A system for bridging the ideological divide by establishing a moral framework for news consumption

by

Jessica Z. Wang

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Author ............................................................ Jessica Z. Wang

Department of Electrical Engineering and Computer Science

May 26, 2017

Certified by ........................................................... David R. Karger

Professor

Thesis Supervisor

Accepted by ........................................................... Christopher J. Terman

Chairman, Department Committee on Graduate Theses
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Abstract

Society is becoming increasingly ideologically divided. People exist in filter bubbles online, where they are exposed to primarily homogeneous perspectives and news sources. However, diversity in news consumption is important: it creates more informed societies, healthier democracies, and more solid understandings of one’s own beliefs. In this thesis, we propose Pano - a system for bridging the ideological divide by surfacing moral framing in news. Pano provides a way to educate consumers of online news to think in a moral framework of shared human values, challenging their understandings of views held by those different from them through collaborative highlighting and annotation of moral framing in text. We demonstrate the effectiveness of Pano in a 10-day field study and find positive changes toward improved empathy and ability to re-frame arguments in the moral foundations of the audiences, showing promise toward the ultimate goal of bridging the ideological divide.

Thesis Supervisor: David R. Karger
Title: Professor
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Introduction

*News shapes our sense of the world, of what’s important, of the scale and color and character of our problems.*

– Eli Pariser, *The Filter Bubble*

News is crucial for our education about the world around us. News creates connections to the human experiences of others, to blessings and sufferings alike. As our lives transition increasingly to the digital world, our sources of news are transitioning as well: from newspapers and televisions, to the Internet and social media. However, in parallel with these shifts, people find themselves surrounded by content and news specifically tailored to them and their preferences. As a result, filter bubbles—places where similar sentiments and perspectives are resonated among a community—have enveloped our online spaces, and it is now too easy to exist in a virtual world of little diversity in news and opinion, where everything reinforces our preconceptions. Society today is becoming increasingly ideologically divided.

When people live in filter bubbles, only seeing and interacting with perspectives similar to their own, society suffers. A lack of diversity of perspective in news consumption leads to less-informed citizens, weaker democracies, and a less solid understanding of one’s own beliefs [31]. Thus, something needs to be done to help people break out of their filter bubbles. A number of existing systems for introducing diverse
content into online spaces try to help encourage people to explore new content; however, while they may help increase the volume of counter-attitudinal content a user sees, simply encountering such content does not ensure that a user will learn from it. Indeed, Nyhan et. al (2010) identified a "backfire effect", in which reading diverse content actually further polarized people toward their preexisting views [40].

We speculate that one driver of the backfire effect is framing: that people are not swayed by facts; but are instead more influenced by personal interpretation and emotion. In light of this, we focus on the framing of content - encouraging people to think generally about where perspectives presented are coming from and what they are rooted in. A social psychology theory called Moral Foundations Theory establishes such a framework for news consumption. It states that differences between the left and right are explained by valuing the same set of human moral foundations but in differing proportions [15]. Consequentially, when the left and right debate, they talk past each other - each side is concerned about different aspects of the issue, and their arguments for their perspectives are rooted in their own moral foundations [14]. Our goals in using moral foundations and building a system for diverse content consumption are to enable people to approach diverse content they may not agree with more objectively, through the lens of moral values, and to understand the underlying morals that factor into their own beliefs and reactions when consuming content. Furthermore, we hypothesize that pushing people to think in a moral framework about controversial issues generates greater understanding and empathy across the ideological divide.

In this thesis, we present Pano - our solution to bridging the ideological divide by establishing common ground built on the framework of shared human moral values. Pano aims to encourage users to adopt the Moral Foundations framework for reading and analyzing news by helping extract and surface moral framing present in news. Pano enables users to learn more effectively from news through collaborative highlighting and annotation: as users read articles, they can annotate the moral
framing used in arguments and read annotations left by other users. Through doing so, users learn to think more deeply about the underlying morality and framing of arguments. Pano also provides insights into the frames present across recommended articles to give users another dimension of insight into their content consumption choices. Finally, Pano provides opportunities for collaborative discussion structured around moral values, to promote enhanced learning through constructive dialog.

The idea fills its critics with dismay. For some, the argument is moral and absolute. Deliberately ending a human life is wrong, because life is sacred and the endurance of suffering confers its own dignity. For others, the legalisation of where the values the judgment path becomes but liberty...in the...assisted dying in fact, the evidence leads to the conclusion that most of the schemes for patient, misery, suffering...suggests that...Sanctity in the particular system of values and principles of conduct. More noble way...The value of a...abuse by society...life. In a secular...but liberty...a cheap alternate...The idea fills its critics with dismay. For some, the argument is moral and absolute. Deliberately ending a human life is wrong, because life is sacred and the endurance of suffering confers its own dignity. For others, the legalisation of...
We present the results of our evaluation of Pano through an eight-day field study in which 35 participants were separated into three conditions - a control group, a group that received education on Moral Foundations Theory, and a group that received education on Moral Foundations Theory and used Pano. Participants were tasked to read two articles every two days for the duration of the study while using Pano, and completed pre- and post-treatment surveys with questions measuring their empathy, their reactions to counter-attitudinal statements, and more. Users of Pano during the user study demonstrated a positive change in empathy, though statistical significance was not reached potentially due to small sample size. Some users also demonstrated an improved ability to re-frame arguments directed toward the other side using frames that resonate with the concerns of that side. Finally, we present the feedback from users about their experiences using Pano, in which many users found Pano to be interesting and useful for thinking more deeply about how arguments were presented.

In the rest of this chapter, we will dive into how things came to be - how technology and the media fuel the ideological divide; why people have a hard time making diverse choices for themselves; and finally, why framing affects our perception of content. Chapter two covers previous research on systems encouraging diverse content consumption, framing, Moral Foundations Theory, and educational systems, as well as findings on user motives in seeking diverse content. Chapter three presents the details of Pano, our system for diverse content consumption. Chapter four describes our evaluation of Pano and our findings. Chapter five discusses our findings and suggestions for informing the design of such systems. Finally, Chapter six concludes with a summary of our contributions and takeaways.

1.1 A Tale of Two Cities

Before we jump into the history of technology and the media, let me begin by telling a story from the recent past. A Tale of Two Cities, if you will. In the spring of
2012, I was a high school senior in a small suburb few have heard of, called Irmo, South Carolina. In the spring of 2016, I was a college senior; at MIT, in Cambridge, Massachusetts. South Carolina is one of the reddest and most Republican states in America; Massachusetts, one of the bluest and most Democratic [19].

Coincidentally, both of these years were presidential election years. The United States presidential election of 2012 was the 57th quadrennial American presidential election. Naturally, as follows, the 2016 presidential election was the 58th. In 2012, I remember sitting in my government class as we discussed and debated the issues of the election. We were asked which side we were on, left or right. When our teacher asked who was on the right, hands filled the air. Then, she asked who was on the left. I could barely muster to raise my hand past the minimum visible level, for as I looked around, I realized I was alone.

Fast forward to November of 2016. I now live in one of the most liberal cities in America - the collective conscience of my vastly left-leaning environment was a stark contrast to my experience just four years prior. As the evening of Election Day—Tuesday, November 8—transpired, and votes poured in, post-election reactions began to rush across the nation. Disappointment flooded the hearts and social media feeds of many - what was supposed to be a night of celebration in the wake of Democratic victory turned into somber realization. In contrast to previous election years, this year’s loss felt much different, because what stood out in the liberal sentiment was the unexpectedness of the outcome. Few saw it coming at all.

