely entirely on this explanation to make sense of the evidence in this case.

6.5 Internal Bargaining

Among the least compelling explanations of the American learning about tactical airpower are those that emphasize the role of internal politicking within the air force and army. According to proponents of this theory, American learning should be explained by the gradual ascension of a cadre of military leaders who supported the tactical airpower mission. These military leaders, having reached a position of authority, would be able to develop networks of support for the tactical airpower mission and direct resources toward the successful execution of the task.

This could not be further from the truth in the American case. Within the air force, there was uniform disdain for tactical airpower operations that only grew over the course of the prewar years. Moreover, although a small cadre of senior air force leaders in the United States supported investing resources in developing a system for effective air support for ground operations, there was virtually no disagreement about what such a system should look like among these leaders. Thus, in the air force, there is no evidence that intraservice
politicking had anything to do with the growing importance of tactical airpower over time. In the army, there was a similar uniformity of views about the appropriate role for aviation assets. With some limited exceptions, there was a strongly held belief that they should be concerned with supporting ground units. Although there was more variation in the army than in the air force regarding the contours of such a system, with some officers supporting a centralized system and others supporting the attaching aviation assets to ground units, the intraservice bargaining approach cannot explain why army officers resolved to adopt the centralized system when they did. After all, there had been army proponents of such a system in very senior positions for years, so why is it that the winter of 1943 was a turning point? Again, for a precise answer to this question, we must look to theories like MFT, which trace how the resolution of interservice disputes in early 1943 led to the adoption and implementation of the new system.

6.6 Dissemination Networks

Finally, like many of the theories identified above, explanations of learning that emphasize the role of dissemination networks find some support in the American case, but are limited in their explanatory value. When it comes to implementation, dissemination networks proved to be critical in ensuring that sound solutions were identified and implemented in the United States. Central to this argument is the fact that the U.S. army employed a continental structure (rather than a regimental structure) in which units were not tied to a specific locality and leaders were routinely shifted from unit to unit. Accordingly, American leaders had grown up in an organization that shared and communicated new information between commands as it emerged. The persistent movement of leaders between

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units, and their willingness to share with and learn from the experiences of other units meant that there were few barriers to the open flow of information between commanders and their units, especially informally. Although it is difficult to precisely assess the effect of these legacies, informal communications networks served the U.S. well. For example, Spaatz was eager to informally disseminate and implement the changes made a Casablanca well before intended through informal exchanges with senior leaders in the field. In this way, the legacies of informal and persistent dissemination of knowledge may have served the Americans well in ensuring that the new tactical airpower system was both debated and implemented throughout the organization.

But while the robustness of American dissemination networks proved quite powerful in the implementation phase of learning about tactical airpower operations, it can tell us little about the identification of that solution. Indeed, the persistent challenge of these explanations is that they can explain a great deal about how new information moves within in an organization, but little about where that new knowledge comes from and why it emerges at a particular time. These networks cannot tell us why tactical airpower emerged as an issue in 1940, nor can it tell us why it took so long for senior leaders—who were all and part of and engaged with a dense communications networks—took so long to align on the implementation of a solution. Thus, for a more comprehensive account we must again look to MFT, which provides us with answers to the question of why this new system was identified, and why it took so long to be implemented.

7 Conclusion

In this chapter, I have examined the empirical record of the American experience with tactical airpower operations before and during World War II for evidence that Military

Filtration Theory is operating. In general, the evidence of the case confirms several of the core predictions of MFT. First, it confirms the prediction that when the American national military strategy was geared toward the defense, military planners largely ignored or suppressed concerns about tactical airpower operations in favor of other priorities. In the case of the air force the main priority was developing an independent strategic bombing capability; and in the case of the army the main priority was defense of the continent. Second, the evidence confirms MFT's predictions that changes in the national military strategy of a state can alert it to new problems. Thus, as the specter of war loomed in the late 1930s and American national military strategy became geared toward offense on land, the challenges of tactical airpower took on a new urgency in the U.S. defense establishment. Finally, the evidence confirms MFT's prediction that although a state may recognize the importance of solving a given operational problem, interservice dynamics will influence the identification and adoption of a solution to that problem. Thus, in the American case longstanding interservice debates that had developed during the prewar period forced the United States to adopt a compromise system of tactical airpower operations that proved ineffective in the early stages of North Africa. It was not until the infusion of resources eased interservice tension that an improved system for tactical airpower operations was selected and deployed throughout the theater.

Although MFT provides a comprehensive account of the process of American learning about tactical airpower, the evidence also illustrates that other variables were at work in this case, albeit in a secondary role. Among the most important of these variables, the experience of battlefield failure was a critical catalyst in overriding American interservice tension and forcing cooperation between the army and air force. Thus, the American case provides confirming—but not definitive—evidence that MFT best explains the learning process.
Chapter 5: German Tactical Airpower

1 Introduction

When the Germans invaded Poland on September 1, 1939, the BBC reported, "when the air raid sirens in the capital first sounded at 0600 inhabitants reacted calmly and some even ran out onto the streets to look up at the sky and had be driven back inside by air raid wardens." Indeed, few civilians in Europe could have known just how dangerous German airpower would prove over the next several years. After all, it was only four years earlier that the Luftwaffe was first revealed to the world as an active component of the German Wehrmacht. The restrictions imposed by the Treaty of Versailles on German military growth in the wake of World War I had included the elimination of its air forces and were intended to suppress, if not put an end to, German military prowess. Given all this, one could excuse those who were shocked by the Luftwaffe’s apparent progress over four short years.

To be sure, the Luftwaffe had grown significantly under Hitler’s direction during the late 1930s, as he funneled resources and personnel into the service. But the story of the

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2 Like the US Army Air Forces, the Luftwaffe went by several different names between 1920 - 1943. For ease of reference, however, I generally refer to the “German air forces” or the Luftwaffe during this period.
3 Wehrmacht is the term used to describe all services of the German military. Before Hitler’s ascension the German armed forces as a whole were called the Reichswehr. For ease of reference, I generally use the terms “German military” or Wehrmacht to describe the German armed forces from 1920 – 1943.
Luftwaffe did not begin in the mid-thirties. In fact, the Luftwaffe that invaded Poland in 1939 was a product of nearly 20 years of research, development, and training that the German military establishment had covertly undertaken in the wake of World War I and from which the Luftwaffe had benefited. Almost as soon as World War I had ended, German military leaders had created a complex, covert structure to maintain and improve German airpower. It was the result of this decades long effort that was so dramatically revealed to the general public during the invasions of Poland, France, and the Low Countries at the start of the Second World War. Although French and British intelligence had warned about the Luftwaffe’s development, the results of its prewar preparations were still striking. Right under the noses of their European neighbors, the Germans had managed to develop one of the most impressive air forces the world had ever seen.

Although precise numbers can be hard to come by, the more conservative estimates of the Luftwaffe strength on the eve of World War II suggest that it was outfitted well,

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with almost 4,000 combat ready aircraft, nearly a third of which were bombers. In addition, the Luftwaffe's impressive force included over 750 fighters, along with 400 ground attack and Stuka (Ju 87) dive bombers. The remaining 600 or so planes were devoted to short and long-range reconnaissance. But even more surprising than the size of the air fleet that the Germans had mustered in this period, was its effectiveness in supporting the rapid thrusts of its ground forces in these early campaigns. Indeed, early German air support was staggeringly successful. Not only had the Stuka dive-bombers supported the breakthrough of armored and infantry forces with their attacks on enemy tanks, artillery, and troop concentrations, but the Luftwaffe's air superiority and battlefield air interdiction missions were equally, if not more, effective at keeping enemy air forces grounded or preoccupied and isolating frontline enemy units from reserves and supplies. Thus, it was not just the number of German planes in the sky, but how well they were employed that left the world in awe.

As in the British and American cases, the available evidence confirms that the Germans successfully employed tactical airpower operations in World War II. But unlike the American and British cases, the Germans were unique in learning many of the lessons of tactical airpower operations before the war began. While the British and American militaries may have been well-aware of the problems presented by tactical airpower

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7 Muller, The German Air War in Russia, 20; Murray, Strategy for Defeat the Luftwaffe, 80.

8 Muller, The German Air War in Russia, 20; Murray, Strategy for Defeat the Luftwaffe, 80.

operations during the prewar period, they were unable to implement their solutions until
interservice rivalries were mitigated by the infusion of resources into the North African
theater. The Germans, on the other hand, managed to sidestep the implementation
problems that arise from such interservice competition, and arrived on the battlefield ready
to deploy joint solutions to tactical airpower problems.

What accounts for the German success in implementing tactical airpower doctrine
before the war began? As with the British and American cases, I explain the Luftwaffe’s
effectiveness by examining the two variables central to Military Filtration Theory: national
military strategy and resource endowments. While British and American military leaders
had only begun to acknowledge the problems of offensive land operations in the late 1930s,
the Germans had been preparing for an offensive ground war for decades.10 Their landlocked
geographic position demanded that any military strategy they pursued first dealt with the
issue of defending or gaining territory from their neighbors on land.11 Although the rise of
Hitler added an immediacy to devising and implementing such a strategy, the longstanding
German focus on landpower meant that the problems of employing aviation in support of
ground forces was a priority for the German military throughout the entirety of the prewar
period. But while it was national military strategy that focused the military’s attention on
tactical airpower operations, it was their resource endowments that induced the successful
implementation of a joint solution along the lines of the system described in Chapter 2. In
contrast to the American and British cases, the implementation of such a system faced little
resistance from the army and air force. Instead, once the extreme constraints imposed by

8–11; Murray, Strategy for Defeat the Luftwaffe, 1; Homze, Arming the Luftwaffe, 19; Barry R. Posen, The
Sources of Military Doctrine: France, Britain, and Germany between the World Wars, Cornell Studies in
Security Affairs (Ithaca: Cornell Univ.Pr, 1984), 183; Addington, The Blitzkrieg Era and the German
General Staff, 1865–1941, 11–12.
11 Rich, Hitler’s War Aims; Randall Schweller, Deadly Imbalances: Tripolarity and Hitler’s Strategy of
the provisions of the Treaty of Versailles were lifted and abundant resources returned under Hitler, there was little reason for the army and air forces to fight over how they were distributed. On the contrary, the Luftwaffe had enough resources to invest in both tactical airpower capabilities and additional missions that it was growing to prefer organizationally like strategic bombing.\textsuperscript{12} When it came time to deploy an effective system for tactical airpower operations few in the German ground or air forces voiced strong objections to the operational concessions they would need to make—not only did these two services have a strong tradition of collaboration, but they were so flush with resources that they could still pursue their preferred missions and capabilities even while working together on the tactical airpower issue. Thus, it was this confluence of several unique circumstances in the German case that made its military organization capable of identifying and implementing an effective system for tactical airpower operations during the prewar period.

Once the war began, the Germans continued to update their tactical airpower operations to reflect the realities revealed on the battlefield. In both the Spanish Civil War and the early invasions of Europe, the Wehrmacht proved that they were capable of integrating new insights from the battlefield into existing doctrine on tactical airpower operations.\textsuperscript{13} In these early years, aviation resource abundance meant that implementing these changes encountered little resistance from both services. Unfortunately for the Germans, however, not even their adaptability in the early years of the war could save them from the onslaught of strategic and material failings that were soon to emerge from Hitler’s expanding ambitions. Since neither Hitler nor his advisors were willing or able to make the necessary materiel concessions to meet the demands of their global strategy, there was little

\textsuperscript{12} Corum, \textit{The Luftwaffe}, 145; Rich, \textit{Hitler’s War Aims}, 50. As we shall see, though military leaders fought little over how these resources were distributed, they did raise significant objections to the deluges of resources and the compromises on quality that they necessitated.

\textsuperscript{13} Proctor, \textit{Hitler’s Luftwaffe in the Spanish Civil War}; Corum, \textit{The Luftwaffe}, 220; Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 98–99.
that could be done by the Wehrmacht to keep up with their ever-expanding commitments.\textsuperscript{14} Nowhere was this truer than in the Luftwaffe where, by 1943, there were neither enough planes nor pilots to conduct the global war of attrition that Hitler now found himself fighting.\textsuperscript{15} Thus, although the Germans may have proven capable of learning before the war began, no amount of organizational adaptability could insulate them from the strategic blunders of their leader. Once resources began to tighten in the Luftwaffe, so too came interservice disagreements over missions and priorities.

I assert in this chapter that Germany’s success in identifying and implementing an effective system for tactical airpower operations is a product of two things: first, their longstanding strategic and military commitment to fighting offensive ground wars, which made them attuned to the problems presented by tactical airpower operations before the war began; and, second, to the abundance of their air force in the prewar period, which made them well placed to implement this system in doctrine and practice. However, I also argue that the emergence of resource constraints later in the war led to considerable interservice tension and, ultimately, the deterioration of the Luftwaffe’s tactical airpower capabilities. In order to demonstrate these points, this chapter proceeds in four additional parts. In the following section, I identify the types of evidence I use in this case, as well as the specific predictions that Military Filtration Theory (MFT) makes with respect to the German experience with tactical airpower operations. In the third section, I examine the prewar period (1920-1939) in order to illustrate how German national military strategy and resource endowments dictated their responsiveness to the challenges of tactical airpower operations.

\textsuperscript{14} For more on the collapse of the German military machine see, for example: Muller, \textit{The German Air War in Russia}; Murray, \textit{Strategy for Defeat the Luftwaffe}; Robin Higham and Stephen J. Harris, eds., \textit{Why Air Forces Fail: The Anatomy of Defeat}, revised and expanded edition (University Press of Kentucky, 2016).

\textsuperscript{15} Muller, \textit{The German Air War in Russia}; Homze, \textit{Arming the Luftwaffe}, 139–80; Murray, \textit{Strategy for Defeat the Luftwaffe}, 69–108.
operations. In the fourth section, I discuss the early effectiveness of the German tactical airpower system in the invasion of Poland. From there, I review the subsequent deterioration of German tactical airpower in the Soviet Union. In doing so, I illustrate that although the Luftwaffe’s organizational dexterity persisted well into the war, no amount of organizational learning could counterweigh Hitler’s strategic blunders. I elucidate this point by examining the Luftwaffe’s performance in their confrontation with the Soviet Union, where Hitler’s lack of resourcing lead to the emergence of interservice wrangling that the Germans had managed to avoid for two decades. Finally, I conclude with a rebuttal of several alternative explanations for the evidence I present in German case.

2 Measurement and Predictions

As in the previous two chapters, in this first section I address three methodological questions before moving on to the empirical record. First, I consider when during the period under consideration (1920 – 1943) I should take samples of evidence about the key variables of interest. Second, I outline the types of evidence I seek out in this case in order to construct a valid and reliable measurement of these variables of interest. In addition, I also review some of the unique limitations facing scholars of the German military during the prewar period and World War II. Finally, I discuss the three specific predictions that Military Filtration Theory (MFT) makes regarding the German case, and preview my findings on each one.

2.1 Measurement

In this chapter, as in the American and British cases, I am concerned primarily with measuring three variables; two independent variables: national military strategy and resources, and one dependent variable: the process of learning vis-à-vis tactical airpower operations. But when, over the course of the quarter-century under study in this chapter,
are the ideal times to measure these variables? As with the other two cases, I take several snapshots of the German military’s progress over time from 1920 to 1943 that roughly correspond with different phases of the tactical airpower learning process. I begin by providing the reader with some peripheral but important background regarding the development of tactical airpower operations under the restrictions of the Treaty of Versailles (1920-1933). From there, I discuss the acceleration of learning about tactical airpower under Hitler as resources flooded the Luftwaffe (1933-1939). But given that this dissertation is about wartime learning, I also examine the early German successes with tactical airpower operations during the early years of war (1939-1941), where they were able to maintain and refine their existing system well. Finally, I assess how the Luftwaffe began to backslide on tactical airpower operations during their engagements with the Soviet Union (1941-1943). In segmenting the period under consideration in this way, I am able to illustrate how and why the unique learning advantages of the German military during the prewar and early war periods were squandered in the later stages of the conflict.

But what evidence am I looking for during each of these periods? As in the previous cases, I rely on a combination of public and private documents and reports to paint a picture of all three variables under consideration. Based on the particular period, however, the combination of sources that I rely on varies slightly. During the early prewar period, when there were restrictions on what the German military could produce both materially and doctrinally, I rely on unofficial sources provide the reader with some doctrinal and operational context related to later tactical airpower developments. In discussing the national military strategy during this period, for example, I rely both on published documents and public speeches as well as unofficial or covert doctrine. Similarly, I examine sources that include both official and unofficial allocations of personnel and materiel resources including, for example, in the civilian aviation sector where much of the air force’s
research and development had been displaced. I also focus my attention on documents that review the standards applied and performance of aviators in unofficial training exercises, as well as reports and unofficial pamphlets that circulated among military leaders during this period. Finally, I look at the civilian research and development in the aviation sector during this period, which was a well-known shell for military research.

After the ascension of Hitler in the mid-thirties, however, I am able to rely more on official doctrine, training, and acquisitions histories in order to paint a picture of the three variables under consideration. In order to establish the contours of German national military strategy and the resources being provided to the military during this period, I rely on the many secondary accounts that focus on Hitler's military ambitions and the resources he made available to the armed forces to achieve his goals. In order to establish where in the learning process the Luftwaffe was at any given moment, I make use of secondary accounts of training, exercises, doctrine, and acquisitions during this period. During the war itself, I again make use of plentiful secondary accounts of Hitler's war strategy and resource struggles, as well as first-hand and secondary assessments of German tactical airpower operations during key battles. Together, these sources provide a comprehensive picture of German national military strategy, resources, and learning vis-à-vis tactical airpower operations from 1920 to 1943.

Critically, however, there are two important caveats to make about sources in this case. First, unlike other the other cases in this dissertation, I am unable to rely on primary source material to construct my account of the German experience with tactical airpower. The main reason for this is simple: I do not speak German. This fact forces me to rely exclusively on secondary accounts of the Luftwaffe during this period or translated primary source documents. However, the pool of translated primary source material from which I can draw is further limited by the fact that there are relatively few primary source records.
available due to the destruction of many German military records in during and after the war. Together, this serves to limit my access to reliable and representative primary source material.

The second and much more serious issue, however, lies in with the secondary historical accounts of the German military during this period. As any scholar of this period knows, there is an abundant supply of secondary accounts on the German military during the period under consideration. However, relatively few of those sources meet the high standards of historical research that one might normally expect for such well-worn territory. In particular, few of these accounts rely on any primary source material and all-too-often import the biases of their authors. The result has been the development and circulation of several unfounded claims about the German military during this period. Nowhere is this more apparent than in the case of the Luftwaffe. As James Corum, one of the leading scholars of the Luftwaffe, notes: “One of the major difficulties in writing about the development of air power thought in Germany is the large number of myths that have grown up around the study of the Luftwaffe since the end of World War II and how—usually by constant repetition—they have become established in the history of air war as accepted fact.”

As a result of this methodological problem, however, I have taken a more discerning approach to utilizing secondary historical accounts of the development of the Wehrmacht, and the Luftwaffe in particular. In general, I have surveyed a significant swath of the existing literature on the Luftwaffe. However, I have weighted more heavily the accounts

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17 For comprehensive, if scathing accounts of the secondary historical literature on the Luftwaffe see the bibliographic essays in: Corum, *The Luftwaffe*; Muller, *The German Air War in Russia*; Murray, *Strategy for Defeat the Luftwaffe*.


provided by scholars who have explicitly referenced and incorporated primary source evidence than those accounts that rely primarily on English-language translations or second-hand reporting from the period. Fortunately, in recent years, a group of enterprising historians have attempted to remedy this imbalance in the literature by publishing articles and books that make explicit their use of primary source materials and actively discredit those historical accounts that misinterpret the available evidence. I rely heavily on their accounts. On the other hand, I am especially skeptical of the British and American “official military histories” and those histories that rely primarily on translated German documents, first-hand accounts of German prisoners of war, or operational memoirs. Where I make use of these accounts, I have cross-referenced them with several more reputable sources—a practice which I employ whenever I utilize secondary historical sources, but which I take extra care to do in this case.

Although this approach has made me more confident in the empirical assertions made here, it has also left me with a more limited pool of resources than in the other cases. This is especially true when it comes to reconstructing the specifics of the operational doctrine employed by the Luftwaffe before and during the war. The limited number of primary sources along with the limited number of reputable scholars of the German military in general and the Luftwaffe in particular, means that this literature has significant holes.

20 There are several historical accounts that fall into this group, but among the best are: Corum, The Luftwaffe; Murray, Strategy for Defeat the Luftwaffe; Boog, The Conduct of the Air War in the Second World War; Muller, The German Air War in Russia; Hooton, Phoenix Triumphant; Homze, Arming the Luftwaffe. I rely on Corum and Muller, The Luftwaffe’s Way of War for translations of German doctrine during this period. As far as I know, no other historians have translated original doctrine so extensively.

21 This includes several “classic” texts on the German military. For example, there is good reason to doubt many of the claims made about German military performance found in Wesley Frank Craven and James Lea Cate, The Army Air Forces In World War II (Washington D.C.: Office of Air Force History, 1983). As Muller and others note, however, there are exceptions to this rule, most notably the British Official History of the German Air Forces, Public Record Office, Rise and Fall of the German Air Force: 1933 - 1945 (Richmond: Public Record Office, 2002).
Corum makes this point best when he says, “For the history of the Luftwaffe, the serious literature on the study of operational doctrine and airpower theory is equally thin. There have been more books written on the Luftwaffe aircraft tail markings (at least three) than there have been on the Luftwaffe’s operational doctrine and air theory (one).” Accordingly, although the empirical observations found in this chapter are rooted in the research of the most reputable scholars in the field, they can be short on specifics in some areas. For example, while I am able to reconstruct parts of the debate over centralization of air assets in support of ground operations, the existing literature on this debate is slim and relies on a series of exchanges between senior leaders rather than a long paper trail of memos, operational reports, and memoirs (as are available in the British and American cases). Similarly, despite several assertions that air superiority and battlefield air interdiction missions were paramount in the minds of senior Luftwaffe planners, there are far fewer records of training exercises and operational outcomes than there are in the American and British cases that would allow me to reconstruct these priorities in mission planning and execution. Nevertheless, at a high level, there exists enough good work on the Luftwaffe that we can arrive at some tentative conclusions about their tactical airpower capabilities. Thus, where there are limitations in the German empirical record about the specifics of tactical airpower operations, I make explicit note of it in the text in an effort to provide the reader with an intellectually honest account of what we do and do not know about the development of the Luftwaffe in these respects.

2.2 Predictions

MFT relies on two variables to explain a state’s progress through the process of learning about tactical airpower: national military strategy and resource endowments. National

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military strategy dictates the problems that a military is able to identify as worthy of further study. Unless and until a state’s national military strategy has an offensive, ground-based orientation, we should not expect its military to be very concerned with issues related to tactical airpower operations. However, MFT also asserts that identifying a problem and solving it are two very different things. In order to understand the process by which a state is likely to implement the solution to the identified problems of tactical airpower operations, MFT directs our attention to resources. Specifically, MFT predicts that a state is more likely to successfully implement cooperative solutions to joint problems when the resources available to the two services in question are abundant. Where resources are scarce and insufficient to ease the need for prioritization, we should expect that competition and disagreement will impede the successful implementation of a solution.

But what, specifically, should we expect to see in the German case? MFT makes three predictions about German military learning related to tactical airpower operations. First, the longstanding German commitment to a military strategy that prioritizes fighting and winning a land war, should have made the German military concerned with the problems of air support of such operations. And, indeed, this is what we see in the German case. The enduring problem of German geography—specifically that is landlocked between enemies to the east and west—had been the animating feature of German military strategy since at least the late 19th century. As a result, German military planning placed a consistent emphasis on problems of land war, which was reinforced and expanded with the rise of Hitler. Given the preoccupation with land conflict under both Hitler and his predecessors, MFT accurately predicts that the German military was concerned with the

23 Murray, Strategy for Defeat the Luftwaffe, 1; Homze, Arming the Luftwaffe, 19; Deichmann, German Air Force Operations in Support of the Army, 8-11.
24 Rich, Hitler’s War Aims, 6-10; Posen, The Sources of Military Doctrine, 183; Schweller, Deadly Imbalances, 100–107.
problems air support of ground operations in the prewar years. Overwhelmingly, the available evidence regarding German prewar planning from 1920 to 1939 bears out this prediction: the German preoccupation with fighting a ground war on either of its flanks forced both the air and ground services to reckon with the issue of air support for these operations throughout the prewar period and into the war itself.

The second prediction that MFT makes deals with the implementation of solutions to tactical airpower problems. Specifically, it predicts that the resource endowments of the air and ground forces during the prewar period should have made cooperation on implementing an effective tactical airpower system straightforward. Indeed, once the restrictions of the Treaty of Versailles were lifted in 1933 and the Luftwaffe was able to develop and deploy an airpower strategy for the coming conflict, resource abundance played a significant role in the positive reception and implementation of effective tactical airpower systems throughout the force. The abundance of resources that became available under Hitler’s rule meant that each service was freed from many of the difficult operational choices that other militaries had to make during this period. These lavish resources meant that both the German air force and army were able to implement and refine their system for tactical airpower operations, while also pursuing other priorities of organizational importance to them. For instance, the Luftwaffe was still able to pursue the development of strategic bombing doctrine during this period, at little cost to tactical airpower operations. Thus, MFT predicts that the German military should have been able to effectively implement solutions to the tactical airpower operations as a result of its ability to invest in several capabilities at once. Broadly, the evidence presented in this case confirms

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the predictions of MFT on the influence of resource endowments in implementation of joint solutions.

The third insight of MFT allows me to make some additional predictions about the robustness of German learning during wartime. Specifically, based on the efficiency that the German military exhibited in identifying the problems of tactical airpower and implementing solutions to them during the prewar period, we should also expect that the Wehrmacht continued to refine and adapt its tactical airpower operations—even if only at the margins—during the war itself. Moreover, we should expect little change in this state of affairs unless and until we observe changes in the national military strategy or resource endowments. And, indeed, in the German case, we observe that during the war itself the effective tactical airpower system that was deployed in 1939 continued to be refined and expanded based on new information from the battlefield. However, as the war continued and Hitler's strategic misjudgments began to undermine the resources available to the Luftwaffe, the Wehrmacht began to regress on the issue of tactical airpower operations.27

As the realities of resource scarcity began to set in, the cooperative relationship between the ground and air forces began to fray. No longer able to invest in and perform several missions at once, the Luftwaffe began to doubt whether tactical airpower was the best use of its more limited aviation assets.28 At the same time, the ground forces, facing significant setbacks themselves, began to grumble that the Luftwaffe air support was insufficient.29 The combined result was that interservice tension emerged in the eastern theater, where resource constraints were most acute.30 Although fighting in the theater concluded before these

27 Muller, The German Air War in Russia, 229–37; Murray, Strategy for Defeat the Luftwaffe, 113–41; Homze, Arming the Luftwaffe, 221–37.
28 Muller, The German Air War in Russia, 191–229; Corum, The Luftwaffe, 224–47.
29 Muller, The German Air War in Russia, 191–229.
30 Murray, Strategy for Defeat the Luftwaffe, 83–84; Corum and Muller, The Luftwaffe's Way of War, 14–16.
fissures could grow too large, they are indicative of how even the best learning remains fragile to the changing dynamics of the battlefield.

Taken together, MFT makes three predictions in the German case: first, that the national military strategy in the prewar period made its military well attuned to the problems posed by tactical airpower operations; second, that implementation of joint solutions was made easier due to resource abundance in the prewar period; and finally, that the Wehrmacht continued to learn and refine tactical airpower operations cooperatively during the war until resource constraints emerged in the eastern theater. For the most part, all three of these predictions are borne out by the available evidence on German tactical airpower operations. It is to presenting this evidence that I will now turn.

3 Prewar Years (1920 – 1939)

In the reminder of this chapter, I review the historical record of Germany’s experience learning to successfully employ tactical aviation in support of ground forces. As has been noted above, the majority of German learning vis-à-vis tactical airpower operations occurred before the Second World War began.31 Not only does this fact of history make the German military an exception—it was the only state to successfully learn about tactical airpower operations before the war began—but it also means that researchers of this phenomenon should turn their attention to the prewar period. In this section, I do precisely that.

31 In reconstructing the development of the Luftwaffe during the early prewar period, I rely on several historical sources, the best among these include: Murray, “British and German Air Doctrine Between the Wars”; Murray, Strategy for Defeat the Luftwaffe; Corum, The Luftwaffe; Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars”; Corum, The Roots of Blitzkrieg; Hooton, Phoenix Triumphant; Homze, Arming the Luftwaffe; Public Record Office, Rise and Fall of the German Air Force; Craig, The Politics of the Prussian Army; Addington, The Blitzkrieg Era and the German General Staff, 1865-1941; Hallion, Strike from the Sky; Cooling, Case Studies in the Development of Close Air Support; Allan Reed Millett and Williamson Murray, eds., Military Effectiveness, vol. 2, 3 vols. (Cambridge ; New York: Cambridge University Press, 2010).
The remainder of this section proceeds as follows. First, I examine the two independent variables at the center of MFT during the prewar era: national military strategy and resources. I separate this discussion into two periods. First, before diving into a consideration of these variables in the immediate prelude to the Second World War, I familiarize the reader with some unique but important context regarding the German case. Specifically, I discuss the unique concatenation of factors influencing German military strategy and resource endowments in the aftermath of World War I that primed the Luftwaffe and Heer for effective cooperation in later years. From there, I turn my attention to evaluating national military strategy and resource endowments under Hitler. In this later period, the empirical record demonstrates how resource abundance conspired with national military strategy to trigger cooperation on the tactical airpower problem between the newly independent Luftwaffe and the Heer. After examining the circumstances influencing Germany’s national military strategy and resource endowments during these two periods, I continue by examining the record of doctrine, training, and acquisitions related to tactical airpower operations in the same timeframe (1920-1933). As we shall see, the Wehrmacht was able to recognize the problems presented by tactical airpower operations, and work cooperatively to implement a set of well calibrated solutions during the prewar years, and especially after the ascension of Hitler. Although German prewar learning was far from perfect, the Wehrmacht outperformed its European and American peers during the prewar years.

3.1 National Military Strategy & Resource Endowments

The story of German tactical airpower begins at the conclusion of World War I. In the wake of its defeat by its European and American adversaries and chaffing at the restrictions imposed by the conditions of the Treaty of Versailles, the German military began a twenty-year project to ensure that history would not repeat itself. National military planning during
this period, combined with resource endowments, converged to ensure that the German military took seriously the problems of tactical airpower from the very outset. Below, I provide the reader with some background regarding unique circumstances influencing national military strategy and resources in the early prewar period (1920-1933) followed by a consideration of these variables during the late prewar period (1933-1939).

3.1.1 Background: Strategy and Resources in the Wake of World War I (1920 – 1933)

German national military strategy in the immediate aftermath of World War I was concerned, first and foremost, with preserving whatever minimal military capability that the victors would allow them to retain. 32 In this effort, General Johannes Friedrich “Hans” von Seeckt was the central figure. 33 Von Seeckt had gone to the Versailles talks expecting to negotiate with the victors and hoping to retain a 250,000-man army with an air force of nearly 2,000 aircraft, but was surprised to discover that there would be little to discuss: it was all but decided that the German army would be allowed 100,000 men total and would have no air force. 34 Although von Seeckt was disappointed with the terms of German

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33 It is difficult to overstate the singular effect of von Seeckt’s leadership on the army during this period. Not only did he steady the sinking ship of the German military establishment, but he used the limited available resources to develop the seeds of German doctrine that would go on to shock the world two decades later. For more see, Corum, *The Roots of Blitzkrieg*; Public Record Office, *Rise and Fall of the German Air Force*, 1; Addington, *The Blitzkrieg Era and the German General Staff, 1865-1941*, 33-34; Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 88; Craig, *The Politics of the Prussian Army*, 387.

surrender, he immediately went work on building a meaningful military capability from the remaining German forces and planning for eventual remobilization.  

For von Seeckt, the fundamentals of the German military problem remained the same: they were geographically stuck between the teeth of their enemies, Poland and France. As a result, it was clear that German forces would need to prepare to deal with one threat above all else: the invasion of German territory by its next-door neighbors. Given that the German military was too weak to defend against both the Polish and French militaries in the wake of World War I—or even against the French alone—von Seeckt began to develop a two-pronged military strategy to deal with Germany’s geography. First, he would take the limited resources available to him and cobble together a military capable of defending against the possibility of a Polish incursion. This would hold at bay at least one of the immediate threats to German security. Second, von Seeckt began the process of long-range planning to create a military force that, in several years, would be able to mobilize against a potential French attack. In this way, von Seeckt directed the German military to develop a national military strategy that could immediately deal with the Polish problem, and eventually address the French one.

But how would the meager post-Versailles German army defend against their Polish neighbors, who were under no such restrictions? Whatever military strategy the senior

German commanders pursued, it would need to compensate for their significant resource disadvantage. In order to develop such a strategy, von Seeckt turned to recent history, directing the German general staff to study the lessons of their loss in World War I.40 Several dozen study groups were arranged, composed primarily of general staff officers, whose task would be to examine different aspects of the German defeat.41 These general staff officers, who had been brought up in the Prussian military tradition of honest and independent thought, were unyielding in their critique of the German failures.42 Among their many observations, however, one conclusion stood out: the Germans, like their adversaries, had been bogged down in the trenches during the First World War, and unless and until the German military could return mobility to the battlefield they would repeat the same mistakes again.43 Thus, moving forward, von Seeckt determined that German military strategy would prioritize mobility of ground forces at all costs.

At the same time, von Seeckt was encouraging his staff to plan on decades-long timelines.44 In addition to the prioritizing mobility and maneuver in ground warfare, German military leaders were developing plans to procure weapons and equipment for the later

43 Homze, Arming the Luftwaffe, 19; Craig, The Politics of the Prussian Army, 397; Addington, The Blitzkrieg Era and the German General Staff, 1865-1941, 30; Posen, The Sources of Military Doctrine, 182–88.
phases of rearmament that German military elites were hopeful would arrive in the thirties.\textsuperscript{45} Although the German military was constrained in the immediate aftermath of the First World War, they believed this situation to be a temporary one, and when conditions improved they would be prepared to hit the ground running.\textsuperscript{46} Thus, while the forces that were available would pack an outsized punch through the innovative use of mobility and maneuver, the Germans were also building the foundation for a much larger force over the long-term. As one historian puts it, “The Reischwehr under Seeckt was designed as a dual-purpose force capable of serving alternately as a highly efficient professional army or as the framework for a greatly expanded army.”\textsuperscript{47} With this dual approach in mind, the German military got to work.

For the German air forces this strategy of agile, mobile ground offensives and long-term rearmament meant that, above all else, it would need to be prepared to support mobile ground operations.\textsuperscript{48} The German air forces had long-known they would be employed in support of a theater-wide ground campaign, and their successful operations in World War I reinforced this mission.\textsuperscript{49} But, by no means whatsoever did this mean that the air force would be the “handmaiden of the German army,” as some historians have suggested.\textsuperscript{50} Von Seeckt, and his primary airpower deputy, Helmuth Wilberg, were clear that the German air forces were an equal and independent branch of the German armed forces.\textsuperscript{51} Although they

\textsuperscript{45} Homze, Arming the Luftwaffe, 23–29; Addington, The Blitzkrieg Era and the German General Staff, 1865-1941, 34; Corum, “The Development of Strategic Air War Concepts in Interwar Germany, 1919-1939,” 24.

\textsuperscript{46} Homze, Arming the Luftwaffe, 23–29; Corum, “The Development of Strategic Air War Concepts in Interwar Germany, 1919-1939,” 24.

\textsuperscript{47} Craig, The Politics of the Prussian Army, 397.

\textsuperscript{48} Corum, The Luftwaffe, 52–53; Addington, The Blitzkrieg Era and the German General Staff, 1865-1941, 30.

\textsuperscript{49} Hallion, Strike from the Sky, 9–53; Corum, The Luftwaffe, 60–65.


\textsuperscript{51} Corum, The Luftwaffe, 80–81, 88; Hooton, Phoenix Triumphant, 25–28; Public Record Office, Rise and Fall of the German Air Force, 3.
would be expected to support the mobile ground forces to the best of their ability, most senior commanders during this period understood that doing so would require a balanced air force that was just as capable of securing air superiority and performing battlefield interdiction as it was of providing close support. And, as we shall see in the following section, this is the type of air force that emerged under the leadership of von Seeckt and Wilberg.