Why were so many people blindsided? One undeniable contributor is the technology we use. The systems we rely on in daily life, by design, embed us into echo chambers - they surround us with people and perspectives that are familiar and often times, similar to our own. Our every interaction with these systems, whether through pressing a like button or clicking a shared link, contribute to black box algorithms that only further strengthen the fabric of these chambers [41]. With ideological di-
vides between the left and right growing, it is more apparent now than ever that there is a need for diversity in the content we are exposed to and consume. In addition, once we are faced with new sources of content and information, we must be media literate and understand how to approach, analyze, and evaluate them. The need for a bridging of sides, of bipartisan understanding of perspectives and values, is strong in times like this.

The next few sections will take us through the evolution of the media and the rise of technology, and how these changes have contributed to an increasingly polarized society.

1.2 From Paper to Pixels

The *New York Times* used to be able to charge premium rates for advertisements. They held a near monopoly on reaching into the homes, minds, and wallets of an important audience—elite New Yorkers—and advertisers turned to them to target ads. Back then, the business models of large news outlets like The *New York Times* were based off of this ability to direct ads at specific channels of consumers, utilizing the concept of scarcity, since no other entities or technologies could distribute content in the same way these newspapers and print publications could [41, 33].

However, in the last decade, times have changed immensely, disrupting the entire foundation upon which publication businesses were built, and spelling out bad news for their future. With the advent of Web 2.0 and mass adoption of the Internet, traditional media models started to fail, because those premium advertisement channels formerly only provided by newspapers like The *New York Times* started to become available all over the web [3]. Nowadays, advertisers can track users like us from the moment we leave our first digital footprints on the web [41], collecting information about our every nuanced behavior and building scarily accurate profiles of our personas - the ideal fodder for corporations when they’re trying to figure out who’s most
likely to click on marquees of lawnmowers or handbags.

A few large private players dominate the information ecosystem of the Internet, namely Google, and Facebook. These technology companies have control over vast gold mines of user data for advertisers, far more than any smaller players could hope to obtain [3]. The fact that they have so much influence over the Internet is the antithesis of the original web’s open principles - the web was meant to democratize, not to be monopolized. However, their user data has enabled the creation of much cheaper advertising platforms that allow advertisers to target their intended audiences in even more precise ways than newspaper advertisement could [41].

The demise of traditional media has many huge implications for society, but the main one we will focus on is this: under pressure of a dated business model, traditional media has changed the scope of their reporting [33]. Publishers are now relying increasingly on social platforms for distribution in an ad-revenue-sharing model, and content creators are focusing on how to get the most clicks. As a result, traditional media finds themselves needing to adapt to, rather than define, how people consume news on these platforms. Traffic-based payment structures alter how journalists view their job and the mission behind their work - it is less about the craft, and more about maximizing the number of eyeballs on it [37, 31].

When journalism turns sensationalist, prioritizing content that is novel or emotional to optimize for social media platforms, the negative ramifications on society further deepen ideological divides. Public distrust of the media grows, and as a result, people are less likely to access accurate information, weakening citizens’ political knowledge. In addition, already-polarized individuals become even more radicalized, [31] adding fuel to the fire breaking apart the ground between the left and right.
1.3 The Age of Information Overload

In addition to changing traditional media models, the Internet also enables mass content creation like never before. Publishing a story and reaching audiences of millions was once only available to the very rich and powerful, who happened to have a publishing press and distribution center on hand; now, all it takes is an Internet connection and some creativity [41]. The vertical integration of traditional publishing has been taken down by low barriers to entry into digital publishing platforms. Publishing has been made accessible to all [3], and the participatory, people-powered media revolution has arrived [33].

Because content has become so easy to create and put online, the problem now is that there is way too much of it. Information overload makes it difficult for consumers to identify the best content - how do you figure out which article to read about your favorite basketball team’s game last night when a search turns up hundreds of different sites, professional news outlets and independent blogs alike, talking about it? Often times, we make decisions out of convenience and familiarity, like picking the top result from Google, or trusting the article our friend shared on Facebook.

Enter information filtering systems. In order to help us make decisions, information filtering systems parse through all the options and surface the ones it determines will be most relevant to us. Examples of such are feed rankings, recommendation algorithms, news aggregators, and search engines. However, information filtering systems contribute to the creation of ideological filter bubbles - places where many similar opinions and perspectives are repeated among and resonated with individuals in them [43]. Social media feeds like Facebook News Feed combine multiple information filtering systems into one place. When our Facebook friends—people that we relate to and trust—share content, we are more likely to engage with and be influenced by that content over content shared by unfavorable sources [4]. As a result, feed ranking and recommendation algorithms interpret our engagement as positive.
and weigh those actors even more heavily - an inevitable feedback loop. Information filtering systems, while well-intended to improve and streamline our online browsing experience, have become vehicles for isolating us into ideological bubbles [44].

An increasing number of U.S. adults are turning to social media sites such as Facebook and Twitter for news. In 2016, a majority of U.S. adults - 62% - accessed news through social media sites, with 18% doing so often. This percentage is up from 49% of U.S. adults in 2012 [38]. Given the shift in traditional media models moving toward social platforms for engagement and advertisement and growth rates of amateur online content, this percentage is only going to increase. That means that we will continue to be reliant on the information filtering systems that power our news choices.

1.4 The Psychology of Choice

When we consume content from our algorithmically-curated social media feeds, or engage with the people and things around us, we also end up in one way or another letting our existing beliefs or preferences factor into our choices. Often times, these choices affirm our existing beliefs and ignore contradictory perspectives. This is called selective exposure, and has vast implications - political theorists agree that an exposure of challenging information to one’s preconceived views and opinions is necessary to develop accurate beliefs [7, 17]. Diverse content consumption, i.e. a balanced news diet, creates more informed societies, healthier democracies, and more solid understandings of one’s own beliefs [31]. However, when people unconsciously selectively expose themselves to content, they are not getting the diversity of perspectives they need. While ideological isolation on the Internet is lower than in day-to-day interactions in the physical world, it is higher than ideological isolation in consumption of news from offline sources [13].

Maintaining a healthy balance of perspectives in information consumption is diffi-
cult, especially when our surrounding environment is working against us, promoting content we are already pre-dispositioned to like. So what is it that causes our unconscious tendency to selectively expose in the first place? The answer is explained by cognitive dissonance, the state of mental stress and discomfort experienced by those holding inconsistent or conflicting thoughts [6]. When given the power of choice, people tend to give preference to information fitting into existing mental models, over new, conflicting information, that threatens to break those models down [20].

1.5 A Framing State of Mind

Paradoxically, many attempts to correct selective exposure have been shown to create further polarization within the individual [44]. Direct forms of introducing conflicting views such as modifying algorithms to weigh diversity (of sources, viewpoints, etc.) more heavily, or recommending articles from the other side, is taken as aggressive. Thus, in minimizing cognitive dissonance while forced to confront two conflicting ideas, people tend to attribute inconsistent views to external factors, for instance, an unreliable source, or media bias. This distrust of not only content but also content sources drives further recedence into one’s filter bubble [10].

An especially damaging situation arises when people select information to confirm existing beliefs, but those beliefs and corresponding information are incorrect or misinformed. Attempts to correct the beliefs of these individuals by showing the actual facts, however, frequently fail at reducing misperceptions, and may actually result in the "backfire effect", an increase in misperception [40].

However, what has been shown to make a positive impact on people is the framing of counter-attitudinal messages. Gaines et. al. (2007) found that while people held similar, fairly accurate underlying knowledge of the facts of the Iraq War, interpretations of these facts varied across partisan groups. It was their interpretations, not the
facts themselves, that separated beliefs across ideological lines [8]. If interpretation is the way in which people intake content, then framing is the method by which authors write, in order to provoke a specific interpretation. Framing has been proven to be effective for positive reception of messages catered to specific populations, including political ideologies [26]. It makes sense then, why blindly introducing diverse content is ineffective - the messages presented are often not meant to appeal to the reader, for they were written for the opposing ideology.

In 2004, social psychologists Jonathan Haidt and Craig Joseph proposed Moral Foundations Theory, which identifies five fundamental moral values that exist in all humans. These five foundations are: care/harm, fairness/cheating, authority/subversion, loyalty/betrayal, and sanctity/degradation [15]. They later showed that liberals and conservatives prioritize these moral foundations differently - liberals most strongly prioritize fairness and care, whereas conservatives value all five foundations equally. Framing messages using the moral foundations is actually quite effective for appealing to liberals and conservatives separately [14], suggesting Moral Foundations Theory as a promising framework for changing how we view partisan news and news consumption.

As described at the beginning of this chapter, Moral Foundations Theory is the framework which this thesis work applies to the design of a system for diverse content consumption. In the next chapter, we dive into why moral framing is a promising avenue - previous work on designing such systems and their shortcomings, more on moral foundations theory, and the benefits of finding the frame that fits.
Related Work

Past research on designing systems for diverse content consumption tackles a wide range of aspects of the filter bubble effect and selective exposure. These systems take on a variety of forms such as modified recommendation algorithms, personal reflection tools, and in-browser contextual systems. Research and evaluation on these systems have also revealed different types of user behavior in response to diversity and diversity-seeking initiatives - users that tend to respond positively to such initiatives are called 'diversity-seeking', while users who avoid or respond negatively to these initiatives are called 'challenge-adverse'. Mechanisms behind why people respond negatively are often related to the framing of the content itself in that the content was not framed for opposite-opinion audiences. In this chapter, we discuss related work on all of the above, as well as a moral framework for framing political issues. We also discuss social annotation systems as a means of education, which we utilize to educate about framing in our system as discussed in chapter 3.

2.1 Designing for Different User Motives

There is no demographic split between individuals that predicts online reading behavior - characteristics such as political preference, demographics, and personality attributes did not predict political bias in an individual’s online news-reading behavior [35]. However, it is clear that in designing for diversity, it is necessary to tailor to a
behavioral split - between "diversity-seeking" behavior, with "high accuracy motives", and "challenge-adverse" behavior, with "low accuracy motives". Diversity-seeking individuals care about their beliefs being correct and will seek content with an array of opinions and perspectives. Challenge-adverse individuals, on the other hand, avoid content that challenges their existing beliefs to minimize cognitive dissonance.

These two user groups respond differently to diversity-seeking initiatives. As further described in section 2.2, the addition of source position indicators displaying both valence (pro/con) and magnitude (moderate/extreme) of user 5 discussions to the discussions decreased selective exposure on participants with high accuracy motives but had no effect on those with low accuracy motives [30]. These motives are not fixed in individuals though - situational and personal factors such as perceived threat level and topic involvement influence whether individuals lean toward diversity-seeking or challenge-adverse behaviors and selective exposure habits. For instance, perceived threat caused selective exposure toward topics for which people had low personal involvement levels [29].

The difference in reaction between diversity-seeking and challenge-adverse individuals in response to diversity-seeking initiatives suggests the necessity of designing for both user groups, especially challenge-adverse individuals. Because a number of existing systems have already shown improvements with diversity-seeking individuals and that these individuals already have the natural tendency to be receptive to diverse content, our system as described in chapter 3 targets challenge-adverse individuals as well.

2.2 Diversity in Content Consumption

Much of the prior work on promoting diversity in content consumption aims to understand and address the factors behind the existence of filter bubbles and selective exposure in information systems. Research shows that often times, people don’t have
the time or want to exert the effort to carefully curate their content; they want to make decisions quickly on what to consume. Thus, people tend to apply selective exposure preferences by selecting sources rather than individual articles [43]. People also believe that their views are more widely held than they often are - they tend to view themselves as normative, and opposers of their views as anomalous [46]. Positive reinforcing behaviors drive the filter bubble effect: a boost in perception of one’s own views brings a boost in personal self-esteem [45], leading people to seek affirming content.

Diversity-promoting systems seek to address these behaviors, and more, in a variety of forms: personal reflection, recommendation and filtering algorithms, behavioral insights, and in-browser contextual systems - social and political annotations. In this section, we take a look at the related work in each of these categories.

**Personal Reflection.** A number of systems focus on pushing people to reflect and think more deeply about issues. ConsiderIt encourages people to develop personal pro/con lists for issues, which can highlight imbalances in a person’s knowledge of issues [23]. OpinionSpace prompts users to rate comments on web forums for how much they respect its content [5]. Reflect encourages listening and understanding by prompting users to synthesize other users’ thoughts in comment sections [24]. These systems nudge people toward more deliberative behavior - advocating for perspective-taking and tradeoff-weighing [44].

**Recommendation Algorithms.** The recommendation algorithm approach is direct in that it targets the mechanism that reinforces filter bubbles online. Munsen et al. created Sidelines, which targets the recommendation algorithms that surface content to news and content aggregators by suppressing user preferences [36]. Garimella et al. developed a new recommendation algorithm that figures out who to best target with opposing-view content [9]. More diverse recommendation algorithms create more diverse content pools which users can select from on social media and news
feeds, increasing overall exposure to diverse content.

**Behavioral Insights - Balancer.** In 2013, Sean Munsen et. al conducted a field study to learn about the effects of providing browsing diversity insights on encouraging reading of diverse viewpoints. To do so, they developed *Balancer*, a browser extension that measures the political left-right balance of sites visited by a user. User studies conducted with Balancer found that feedback about aggregate bias or lean in one’s reading behavior led to modest moves toward more balanced exposure. Specifically, the insights led to 1-2 additional visits per week to ideologically opposing sites or 5-10 additional visits per week to centrist sites [35]. While providing insights on the ideological split of one’s browsing activity did not bring about significant change, the results suggest that it may be useful to incorporate into a larger system.

### 2.2.1 In-browser Contextual Systems

In-browser contextual systems present information about articles to users from within the browser - these cues may be attached directly to links, or appear on the pages of the articles themselves. This approach presents additional information about content that the user can utilize to help inform decisions pre-exposure or at the time of exposure; before the user has the chance to solidify opinions about the issues at hand.

**Social Cues.** Social cues provide information about others who have engaged with content, and have been shown to be generally persuasive, especially with close friends [17]. Research has shown that social cues can increase engagement or drive positive change in other metrics: showing how popular an article is affects the time people spend engaging with it [22]. The existence of peer names in advertisements increased engagement with the ads. Adding names and photos of people to news posts marginally increased click rates; when the personal info shown was of friends, the perceived interestingness of the posts increased [25].

However, attempts to bridge the ideological divide using social cues by surfacing
commonalities between readers of news have not reached much success. Adding social cues and annotations such as location, employer, music tastes, organizational affiliations, and friendship to show that a story was shared by a person similar to them had no effect on interest in reading conflicting content, and in fact, a negative effect for shared job types [1].

**Political Cues.** Another study placed political cues such as source position indicators on others’ opinions in online discussions to show how pro/con and moderate/extreme an opinion on an issue was. The source position indicators had moderate success, but only with users who wanted to seek diverse information [30]. As discussed in section 2.1, this represents the difference in effect between ‘diversity-seeking’ and ‘challenge-adverse’ users.

Real-time corrections to political misperceptions have been shown to be modestly more effective than delayed corrections; however, this is only for individuals predisposed to reject the claim on the issue at hand. For individuals who believe the original content, real-time corrections actually create distrust in the correction [10].

In general, research suggests that some elements of in-browser contextual systems may be useful for increasing diversity, but must be tailored toward specific user populations.

### 2.3 Framing

As suggested by diverse content systems described above, there is a delicate balance that must be taken toward designing for diversity if presenting counter-attitudinal content, because directly confrontational designs can be viewed as attacks toward readers, and create distrust of sources [10]. However, research supports strategic framing of the message as being crucial for positive reception. A presentat-
tion that highlights varying framing in articles has been shown to be an effective way to motivate people to consider a greater breadth of opinions [42]. Furthermore, research highlights exactly what types of framing is most effective for specific ideologies - for instance, Lavine et. al showed that conservatives prefer messages framed in terms of loss, whereas liberals prefer messages framed in terms of benefit [26]. In the next section, we discuss a moral framework that rationalizes differences in framing of political issues between the left and right.