Although German national military strategy at this time meant that the air force was paying attention to the problems of supporting ground units from the air, the constraints imposed on the Germans by the Treaty of Versailles in the wake of World War I also reinforced their commitment to combined and joint operations, especially vis-à-vis tactical airpower. As noted above, Treaty of Versailles restrictions during this period were considerable. Not only was the German army a shadow of itself, but the maintenance and development of an air arm had been explicitly prohibited by the agreement. Perhaps counterintuitively, however, these extreme conditions produced several reinforcing mechanisms for cooperation between the German army and air forces. Thus, as Edward Homze, a historian of this period, notes, “allied treaty restrictions stimulated the Germans to turn adversity into advantage.”

Specifically, there were two ways in which the Versailles restrictions resulted in increased cooperation between the air and ground services. First, and most importantly, there was the simple issue of air force survival. As noted above, the Versailles provisions had prohibited the maintenance of any military air forces. Accordingly, if the air force were to survive, it would require the patronage and protection of another service. The Germany

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52 Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 96; Corum, The Luftwaffe.
53 Homze, Arming the Luftwaffe, 6.
navy, for its part, had no interest in coming to aid of their air counterparts, which meant the air forces would need to make their way into the good graces of the army.\textsuperscript{55} Only by hiding in the ranks of their army counterparts could air force leaders continue to develop and engage in military planning for airpower in future wars. The result was that any and all of the air force infrastructure and personnel that survived the immediate post-war period were drawn from and indebted to their army counterparts.

But allowing the air force to hide in its ranks meant that the army would have to concede some of its already stretched resources to the support their sister service.\textsuperscript{56} After all, the army was also operating under constrained conditions, with less than half of their proposed ground strength.\textsuperscript{57} Nevertheless, von Seeckt—and many senior army commanders—were endowed with a considerable degree of air-mindedness, and believed that airpower would play a definitive role in the wars to come.\textsuperscript{58} Many had seen firsthand the effectiveness of airpower in the later battles of World War I, and their studies of the lessons of the Great War confirmed that the army would need to make a place for the air force.\textsuperscript{59} As a result, the army was willing not just to concede some of its resources to the covert air force enterprise, but having realized that airpower would play an integral role in future victories, it did so without undermining the coequality of the air forces.\textsuperscript{60} Thus, the alliance that was forged between the army and air force as a result of the Treaty of Versailles provisions was collegial and cooperative.

\textsuperscript{55} Corum, \textit{The Luftwaffe}, 26.
\textsuperscript{56} Craig, \textit{The Politics of the Prussian Army}, 357; Corum, \textit{The Luftwaffe}, 49.
\textsuperscript{57} Corum, \textit{The Luftwaffe}, 49–50; Addington, \textit{The Blitzkrieg Era and the German General Staff, 1865-1941}, 29–30.
\textsuperscript{58} Corum, \textit{The Luftwaffe}, 88; Corum, “The Luftwaffe’s Army Support Doctrine, 1918–1941,” 49–52; Homze, \textit{Arming the Luftwaffe}, 5–6.
\textsuperscript{59} Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 88–91; Homze, \textit{Arming the Luftwaffe}, 4–5.
\textsuperscript{60} Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 88.
In addition to incentivizing an alliance between the two services, the resource
constraints of this period also reinforced cooperation in a less direct way: personnel. Facing
such large cuts to his military forces, von Seeckt was forced to eliminate and streamline
many positions in the German military.61 The counterintuitive result of these cutbacks,
however, was that von Seeckt and his subordinates were in a position to retain only those
officers and personnel who were of the highest quality.62 This was especially the case in the
air force, where von Seeckt had been able to make room for less than 150 air officers.63 In
short, von Seeckt essentially had the pick of the litter. He and his deputies were able to
select those officers who had shown not just operational prowess in the Great War, but who
were also aligned with his long-term vision of a mobile, joint combined arms team.

Thus, it was in fact because of the restrictive provisions of the Treaty of Versailles
that the German air and ground forces had a cooperative alliance that would serve to ensure
that implementation of joint solutions would meet little resistance from either service.
Taken together, the restrictions on German rearmament along with a German military
strategy that emphasized mobile ground operations, meant that its air and ground forces
were positioned well to understand and address problems of tactical airpower from the get-

go.

3.1.2 Strategy and Resources under Hitler (1933 – 1939)
When Hitler arrived on the political scene in 1933, he inherited a military that was
considerably stronger than anyone had expected it to be. The German army had developed

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61 Addington, The Blitzkrieg Era and the German General Staff, 1865-1941, 28; Watt, Too Serious a
Business, 40.
62 Craig, The Politics of the Prussian Army, 393; Addington, The Blitzkrieg Era and the German General
Staff, 1865-1941, 28.
63 Corum, “The Development of Strategic Air War Concepts in Interwar Germany, 1919-1939,” 22; Homze,
Arming the Luftwaffe, 6.
the fundamentals of a doctrine for mobile, maneuver warfare that would prove highly effective in execution, and had maintained a well-trained, if small and modestly equipped, ground force. At the same time, the German air forces had siphoned off just enough resources from their army counterparts to maintain a modest but efficient doctrinal and training enterprise and had used the private sector and their Soviet allies as a cover for deeper air force development. Moreover, the benefits of the long-range planning that the air force had undertaken in the early postwar period were beginning to reveal themselves to German leaders in the mid-thirties. The result was that Hitler inherited an air force that was doctrinally, operationally, and technically quite capable given the circumstances, and this would prove especially true when it came to air support of ground operations. Nonetheless, Hitler would leave his mark on the German military, and the Luftwaffe was no exception.

As a military strategist, Hitler’s failings are well-documented. Not only did he have a problematic tendency to meddle in military affairs, but he often did so in counterproductive ways. Nevertheless, his belief in violent expansion of the German state did serve to reinforce the military’s concern with fighting a mobile ground war on the continent. Indeed, Hitler was as committed as any previous German leader to designing a military that could win a war against Polish and French forces on land and, to do so,
ensuring that the Luftwaffe was integrated with the ground campaign. As a result, the national military strategy under Hitler, in emphasizing territorial expansion, also reinforced the military’s concern with air support of ground operations.

Fundamentally, Hitler’s approach to world affairs rested on his disturbing, but deeply held, belief that the German people were not only entitled to expand around the globe, but that the fate of human civilization relied on them doing so. For Hitler, this vision presented first and foremost a problem of space: “as Hitler viewed the problem, the German population was too small and its territorial base was too limited to guarantee the survival of the racially superior Germans in the world arena of racial competition; if the German race was to survive, both its population and territorial base would have to be extended.” In order to fulfill his perverse vision of the world, Hitler would need to expand territorially. But Hitler was equally clear about where this territorial expansion would take place: while other nations were concerned with colonial expansion, Hitler was concerned primarily with expansion on the Eurasian landmass. As a result, Hitler would need a military that was designed to go on the offensive and who could take and hold large swaths of foreign lands on the European continent. With such a force, Hitler believed he could sustain the program of expansion that was required for the survival of the German race.

But Hitler could not exempt Germany from the reality that it was surrounded by enemies on all sides. If the German race was to expand, Hitler was first and foremost going to need to deal with France and Poland. In this way, his military strategy differed little from that of his predecessors going back decades. But unlike many of his predecessors, his ambitions went well beyond his continental neighbors—in Hitler’s worldview, vanquishing

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71 Ibid., 4–6; Schweller, *Deadly Imbalances*, 93–107.
France and Poland would merely be the first phases in a long train of offensive campaigns that would eventually secure large swaths of the Eurasian landmass.\footnote{Schweller, *Deadly Imbalances*, 93-100; Craig, *The Politics of the Prussian Army*, 483; Rich, *Hitler’s War Aims*, 4-9.} In undertaking such a project, Hitler knew he would need to balance his military strategy with diplomatic and political feints; and, for all of his horrific failings as a leader and a person, Hitler was a master manipulator.\footnote{Rich, *Hitler’s War Aims*, 83-84; Addington, *The Blitzkrieg Era and the German General Staff, 1865-1941*, 38-39; Craig, *The Politics of the Prussian Army*, 484.} By exploiting growing international support for national sovereignty and self-determination, he was able to disguise his ambitions from European leaders, while also knitting a web of alliances that would support his military efforts.\footnote{Rich, *Hitler’s War Aims*, 84; Craig, *The Politics of the Prussian Army*, 484.} Still, the first and most crucial step of Hitler’s plan for world domination began as did all other German military campaigns: with the successful ground offensives to the east and west.

From the perspective of airpower, this meant a continuation of existing efforts: the creation of a balanced force that was capable of supporting forces on land, while also retaining a suite of independent capabilities that could reach out and touch targets deeper in the rear.\footnote{Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 96; Addington, *The Blitzkrieg Era and the German General Staff, 1865-1941*, 43-45.} In this way, Hitler’s growing emphasis on offensive incursions was more a difference of degree than of fact for the Luftwaffe. Although they had spent much of the past decade planning for defending against Polish and French aggression, there was always an offensive flavor to German air doctrine.\footnote{Posen, *The Sources of Military Doctrine*, 182-88; Corum, *The Roots of Blitzkrieg*.} As we will see in the next section, the German air forces’ view of all operations—defensive or offensive—was to take and retain the initiative early in the campaign, in order to knock out enemy air and interdiction targets.\footnote{Posen, *The Sources of Military Doctrine*, 182-88; Murray, “British and German Air Doctrine Between the Wars”; Addington, *The Blitzkrieg Era and the German General Staff, 1865-1941*, 43-44.}
Thus, from a military perspective, and especially from an airpower perspective, Hitler's global ambitions were an outgrowth of preexisting practice.

In order to achieve this expansionist vision, however, Hitler knew that his efficient but still small military would need resources. More importantly, Hitler was also aware that the well-respected military establishment could serve as a powerful break on his ambitions if he did not coopt its leaders to his cause. Accordingly, Hitler quickly moved to endear himself to military leaders by providing them with the thing they had been starved of for over a decade: resources. As Corum puts it, “Hitler was quite popular with the senior military and Luftwaffe leadership, especially in the early years of his rule, but not because of his theories of warfare. Hitler won the admiration and gratitude of the military for instituting rearmament on a scale beyond the military’s wildest dreams.” And lavish he did: over the course of several years Hitler directed such an exorbitant amount of resources to the military that many officers were overwhelmed by the rapid expansion the infusion would require. In short, Hitler bought compliance from the military.

The resources that Hitler directed to the military came in two forms. First, he expanded both the money and materiel available to the Wehrmacht, and especially the Luftwaffe. Although there were significant organizational problems that emerged from such a rapid infusion of funding—and the often-absurd productions goals that were developed to meet Hitler’s insatiable demand for the illusion of numerical military prowess—the Wehrmacht grew dramatically under Hitler. The Luftwaffe, in particular, was the

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79 Rich, Hitler’s War Aims, 50–52; Craig, The Politics of the Prussian Army, 469–86.
80 Rich, Hitler’s War Aims, 50–52; Craig, The Politics of the Prussian Army, 469–86.
81 Corum, The Luftwaffe, 145.
82 Homze, Arming the Luftwaffe, 98–139; Public Record Office, Rise and Fall of the German Air Force, 3–8.
83 Rich, Hitler’s War Aims, 50; Public Record Office, Rise and Fall of the German Air Force, 4.
84 Homze, Arming the Luftwaffe, 98–139.
recipient of significant material resources. According to the best estimate, in the first full
year of Hitler’s rule, German aircraft production increased by at least 1,500 planes, and by
1935 Luftwaffe production had reached 3,000 aircraft.\textsuperscript{85} By 1938, it had a production rate
of over 5,000 aircraft, 3,000 of which were combat ready; and by 1939 had an output of
nearly 7,500 aircraft of which nearly 5,000 were combat ready.\textsuperscript{86} Again, these numbers mask
real deficiencies in terms of technology, training, and readiness, but reveal a commitment
to output.

But even more than the materiel resources, Hitler also infused the Wehrmacht in
general and the Luftwaffe in particular with much needed personnel. In terms of enlisted
personnel, Hitler reinstituted conscription, leading to an influx of youthful soldiers and
pilots.\textsuperscript{87} But even more important than the number of conscripts that were available to the
Wehrmacht was Hitler’s appointment of Hermann Göring as commander of the Luftwaffe.\textsuperscript{88}
Göring was not just a popular public personality, but Hitler’s closest confidante and
advisor.\textsuperscript{89} The result was that the Luftwaffe could be further assured of its continued
independence and more than its fair share of the resource pie for the foreseeable future.\textsuperscript{90}
Thus, the Wehrmacht was suddenly flush with new personnel, and the Luftwaffe had come
out in a particularly cushy spot.

\textsuperscript{85} Ibid., 159.
\textsuperscript{86} Muller, \textit{The German Air War in Russia}, 20; Murray, \textit{Strategy for Defeat the Luftwaffe}, 12, 17; Homze, 
\textit{Arming the Luftwaffe}, 159.
\textsuperscript{87} Rich, \textit{Hitler’s War Aims}, 51; Craig, \textit{The Politics of the Prussian Army}, 483; Murray, \textit{Strategy for Defeat 
the Luftwaffe}, 6.
\textsuperscript{88} Rich, \textit{Hitler’s War Aims}, 50; Homze, \textit{Arming the Luftwaffe}, 54; Addington, \textit{The Blitzkrieg Era and the 
German General Staff, 1865-1941}, 43; Watt, \textit{Too Serious a Business}, 68.
\textsuperscript{89} Murray, \textit{Strategy for Defeat the Luftwaffe}, 4–5; Addington, \textit{The Blitzkrieg Era and the German General 
Staff, 1865-1941}, 43; ibid., 95; Corum, “The Development of Strategic Air War Concepts in Interwar 
Germany, 1919-1939,” 27.
As it would turn out, however, some of these personnel decisions would be Janus-faced. Several of the senior leaders, though politically favored by Hitler, proved to be hapless military professionals. For instance, although Göring had Hitler’s ear, he was uninterested in overseeing the Luftwaffe; and others, like Ernst Udet, mismanaged Luftwaffe acquisitions during the war. Similarly, the infusion of a young conscript force, with all of their pro-Nazi fervor, served to undermine senior leaders’ confidence in their commitment to the military as opposed to their commitment to Hitler. Even so, in the early part of Hitler’s rule, the infusion of politically favored actors, and most importantly Göring, along with highly-trainable pilots and personnel served to bolster the strength of the Luftwaffe dramatically.

As we will see in the next section, the addition of personnel and material resources to the Wehrmacht in general and the Luftwaffe in particular meant that continuing to invest in cooperative efforts rarely came at a cost to their organizationally preferred missions. The Luftwaffe could continue to pursue joint solutions to the tactical airpower problem while simultaneously investing in capabilities that were independent of the other services because there were enough resources to do both.

3.2 Prewar Tactical Airpower Operations: Doctrine, Training, and Acquisitions

But how did these strategic and resource inclinations manifest themselves in practice? What, precisely, did the system of tactical airpower operations developed and employed by

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the Luftwaffe during the prewar years consist of, and how close was it to the standard described in Chapter 2? Although the empirical record on the German system of tactical airpower remains somewhat opaque, the existing evidence suggests that the air force’s support for ground units was very close to the standard described in Chapter 2 and grew closer to this standard as more resources were provisioned by Hitler. By the mid-1930s, the German air doctrine was clear about the need for centralized command of air assets to allow for massing on critical ground targets, as well as the need to achieve air superiority and focus on battlefield interdiction targets before providing close support. In addition, German thinking on constant communication between ground and air forces was robust and, especially in the late thirties, German air units were frequently training with their ground counterparts. To be sure, there were problems with the system that the Germans employed. But relative to their peers, these problems were marginal and the Luftwaffe proved adept at acknowledging them and further refining their doctrine early in the war.

Put simply, the Germans were able to successfully learn how to employ a high standard of tactical airpower operations well before the Second World War began. In this section I examine the contours of the tactical airpower system the Germans developed over this period. Specifically, I discuss German doctrine, training, and acquisitions related to tactical airpower operations from 1920 to 1939, with a special focus on the latter part of this period when resource endowments should have made implementation of tactical airpower solutions robust.

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94 Murray, “British and German Air Doctrine Between the Wars”; Corum, “The Luftwaffe’s Army Support Doctrine, 1918-1941,” 63; Hooton, Phoenix Triumphant, 99–100; Muller, The German Air War in Russia, 6–7.
95 Corum, The Luftwaffe, 234; Hooton, Phoenix Triumphant, 100.
96 Murray, “British and German Air Doctrine Between the Wars”; Corum, “The Luftwaffe’s Army Support Doctrine, 1918-1941.”
3.2.1 Doctrine

The overarching concept of tactical airpower developed by the Luftwaffe during the prewar period saw air support of ground operations as a multifaceted endeavor that would marshal all aspects of the German airpower apparatus to defeat the enemy. By the end of the thirties, this vision had evolved into a doctrine for tactical airpower operations that combined the fight for air superiority, strikes against battlefield air interdiction targets in the rear, close support of the frontline units, and even attacks on strategic targets deep inside enemy territory in a coherent body of thought. This approach to tactical airpower was a flexible, broad, and balanced, and was rooted in the Prussian tradition of combined arms warfare that emphasized marshalling all available strength in a synchronous attack. The results for Germany's enemies were—at least initially—devastating.

Like the American case, German airpower doctrine was intended to be a general guide for operations, rather than a rigid set of rules: "[German doctrine] was a clear, concise formulation. It was not meant to restrict or dogmatize but rather to give air force commanders the widest latitude and to encourage maximum flexibility." Unlike in the

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97 In recent years, several new historical accounts have been published charting the evolution of German doctrine during the interwar years, composed by historians with access to primary source material who have corrected many of the myths that have grown up about this period. Although the number of historians undertaking this task is limited, they have been prolific in their work. Among the best from this group are: Corum and Muller, The Luftwaffe's Way of War; Corum, "The Luftwaffe's Army Support Doctrine, 1918-1941"; Corum, The Luftwaffe; Corum, "From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars"; Murray, Strategy for Defeat the Luftwaffe; Murray, "British and German Air Doctrine Between the Wars"; Murray, "The Luftwaffe before the Second World War"; Muller, The German Air War in Russia; Boog, The Conduct of the Air War in the Second World War; Deichmann, German Air Force Operations in Support of the Army.