2.4 Moral Foundations Theory

Morality varies between cultures, and yet displays many common themes [34]. In order to explain this, social psychologists Jonathan Haidt and Jesse Graham proposed Moral Foundations Theory (MFT), stating that human moral thought is based upon five fundamental psychological foundations that are found across humanity. The idea behind the foundations is that human morality is the result of biological and cultural evolutionary processes that made us sensitive to many different (and often competing) issues. These five foundations are:

- Care/harm. This foundation is related to an ability to feel (and dislike) the pain of others. It underlies virtues of kindness, gentleness, and nurturance.

- Fairness/cheating. This foundation generates ideas of justice, rights, and autonomy.

- Loyalty/betrayal. This foundation underlies virtues of patriotism and self-sacrifice for the group.

- Authority/subversion. This foundation underlies virtues of leadership and followership, including deference to legitimate authority and respect for traditions.

- Sanctity/degradation. This foundation underlies notions of striving to live in an elevated, less carnal, more noble way.
Some of these issues are about treating other individuals well (the first two foundations - care and fairness). Other issues are about how to be a good member of a group or supporter of social order and tradition (the last three foundations). A sixth foundation—liberty/oppression—was actually proposed recently, after the publication of the original five foundations above. However, liberty is not included in the work of this paper because its standing as a foundation is still debated [34]. Each person holds all of these five foundations, but differences between individuals are accounted for by different proportions of expression between the foundations.

In fact, research shows that liberals and conservatives have distinctly differing moral foundations. Liberals prioritize care and fairness, whereas conservatives prioritize all five foundations equally [14]. Although liberals and conservatives do both value care and fairness, the two sides often talk past each other. For instance, because fairness is a primary concern to liberals, while only one of many concerns to conservatives, liberal arguments appealing to fairness are lost on conservatives, who do not weigh fairness nearly as heavily. Similarly, conservative arguments for authority, loyalty, or sanctity are lost on liberals, who give little thought or consideration to those foundations.

The left and right perspectives on many issues in today’s society tends to line up well with what moral foundations theory supposes. An example of such an issue is same-sex marriage - many liberals support legalizing same-sex marriage to be fair and compassionate (fairness and care), whereas many conservatives are reluctant to change the sanctity of the institutions of marriage and the family, basic building blocks of society (sanctity). Another issue is the debate surrounding President Trump’s immigration ban of January 2017, banning all immigration from specific Muslim-majority countries. Many conservatives supported this measure, wanting closed borders out of loyalty to their own country - the mindset of protecting the safety of our own citizens before allowing in foreigners. However, many liberals denounced this attempt to ban immigration by calling the measure unfair, discriminating against individuals by reli-
gion. Furthermore, they felt that there was a lack of compassion for refusing to take in refugees from war-torn Middle Eastern countries.

2.4.1 Moral Framing

As it turns out, when people talk issues, they tend to speak in the frame of their own moral foundations. However, if the audience holds vastly different moral foundations than the speaker, then much is lost; the audience cannot relate to the moral concerns being voiced.

Prior studies have shown that people from one side can be swayed to support policies from the other side if the policies are framed using the moral foundations they care about. In one study, researchers took a traditionally conservative view—making English the official language of the United States—and framed it using a liberal moral foundation of fairness. The reframed statement was: "making English the official language of the United States leads to fairer outcomes for immigrants by helping them avoid discrimination". This reframed statement was able to convince a significant number of liberals to support the original policy.

In light of the potential in utilizing moral framing, we now discuss in the next section the means by which we can communicate and teach moral framing to users.

2.5 Active Learning Through Social Annotation

As influential as news is, so too is the means by which we interact with it as an educational medium. Enter social annotation - the ability for users to modify content with highlights, comments, and other content-relevant or contextual information. Social annotation (SA) as a means of interacting and engaging with content has been shown to be a particularly effective educational tool, with various SA systems deployed in live classrooms today.
Social annotation boosts participation and engagement [27][28], improves instruction [27], promotes attention, organization, and communication [49], and improves reading comprehension skills [2]. Furthermore, other readers benefit from social annotations present on a page - these future readers get exposure to new ideas, see other perspectives, and build knowledge about the annotated content [21]. An example of an educational social annotation system is NB, which lets users highlight and have discussions about lecture notes and class material as they are reading [48].

In the next chapter, we describe our system and how the related work discussed in this chapter has influenced our design and goals.
Pano

Our goals in developing Pano are to teach users to think in a moral framework both online and offline and encourage productive dialog and a greater understanding and empathy for the perspectives of the opposing side. The design of Pano was motivated by these goals and the findings from work on related systems. In this section, we describe our goals for the system, the specific motivations behind our design choices, the implementation details of the system, and a walk-through of the interface and features of the finished system.

3.1 System Goals

We designed Pano with the overall goal of helping people consume and think about news in a moral framework - in establishing such a framework, we lay a common ground for which readers can connect to the perspectives of articles they may not agree with.

Many people are not even consciously aware of their own moral values, much less the moral values embedded within the rhetoric in journalism. In order to solve this, Pano helps users extract and surface moral framing in news, and lets users interact with this information in ways that can educate them about the moral framework that we describe later in this chapter. Through repeated usage, Pano hopes to accomplish
the following.

**G1.** Teach users to think in a moral framework when reading and thinking about news.

Pano also hopes to encourage more constructive discussion among members of its online community, as well as more generally. The following are Pano’s goals related to this aspect.

**G2.** Encourage a greater understanding and empathy for the perspectives held by the opposing side.

**G3.** Encourage more productive dialog involving perspectives held by the opposing side.

In section 3.2.1, we describe how these goals have motivated specific design choices made in the development of Pano.

### 3.2 Design of Pano

The general design of Pano is motivated by our goals outlined above - to help users learn and adopt a new framework for thinking and processing news. The design choices made for specific Pano features are partially informed by previous work described in chapter 2. In the following subsections, we outline the motivations that informed the broader design of Pano.

#### 3.2.1 General Motivations

**Lightweight.** The system had to be minimally disruptive to a user’s normal news consumption process. What Pano introduces into a user’s browsing experience must be seamless, so that users do not feel that the system is too time or labor-intensive to use, and users do not rely on prompts or triggers from Pano to think in the moral
values-based framework (G1).

**Diversity-Seeking vs Challenge-Adverse Users.** In section 2.1, we described how user behavior in reading bipartisan news can be categorized into "diversity-seeking" and "challenge-adverse" behavior. These categories are not static within a person, but a person may change labels based on factors such as the topic at hand and level of personal involvement in the topic. We wanted to ensure that Pano would be flexible enough to accomplish our goals for both types of user behavior. Pano must provide the functionality for varying levels of involvement and engagement to exist in the same space. This way, challenge-adverse users do not find themselves forced to carry out any specific actions that they are reluctant or resentful to do. Diversity-seeking users, on the other hand, who are more engaged with Pano, will have the option to interact with news in ways that enrich their learning (G1). We describe in section 3.2.3 how active vs passive learning manifests itself in Pano.

### 3.3 Implementation

In this section, we discuss the Pano stack and implementation details. The Pano system is built on top of the Eyebrowse system, with a Chrome extension client application in Javascript, HTML, and CSS, and a back-end server written in the Django web framework and a MySQL database \[51\].