98 Murray, Military Adaptation in War, 138; Murray, "British and German Air Doctrine Between the Wars"; Corum, "The Luftwaffe's Army Support Doctrine, 1918-1941," 58.

99 Murray, Military Adaptation in War, 137-38; Addington, The Blitzkrieg Era and the German General Staff, 1865-1941, 43-44.

100 Knox, May 1940, 160-63.

101 Murray, Strategy for Defeat the Luftwaffe, 8.
American case, however, the introduction of nuanced, flexible doctrine related to air support of ground operations did not result in the distortion of operations to suit the organizational preferences of the air or ground services. Instead, German doctrine served a general guide for tactical airpower operations, and the spirit of the prescriptions were honored by both air and ground commanders. Moreover, German doctrine related to tactical airpower tended to be clearer than American prescriptions and, where it existed, British guidance on the issue. Thus, not only was German doctrine related to tactical airpower operations clear, but the cooperative alliance that had formed between the army and air forces served to ensure that where doctrinal ambiguities did exist they were not exploited toward counterproductive ends.

The first statement of doctrine for air support of ground units emerged from the post-World War I general staff studies ordered by von Seeckt. At von Seeckt’s direction, a cadre of 130 former air force officers had examined the experience of the German air forces in World War I and distilled several observations. On the basis of their conclusions, the German military published Army Regulation 487: *Leadership and Battle with Combined Arms* in 1921. The document would be revised again two years later, but even in its original formulation, the Germans showed an awareness and acceptance of several of the core principles of effective tactical air operations. On the centralization of command under a senior air force commander at higher headquarters, the regulation clearly states:

104 Significant portions of the 1921 doctrine have been translated by Corum and Muller, *The Luftwaffe’s Way of War*, 72–86. Corum also reviews many of the core principles in several of his other works. For more see, Corum, *The Luftwaffe*, 23.
The aerial battle units are a powerful weapon in the hand of the [air] commander. Their deployment is strictly regulated...During operations, the commander had the responsibility for determining the most important objectives for reconnaissance, as well as the decision to assemble and deploy superior aerial forces, in coordination with the ground forces, over the most important sector of the ground battle...Troop units not directly involved in combat at the decisive point cannot generally count upon receiving air support.  

Not only was the doctrine clear that the air commander would be in charge of all air assets, as opposed to his ground counterpart, but it also made clear that the air commander would be free to mass his assets on key nodes of the battlefield as he saw fit. Moreover, the doctrine made explicit that ground units should not expect air support unless they were engaged at a key point on the battlefield. Similarly, the doctrine is clear about the prioritization of air superiority and targets in the rear of the battlefield over close support, stating that “generally, targets of the attack groups—enemy reserves, batteries, strongpoints, and supply—lie further to the rear.” Finally, the regulation made explicit the need for constant communication between air and ground units, noting that “Rapid transmission of orders is decisive for the operation of the flying units. They must always be in contact to receive orders. It is especially important in a war of movement for the air commander to stay at his airfield near his command post.”  

Taken together, the principles outlined in this first statement of tactical airpower are suggestive of the robust understanding of the core challenges of these operations. Not only does the doctrine make clear the need for centralized command as an enabler of mass, but it also is clear on the need for army and air forces to understand and accept the prioritization of air superiority and interdiction targets over the immediate demands of direct support. In addition, its emphasis on communication and

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105 Corum and Muller, *The Luftwaffe’s Way of War*, 73.
106 Ibid., 74.
107 Ibid., 79.
collocation of headquarters is also suggestive of a genuine understanding of the challenges and needs that would be faced by operators.

Although several statements of ancillary air doctrine—especially dealing with the employment of air assets in a “strategic” capacity, a point which I discuss at length below—would emerge during the prewar years, it was not until 1936 that an updated doctrine for tactical airpower operations was developed in the Wehrmacht. In the intervening period, the German air forces had been hard at work training and experimenting with the tactical airpower mission in joint maneuvers with the ground forces. Moreover, under the leadership of General Walther Wever, the Luftwaffe had developed into an organization that emphasized a balanced, combined approach to mobile warfare. The result of all these trends was the publication of Luftwaffe Regulation 16: Conduct of the Aerial Warfare. The regulation is notable first and foremost for its length: it details nearly every possible target and operation that an air force might plausibly undertake in war, including strategic and tactical missions. But like its 1921 predecessor, the doctrine reinforces several of the core precepts of effective tactical airpower operations, including both the need for the primacy of the air commander over air units in order mass against critical targets, the need for close coordination between air and ground commanders, the continual prioritization of air superiority, and the need for constant communication.

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109 Deichmann, German Air Force Operations in Support of the Army, 30; Corum, The Luftwaffe, 150.
111 Corum and Muller, The Luftwaffe’s Way of War, 118–60; Addington, The Blitzkrieg Era and the German General Staff, 1865-1941, 43–44; Hooton, Phoenix Triumphant, 100; Boog, The Conduct of the Air War in the Second World War, 425.
112 Corum and Muller, The Luftwaffe’s Way of War, 118–60.
113 Ibid.; Addington, The Blitzkrieg Era and the German General Staff, 1865-1941, 43–44.
In addition to these important facets of tactical airpower, the doctrine also details the strategic targets that the Luftwaffe might usefully pursue, as well as a host of other issues related to air defense and reconnaissance. While it is not necessarily unusual for a doctrine of this sort to include several different sections, the many priorities that the document lists in addition to the tactical airpower mission is noticeable. And, to certain extent, this should be expected: by 1936 the Luftwaffe had received an infusion of resources that allowed it to pursue several different operational missions. Thus, it should come as little surprise that the doctrine of the period reflected not only an understanding of the principles of effective tactical airpower, but also detailed thinking on additional mission sets that it had recently begun to pursue more aggressively. Critically, however, Regulation 16 did not diminish or demote tactical airpower to secondary status with the addition of other missions, instead tactical airpower retained its standing as an important element of a broader airpower strategy in the late 1930s. While Luftwaffe doctrine on tactical airpower operations were relatively few and far between, the available evidence suggests that the core precepts of effective tactical airpower identified in Chapter 2 were present in German doctrine from the outset. Although additional missions were added to the Luftwaffe’s ledger by the late 1930s, the doctrine suggests that tactical airpower retained significant standing among these priorities.

3.2.2 Training & Command

As we saw in the American case, however, doctrine can only tell us so much about the actual practice of tactical airpower. After all, it is plausible that German air doctrine

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114 Corum and Muller, The Luftwaffe’s Way of War, 118–60.
115 Rich, Hitler’s War Aims, 50; Public Record Office, Rise and Fall of the German Air Force, 4.
116 Murray, Military Adaptation in War, 138; Boog, The Conduct of the Air War in the Second World War, 425; Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 96.
expounded all of the core components of air ground cooperation, but its intentions were distorted in execution. In order to get a sense of how tactical airpower operations were performed in practice, we must also look to the training and exercises that were conducted during this period. Although in the immediate aftermath of the First World War the restrictions of Versailles prevented the German air force from training, there was significant—albeit basic—training being conducted in the Soviet Union throughout the twenties. The result of this covert training was that when the Luftwaffe was revealed to the world in the mid-thirties, it could immediately begin training for more advanced operations. Among the operations for which it soon began exercising was the support of ground units from the air. On three occasions between 1934 and 1937 the Luftwaffe participated in joint maneuvers with their ground counterparts to help prepare for this sort of operation.

The first of these exercises began in December 1934 under the direction of Wever. In these exercises, the Wehrmacht was tasked with defending against a French attack of southwest Germany. The missions that the Luftwaffe was responsible for during these exercises were varied, but primary among them were tactical airpower operations. As Corum notes:

> It is impressive to note that in these ate 1934 war games by Wever, virtually all aspects of aerial warfare are included, from strategic bomber attacks against the enemy aircraft industry and transportation net by Germany’s longest range and heaviest bombers, to the use of dive

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117 There are relatively few good historical accounts of the training undertaken in the Soviet Union, however, recent works have begun to remedy this hole in the literature. See, for example, Johnson, “The Faustian Pact: Soviet-German Military Cooperation in the Interwar Period.”


119 There are remarkably few accounts of these exercises in the English language literature. Recently, three accounts by well-respected historians in this field have been released: Corum, The Luftwaffe; Hooton, Phoenix Triumphant; Muller, The German Air War in Russia.

120 Hooton, Phoenix Triumphant, 99–100; Muller, The German Air War in Russia, 15; Corum, The Luftwaffe, 152–55.

121 Corum, The Luftwaffe, 152–53; Hooton, Phoenix Triumphant, 100.
bombers as an interdiction weapon, to fighter planes operating in the close interdiction and air support roles, attacking the enemy army directly.\(^{122}\)

It was during these winter exercises that Wever and his Luftwaffe counterparts attempted to illustrate that tactical airpower operations were best employed as part of an overall, theater-wide strategy to debilitate all facets of the enemy’s warmaking capabilities. Given that the Luftwaffe had just received an infusion of resources, it should come as little surprise that tactical airpower, although still a priority for the Luftwaffe, was considered just one part of a multifaceted airpower strategy.

A year later, Wever conducted a second set of air-ground exercises with the explicit goal of impressing upon his ground counterparts the need for air superiority and battlefield interdiction, in addition to direct support of ground forces. During these exercises, Wever first allocated nearly 25 percent of his air assets to direct support of the army, without additional assets employed to secure air superiority.\(^{123}\) The result was, unsurprisingly, abysmal.\(^{124}\) The notional French air forces were left untouched and continued to harass air and ground units.\(^{125}\) On the following days, however, Wever “concentrated his assets to destroy the enemy air forces in detail.”\(^{126}\) Wever had made his point: air forces in support of ground units were most effective when they prioritized air superiority first.\(^{127}\) The result was an emphasis on air superiority and interdiction over close support:

The use of fighter planes in low-level attacks against ground targets was an important secondary mission for the fighter force—after winning the air superiority battle—the fighter inspectorate worked to create tactics for attacks against ground targets... In short, the

\(^{122}\) Corum, *The Luftwaffe*, 155.
\(^{123}\) Hooton, *Phoenix Triumphant*, 100.
\(^{124}\) Ibid.
\(^{125}\) Ibid.
\(^{126}\) Ibid.
\(^{127}\) Ibid.
emphasis for army support missions in the Luftwaffe doctrine was on conducting interdiction campaigns rather than on direct close support for troops engaged in combat on the front. Although Wever’s antics did not fully silence the skeptics of such an approach, these exercises forced most in the Wehrmacht to concede the merits of prioritizing air superiority and battlefield interdiction during tactical airpower operations, and to allow this principle to be touted in doctrine and practice moving forward.

In addition to the emphasis on air superiority that emerged from these exercises, improvements were also made in the communications and liaison structure of air support. Based on the conclusions of these exercises, Wever was able to institute a liaison system between air and ground units that allowed for constant communication regarding targets. The system, who operators were known by the shorthand “FLIVOS,” was aimed at squaring a problematic communications circle: “The Luftwaffe was not willing to place any air force combat units under army command, even though it was willing to provide direct support.” Rather than insist that the Luftwaffe subordinate its units to a ground commander, the FLIVOS system embedded air officers with ground units to “act as the Luftwaffe’s forward intelligence, passing requests for direct support directly to the Luftwaffe wing or air division.” The result was that ground units were kept in constant contact with their Luftwaffe counterparts, but that contact was managed and filtered through specially trained air force officers. Moreover, the approval of requests passed by FLIVOS to higher

128 Corum, *The Luftwaffe*, 244.
129 Corum, “The Luftwaffe’s Army Support Doctrine, 1918-1941,” 60; Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 96.
130 Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 96.
131 Ibid.
132 Corum, “The Luftwaffe’s Army Support Doctrine, 1918-1941,” 60; Corum, “From Biplanes to Blitzkrieg: The Development of German Air Doctrine Between the Wars,” 96.
headquarters remained at more senior levels, in order to preserve the air commander’s ability to concentrate and mass fire when necessary.

Finally, in September 1937, the Wehrmacht “embarked on a program of the largest peacetime air and joint air/ground exercises seen in the prewar period.” Over nearly a week, air and ground forces tested the provisions outlined in Luftwaffe Regulation 16. As it had been done previously, the Luftwaffe was responsible for both supporting mobile ground units and striking strategic targets deep in enemy territory. But there was also a noticeable and growing emphasis on the use of the Luftwaffe in support of motorized and Panzer divisions at the decisive point in the ground battle. Thus, by the 1937 maneuvers, specialized units had been allocated to provide direct support for motorized ground units and in several subsequent maneuvers special attention was paid to training for these operations. In addition to their practical effects, commanders in the Luftwaffe also knew how important this training was in creating a shared understanding between air and ground officers in combat. As Corum puts it, “The Luftwaffe officers were not to attend army training and war games as observers but were expected to take a direct part acting as air commanders in training exercises...Luftwaffe officers were expected to know army tactics and doctrine, and [were] expected to educate the army about the roles and capabilities of air power.” After the joint exercises had been completed, the Luftwaffe went to work distilling and distributing the lessons of the maneuvers. Among the primary conclusions was that communications systems still required significant refinement due to “numerous deficiencies at the tactical level.” Nonetheless, senior leaders were broadly satisfied with

134 Muller, *The German Air War in Russia*, 16; Corum, *The Luftwaffe*, 234.
135 Corum, *The Luftwaffe*, 245.
138 Ibid.; Muller, *The German Air War in Russia*, 18.
the performance of the Luftwaffe in support of ground units. In general, senior commanders were satisfied with how effectively the Luftwaffe had met the various demands of competing mission sets, from tactical airpower operations to strategic and interdiction operations. These maneuvers had confirmed the merits of the balanced, multifaceted approach to aerial warfare that had taken root in the Luftwaffe, and tactical airpower’s role in it.

It was also around the time of the maneuvers that the Luftwaffe began to test and implement a command structure that could balance its many competing mission priorities. By 1934, the Luftwaffe had developed a command structure that did just that, and would eventually become the command structure employed in the early part of the war. This structure split the Luftwaffe into six regional air districts. Each air district was assigned a corresponding air fleet (Luftflotte) that was a self-contained collection of diverse air assets, and which could be deployed independently and in different combinations. Most importantly, the Luftflotten were all under the command of a single air officer, who worked closely with but was not subordinate to his ground counterpart (see Figure 5). Additionally, each Luftflotte would have full complement of staff, support, and auxiliary officers, allowing it to be fully contained and easily deployable. In execution, the areas of responsibility for each of the Luftflotten would expand with the ground advance.

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In addition to the regional Luftflotten, however, the Luftwaffe was also attuned to the special needs of the ground forces in close combat. Accordingly, there was also a headquarters designated for army support operations, which could easily be shifted to the key points on the battlefield in order to attend to the immediate needs of the ground component.  

Under the command of individuals like Field Marshal Hugo Sperrle, a proponent and student of close air support, these units would prove very capable in the close support capacity. The result of this command system in execution was that the bulk of the Luftwaffe—arranged in Luftflotten—could attend to the needs of the battlefield as a whole, while it also retained the ability to respond to the immediate needs and requests of

146 Corum, The Luftwaffe, 156; Boog, The Conduct of the Air War in the Second World War, 434.
147 Corum, The Luftwaffe, 245.
ground commanders with specialized close support units.148 Where it was needed most, close air support could be provided readily and capably, without eating into the resources available for other missions. Taken together, the result was a capable and flexible command structure, whose senior officers retained a high degree of control and, critically, the ability to mass at the places it would be most useful. It was this system that would prove so effective over the battlefield in the early stages of the war.

Accordingly, in the late 1930s, the Luftwaffe proved capable of employing tactical airpower operations alongside the demands of more strategic mission sets. Moreover, after each of these maneuvers the Luftwaffe distilled the major takeaways which were “studied intensively and critically by the staffs with the intent of noting deficiencies in training, equipment, tactics, and planning” and then distributed widely throughout the force.149 In this way, the Luftwaffe was not only testing the effectiveness of the system of tactical airpower operations it had developed, but it was updating and refining that system based on new inputs.

### 3.2.3 Aircraft

But even if the Luftwaffe had been doctrinally and operationally prepared to deploy tactical airpower operations, it would still need to build an air force capable of undertaking that mission. When Hitler came to power, there was much work to be done in order to provide the Luftwaffe with the number and quality of military aircraft that would be necessary to fulfill his ambitions. In this section I review what historians have been able to reconstruct about the German aircraft industry in the prewar period in order to illustrate the German commitment to tactical airpower also manifested itself in the planes acquired.

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Fortunately for Hitler, the German air forces had displaced much of their research and development into the private sector in the twenties and early thirties.\(^{150}\) Civilian aviation firms like Lufthansa had basically become a front for planning and development of military aircraft.\(^{151}\) In the immediate aftermath of World War I, these civilian institutions were primarily geared toward planning for future weapons acquisition, and laying the groundwork for future rearmament.\(^{152}\) By the late twenties, however, Luftwaffe rearmament had begun in earnest.\(^{153}\) Although it is difficult to discern a definitive account of investment and output in the aviation industry for military purposes during this shadowy period, it is clear that the German military had begun developing civilian prototypes for future military aircraft, which could also be used in a military capacity should the circumstances demand it. According to the best estimates during this period, by 1928, the German aviation industry (including Lufthansa, Junkers, Dornier, Heinkel, and several others) estimated that it could annually produce nearly 3,000 aircraft for military use, on top of the fleet of civilian airliners in use in Germany.\(^{154}\) Even so, most of the civilian aviation industry struggled to meet the requirements of range and size that the military planners demanded, a situation that only worsened as the German economy began to flag in the early thirties.\(^{155}\)

When Hitler arrived on the scene, however, the Luftwaffe's constraints on military acquisitions were suddenly lifted.\(^{156}\) The results were dramatic. Within the first two years of Hitler's regime, "the fragile child of 1933 had grown lustily. The original total of eight airframe and six engine firms, debt-ridden and near collapse, grew to fifteen airframe and

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\(^{151}\) Homze, *Arming the Luftwaffe*, 50–63; Corum, *The Luftwaffe*, 77.


\(^{154}\) Homze, *Arming the Luftwaffe*, 31.

\(^{155}\) Ibid., 28; Murray, *Strategy for Defeat the Luftwaffe*, 4–5.

seven engine firms, all booming and financially sound.” By 1938, these firms had delivered over 3,000 first-line aircraft to the Luftwaffe and by 1939 that number had increased to almost 4,000 combat ready planes. In just a few years, Hitler had managed to reverse the fortunes of both the Luftwaffe and the aviation industry on which it relied.

But what airframes was the Luftwaffe investing in? The first and most important thing to understand about the German aviation industry in the years preceding the war is that turbulence in the Luftwaffe’s organization manifested itself in the pursuit of several different—and sometimes contradictory—aviation assets: “throughout the late 1930s, the Germans produced numerous plans for aircraft production due to constantly changing goals and priorities.” While the specific acquisition and production missteps of the Third Reich are well-documented elsewhere, there were some general trends that dominated aircraft production. Perhaps the most significant is that the majority of German interest in the mid-thirties was in light and medium bombers. By the best account of this period, the Luftwaffe had planned to procure nearly 1,200 medium bombers (including the Do 11, 23, Ju 86, Do 17, and He 111) in 1935 alone. Another 1,000 fighters were ordered and 500 airframes were allocated for dive bombers (He 123, He 50, and Ju 87) under these plans. Only three airframes were allocated to heavy bombers, almost certainly because German engine technology had flagged in the late twenties and never fully recovered. There were several reasons that the medium bomber became the preferred aircraft of the Luftwaffe, but most historians attribute its popularity to its ability to effectively perform several missions.

157 Homze, Arming the Luftwaffe, 92.
158 Murray, Strategy for Defeat the Luftwaffe, 12.
159 Ibid.
160 Homze, Arming the Luftwaffe.
161 Ibid., 130–33; Addington, The Blitzkrieg Era and the German General Staff, 1865-1941, 45.
162 Homze, Arming the Luftwaffe, 105.
163 Murray, Strategy for Defeat the Luftwaffe, 12–16.
164 Ibid., 7; Corum, “The Development of Strategic Air War Concepts in Interwar Germany, 1919-1939,” 23.
in a confrontation with Germany’s neighbors. Among other things, these medium bombers, particularly when employed with protective fighter cover, would prove very useful in battlefield and deep interdiction missions against France and Poland. In this way, the Luftwaffe’s priorities in the late prewar period appear to have been well-aligned with its short-term goals of executing several reinforcing airpower missions at once.

Though these estimates should be taken with a grain of salt given the well-documented idiosyncrasies of the Luftwaffe acquisition process, the priorities outlined in the mid-1930s serve as a helpful check on the doctrinal and training enterprises of the Luftwaffe during this period. The aspirational acquisitions programs developed by the Luftwaffe in the 1930s are suggestive of their priorities. Unlike in the American and British cases, the Wehrmacht and Luftwaffe leadership was careful not to allow the strategic mission to cannibalize preparations for tactical airpower operations. Instead, on the eve of World War II, the Luftwaffe was endowed with the tools to undertake a variety of missions in its neighborhood, and tactical airpower operations were first among them. When combined with the doctrine and training that the Luftwaffe had cultivated in this period to undertake tactical airpower operations against its neighbors in Poland and France, it was positioned to do real damage on the ground.

3.3 Trouble in Paradise? Disagreements Between the Air and Ground Forces
Although the Luftwaffe outperformed its peers when it came to cooperative learning about tactical airpower, the empirical record also reveals some fissures between the army and Luftwaffe that are important to acknowledge. Despite their cooperative approach to tactical

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166 Homze, *Arming the Luftwaffe*, 132.
airpower operations, there was some debate between the services regarding issues familiar to students of tactical airpower operations: centralization of air assets; close support (CAS) of ground units; and the balance of strategic and tactical airpower. I will review the contours of the debate around these issues.

As in the American and British cases, the centralization of air assets under a higher echelon air commander was met with some consternation in Germany, particularly among ground officers. Ground officers preferred having air assets under their control and focused on performing direct support of their operations. As in the other cases, however, the air forces chaffed at the notion that a ground officer, particularly in lower echelons, would fritter away air assets and prevent the concentration of firepower at theater-wide targets. This disagreement remained a perennial issue for the Luftwaffe, but reached the highest levels of debate in the early 1930s. Indeed, in 1932 the chief of the Troop Office in the Reischwehr, General Kurt von Hammerstein-Equord publically voiced his concern over air force control of aviation assets, when he proposed that “aviation would be divided into three branches, the greater part coming under the direction control of the army commander.” The plan was immediately and forcefully rebuffed by air leaders, who ultimately won the day, but the mere presence of such a high-level debate suggests that there remained some ground commanders who were dissatisfied with the prospect of handing over full control of aviation to air commanders. Although ground commanders would continue to grumble

168 Muller, The German Air War in Russia, 18; Boog, The Conduct of the Air War in the Second World War, 432–34.
169 Muller, The German Air War in Russia, 18; Murray, “British and German Air Doctrine Between the Wars”; Hooton, Phoenix Triumphant, 99–100.
171 Corum, The Luftwaffe, 87.
172 Ibid.
about this division of labor, by the late thirties the possibility of attaching Luftwaffe assets to ground units was considered a closed issue: "after 1936-37, not one single fighter group was assigned to the major army units, despite the repeated demands of the German Army." 173 By this time, not only had the maneuvers and exercises discussed above proven the supremacy of leaving the bulk of air assets unencumbered by attachment to specific ground units, but the appointment of Göring, who was unwilling to subordinate the Luftwaffe to the ground forces, served to silence most loud objections from ground commanders. 174 Just as important, Hitler’s resourcing ensured that the Luftwaffe had sufficient assets to attend to both its independent missions as well as close support, ground commanders’ concerns were quieted.

Related to the debate over the centralization of air assets under a single air commander, there were also significant disagreements about the necessity of direct support for engaged ground units. 175 As noted above, ground commanders in the prewar years were displeased with the level of close air support that was being provided by the Luftwaffe. There was good reason for this: the Luftwaffe was explicit in prioritizing air superiority and battlefield interdiction targets ahead of close or direct support. 176 They had been clear about this ranking since the early 1920s, no matter how loudly the ground commanders objected. 177 But as late as 1937, there remained an open debate between ground and air commanders about whether and how close support should be provisioned. Ultimately, this dispute would be resolved over the skies of Spain, where Field Marshal Wolfram von Richthofen would

174 Murray, Strategy for Defeat the Luftwaffe, 4-5; Homoe, Arming the Luftwaffe, 54.
175 Murray, Strategy for Defeat the Luftwaffe, 139-139; Corum, The Luftwaffe, 223; Knox, May 1940, 163; Cooling, Case Studies in the Development of Close Air Support, 74.
176 Corum, The Luftwaffe, 223; Knox, May 1940, 163; Cooling, Case Studies in the Development of Close Air Support, 74.
177 Muller, The German Air War in Russia, 18; Murray, “British and German Air Doctrine Between the Wars”; Hooton, Phoenix Triumphant, 99-100.
demonstrate the utility of having specially trained units available for use in close support missions along with a robust BAI and strategic bombing outfit. Like the command structure developed in 1934 that had both independent, regional air forces and a specialized headquarters for ground support, the Luftwaffe would bolster this capability in the late 1930s to better meet the demands of the ground forces and replicate the successes seen in Spain. Thus, as I will discuss in the following section, rather than redirect the Luftwaffe assets from air superiority and battlefield interdiction targets, the German solution to providing more robust close air support was to use its considerable resources to add specially trained units and allocate them to direct support of the battlefield.

Finally, there was the issue of the balance between strategic and tactical airpower in the Luftwaffe. Since the close of World War II there has been a great deal of misinformation spread about the Luftwaffe's consideration of and commitment to a strategic bombing capability. Among these is the myth that the Germans were uninterested in strategic bombing, and instead focused entirely on tactical airpower. However, the literature on the strategic bombing debate in Germany has grown in recent years and in an effort to correct the misleading and misinformed assertions of early scholars of the Luftwaffe, historians of German air doctrine have gone to great lengths to demonstrate that there was a vocal and powerful strand of air force thinking during the prewar period that advocated for strategic bombing missions. These scholars are correct in drawing our attention to the nuanced and multifaceted air doctrine that emerged in Germany, particularly in the 1930s,

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179 For an overview of the misinformation about strategic bombing see the bibliographic notes in: Corum, *The Luftwaffe*; Muller, *The German Air War in Russia*; Murray, *Strategy for Defeat the Luftwaffe*.
which conceived of a major role for strategic bombing. For example, the Germans published several formal and informal documents touting the importance of what they referred to as "operational" air warfare, but which had several components of the strategic bombing logic embedded in it.\textsuperscript{181} The most forceful exposition of this philosophy was articulated in two air force pamphlets, published in 1926 and 1930 respectively, which advocated first for the addition of strategic targets to the air forces' list of priorities and even went so far as to suggest the creation of a separate, supplementary "strategic air force," which would focus on targets deep inside enemy territory.\textsuperscript{182}

Despite this vocal advocacy for adding a strategic component to German air force doctrine, however, there is an important caveat. We should be clear that the German conception of "strategic bombing" was distinct from the Anglo-American conception of this doctrine and these operations never considered a replacement for tactical airpower operations.\textsuperscript{183} Although the doctrine for the German operational air war did include many strategic targets, these were considered one part of a much broader campaign against the adversary, which also included battlefield air interdiction and close support targets, and strategic campaigns were never considered an alternative to tactical airpower operations.\textsuperscript{184} Unlike the British and American strategic bombing advocates, Luftwaffe leaders still understood, accepted, and resourced the tactical airpower mission. Rather than seeing strategic bombing as a way to avoid ground conflict altogether, Luftwaffe leaders saw it as

\textsuperscript{181} Corum and Muller, \textit{The Luftwaffe's Way of War}.
\textsuperscript{183} Corum, "The Development of Strategic Air War Concepts in Interwar Germany, 1919-1939," 24–25; Muller, \textit{The German Air War in Russia}, 11.
a complimentary strategy to erode the enemy’s will to fight.\textsuperscript{185} In short, “the Luftwaffe [was] not considered capable, a priori, of settling a conflict by itself through its strategic role. Nor [was] it considered as a simple auxiliary force, limited, for instance, to the tactical role. It [was] situated between the two extremes.”\textsuperscript{186} Although technological challenges would impede the Luftwaffe’s ability to undertake strategic missions at long ranges, from a doctrinal perspective this dual emphasis on both tactical and strategic missions reflected their desire to develop a balanced force capable of executing several different types of missions successfully. Thus, Corum is correct when he notes “The German military developed a wide range of ideas and practical doctrines about air power, and, it can be argued, had by the start of World War II the most comprehensive systemic body of thought about airpower of all the major powers.”\textsuperscript{187} It was this comprehensive air doctrine—and especially its approach to tactical airpower—that would prove so deadly in 1939.

Despite the fissures that existed between the German ground and air forces during the prewar period over centralization and close air support, tactical airpower remained a priority for the Luftwaffe throughout the duration of this period. Moreover, the close cooperation between the air and ground forces in the prewar period made the implementation of this doctrine proceed smoothly in practice—command was centralized, superiority and battlefield interdiction missions were prioritized over close support, communication was robust, and training was provided to the highest degree possible. Although there were refinements that still needed to be made, the world was about to discover just how dangerous the Luftwaffe had become.

\textsuperscript{185} Muller, \textit{The German Air War in Russia}, 9–15.
\textsuperscript{186} Boog, \textit{The Conduct of the Air War in the Second World War}, 425.
\textsuperscript{187} Corum, \textit{The Luftwaffe}, 10.
Once the war began, the Germans proved equally adept at maintaining and refining their system of effective tactical airpower operations as they had been in developing tactical airpower principles before the war broke out. I describe in the first part of this section the way in which the Germans successfully preserved and enhanced tactical airpower operations during combat operations in two countries—Spain and Poland—in order to illustrate the ways in which the German military continued to learn once fighting began. In both of these theaters the Germans were able to improve on their tactical airpower system, and remained attuned to studying the lessons of the battlefield and making refinements in real-time. I conclude this section, however, with a discussion of later German performance in the Soviet Union in order to illustrate how, despite the efforts of the Luftwaffe, the strategic overreach of Hitler’s strategy could not be overcome by even the best learning organization. Instead, the Wehrmacht began to revert back to interservice competition over tactical airpower operations as resources failed to keep pace with Hitler’s growing ambitions.

4.1 Spanish Civil War: Refining Tactical Airpower Operations

Although several World War II combatants would participate in the Spanish Civil War, it was the Germans who capitalized most on this experience: in the skies over Spain, the Luftwaffe would confirm and refine several the core principles of tactical airpower operations, while also plugging holes that existed in its doctrine. When Hitler unilaterally decided that he would send his air forces to support the nationalist uprising in Spain, he could not have predicted that there would be such positive dividends for the air forces.
But, in 1939, the Luftwaffe was positioned well to continue improving their tactical airpower capabilities. Not only was the organization attuned to this mission set as a result of its orientation toward offensive ground combat, but the cooperative interservice relationship between the ground and air forces also ensured that improvements would continue to be implemented in practice.\(^{190}\) Thus, in the final accounting, the Luftwaffe’s experience in Spain was a boon for the German military.

Specifically, the Luftwaffe—known as the Condor Legion in Spain—gained four insights about tactical airpower operations while fighting abroad: first, it confirmed several of the core principles of their existing tactical airpower doctrine, including the need to prioritize air superiority and mass air assets; second, the fighting revealed the effectiveness of allocating a small number of specially trained air units to the close air support mission; third, Spain revealed some technical flaws with existing equipment; and, finally, the conflict demonstrated the effect of combat experience on pilot training. Below, I review each of these lessons in greater detail.

The first and most important lesson that the Germans learned and heeded in the Spanish Civil War was that many of the principles of their existing system for tactical airpower operations were effective.\(^ {191}\) In particular, the experience in Spain reinforced the importance of two components of tactical airpower doctrine: the need to prioritize air superiority and battlefield air interdiction strikes over close support, as well as the importance of concentration and mass at decisive points on the battlefield.\(^ {192} \) Moreover, the operations in Spain confirmed just how tightly linked these two principles of tactical airpower operations were in practice. In Spain, it became clear that it was only after


Luftwaffe fighter units had gained air superiority that its bombers and attack aviation were able to target the transportation, logistics, command, and supply centers in the rear of the battlefield. Senior commanders came to understand that whatever the target, dispersion of aviation assets would diminish the Luftwaffe’s effectiveness. Moreover, concentration of air assets proved decisive in several key battles during the Spanish campaign, and word of this success soon found its way back to the upper echelons of the Luftwaffe. In addition to concentrating on key targets, the fighting in Spain also revealed that attacking in waves would have a particularly debilitating effect on the enemy ground forces who would be unable to recover from the relentless barrage of air assets. Accordingly, the reports coming out of Spain confirmed the Luftwaffe’s preference to prioritize air superiority and battlefield interdiction targets, as well as their view that air assets should never be dispersed to individual ground units.

In addition to confirming many of the existing doctrinal principles for tactical airpower operations, the fighting in Spain also forced the Luftwaffe to consider and, eventually, accommodate principles that they were less keen to incorporate. As noted in the previous section, there existed in the Luftwaffe significant antagonism toward close support: “it was thought [in the Luftwaffe High Command] that the best way to support army operations was would be through indirect support, through air attacks in the rear areas of the combat and against the hostile armament industries.” But evidence from the Spanish battlefields clearly indicated that small, specially trained air units could effectively be


employed in close support of ground units. Moreover, it soon became clear that dedicating some portion of the air forces solely to this mission could have a devastating effect on the enemy’s engaged ground forces. Under the command of Richthofen, who had arrived in Spain as a skeptic of close support, the Condor Legion discovered that medium and dive bombers could be effectively employed against targets on the front lines. Having secured air superiority throughout most of the theater, Richthofen and his team of close support fighters and bombers were able to pick off enemy targets from artillery to troop concentrations all from the air. In doing so, Richthofen’s units also became attuned to and accommodating of the unique needs of close air support, including the communication and signaling burden of such missions:

Functioning as airborne artillery, the Germans learned of the dire necessity for close coordination with the ground forces. The importance of timing the ground assault with the air strikes was apparent and thus the necessity of having a Legion officer with the assault division, and he had to have immediate communications with the Legion Command Post.

As a result of this experience, Richthofen and others would eventually develop a system of mobile radio links that allowed air and ground units to remain in constant contact during close air support missions, but in the meantime air units worked with their ground counterparts to develop various signaling mechanisms to improve communications. The

200 Muller, The German Air War in Russia, 19; Cooling, Case Studies in the Development of Close Air Support, 75–76.
201 Proctor, Hitler’s Luftwaffe in the Spanish Civil War, 257–58; Murray, Military Adaptation in War, 139.
202 Proctor, Hitler’s Luftwaffe in the Spanish Civil War, 257.
result was the emergence of a small, but well trained, air force that was devoted exclusively to the mission of supporting ground units making a forward advance, and that had developed several effective solutions to the problem of communication and signaling in real-time.\textsuperscript{204}

The impact of this organization spoke for itself: Spanish forces facing Richthofen's combined air-ground team were quickly and easily overrun, unable to escape the punishing fire of the Condor Legion's fighter and bomber crews.\textsuperscript{205} Although the actual destructiveness of such attacks remains a matter of debate, as scholars now know that close air support operations in World War II rarely scored as many kills as were claimed, the effect of these attacks on morale in Spain and later in Europe is well documented.\textsuperscript{206} But Richthofen's success in Spain also revealed an important nuance about tactical airpower operations, specifically, that a small number of specially trained aviators could attend to many of the close support needs of the ground forces, especially if air superiority was secured. Under this arrangement, the Germans realized they could accomplish great deal with a relatively small close support force. Thus, while the actual quantity of specialized close air support units would remain limited in the Luftwaffe—until 1941, there was in fact only one air corps, VIII Fliegerkorps, dedicated to close air support—the outsized punch of these units in Spain was a key takeaway for many airmen who served there.\textsuperscript{207} Despite facing initially firm resistance from the Luftwaffe High Command, the system of close air support employed in

\begin{footnotesize}
\textsuperscript{204} In fact, to the observer of tactical airpower during this period, the system of close air support developed by Richthofen in Spain looked remarkably similar to the widely-heralded system developed by Pete Quesada five years later in Western Europe.