#### 3.3.1 Eyebrowse

Eyebrowse is a browser application developed by the Haystack group at MIT CSAIL that aims to create a social outdoors for web browsing. It tracks an individual’s web browsing and utilizes that data to provide benefit and utility through a number of social and personal features. The Eyebrowse Chrome extension allows users to control what pages they share while browsing, and the web interface displays a real-time,
publicly-accessible stream of all Eyebrowse users’ activity. Eyebrowse is an ideal platform for building Pano upon; it is an in-browser tool and can thus modify pages that users open, and the social outdoors aspect provides an existing online community. Eyebrowse also provides multiple dimensions of insight into browsing activity, as not only does it collect pages visited, but also time spent on page, others who have also visited the page, and their corresponding time spent on page [50].

3.3.2 Pano Implementation

Pano augments the existing Eyebrowse data model and adds new controller functions to multiple server components. On the client side, Pano introduces new functionality by injecting content scripts that allow for in-page highlighting and annotation into pages. Pano also augments the existing extension popup interface with a new set of tabs and hooks up to the Facebook Javascript SDK to extend Eyebrowse commenting into Facebook sharing of links. In the next section, we present a detailed look at these features.

3.4 System Features and Interface

In this section, we will walk through the Pano interface and showcase the various features of Pano, and describe how they relate to our overall goals for the system. We also detail our method for moral frame extraction from text, a fundamental component of Pano.

In-page highlighting and annotation. The first major component of Pano provides the ability to highlight and annotate news articles across the web. The purpose of this component is to train users to become familiar with the moral foundations framework and to collaboratively annotate and discuss news in the context of moral frames. Highlighting and annotating text requires a deeper reading of the content,
pushing the user to be conscious about moral framing (G1). Pano injects content scripts into Eyebrowse-whitelisted pages that allow users to add highlights by selecting phrases within paragraphs. Upon selection, an "Add highlight" button appears above the selection as shown in figure 3-1.

The design for the highlighting functionality was motivated by successful existing applications with highlight functionality, e.g. Medium. Highlighting on Medium is as simple as just selecting text and waiting for a tooltip to appear above the highlighted text with options for what to do with the highlight [32]. Because highlighting on Pano is meant to be done on short sentences and phrases, and while the user is in the process of reading an article, this design is ideal because it is efficient and has natural mapping with the physical action of highlighting.

An alternative option for the highlighting interface is an "edit mode", in which users can only highlight while in this mode. The advantages of this are that it ensures that a user is deliberate when highlighting, i.e. users cannot accidentally highlight things while browsing. However, the friction introduced by requiring a user to enter then exit highlight mode each time is too high for Pano’s use case.

An additional motivation for informing the design of the highlights was for users who land on a page to quickly get a sense of which moral foundations are most present in an article. In order to achieve this glanceability, Pano colors each highlight based on the most popular tag for that highlight. Thus, upon landing on a page, a user may observe one or a few colors dominating the highlight landscape of the text, and immediately associate those colors with prevalence in the moral framing of the content.
Ever since Donald Trump handed down his executive order temporarily halting all immigration from seven majority-Muslim nations for three months and barring refugees from Syria indefinitely, the social-media outpouring from liberals has focused, understandably, on how unfair the policy is to Muslims.

Figure 3-1: Selected text with the 'add highlight' feature. Excerpt from *The Atlantic*.

Upon clicking the "Add highlight" button, a dialog appears that allows the user to select tags from the set of moral foundations values (figure 3-2). Hovering over each value tag on this interface displays the definition of that value.

Upon clicking "Save", the add highlight dialog collapses and permanently highlights the selection on the page. The next time the user visits the page, the highlight will be auto-colored in. The color of the highlight corresponds with its most highly upvoted tag (figure 3-3).

When a user hovers over a highlight, a dialog will pop up below the highlight with the annotation information as seen in figure 3-4. This dialog displays the following.
Ever since Donald Trump handed down his executive order temporarily halting all immigration from seven majority-Muslim nations for three months and barring refugees from Syria indefinitely, the social-media outpouring from liberals has focused, understandably, on how unfair the policy is to Muslims.

Figure 3-3: Saved highlight as it appears in an article. Excerpt from The Atlantic.

Ever since Donald Trump handed down his executive order temporarily halting all immigration from seven majority-Muslim nations for three months and barring refugees from Syria indefinitely, the social-media outpouring from liberals has focused, understandably, on how unfair the policy is to Muslims.

Figure 3-4: Annotation interface of a highlight. Excerpt from The Atlantic.

- This highlight’s tags
  - Tag description
  - Number of upvotes
  - Upvote button
  - Users who have upvoted this tag
  - Comments on this tag
  - Ability to add, edit, and delete your comments on this tag
  - Ability to delete this tag, if you are original creator

- Ability to add additional tag to this highlight
• Ability to delete this highlight, if you are original creator

Highlights, tags, comments, and upvotes are all public, so users can see and interact with each others’ annotations and highlights.

In figure 3-5, we show an example of a comment left by a user (from our user study evaluation).

The displayed color of a highlight corresponds to the color of the most highly voted tag on that highlight. Figure 3-6 shows an excerpt from an article with multiple highlights and multiple different tags. As a result, upon landing on an article with highlights, if particular moral frames are used very strongly in the argument of that article, a user can immediately detect the presence of those frames.

Existing web annotation systems like Hypothes.is [18] and Genius Web Annotator [12] display annotations on a page by inserting a slide-out sidebar onto the right side of the page, which displays all comments like a feed. However, this detracts from
The argument is over the right to die with a doctor’s help at the time and in the manner of your own choosing. As yet only a handful of European countries, Colombia and five American states allow some form of doctor-assisted dying. But draft bills, ballot initiatives and court cases are progressing in 20 more states and several other countries (see article). In Canada the Supreme Court recently struck down a ban on helping patients to die; its ruling will take effect next year. In the coming months bills will go before parliaments in Britain and Germany.

The idea fills its critics with dismay. For some, the argument is moral and absolute. Deliberately ending a human life is wrong, because life is sacred and the endurance of suffering confers its own dignity. For others, the legalisation of doctor-assisted dying is the first step on a slippery slope where the vulnerable are threatened and where premature death becomes a cheap alternative to palliative care.

Figure 3-6: Various highlights on an article about physician-assisted suicide. Excerpt from The Economist.

the experience because it overlaps a large part of the page’s content. Pano instead employs in-line annotations - annotation dialogs appear right below the highlighted text upon hover and can be exited by clicking anywhere outside of the box. This design is efficient, reduces latency, and has quick dialog closure.

Our annotation design allows for users to either passively or actively learn, depending on their level of interest and engagement with the content. In section 3.2.1, we described two types of users - diversity-seeking, and challenge-adverse. With this design, challenge-adverse users can simply observe highlighting and annotations present on the page, without being required to contribute. This lets them passively learn, as they will intake highlights and annotations as they read, but may not wish to do anything with them. Diversity-seeking users, on the other hand, are likely to be the contributors who actively highlight and annotate articles, engaging in active learning - learning by doing.

**Extension popup interface.** The extension popup interface is accessed from the
Chrome browser bar by clicking the Eyebrowse eye logo. The Pano interface is a tab of the main Eyebrowse extension. It has three components.

1. **Framing.** The framing tab shows which tags are present in the current page. There are two types of tags - auto-generated and user-tagged. Auto-generated tags are those detected by our moral content script. User-tagged tags are those present in highlights created by users. There is also the functionality to toggle the in-page highlighting feature.

2. **Recommendations.** The recommendations tab shows pages similar to the current page - such as articles on the same topic. The moral value frames present in those pages are also displayed with each recommendation.

3. **Summary.** The summary tab has a globally viewable and editable summary for the page. It also presents the moral value tags for the page.

Below in figure [3-8](#) is an example of a summary contributed by a user during our user study.
3.4.1 Measuring Moral Content

The final major component of Pano is the extraction of the moral value frames present in text, specifically articles. Current common methods of doing so have relatively low accuracy [11], so it was important that in addition to our implementation of a moral content extractor, our interface provides users ways to correct for inaccuracy.