\textsuperscript{205} Proctor, \textit{Hitler's Luftwaffe in the Spanish Civil War}, 251-67; Corum, \textit{The Luftwaffe}, 182-224.


\textsuperscript{207} Boog, \textit{The Conduct of the Air War in the Second World War}, 439.
\end{footnotesize}
Spain gained a following among the senior officers fighting there and soon found a place—even if a small one—in Luftwaffe tactical airpower operations as a whole.208

In addition to cueing the Luftwaffe to the need for additional close support units, the operations in Spain cast some doubt on the effectiveness of certain equipment employed in the air campaign.209 First, the Spanish campaign revealed significant flaws in some aircraft like the Ju 52 bomber, which proved ineffective in combat and was repurposed as a transport aircraft.210 Similarly, there were also aircraft that were ineffective at their intended combat mission, but proved capable in other combat scenarios. For instance, the He 51 was jettisoned as a fighter since it could barely keep up with the Soviet-supplied aircraft employed by the Republican forces, but it was repurposed by Richthofen as a ground attack plane.211 In this way, the Legion’s combat operations in Spain proved useful not just from a doctrinal perspective, but as a proving ground for the evolving technical capabilities of Luftwaffe aircraft.

Finally, the operations in Spain made clear the importance of combat experience for the pilots themselves. By the end of the German involvement in Spain, nearly 19,000 airmen had rotated through the theater.212 In the process, they had become acquainted with the application of doctrine, command structure, communications tools, and the aircraft themselves. As one historian points out:

Due to the Spanish Civil War, by 1939 the Luftwaffe had more veterans who had participated in a modern air war than any other air force in western Europe. The Luftwaffe officers and

208 A common misconception about the Luftwaffe in World War II is that it devoted most of its resources toward close air support operations. By all accounts of close air support aircraft and operations, however, these claims appear exaggerated. For example, at the start of the Polish campaign, only 300 of the 4,000 or so combat ready aircraft were the famed Stuka dive bombers. For more see Muller, *The German Air War in Russia*, 20.


211 Proctor, *Hitler’s Luftwaffe in the Spanish Civil War*, 255.

212 Corum, *The Luftwaffe*, 220.
men who served nine- to twelve- month tours in Spain returned to their units and the lessons learned in Spain were quickly disseminated throughout the entire Luftwaffe.\textsuperscript{213}

The lessons learned in Spain were absorbed and adopted throughout the Luftwaffe as many airmen saw their effectiveness firsthand. Almost immediately, these airmen would be thrown again into operations on the continent, where it would soon become clear that their experience in Spain had helped repair the holes that existed in the German tactical airpower system.

Taken together, the lessons of Spain vis-a-vis tactical airpower operations were readily identified and adopted by the Luftwaffe. The experience in Spain confirmed the principles of mass and air superiority, refined the Luftwaffe’s close air support capability, pressure-tested new airframes, and provided combat experience to thousands of airmen. Although some in the Wehrmacht were skeptical that the lessons of Spain were applicable to future conflicts on the continent, the overwhelming majority of airmen found the experience to be a formative one. Ultimately, many of these changes were small, but had the Luftwaffe not been so well positioned to absorb these lessons after twenty years of cooperation with the ground forces, it is unlikely that they would have been willing to make such refinements.

\section*{4.2 Success in Poland}

When German pilots returned home from Spain in 1939, few knew just how quickly they would find themselves back in combat. It was only months later that Hitler would order the Wehrmacht to invade Poland. Here, I briefly review the record of tactical airpower operations in Poland, as well as the key takeaways identified by the Luftwaffe in the wake of the campaign. In doing so, two things are clear. First, the Luftwaffe’s performance in

\textsuperscript{213} Ibid., 255.
Poland demonstrated that the prewar learning about tactical airpower had been a success for Germany. But second, the Luftwaffe also proved capable of identifying and absorbing even the minor lessons of combat vis-à-vis tactical airpower operations. Both of these feats are equally suggestive of the strength of the German learning apparatus.

The Luftwaffe, fresh off of the campaign in Spain, had developed a capable tactical airpower machine by 1939. Not only had the experience in Spain influenced the thinking of frontline operators and senior airmen, but the lessons of the campaign had been studied by and integrated into operational practice. At a tactical level, many of the refinements were easy to make and were undertaken quickly. For instance, the problem of sustaining constant communication between air and ground units, particularly in close support missions had been a persistent issue in Spain. Recognizing that contact between air and ground units during close air support operations is a demanding but essential element of effective tactical airpower operations, Richthofen worked to integrate specially equipped command cars that would travel with armored columns using radio communications to maintain contact with air units overhead. But, as important as these tactical improvements may have been, the Luftwaffe also had a doctrinal and experiential advantage going in to Poland that could not be rivaled by any of its European peers.

In practice, the Luftwaffe's tactical airpower operations in Poland employed aspects of several of the core principles of effective tactical airpower outlined in Chapter 2: command was centralized, targets were prioritized, signal and liaison was robust, and the Luftwaffe pilots were well trained. Most observers of this campaign will point out that the Luftwaffe

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215 Corum, The Luftwaffe, 194; Muller, The German Air War in Russia, 222–24.
216 Corum, “The Luftwaffe's Army Support Doctrine, 1918-1941,” 70–73; Muller, The German Air War in Russia, 21–22; Hallion, Strike from the Sky, 132.
performed a remarkable dance in the skies over Poland—so good, in fact, the Germans managed to surprise even themselves with the effectiveness of the operations. But what, specifically, was notable about the Luftwaffe’s performance in Poland? In many ways, there was nothing particularly exceptional about the Luftwaffe’s tactical airpower operations—they simply executed well on the doctrine and training that they had developed over the course of the previous twenty years. What was striking, however, was just how effective that system proved to be when pitted against an unwitting adversary.

As prescribed in the Luftwaffe’s doctrine, the air campaign began with a series of attacks on the Polish air forces—both in the air and in the ground—in order to gain air superiority. After effectively destroying the Polish air force over the course of several days, the Luftwaffe’s medium bombers were deployed to find and destroy battlefield air interdiction targets, primarily attacking transportation and rail hubs in order to prevent reinforcements and supplies from making it to the battlefield. Communications and supply depots were also targeted to great effect. Finally, the small but well-trained close support assets were on hand to support the German ground force as necessary, and showed considerable flexibility as they were moved from supporting one ground unit to another. Throughout the Polish campaign, Luftwaffe commanders retained control over their aviation assets and employed them as needed to decisive sectors of the battlefield.

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Era and the German General Staff, 1865-1941, 74-82; Murray, Strategy for Defeat the Luftwaffe, 30-35; Muller, The German Air War in Russia, 21–22; Corum, The Luftwaffe, 271–75.
218 Muller, The German Air War in Russia, 21.
220 Corum, The Luftwaffe, 272; Murray, Military Adaptation in War, 140; Deichmann, German Air Force Operations in Support of the Army, 105.
221 Hooton, Phoenix Triumphant, 181.
In addition to the sequential and effective achievement of these priorities, the campaign in Poland also illustrated the importance of several small but impactful elements of effective tactical airpower systems. In terms of communications between air and ground units, Richthofen’s mobile command cars proved very useful during the Polish campaign.\textsuperscript{224} But it was also the FLIVOS system that had been developed by Wever three years earlier that ensured that Luftwaffe pilots were getting direct, accurate, and timely information about changes on the battlefield.\textsuperscript{225} Though problems with communications persisted, especially as the tempo of the ground force movements increased, the Luftwaffe outpaced their peers in ensuring that ground and air units were sharing information in meaningful ways.\textsuperscript{226} In addition to the impressive communications infrastructure that the Germans deployed, the logistics and supply supporting the Luftwaffe throughout the campaign was noteworthy.\textsuperscript{227} Even with the rapid advance, airmen had a robust supply force consisting of 117 motorized supply columns that managed to keep pace with the main advance.\textsuperscript{228} Taken together, all of these discrete advantages converged to ensure a favorable outcome for the Luftwaffe. And, indeed, it was this performance that they would repeat in France in the following May.

That being said, the Luftwaffe was also aware they there were still improvements to be made. While Hitler and Göring were celebrating their victory, Wehrmacht leadership—and especially those in the Luftwaffe—were closely studying their performance.\textsuperscript{229} In several

\textsuperscript{224} Corum, "The Luftwaffe’s Army Support Doctrine, 1918-1941," 70-73; Muller, The German Air War in Russia, 21-22; Hallion, Strike from the Sky, 132.
\textsuperscript{225} Corum, "The Luftwaffe’s Army Support Doctrine, 1918-1941," 70.
\textsuperscript{226} Hallion, Strike from the Sky, 131; Corum, "The Luftwaffe’s Army Support Doctrine, 1918-1941," 70; Muller, The German Air War in Russia, 21.
\textsuperscript{227} Corum, "The Luftwaffe’s Army Support Doctrine, 1918-1941," 69.
\textsuperscript{228} Ibid., 70.
\textsuperscript{229} Muller, The German Air War in Russia, 22; Murray, Military Adaptation in War, 141; Corum, The Luftwaffe, 275-77.
areas, Luftwaffe commanders saw room for improvement. First, smaller and more easily remedied issues, like the collocation of ground and air force headquarters, were identified and fixed. In addition, more substantial problems were aired. For instance, the issue of unreliable communications and delayed requests persisted. Despite the improvements made by Richthofen's command cars and the well trained FLIVOS, there remained complaints from the ground forces concerning friendly causalities and delayed responses. Relatedly, the Luftwaffe proved much more capable of attacking fixed targets than they did hitting forces on the move. Given the emphasis on mobility in the Wehrmacht, the Luftwaffe's inability to keep up did not go unnoticed. For these larger issues of communication and coordination, the Wehrmacht was quick to initiate further testing and development. By April 1940, the army and air forces were again engaged in joint maneuvers intended to examine close air support operations between Panzer and Stuka units in detail. Thus, on both large and small issues, the Luftwaffe was still attempting to distill and implement lessons for future operations. In other words, even with its successes, the Luftwaffe remained willing to critically analyze its tactical airpower performance and incorporate these insights into future operations.

4.3 Soviet Union: The Beginning of the End

230 Corum, The Luftwaffe, 277.
231 Muller, The German Air War in Russia, 21; Murray, Military Adaptation in War, 143.
232 Hallion, Strike from the Sky, 131; Murray, Military Adaptation in War, 143; Muller, The German Air War in Russia, 22.
233 Muller, The German Air War in Russia, 22; Murray, Military Adaptation in War, 141.
234 Given the importance of the eastern theater to the demise of the Third Reich, there are remarkably few studies of airpower in that theater. By far the most comprehensive is Muller, The German Air War in Russia. Several shorter, but still helpful, accounts can also be found in Public Record Office, Rise and Fall of the German Air Force; Murray, Strategy for Defeat the Luftwaffe.
There is no doubt that the early German victories in Czechoslovakia, Poland, France, the Low Countries, Greece, and Yugoslavia, stunned the world. The speed and violence with which Hitler had begun to realize his vision for global conquest was an unwelcome shock for many observers; and even Hitler himself could not have predicted the success that would meet his enterprise. Moreover, the collapse of the French and Polish militaries, which many believed would act as a check on German aggression, and the middling performance of the British forces in the early ground battles of the war did little to reassure Europe that Hitler could be stopped. But, by 1941, cracks in Hitler’s foundation were beginning to emerge: the Royal Air Force had successfully repulsed the Luftwaffe from its skies, and the Allied forces in the Mediterranean were steadily improving. Moreover, the diplomatic situation facing Hitler was growing bleaker. Although he had secured an alliance with the Italian and Japanese dictators, Hitler was now facing down the combined military might of the British, American and Soviet forces. Even so, Hitler believed that if he could defeat the Soviet Union with a rapid offensive, he would be able to continue his project of global conquest. 235

For their part, the Wehrmacht was trying to keep pace with Hitler’s expanding ambitions, but struggled to keep up. 236 This was especially this case in the Soviet Union, where the Luftwaffe attempted to meet the demands of the expansive battle that Hitler had waged. Fundamentally though, Hitler’s strategic overreach, accompanied with the mismanagement of industrial resources had put the Wehrmacht in an impossible position. 237 Without more men and materiel, the Wehrmacht—and the Luftwaffe in particular—could not meet the demands of the battlefield in the east. 238 Facing this resource deficiency, the

236 Corum, The Luftwaffe, 285; Murray, Strategy for Defeat the Luftwaffe, 78.
237 Muller, The German Air War in Russia, 230–35; Cooling, Case Studies in the Development of Close Air Support, 97.
238 Homze, Arming the Luftwaffe, 257–67; Deichmann, German Air Force Operations in Support of the Army, 126.
cooperative, collegial relationship between the Luftwaffe and the army began to falter. Unlike the previous decade, resources were strained, and the result was that difficult choices had to be made about battlefield priorities in the eastern theater. Under these circumstances, organizational pathologies reared their heads in the German case. No longer able to execute on its comprehensive vision of airpower, the Luftwaffe began to shift resources toward what it hoped would be a decisive strategic bombing campaign in the Soviet Union. Meanwhile, the army was becoming dissatisfied with tactical airpower operations, which were growing strained under the pressure of the Soviet Union’s expansive frontlines and the dwindling resources devoted to these operations. In the end, the Luftwaffe could do few of its missions well and was hampered by internal divisions over the best use of limited resources. Thus, the remainder of this section teases out the demise of Luftwaffe effectiveness in the Soviet Union.

Hitler and his advisors were counting on a swift victory in Soviet Union. After all, their continental invasions up until that point had led to the capitulation of some formidable adversaries. Moreover, Hitler’s invasion of the Soviet Union was intended primarily as a diplomatic enterprise—he hoped that by defeating the Soviets he could force the British to ally with his cause, so a quick, decisive victory would serve his purpose best.

At least initially, the German invasion of the Soviet Union seemed to go well-enough. As it had done several times before, the Luftwaffe began their attack with a series of surprise raids on Soviet airfields, supported by fighters taking out any Soviet aircraft that managed

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241 Muller, *The German Air War in Russia*, 132–35.
to make it off the ground.\textsuperscript{243} At the same time, the German ground forces drove into Soviet territory with the Luftwaffe providing close air support and battlefield air interdiction strikes.\textsuperscript{244} But the early gains of the Soviet campaign soon evaporated. The Soviet Union was not France, and conquering it would require a great deal more than a rapid surprise attack. Hitler had not accounted for the vast geographic, material, and demographic resources available to the Soviets that all but guaranteed that the invasion would devolve into a war of attrition.\textsuperscript{245} The Germans would need a large and high-functioning logistical system to supply the forces which were now stretched thin over the Soviet landmass, along with a bevy of replacement material and personnel to compensate for the losses incurred in a war conducted over such a massive expanse.\textsuperscript{246} Hitler's Wehrmacht was ill-prepared to wage such a campaign.

For the Luftwaffe, the invasion of the Soviet Union presented a host of challenges. First, there was the problem of supply and materiel, which became acute as the campaign continued.\textsuperscript{247} As one historian describes it:

The deeper that flying units moved in to Russia, the more precarious became their supply situation. By mid-July air units were crying for fuel and ammunition; and within the jumble moving forward to the spearheads, the Luftwaffe's logistical system functioned no more efficiently than that of the army.\textsuperscript{248}

\begin{itemize}
\item \textsuperscript{244} Public Record Office, \textit{Rise and Fall of the German Air Force}, 224; Deichmann, \textit{German Air Force Operations in Support of the Army}, 110.
\item \textsuperscript{248} Murray, \textit{Strategy for Defeat the Luftwaffe}, 83.
\end{itemize}
Moreover, the lack of robust fuel and supply lines over these vast distances served to exacerbate the challenge of maintaining and repairing aircraft over such large distances.\textsuperscript{249} The result was that damaged planes were often out of commission for long stretches of time, and even those aircraft that were still functioning had their operations constrained by fuel shortages. Perhaps if the Luftwaffe were not suffering high attrition rates, the need for maintenance and repair in the field might have been less problematic. But this could not have been further from the truth: in the early stages of the campaign, the Luftwaffe was losing aircraft at a rate not seen since the Battle of France, registering 16 percent losses in July 1941.\textsuperscript{250} Furthermore, in the critical category of combat ready aircraft, the Germans appear to have reached a plateau by 1939, and actually lost almost 500 first-line planes between 1940 and 1942.\textsuperscript{251} As a result of Hitler’s overconfidence, the Germans had begun their offensive into the Soviet Union with \textit{fewer} aircraft than they had when they invaded France.\textsuperscript{252} The result was that aircraft were going out of commission far faster than they could be repaired and returned to service, and those that were still in service were starved for fuel and supplies.

Even more problematic than the challenges of supply and maintenance on the eastern front, however, was the issue of the sputtering German aviation industry. It is difficult to overstate just how poor Hitler’s industrial war planning proved to be. Assuming that the easy victories in Poland and France would be repeated around the continent, Hitler had failed to invest in industrial production in Germany, particularly when it came to aviation

\textsuperscript{249} Ibid., 84; Cooling, \textit{Case Studies in the Development of Close Air Support}, 97.
\textsuperscript{250} Murray, \textit{Strategy for Defeat the Luftwaffe}, 89.
\textsuperscript{252} Ibid., 80; Cooling, \textit{Case Studies in the Development of Close Air Support}, 97–98.
Moreover, years of industrial mismanagement under Hitler’s political allies—many of whom lacked the qualifications for their roles—was beginning to catch up with the Luftwaffe. Heavy investment in vulnerable dive-bombers, along with abandoning the four-engine long-range bomber, meant that the German air fleet was weak in two critical areas. In addition, the advantages that the Germans had enjoyed in the other aviation categories were diminishing as the early investments of the Allied industrial effort were starting to bear fruit. The result was that, by 1942, the German aviation industry was faltering relative to its adversaries: not only was it not producing enough planes, but the aircraft it was producing were outmatched and ill-equipped to meet Hitler’s growing strategic demands.

Despite this bleak outlook, however, the Luftwaffe tried to remain adaptive throughout the Soviet campaign. The Luftwaffe continued to perform tactical airpower operations and even with the growing resource constraints they continued to make some improvements. As Richard Muller, the author of the most comprehensive history on the Luftwaffe in the Soviet Union, puts it:

Throughout the four years of the eastern campaign, German air force methods for cooperation with the army improved markedly in both the technical and operational spheres. Although equipped with aircraft designs ill-suited for the task, the Luftwaffe gave a good account of itself in support of ground operations from 1941 to 1943. Only when the scope of its operations became impossibly large, owing both to the expanding nature of the war and to its

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leadership's imprudent assumption of too many tasks, did the Luftwaffe lose the ability to gain a decision 'in the third dimension.'

Indeed, Luftwaffe units continued to employ the core tenets of the robust tactical airpower system. By fighting the battle for local air superiority, massing its forces at decisive points on the battlefield (primarily in the immediate rear) and continuing to employ its ever-improving close support capability, the Luftwaffe was able to make a significant contribution to the Soviet campaign, even as resources dried up.

But constrained resources would also begin to take their toll on the cooperative inclinations of the Luftwaffe. As the resource and supply challenges began to emerge, and especially after the start of 1943, some in the Luftwaffe believed that tactical airpower operations should no longer remain a priority for their forces. More specifically, as resources became increasingly scarce and the effectiveness of tactical airpower operations diminished in proportion, the air staff—at the direction of its new chief, General Gunter Korten—began prioritize strategic bombing over tactical air support. The argument supplied by these officers was that tactical airpower operations in support of bogged down ground forces could not deal a decisive blow to the Red Army, and therefore should be diminished in favor of a strategy that could: "The Luftwaffe High Command was beginning to realize that a policy of pure army support—4/5ths of the whole German bombing effort on the Russian front had been committed to this policy—could gain no decision against the

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258 Muller, The German Air War in Russia, xv.
259 Public Record Office, Rise and Fall of the German Air Force, 166–67; Muller, The German Air War in Russia, 218–27.
261 Public Record Office, Rise and Fall of the German Air Force, 239–40; Muller, The German Air War in Russia, 229–35.
262 Muller, The German Air War in Russia, 149–54; Public Record Office, Rise and Fall of the German Air Force, 239.
Russians. 263 Thus, by fall 1943, significant Luftwaffe resources had been shifted toward strategic targets. 264 While the historical record on this shift is murky, the few historians that cover this period in depth agree that the increasing resource constraints, accompanied by a series of brutal losses in tactical airpower operations, caused air leaders to chafe at the notion of "serving as the army's 'fire brigade.'" 265 Ultimately, the attempt to shift toward a strategic doctrine fell flat in practice, as the Luftwaffe had none of the aviation assets it would need to complete such a mission, but that did not stop a desperate Luftwaffe from trying. 266

At the same time, ground commanders were clamoring for more direct support of their advances. 267 Ground commanders knew what the Luftwaffe was capable of when they resourced close air support, as many of them had witnessed the effectiveness of Richthofen's forces in earlier campaigns. 268 But the expanse of the eastern front, combined with the diversion of aviation assets to strategic missions meant that tactical airpower operations were faltering. 269 In an effort to meet these demands at the end of the Soviet campaign, some senior commanders recommended that the Luftwaffe be split in two—with a strategic air force under Luftwaffe control on one hand, and a devoted close air support force under army control. 270 Ultimately, steps short of wholesale division were taken to further improve the responsiveness to ground requests, but the proposal of such a system in the first place

263 Public Record Office, Rise and Fall of the German Air Force, 223.
264 Ibid., 240; Corum and Muller, The Luftwaffe's Way of War, 149–87.
265 Muller, The German Air War in Russia, 114.
266 Ibid., 231–32; Murray, Strategy for Defeat the Luftwaffe, 88–94; Cooling, Case Studies in the Development of Close Air Support, 102.
267 Muller, The German Air War in Russia, 219–27.
268 Corum, The Luftwaffe, 243–49.
269 Murray, Strategy for Defeat the Luftwaffe, 80; Cooling, Case Studies in the Development of Close Air Support, 98.
270 Muller, The German Air War in Russia, 220.
is suggestive of the growing divisions between the once-aligned ground and air forces in the eastern theater.

In these ways, the latter half of the Soviet campaign ushered in new resource constraints on the Luftwaffe that put a marked strain on its ability to meet the many demands of the battlefields in the eastern theater. The result, as MFT would predict, was that fissures in the cooperative air-ground spirit began to impact operational outcomes, and the process of continual joint learning began to sputter. Though some remedies were attempted, neither the ground nor the air forces of the Wehrmacht were satisfied with operations in the eastern theater, as their once-shared priorities started to diverge. Germany’s defeat at the hands of the Soviets spared the Luftwaffe from spiraling wholesale into the same competitive interservice dynamics that were observed in the early American and British experience with tactical airpower but early indications were likely a signal of deeper problems to come. In the closing months of the eastern campaign the Luftwaffe was a shell of its former self, having unsuccessfully attempted to achieve too many competing priorities with too few resources. The result was disappointing for the Germans, but a boon for the Allies:

The same leadership that was capable of realistically assessing the operational situation in the east and furthering the development of such useful innovations and improvisations as close support, night ground attack, or specialized anti-tank aircraft also pursued a policy of strategic bombardment of Soviet war potential that was not merely ineffective, but positively detrimental to the smooth and concentrated employment of German air power in the theater.  

Despite their best efforts to retain and expand what they had learned over the past 25 years about tactical airpower operations, the emergence of resource constraints meant that the Luftwaffe became susceptible to the same organizational dynamics that had earlier plagued

\[27^{1}\] Ibid., 232.
the U.S. and Britain. In the end, nothing could insulate the Luftwaffe from the organizational and operational chaos that Hitler’s profound strategic failures would create.

5 Alternative Explanations

Altogether, the German experience illustrates just how powerful the combined effects of national military strategy and resource endowments can be when it comes to military learning. The values on these variables in the German case meant that the Luftwaffe was able to learn to successfully employ tactical aviation in support of ground forces before the war began. But in addition to their ability to learn during peacetime, the Wehrmacht was also able to continuing learning and refining well into the war. The learning process only ground to a halt when resource endowments became constrained as the war progressed.

But there are, of course, other explanations that may offer some insight into the German learning experience during this period. In this section, I review the alternative explanations outlined in Chapter 1. First, I address the explanations that point primarily to the unique dynamics of wartime as catalysts for learning: threat/failure and theater necessity. From there, I consider the possibility that other variables are doing the explanatory work in this case, including: emulation, civilian intervention, internal bargaining, and dissemination. I find that none of these explanations are theoretically or empirically more compelling the explanation provided that of MFT.

5.1 Threat/Failure and Theater Dynamics

More than any other alternative explanations, those that rely on the eccentricities of war to explain the learning process are easily rebuffed by the German case. Indeed, the simple fact that the Germans were able to successfully learn to perform tactical airpower operations
in the period between the First and Second World Wars casts doubt on the notion that wartime dynamics are necessary for military learning to occur.

Even so, however, proponents of this view could argue that the idiosyncrasies of the German experience during the interwar years effectively replicated the conditions of the wartime environment. These scholars might argue that the severe resource constraints imposed by the Treaty of Versailles in fact replicated the feelings of fear and threat at an organizational level that militaries traditionally only feel during wartime. These circumstances would force the organization to look outside itself for new solutions and induce an openness to cooperation that in more propitious circumstances would be shunned. Thus, the argument would go, the cooperative evidence we observe during the prewar period in the German case would be operating by the same logic of wartime dynamics, despite being catalyzed by different circumstances.

Fundamentally, however, this explanation stretches its logic too far. Indeed, confirming evidence of a theory’s the logic that does not also confirm the its cause is practically useless. If wartime dynamics are not necessary for generating the conditions that induce learning, explanations that point to its causal significance have very little value. Although the German case confirms that threats to organizational survival in peacetime may create similar conditions as threats to actual survival on the battlefield, it cannot be used as confirming evidence of wartime theories of military learning.

5.2 Emulation

Explanations that emphasize imitation or emulation on the part of the Germans during the prewar period fare somewhat better than those which emphasize wartime dynamics. The logic of such a theory would be straightforward: the Germans, seeing the successes and failures of other states employing tactical airpower operations during the skirmishes and
small wars of the period between the two World Wars simply adopted elements of these systems into their own operations.

To a certain extent, the behavior of the German general staff during this period would seem to confirm, at least in principle, that the Luftwaffe was capable of identifying and learning from the experiences of other states. This was especially true in the immediate aftermath of World War I, when the Versailles restrictions limited the amount of air training and testing that the Germans could do themselves. As a result, the German general staff was keen to identify and assess the doctrine of other states. For instance, when weighing the benefits of strategic bombing doctrine, the Germans looked to the debate that had taken root in England and the United States. At least in theory, then, one could imagine that the German general staff chose to adopt the tactical airpower system of a state they had observed on the battlefields of World War I or from their study of contemporary doctrinal developments.

There are two main problems with this explanation. The first is an empirical one, namely, that while the Germans studied the doctrine of strategic bombing in other states, there is little available evidence to suggest that they did the same for tactical airpower operations. Moreover, the lessons that the Germans took from World War I were, by all accounts, lessons related to their own tactical airpower systems, as opposed to those of their adversaries.

The second, more difficult problem for this explanation, is that even if we concede the possibility of emulation, it is not clear who the Germans would have been imitating during this period. Although some states had employed small portions of the tactical airpower system described in Chapter 2 toward the end of World War I, most of those states were far from adopting the complete standard of effective tactical airpower operations. It was in fact the Germans who were first able to conceive of such a
comprehensive system for these operations. The German air forces had begun to adopt many of the core principles of tactical airpower operations as early as 1921, and certainly by 1935 they had explicitly and actively incorporated them into their doctrine—a full four years before the Americans and British had even acknowledged the problem. For their part, the Soviet and French air forces were out of date in solving the problems of tactical airpower operations, and were unlikely to provide many clues for the Germans in the prewar period. Instead, these tactical airpower solutions that the Germans were able to identify and implement during the interwar period were very much the product of a careful analysis of their own experiences in World War I, and their detailed assessment of their goals and resources during the prewar period. Thus, even if we concede that it is possible that the Germans could have engaged in some imitation there is little evidence to suggest that they did so and, more importantly, who they would have imitated in the first place.

5.3 Civilian Intervention

Proponents of the civilian intervention school would argue that it was civilian intervention—spurred by the prospect of impending war—that forced the German military to identify new problems and implement their solutions. At first glance, the German case would seem to present good evidence for this explanation. Indeed, it was not until Hitler directed resources and personnel toward the tactical airpower mission in the late 1930s that the Luftwaffe's tactical airpower system began to improve. Moreover, the empirical record is clear that Hitler was known to intervene on military matters at both the strategic and tactical levels. It seems plausible then that it was the interventions of Hitler into the practices of the Luftwaffe that catalyzed learning and the implementation of solutions related to tactical airpower operations.
On closer examination, however, this explanation proves less compelling. In particular, two problems stand out. First, there is the issue that the German air forces had both identified and begun to implement the standard for tactical airpower operations before Hitler arrived on the scene. As noted previously, Hitler's strategy was largely a continuation and expansion of preexisting military goals and, therefore, his interventions served to deepen investments in preexisting military priorities and solutions. But this point is not damning by any measure: deepening and expanding the Luftwaffe's commitment to this issue could, in and of itself, be considered decisive in the successful completion of the learning process.

What is more problematic, however, is that Hitler's interventions in this space were often counterproductive. Although Hitler did direct significant material resources to the Luftwaffe, his personnel interventions served to undermine much of its practical effect. His appointment of several political cronies, with virtually no experience or interest in running an efficient and effective air organization, meant that most individuals in the upper managerial echelons of the Luftwaffe were undermining attempts at lower levels to implement the systems that had proven so effective in early testing and training. Moreover, Hitler was equally adept at removing those officials who were advocates of robust tactical airpower systems for their lack of loyalty and their criticisms of his unwise political and strategic maneuvering. The result was that Hitler's interventions to provide additional resources were squandered by the personnel that he had appointed. Indeed, it is only because of enterprising officers at lower levels—and their ability to flout his personnel interventions—that failure was staved off for so long. Thus, even the most generous assessments of Hitler's interventions could only argue that his interventions were, in part, helpful to the tactical airpower cause; and, more accurately, would have to admit his interventions in other respects undermined progress in this respect.
5.4 Internal Bargaining

As in the American and British cases, there is the little empirical evidence in the German experience confirming the internal bargaining theory. If this theory were true, we would expect that the German success in learning about tactical airpower operations was preceded by years, if not decades, of internal debate about different approaches to the employment of aviation in war. Only after this debate had been resolved, and the proponents of tactical airpower operations had been elevated to positions of authority in the German military should we expect to see the Germans taking this problem seriously.

In a limited way, there is some evidence that proponents of tactical airpower or, more broadly, a joint approach to warfare, had risen to the most senior ranks of the German military during the prewar years. As noted above, von Seeckt was an ardent supporter of combined arms and joint warfare, and it was this commitment that led him to appreciate the need for a coequal alliance with the army in the immediate aftermath of World War I. Similarly, Sperrle and Richthofen, two of the most vocal advocates of close air support were in senior positions at the outset of the war. Thus, proponents of this view might argue that the dominance of officers who believed in joint and combined warfare led to the successful identification and implementation of tactical airpower systems in the German case.

However, while theories of internal politicking may help us understand the success of tactical airpower learning in the early part of the war, it can tell us much less about the backsliding that occurred with tactical airpower operations in the eastern theater. Indeed, these theories cannot explain why implementation began to falter over the skies of the Soviet Union; little about the composition of senior German military leaders had changed but, as we have seen, the provision of effective tactical airpower operations in the theater began to falter. In this context, it is not enough to simply say that disagreements between senior leaders emerged in the eastern theater—as proponents of this view might argue—
instead, it is important to be precise about why these disagreements emerged when they did. For answers to that more difficult question, we must look theories like MFT for additional analytical clarity.

5.5 Dissemination Networks

Finally, theories that emphasize the role of dissemination networks in explaining German learning about tactical airpower also fall short in the face of evidence from the case. For proponents of this view, the logic is that it was the robust German information processing and dissemination structure that allowed it to surpass its peers in learning about tactical airpower. To a certain extent, the robust and flexible communications infrastructure that existed in the German military supports this proposition. The Germans have long been admired for their ability to successfully manage the flow of information, as well as their ability to avoid the pitfalls of micromanagement. Nowhere was this more the case than during the prewar period, when the Germans first created a vast, intricate, and covert information dissemination network for sharing new ideas not just on tactical airpower operations but on broader issues of airpower and warfighting. Moreover, their reputation for impressive communication only grew in the lead up to World War II and in the early campaigns. As many scholars have pointed out elsewhere, the Germans were notorious for making sure that cutting edge information and technology was disseminated throughout the force through both official and unofficial channels.

As with the British and American cases, however, this explanation falls short in explaining the sources of this information. Again, the communications infrastructure of a military organization is only as useful as the information put in to it—a military that speedily and effectively communicates bad ideas is no better off than a military that does not communicate at all. Although this theory may tell us something about the German
success in implementing solutions to the tactical airpower problem, it reveals little about where these ideas emerged from in the first place. For answers to that critical question, we must look elsewhere; and for this reason, this theory falls short.

6 Conclusion

The evidence presented above provides strong confirming evidence for Military Filtration Theory. Not only does it confirm MFT’s prediction that the longstanding German commitment to fighting an offensive ground war against its neighbors would make the Luftwaffe especially attuned to the problems of air support of such operations, but the evidence also confirms its prediction that the nature of German resource endowments served to influence the process of implementation of solutions to the tactical airpower problem. During the prewar period, the German focus on ground operations was meaningfully implemented when Hitler lavished resources on the military. The dividends of such cooperation were put on display during the Spanish Civil War and the early campaigns in Western Europe, all while the Wehrmacht continued to refine and improve on an already impressive system of tactical airpower operations. It was not until significant—but not fatal—resource constraints returned during the Soviet campaign that the cooperative alliance between the two services began to fray. During this phase, the realities of limited resources compounded by organizational and operational disagreements about how to best use the limited aviation assets began to undermine the years of exceptional growth and improvement that the Luftwaffe had exhibited.
Chapter 6: Conclusion

1 Summary of Findings

1.1 Argument

Above all else, this dissertation has attempted to explain how militaries learn during wartime. To do so, I have proceeded in three reinforcing steps: first, I have articulated a more precise conception of learning; second, I have developed a theory of wartime military learning; and finally, I have tested my theory against evidence from the British, American, and German experiences in World War II. Here, I review the main conclusions and contributions of each of these steps.

The first goal of this dissertation has been to develop a more nuanced definition of learning than has been applied in previous work. I have defined learning as a process consisting of two separate, but equally important, phases: identification of the problem and the implementation of a solution. In defining military learning in this way, I have been able to assess not just whether a state learns the right lessons from war, but how it proceeds through both of these stages. As a result, I have been able to demonstrate that there is considerable variation in the process of learning that has real implications on the battlefield even among states that, on the surface, appear to have learned successfully.

Second, I have developed a theory of wartime military learning to explain the variation we observe in this process, Military Filtration Theory (MFT). MFT relies on two variables to explain how states move through the learning process: (a) national military strategy; and (b) resource endowments. In the first stage of learning, identification of the problem, MFT predicts that national military strategy, i.e. the type of war a state believes
it will fight, will be the most influential determinant of whether and how a state
acknowledges and studies a given military problem.

But problem identification is not the same as implementing a solution to that
problem. Accordingly, MFT looks to a different explanatory variable at this second stage
in the learning process: resource endowments. I argue that the distribution of resources can
heighten or ease tension within the military and will, therefore, influence when and how
new concepts are implemented. I argue that where resources are abundant, we should expect
interservice tension to be low and, therefore, implementation of the lessons to occur. On the
other hand, where resources are scarce, interservice tension is likely to be high and we
should expect implementation not to occur.

Taken together, MFT predicts that national military strategy and resource
endowments will influence the two phases of the learning process. In the first phase—
identification of the problem and potential solutions—national military strategy will dictate
which issues are acknowledged and studied further. In the second phase of learning—the
selection and implementation of solutions—resource endowments will influence whether
known solutions are readily deployed on the battlefield. In this way, MFT is able to provide
more precise estimations of why and how militaries should move through the entire process
of learning.