In order to extract moral value frames from an article, we started with the Moral Foundations dictionary (cite) from [moralfoundations.org]. This dictionary provides proportions of virtue and vice words for each foundation. The dictionary was parsed into JSON format, and then a trie was constructed from the dictionary, with the value at trie leaves being the moral foundation corresponding to the word created by traversing down that trie branch.

Given a specific article to analyze, first, the entire HTML of the article is downloaded. Then, all HTML tags are parsed out, i.e. content in between "<" and ">"
symbols. Then, the remaining string is split by the space character, and an alphabetic regex is used to check if each string fragment is a word. Then, each identified word is checked for existence in the trie; if there is a match, the corresponding moral foundation is recorded. After all words are checked, the final total counts for the moral foundations identified are returned.
Evaluation

We conducted a field study to evaluate the effectiveness of Pano toward our goals outlined in section 3.1. Looking inward, we wanted to affect how people process or evaluate new information. Looking outward, we wanted to affect how people perceive others’ political stances, to move away from demonizing and vilification and toward more morally-based perceptions. We also wanted to see if we could encourage understanding and empathy toward others. We outline the hypotheses of our experiment below.

**H1.** Education about moral framing leads to greater empathy toward others than no education.

**H2.** Using Pano to both passively and actively engage with moral framing while consuming news leads to more re-framing of issues in terms of moral frames than no usage of Pano.

**H3.** Using Pano to both passively and actively engage with moral framing while consuming news leads to greater empathy toward others than no usage of Pano.

In this section, we describe the field study conducted to evaluate Pano and our findings from the results.
4.1 Participants

Through university-affiliated mailing lists as well as social network publicization, we recruited participants who read in online news. Potential participants filled out an interest survey and were filtered for the following criteria: (1) Google Chrome as primary Internet browser users, and (2) readers of at least 6+ online news articles weekly. The first requirement was necessary since the study involved the use of a Google Chrome extension. The second requirement was instituted because the study requires reading eight online news articles over an eight-day period, and for people that do not normally read a lot of online news, introducing the study tasks would be too drastic of a change from their normal habits. Participants also had to be available for the specified 10-day study period.

137 people filled out the interest survey; of them, 78 met the qualifications above and were sent a consent form outlining the details of the study. 50 participants returned the consent form and were officially enrolled into the study. By the end of the study period, 35 participants completed the study; the remaining 15 dropped off during the study period by not completing surveys and/or tasks. Out of the 35 participants, 51.4% (18 participants) were male and 48.6% (17 participants) were female, with an age range of 19-56 and an average age of 26.6. Participants were also asked to rank where they generally fall on the left-right spectrum (0 = very conservative, 1 = conservative, 2 = slightly conservative, 3 = moderate, 4 = slightly liberal, 5 = liberal, 6 = very liberal), with the average being between slightly liberal and liberal (4.2188).

Participants filled out two pre-study surveys, read articles while using Pano an 8-day period, then filled out a post-study survey. They were compensated with $40 Amazon gift cards for completing all study components.
4.2 Experiment Design

There were two system conditions and two moral foundations theory (MFT) education conditions. The two system conditions were: 1) experimental condition - Pano, and 2) control condition - Eyebrowse, as described in section 3.3.1, with recommended pages. The two education conditions were: 1) no MFT education, and 2) MFT education via survey result explanation. Participants were randomly assigned to one of three groups:

G1: Control. Control system + no MFT education
G2: Education. Control system + MFT education
G3: Treatment. Experimental system + MFT education

4.3 Procedure

The user study was conducted virtually, with communication with participants done over email. We selected four current issues in U.S. politics to be the content focus of the study. These four issues were:

1. Euthanasia/Physician-assisted suicide (PAS)
2. Free speech on college campuses (FS)
3. Healthcare (HC)
4. Affirmative action in college admissions (AA)

In order to evaluate our hypotheses, we draw the following parallels between our hypotheses and our experiment design. An understanding of one’s own moral values and the framework at large are achieved in the MFT education condition. In addition, because perspectives presented in news articles reflect a set of perspectives shared by a group of people, we use an understanding of the moral frames present in an article as a proxy for an understanding of others’ moral frames.
In the next few subsections, we describe the stages of the study and the materials used in each.

### 4.3.1 Pre-study Surveys

At the beginning of the study, all participants completed two surveys: a "pre-study survey", and a "Moral Foundations questionnaire".

**Pre-study survey.** The pre-study survey had four sections:

1. **Basic information.** General political preferences and empathy measurements.

2. **Issue stances.** For each of the four issues, the liberal and conservative perspectives are presented. Participants are asked where their views lie on the left-right spectrum and then are asked to write an argument trying to convince someone from the other side of their view.

3. **"How would you explain it?"** For each of the four issues, participants are shown the perspective opposite to their own. They are asked 1) what their first impression of someone who says that perspective is, and 2) if they put themselves in the shoes of the person saying that, why would they say that.

4. **"How do you feel about it?"** Participants are asked to rank how much statements in the form of "I can feel when...", "I can see why..." describe them.

The purpose of the pre-study survey was to provide a calibration point for participants pre-treatment. For long-response answers, we were looking for the presence or absence of moral language and moral framing. For questions where participants answered from a list of choices, or on a numeric scale (basic information, issue stances), the value of their answers (e.g. 2 on a scale of 1-7) was used in our analysis.

**Moral Foundations questionnaire.** The second survey was a "Moral Foundations questionnaire". This was adapted from the "Moral Foundations Questionnaire" by Jonathan Haidt and Jesse Graham on [yourmorals.org](http://yourmorals.org). The survey consists of two
parts, sixteen questions per part, with questions presented in randomized order. The prompt for the two parts were the following.

Part 1. When you decide whether something is right or wrong, to what extent are the following considerations relevant to your thinking? Please answer on a scale from Not At All Relevant (This consideration has nothing to do with my judgments of right and wrong) to Extremely Relevant (This is one of the most important factors when I judge right and wrong).

Part 2. Please read the following sentences and indicate your level of agreement or disagreement.

The first part presented statements asking about if someone conducted certain behaviors ("Whether or not someone did something to betray his or her group"). The second part presented general statements ("Respect for authority is something all children need to learn"). Each question tested a specific moral foundation. There were three questions for each foundation, plus one dummy question, per part.

Upon submitting this survey, participants were shown one of two screens based on MFT educational condition: for the "no MFT" condition, a "Thank you for completing this survey" screen was shown. For the "MFT education" condition, a page detailing what moral foundations theory is, their results and how to interpret them, a graph of how they compare to typical liberals/conservatives, and what the implications of their results are was shown.

The purpose of the Moral Foundations questionnaire was to provide measurements for our analysis of where participants' moral foundations lie. Furthermore, the detailed results served as the education variable from the experiment design.

4.3.2 Reading Period

Participants were sent article briefings every two days, for a total of four article briefings over eight days. Each article briefing consisted of two articles about the
same issue but from opposite ideological sides. All participants were asked to read both articles. Participants in the treatment system condition (treatment group) were tasked to use Pano to do the following tasks:

- Contribute at least two observations to the page, by either highlighting and annotating sentences or contributing to an existing highlight annotation.
- Share the articles if they’d like.
- Read the framing tab of the extension.
- Read and contribute to the summary tab of the extension.
- Browse the recommendations in the recommendations tab of the extension and click on any that interest them.

Participants in the control system condition (control and education groups) were tasked to just look at the recommended pages in the extension, and click on any that interest them, as well as share either of the articles if they’d like. After completion of reading and tasks, all participants filled out a quick form with them questions such as "Did you like article 1?", "Where would you rank article 2 on the left-right spectrum?", and then asking for a reflection of their thoughts on the author’s perspective of each article.

The purpose of the article briefings and corresponding usage of Pano was for participants to be exposed to diverse perspectives, and then for the treatment group, to utilize Pano to engage and interact with the articles from a moral framing angle. The purpose of the post-reading reflection response was to gain insight into the participants’ thoughts upon reading the articles.

4.3.3 Post-study Survey

The post-study survey was very similar to the pre-study survey, but with unnecessarily repetitive questions removed. These were questions such as religious affiliation and political party affiliation whose answers were very unlikely to have changed over
the 10-day duration period of the study. All other questions remained the same between the post-study survey and the pre-study survey. The purpose of asking identical questions in the post-study survey was to measure the change in participants’ answers pre-treatment and post-treatment. Specifically, we looked for increases in understanding and empathy with perspectives from the other side, and an increase in the amount of moral language and moral framing used in long-form responses.

4.4 Data Analysis

From the user study, several types of data were collected:

- Empathy responses on a numerical scale from the pre- and post-surveys
- Long-form text responses from the pre- and post-surveys
- Long-form text responses from the article reflections

Our data analysis methods consisted of both quantitative and qualitative measures, which we describe below.

4.4.1 Quantitative Methods

In order to evaluate hypotheses H1 and H3, and measure changes in empathy between conditions, several different statistical tests were conducted on the numerical responses to look for differences between the experimental conditions. The responses used were from the "How do you feel about it?" section of the surveys as described in section 4.3.1. In the surveys, users were prompted to rate on a scale of 1-5 how much specific statements described them, with 1 being "Does not describe me" and 5 being "Does describe me". The statements were a mix of situational and cognitive empathy statements such as "I can see why someone would want to let people choose physician-assisted suicide to end their life" (cognitive), and "I can feel what people who want to disallow free speech feel when they see or hear a public speech that is harmful and/or offensive to others" (situational).
Two types of statistical tests were used: two-tailed paired t-tests and permutation tests. For the t-tests, we compared pre- and post-survey results between each condition in five ways: four tests for each issue, and one test for all four issues together. This statistical analysis method controls for initial differences in users since it compares the same users before and after. For the paired t-test, we assume that observations, i.e. users, are independent and that the dependent variable, i.e. empathy responses, is normally distributed.

For the permutation tests, we used an averaged index of empathy per participant across the four issues individually, and then all four issues together. The permutation test is different from the paired t-test in that it is not sensitive to the underlying distribution. For the permutation test, the samples are assumed to be independent and exchangeable, that is, there is no hidden structure to the data.

Permutation tests combining the advantages of both of the above approaches were also run using the difference between baseline and endline empathy, taking an averaged index of difference in empathy per participant, and comparing across experiment conditions.

4.4.2 Qualitative Methods

To evaluate hypothesis H2, we also wanted to determine whether there was a change in the way people talked about issues. We collected long-form text responses in both pre- and post-surveys asking participants to write responses for the following prompts on each of the four issues: (1) argument for other side: an argument directed toward someone who disagrees with their view, (2) first impression: their first impression of the perspective of someone with a disagreeable opinion, and (3) other’s shoes: if they put themselves in that person’s shoes, why would they say that. We also collected (4) reflections: long-form reflections from each participant in response to the article briefing readings where participants reflected on the author’s perspective.
To determine whether people changed the way they framed each of their pre (baseline) and post (endline) survey responses for 1-3, participants’ baseline and endline responses were compared against each other, and two coders independently looked for the presence of moral framing in both. Then, coders looked to see whether there was a change in the moral framing used. Finally, the coders’ results were compared against each other, and overlapping results were kept.

There were two types of changes the coders considered positive in the moral framing of participants’ responses:

1. No moral framing present to moral framing present.
2. Arguments with moral framing in one’s own frames to arguments with moral framing in the audience’s frames.

Table 4.1 shows the general rubric used for coding moral frames.

<table>
<thead>
<tr>
<th>Moral Frames in Selected Issues</th>
<th>Left (liberal)</th>
<th>Right (conservative)</th>
</tr>
</thead>
</table>
| Physician-assisted suicide (PAS) | Fairness: provide the choice to end one’s life  
Care: opportunity to end one’s suffering | Morality: the immorality of ending one’s life  
Sanctity: the sanctity of life |
| Healthcare (HC) | Fairness: opportunity for HC for all  
Care: the advantaged take care of the disadvantaged | Fairness: the unfairness of paying for someone else |
| Free speech (FS) | Care: protection from harmful speech | Fairness: the right to speak as one likes |
| Affirmative action (AA) | Fairness: level the playing field for the disadvantaged  
Care: help minorities overcome harm from past injustices | Fairness: unfair for one to receive preferential treatment due to race alone |

Table 4.1: Table of moral frames in selected issues

For (2), first impressions, the coders also looked for a change in tone. If there
was a change, the change was considered positive - \texttt{pos}, or negative - \texttt{neg} depending on whether the response changed in the amount of negative sentiment.

4.5 Results

In analyzing our quantitative survey response data from the pre-study and post-study surveys, we found a positive change in the means between before and after for both of 1) the treatment group’s pre- and post-study survey results, and 2) the treatment group versus the control group’s post-study survey results. A positive change in the means indicates an increase in reported empathy, as users are indicating that they are more able to strongly identify with statements such as "I can see why..." and "I can feel what...", which is good news for our hypotheses. The results did not achieve statistical significance, however, and we believe this may be due to small sample size ($n = \text{approximately 10 per group}$).

In this section, we present the results of our quantitative and qualitative analysis as detailed previously in section 4.4. We also present metrics around the usage of Pano as taken during the evaluation period, and user feedback collected after the conclusion of the study.

4.5.1 Empathy Analysis

For the empathy analysis, we use a paired t-test as described in section 4.4.2 above to compare baseline and endline results. Our null hypothesis for our t-tests is that $\mu_d = \mu_1 - \mu_0 = 0$. We also use a permutation test to compare endline results across groups. Our null hypothesis for our permutation tests is that the underlying distributions between the two groups being compared are the same. The plot in figure 4-1 shows average differences in empathy scores between baseline and endline measurements for each user in the study.

For the first part of the analysis, the survey questions were broken down by issue
and a separate statistical test was run for a user’s empathy score for each issue. Table 4.2 shows the results of the permutation test comparing post-survey results between groups on questions measuring empathy related to the four selected issues. The mean, i.e. test statistic, represents the difference in means between test groups. Table 4.3 shows the results of the paired t-test comparing baseline vs. endline survey data within groups. The mean, i.e. test statistic, represents the difference in means between baseline and endline empathy scores.

<table>
<thead>
<tr>
<th>Comparison</th>
<th>PAS</th>
<th>HC</th>
<th>FS</th>
<th>AA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>p</td>
<td>Mean</td>
<td>p</td>
</tr>
<tr>
<td>G3 vs G1</td>
<td>1.1</td>
<td>0.0258</td>
<td>0.6</td>
<td>0.0662</td>
</tr>
<tr>
<td>G2 vs G1</td>
<td>0.9778</td>
<td>0.0333</td>
<td>0.5556</td>
<td>0.1941</td>
</tr>
</tbody>
</table>

Table 4.2: Table of results from permutation test for individual issues
Using $\alpha = 0.05$ with a Bonferroni correction factor of 4, these results do not indicate significance across any of the tests with our adjusted threshold of $p < 0.0125$. Thus, we fail to reject the null hypothesis. We note though that the G3 paired t-test for healthcare issues ($p = 0.0192$) is very close to our significance threshold. However, given our small sample sizes for each group, the data is subject to much noise.

For the second part of the analysis, we tested for general empathy using the permutation test - first an averaged index for the selected four issues, then an averaged index for all issues. The broader range of issues included additional topics of same-sex marriage, immigration, gun control, and police brutality. Table 4.4 shows the results of this analysis.