Finally, to test this theory, I ask whether MFT’s predictions are borne out in a novel
set of empirical cases: learning about tactical airpower operations in Britain, America, and
Germany during World War II. I apply my theory to tactical airpower operations in this
period for several reasons. First, tactical airpower operations represent a difficult subset of
military learning: joint operations. Learning about these operations presents an especially
high bar for theories of military learning—one which, if cleared, provides strong evidence of
a theory’s applicability in less difficult learning environments. In addition, there is
considerable variation between each states' learning process with regard to tactical airpower operations in World War II. I also chose to focus on tactical airpower operations since these tasks have emerged as perennial and favored military mission for many world powers. Finally, as I note in Chapter 2, these operations had a significant influence on battlefield effectiveness during World War II and, to be sure, in modern battlefield contexts as well. As a result of its extensive use, then, a close study of this subset of operations will in-and-of-itself make an important contribution to the field. For all of these reasons I focus on learning about tactical airpower operations during World War II.

But what exactly does this empirical testing of the theory find? In the remainder of this section, I review the predictions of MFT in each empirical case considered, along with a brief summary of the evidence brought to bear in each of the previous chapters.

1.2 British, American, and German Tactical Airpower Operations

In each of the cases under consideration in this dissertation, MFT makes three core predictions about what we should expect to see if its logic is borne out in the empirical record. First, it predicts that states with deterrent air and sea-based national military strategies in the prewar period should be unlikely to consider or acknowledge the problems of tactical airpower operations, which are more closely related to the conduct of offensive, ground warfare. Where states' military strategies are concerned with offensive ground operations, however, we should expect tactical airpower operations to be acknowledged and studied closely. Second, MFT predicts that if and when states do start to acknowledge the problems associated with tactical airpower operations, it should be a result of their national military strategies shifting toward offensive, ground operations. Only then would MFT predict that tactical airpower operations attract the attention necessary to initiate the meaningful consideration of its problems and solutions. Finally, however, it predicts that even in states that have acknowledged and developed solutions to the problems of tactical
airpower, we should not expect to see widespread implementation until air resources in the theater are sufficient to meet the ground forces’ needs without coming at a considerable cost the air forces’ preferred missions. In the remainder of this section, I briefly review whether and how the case evidence in Britain, America, and Germany coheres with each of these predictions.

More so than any of the cases under consideration in this dissertation, the British experience learning about tactical airpower operations adheres most closely to the predictions of Military Filtration Theory. In this case, MFT makes three predictions. First, that Britain’s deterrent military strategy during the prewar period would prevent it from acknowledging the problems of tactical airpower operations. Second, that changes in British national military strategy toward a more offensive, land-oriented strategy, forced the military to become more attuned to the problems of tactical airpower operations. Finally, MFT predicts that despite identifying a solution the many challenges of tactical airpower, the persistent resource constraints facing the Royal Air Force should have prevented implementation of identified solutions until resources available in the theater increased.

The evidence in the British case closely matches the predictions of MFT. For the bulk of the prewar period, the British military strategy, which heavily emphasized deterrence by air, meant that tactical airpower operations went ignored. It was only after the Battle of France, when the British came to recognize that they might need to fight an offensive ground war that they were willing to acknowledge and devote resources to study the problems of tactical airpower operations. As a result, within months of the debacle in France, the British military had identified many of the core components of a solution to the problems of tactical airpower operations. However, delays in the implementation of this solution lasted almost three years as a result of resource constraints. It was not until the provision of additional airpower resources were actually deployed to the theaters of
operations in late 1942 and early 1943 that we see the widespread deployment of this new, effective system of tactical airpower operations. In this way, the British case confirms many of the predictions of Military Filtration Theory.

The American experience learning to employ tactical airpower operations provides confirming evidence for Military Filtration Theory, but also illustrates some important caveats. In the American case, MFT also makes three predictions. First, as in the British case, it predicts that the deterrent American military strategy in the prewar period would allow U.S. leaders to remain unaware and unconcerned with the problems of tactical airpower operations. Similarly, the fall of France in 1940 and the entry of the British into the war should have served to shift American attention toward the problems of offensive ground war, and we should see the consideration and study of tactical airpower operations during this period. Finally, once the American industry began to provide significant numbers of aviation assets for operational use in late 1942 and 1943, we should see the implementation of these identified solutions.

In general, the evidence in the American case adheres to the predictions of MFT. The evidence suggests that the fall of France caused a shift in national military strategy that led to increased attention to the tactical airpower problem set. However, in the absence of meaningful resource abundance it appears that the United States delayed implementation of these solutions until American industrial capacity began to supply abundant operational aircraft in late 1942. But in addition to confirming the core predictions of MFT, the American case also cues us to several reinforcing—if not independently decisive—factors that may have influenced American learning about tactical airpower operations. Perhaps more so than any other alternative explanation, the importance of failure emerges in the U.S. case. After all, the American airpower failings during Operation Torch appear to have helped convince Allied leaders to intervene explicitly on the issue of tactical airpower
operations in late 1942, and his interventions precipitated significant changes at the Casablanca Conference in early 1943. Thus, the battlefield failures experienced during Operation Torch almost certainly had a role to play in the implementation phase of American learning about tactical airpower operations. That being said, it is unlikely that even these interventions regarding tactical airpower operations in the wake of Torch would have had any meaningful impact absent the presence of abundant resources in the theater. Accordingly, although wartime failure adds some additional color to MFT’s explanation of the American case, it appears to be ancillary to the theory, as opposed to contradictory.

Finally, in the German case, MFT makes very different predictions about the process of military learning about tactical airpower operations than in the British and American cases. In the German case, MFT predicts that Germany’s longstanding commitment to fighting offensive ground wars should have made it attuned to the problems and potential solutions of tactical airpower operations well before the start of World War II. In addition, it argues that we should see significant implementation of these solutions before the war breaks out, for two reasons. During the first part of the prewar period (1920-1933) several idiosyncratic factors converged to make effective tactical airpower operations a priority for both the air force and army. Among these factors, the severe restrictions on air force development imposed by the Treaty of Versailles meant that the Luftwaffe needed the army in order to survive. From 1933-1939, however, it was the infusion of aviation resources at Hitler’s insistence that MFT predicts would ensure the continued implementation of effective tactical airpower systems. Only as those resources became constrained over the course of the war does MFT predict that widespread implementation of effective tactical airpower systems should begin to diminish.

Like the British case, the existing empirical evidence on German learning about tactical airpower operations appears to adhere to the predictions of Military Filtration
Theory. Not only did the German military become aware of and closely study the problems of tactical airpower operations early in the prewar period, but it went on to consistently and broadly implement effective solutions to this problem for the duration of the prewar years. It was only after the Luftwaffe’s resources became strained that widespread implementation of tactical airpower operations started to wither.

As I note in each of the empirical chapters, there are, of course, limits to the explanatory power of Military Filtration Theory. Many of the alternative explanations in the existing literature are better thought of as complimentary than competing. That being said, none of the alternative explanations considered in this dissertation provide as much granularity and insight alone as that provided independently by MFT. As a result, MFT is, relatively, a more robust explanation of the empirical realities of learning about tactical airpower operations in World War II than those that currently exist in the literature on military learning.

2 External Validity

But even if we concede that the weight of the evidence in the British, American, and German cases confirms the predictions of Military Filtration Theory, there remains the question of whether and how applicable this theory is to operations, wars, and organizations outside of those considered here. Accordingly, I briefly review in this section two of the primary arenas in which MFT could be brought to bear; and, in doing so, I provide some initial evidence suggestive of MFT’s external validity.

The first question about MFT’s external validity relates to whether its logic stands the test of time. In other words, does MFT accurately predict the behavior of states toward learning about tactical airpower in the modern context? In this respect, the stakes are high. Scholars of World War II often suggest there is much to learn from this conflict, but there remain concerns about the unique dynamics of this particular war and the incentives that
it created for learning, effectiveness, and warfighting in general. Fortunately, on this score, MFT performs well. A cursory look at the history of tactical airpower operations, certainly in the United States and Britain, confirms that the patterns identified by MFT in World War II have been repeated in most major conflicts to this day.

But what specifically would MFT predict regarding contemporary tactical airpower operations? As in World War II, MFT would argue that absent the immediate military need for tactical airpower operations to be performed effectively, there are powerful organizational impediments that would lead militaries to ignore the development of this capability. Moreover, even in the states where there is attention paid to this issue, there remains the need for resource abundance for effective tactical airpower operations to be realized in practice. As we have seen, even in wartime, these conditions rarely exist at the outset, and often take some time to develop fully. Moreover, both of these conditions rarely apply in peacetime, when there are even fewer resources and less concern with the possibilities and needs of warfighting. Taken together then, MFT would predict, first, that wartime learning about tactical airpower operations will be perennially difficult for most states; and, second, that we should also expect the dividends of preexisting learning about tactical airpower to be short-lived in peace.

In both of these respects, the empirical record—at least in modern British and American history—supports the predictions of MFT. First, learning about tactical airpower has remained a persistent challenge in Britain and the United States in nearly every major conflict since World War II, as national military strategies and resource constraints make them both disinclined to think about these issues or provide the necessary capabilities to perform them.1 Similarly, in both of these states, learning about tactical airpower operations

quickly dissipates with peace, as interest in and resources provided for the issue of tactical airpower operations consistently decline. Thus, at least broadly, MFT performs well in explaining the modern record of U.S. and British tactical airpower operations.

From the perspective of external validity, however, there remains a second question: how does MFT perform in explaining learning about joint tasks other than tactical airpower operations? For example, what would MFT say about a state learning to perform Antisubmarine Warfare (ASW) during World War II, which required the navy and air force to work closely together to hunt enemy submarines? As noted above, MFT would argue that a state's performance in learning about these operations would be linked first, to its national military strategy and, second, to its resource provision vis-à-vis the navy and air force. Specifically, MFT would predict two things. First, in states with offensive, ground-based military strategies, like Germany, MFT would predict that ASW would garner little attention, unless and until the state's military strategy shifted to a more expansive vision of cross-ocean conquest. On the other hand, states whose national military strategy is concerned with fighting a war on the seas should be more likely to consider these issues to be paramount. Second, MFT would predict that absent abundant naval and air resources we should not see implementation in any of these states even if they have recognized the problem. Like the army-air force relationship, the navy-air force relationship should be equally tense. Accordingly, we should not expect cooperation between the services in any state, unless and until doing so does not come at a cost to their preferred independent missions.

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Testing the predictions of MFT against the extensive empirical record on ASW during World War II would require more time and consideration than is available here. Broadly, however, the history of ASW during this period raises some interesting, if incomplete, points vis-a-vis navy-air force cooperation in World War II. In the British experience with ASW, for example, there is some evidence that is supportive of MFT’s predictions. For instance, despite the longstanding national commitment to fighting wars at sea and the recent experience of World War I, the Royal Air Force remained largely unconcerned with the problem of ASW before the war began. The Royal Navy, on the other hand, paid more attention to this issue, but was overconfident in its ability to meet the ASW threat independently. In this way, MFT’s predictions are borne out in the context of the prewar Royal Navy experience with ASW, but appear to have less traction in the RAF context.

MFT may also help us understand the evolution of Navy and RAF cooperation regarding ASW once the war actually commenced. Indeed, in the early part of the war, an unusual set of circumstances meant that the RAF had the resources necessary to meet the German submarine threat. Specifically, the rejection of two engine bombers by Bomber Command meant that those planes could be repurposed for ASW missions, which at that time were primarily concentrated around the British Isles. With enough resources in hand to meet the relatively-limited German submarine threat, the RAF and Royal Navy were largely in agreement about the importance of both air and surface convoy escort to meet the threat. However, as the German submarine menace expanded further into the North Atlantic, Coastal Command had only a small force of very long range (VLR) aircraft capable of escorting convoys there. The result was an acute resource scarcity related to ASW in the North Atlantic. In the face of this scarcity, Coastal Command chose to focus on increasing its independent, offensive air patrols using existing aircraft, rather than developing and
committing VLR assets that could escort convoys at long ranges and effectively counter the German U-Boat threat. Thus, once scarcity arose, doctrinal fissures between the RAF and the Navy that had been latent early in the war began to emerge, and the fragile interservice agreement became badly strained. In this limited way, the evidence related to ASW during World War II suggests that at least some of MFT's predictions are applicable outside of the tactical airpower context. However, there is much more nuance and empirical richness to the ASW story during this period. As a result, in future work, a more extensive consideration of this topic would be warranted.

Thus, MFT appears to perform well both outside of the World War II context and applied to different types of joint operations. This does not mean, however, that we should expect MFT to successfully explain all cases of military learning. Indeed, there are several areas that are outside the scope of this theory, primarily because the learning process would take place in environments with sufficiently different strategic or organizational dynamics at play. Where the strategic or organizational environment is sufficiently unique, MFT's explanatory power may be more limited.

That being said, there are other areas in which I would expect that the theory will hold up under similar conditions. For instance, I would expect MFT to provide insight into the process of intraservice learning about tasks like combined arms or amphibious assault operations during conventional military operations, where many of the same organizational and strategic dynamics are at play. Similarly, MFT should be able to tell us something about joint learning in other types of wars, including unconventional and counterinsurgency conflicts, although it may require some revisions given the different strategic contexts at play. There may also be some non-Western militaries whose experiences with joint operations can be explained by MFT. Thus, both of these environments would provide fertile testing ground for extensions and refinements of MFT. To do so, of course, is well
beyond the scope of this dissertation, but these areas may offer interesting terrain for further exploration by future scholars of military learning.

3 Implications

Putting aside concerns about external validity for a moment and, instead, taking MFT simply as a robust explanation of learning about tactical airpower operation in World War II, there remain several important implications of the findings in this dissertation. Here, I briefly review several of these contributions to both the theory and practice of military learning.

The first set of contributions made by this theory are largely academic in nature. Four, in particular, stand out. First, this dissertation makes clear that the entirety of the learning process matters a great deal for our understanding of it. Too often, scholars of change, innovation, adaptation, and learning in the military have focused their attention on one or the other of the two phases of learning—identification or implementation—rather than both. Though much of the work in this field is implicit about these stages, rarely do they acknowledge explicitly not just that two phases exist but that each phase has unique dynamics. As this dissertation has shown, however, different variables prove important in different phases of learning. In addition, conceiving of learning in this way allows us to uncover and explain more variation in learning—some states may struggle more with implementation than identification, and vice versa. Moreover, the necessary interventions to shake loose these bottlenecks may be different. It is only by explicitly defining learning as a phased process, which states can move through differentially, that we can come to any genuine understanding of its operation in the military context.

Second, the findings of this dissertation have confirmed what many scholars have foreign policy and military operations have long known: strategy matters. Not only does it matter at the highest levels of grand strategy, but those larger strategic plans trickle down
to military preparedness in clear and important ways. The Germans were better prepared
than the British and United States for the impending fight because their national military
strategy required them to be. Moreover, in the context of learning, it is important to note
that military learning starts first with changes at the highest levels of civilian strategizing.
Absent these changes, we should not expect the military to miraculously overcome its
longstanding and deeply-entrenched organizational preferences and initiate learning
independently. Thus, the importance of both grand strategy and military strategy should
not be underestimated.

Third, my findings confirm the view that resources matter immensely to military
learning and change, but amends and expands the existing work on the importance of this
variable by testing it in the joint context. More specifically, I illustrate that the relationship
between resources and joint learning is linear—where resources are scarce joint learning will
be difficult, but where they are abundant, joint learning will face less resistance. In doing
so, I am able to expand the existing literature’s insights on the impact of slack versus
scarcity.

Finally, my empirical work demonstrates the importance of applying hard tests and
high bars to theories of military behavior. Indeed, the observations about learning and
change made here are unlikely to have been revealed in less challenging empirical contexts.
High empirical bars allow us to refine and expand existing theories of learning and change,
and that has been the underlying goal of this dissertation. I have aimed to distill additional
nuance and granularity by testing theories of military learning, including my own, in a
challenging empirical context and, in doing so, I have developed a deeper understanding of
this process.

Just as important as these theoretical and empirical contributions to the academic
literature, however, are the ways in which the findings of this dissertation can be brought
to bear on practical matters of military learning. In this respect, four additional observations stand out. First, and perhaps most important from a practical perspective, this dissertation has demonstrated quite clearly that interservice collaboration and competition are complex phenomena. Civilian and military leaders who believe that telling the military to “be more joint” will result in meaningful changes across the board are in for a nasty surprise—interservice cooperation is not easy, and we should not expect it, even in the face of extraordinary circumstances. In both peace and war, demands for jointness must be accompanied by persistent, careful, and calibrated interventions in order for real changes to be made and, just as important, for that collaboration to occur in the right places. Military cooperation can—and should—be cultivated, but success in this enterprise will only result from careful and deliberate interventions.

Second, and related, this dissertation has gone to great lengths to illustrate just how powerful organizational interests and biases can be, even in the face of extraordinary incentives to relinquish them. Even in war, the legacies of cooperation and competition that exist between the services can act as potent breaks or accelerants of learning. Acknowledging that these interests are both predictable and understandable will allow for more targeted approaches to undermining or exacerbating them at appropriate times. In this way, understanding where and why these interests exist is critical to effectively directing militaries to achieve national ends.

Third, an implicit but critically important observation about the cases under consideration here should be made unambiguous: when it comes to learning, the distinctions between war and peace are difficult to discern. In each case, the prospect of war and its actual onset had important effects on the states’ learning process. However, it would be disingenuous to claim that those wartime learning processes were not influenced by that planning, preparation, and organizational dynamics that existed well before the war—or the
threat of it—emerged. Although the distinction between war and peace may prove useful from an analytical perspective, its utility diminishes when put into practice.

Finally, if nothing else, this dissertation has demonstrated one thing: military learning is hard. It is hard to initiate and it is hard to maintain. It is hard in war and in peace. It is hard for the army, the navy, and the air force. It is hard for the British, Americans, and Germans. To understand military learning is to understand how difficult it is in practice. Accordingly, leaders cannot simply tell their militaries to learn. They must be willing to invest considerable time, resources, and attention to ensure that learning occurs and continues. If they are unwilling to do so, they should expect failure.

This dissertation began with the question “How do militaries learn in war?” I have provided an answer that is reflective of the complex and nuanced nature of the topic. In doing so, I have made a small contribution to our understanding of how wars are fought and won. To be sure, there is still much work to be done on this question. Like all questions of war, the answers are not simple or complete; and that, of course, is why we must keep asking them.
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