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Selected Issues</th>
<th>All Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>p</td>
</tr>
<tr>
<td>G3 vs G1</td>
<td>0.27</td>
<td>0.153</td>
</tr>
<tr>
<td>G2 vs G1</td>
<td>0.3956</td>
<td>0.1017</td>
</tr>
</tbody>
</table>

Table 4.4: Table of results from permutation test using averaged index across issues

We compare our p-values to a threshold of $\alpha = 0.05$; because neither p-value is less than 0.05, we fail to reject the null hypothesis.

For the final part of the empathy analysis, we tested for general empathy across experiment groups taking into account changes in baseline and endline responses. The results of the permutation test of the difference between baseline and endline empathy scores on questions drawn from the four issues are shown in table 4.5.
These results do not indicate statistical significance using a threshold of $\alpha = 0.05$ compared to our p-values, and thus we fail to reject the null hypothesis. Although we do not achieve statistical significance from the results of the evaluation, we note that the difference in means across treatment versus control (G3 vs G1) in both tests are positive, indicating a move in the right direction.

### 4.5.2 Moral Framing Analysis

Eight participants were determined by trained coders to have strong positive reframing as defined in section 4.4.2 in their responses to the following prompt on physician-assisted suicide: "Write an argument directed toward a person from the opposite side to convince them of your side." Of these eight participants, five were from G3 (33% of all G3 participants), two from G2 (22%), and one from G1 (8%). Although this sample size is too small to draw any statistically significant conclusions from, we note that the overwhelming majority of participants who reframed their responses were from one of the two the moral foundations education treatment groups (G2 and G3), and that the percentage of reframed responses from G3, participants who used Pano, is higher than that of G2, participants who used the control extension.

In table 4.6 we show an example of a participant’s reframed response, and the moral frames present before and after.

### 4.5.3 Engagement Metrics

A number of quantitative measurements around user engagement with Pano were taken throughout the user study. Table 4.7 shows these various metrics. Table 4.8 shows the most popular tags that users tagged on each article.
Pre-study

Terminally ill patients who want to die are an inefficiency in the healthcare system; these resources could be freed to help other ill people.

No moral frames

Post-study

It is inhuman to let a patient suffer from a terminal illness when the patient desperately wants to end her life

Morality, care

Table 4.6: Pre- and post-study survey response from a participant demonstrating strong positive reframing.

<table>
<thead>
<tr>
<th>Briefing</th>
<th>Highlights per article</th>
<th>Avg tags per highlight</th>
<th>Avg votes per tag</th>
<th>Summary edits</th>
<th>Comments per tag</th>
<th>Avg interactions per user</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PAS - left</td>
<td>26</td>
<td>1.7692</td>
<td>2.1087</td>
<td>1</td>
<td>0</td>
<td>6.3333</td>
</tr>
<tr>
<td>1. PAS - right</td>
<td>36</td>
<td>1.5278</td>
<td>2.1818</td>
<td>1</td>
<td>0.0727</td>
<td>7.6667</td>
</tr>
<tr>
<td>2. FS - left</td>
<td>19</td>
<td>1.6842</td>
<td>2.1563</td>
<td>1</td>
<td>0.0313</td>
<td>3.1429</td>
</tr>
<tr>
<td>2. FS - right</td>
<td>17</td>
<td>1.2941</td>
<td>2.0909</td>
<td>1</td>
<td>0.0455</td>
<td>5.1538</td>
</tr>
<tr>
<td>3. HC - left</td>
<td>20</td>
<td>1.45</td>
<td>2.2414</td>
<td>1</td>
<td>0.1034</td>
<td>4.7690</td>
</tr>
<tr>
<td>3. HC - right</td>
<td>21</td>
<td>1.3810</td>
<td>2.3103</td>
<td>1</td>
<td>0</td>
<td>4.9231</td>
</tr>
<tr>
<td>4. AA - left</td>
<td>15</td>
<td>1.5333</td>
<td>2.2609</td>
<td>1</td>
<td>0.0435</td>
<td>3.7143</td>
</tr>
<tr>
<td>4. AA - right</td>
<td>22</td>
<td>1.4545</td>
<td>2.0312</td>
<td>1</td>
<td>0</td>
<td>4.6429</td>
</tr>
</tbody>
</table>

Table 4.7: Table of user engagement with Pano features

<table>
<thead>
<tr>
<th>Briefing</th>
<th>Top moral framing tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PAS - left</td>
<td>Fairness, sanctity, authority</td>
</tr>
<tr>
<td>1. PAS - right</td>
<td>Care, fairness, degradation</td>
</tr>
<tr>
<td>2. FS - left</td>
<td>Care, harm, betrayal</td>
</tr>
<tr>
<td>2. FS - right</td>
<td>Fairness, harm, authority</td>
</tr>
<tr>
<td>3. HC - left</td>
<td>Cheating, betrayal, subversion</td>
</tr>
<tr>
<td>3. HC - right</td>
<td>Care, authority, morality</td>
</tr>
<tr>
<td>4. AA - left</td>
<td>Harm, fairness, subversion</td>
</tr>
<tr>
<td>4. AA - right</td>
<td>Fairness, harm, morality</td>
</tr>
</tbody>
</table>

Table 4.8: Table of top moral framing tags in each article

These metrics show high levels of engagement for some components, such as highlights per article, and low levels of engagement for others, such as summary edits. Engagement metrics are also relatively consistent across article topics and left-right
lean. We discuss the implications of these results in chapter 5.

4.6 User Feedback

User feedback on the overall experience of using Pano during the user study was collected from G3 participants post-study via an anonymous survey. 11 out of 15 participants responded. In this section, we summarize the responses received and note some highlights from the feedback.

Most crucially, users were asked whether Pano affected the way they thought about articles. A majority of respondents said that using Pano changed how they thought about the articles and perspectives they were reading - people liked being able to see moral framings highlighted by other users. A user wrote that he/she "started to examine how the article presented the argument instead of the content of the article alone", a sentiment echoed by several other responses.

Users were also asked more specifically about each of the two main components of Pano: in-page highlighting and annotation, and the features on the extension popup (page framings, recommendations, and page summary). In response to what users thought about the ability to highlight and tag in articles, users described their feelings as "interesting", "pretty neat", "a cool idea", and "potentially useful". Two of the respondents were confused what the point of moral frame tagging was, and we discuss this further in section 5.1.1. In response to how easy or difficult it was to use the feature, users described usage as "easy" across the board.

In response to what users thought about the features in the extension popup, about half of respondents liked them, pointing out "Recommended Pages" as an especially useful feature. The other half did not use the features much or did not find them particularly useful. One user found utility with the summary feature: "...contributing summaries whenever I remembered was useful to review what I had retained
from the article."

Finally, in response to whether users shared the articles they read to their social networks or friends outside of Pano, across the board, all users did not. However, a few users mentioned sharing them privately with individual friends or bringing up the articles in conversations.
5

Discussion

From our evaluation results and post-evaluation feedback, users were engaged in and actively participated in the process of collaborative highlighting and annotation of articles. Many users found Pano to be useful, describing the ability to highlight and annotate as easy to use and interesting. While some features, such as tagging, upvoting, and recommended articles received much exposure and positive reception, other features such as commenting and page summaries were rarely utilized. Some users expressed that the use of Pano led them to think deeper about articles. Although our quantitative evaluation analysis did not lead to statistically significant results given our small group sizes of around 10 participants per group, we plan to conduct further user studies with larger population sizes over an extended time period.

In this chapter, we discuss our takeaways from the design and development process of Pano, as well as from conducting the evaluation. We provide suggestions for the broader design implications resulting from our work, and direction of future work in the development of Pano.

5.1 Engagement with Pano

The main features of Pano - highlighting and annotation, as well as recommendations, gained positive reception with users. However, other features, such as page
summaries, page framings, and commenting were rarely utilized.

5.1.1 Highlighting and Annotation

The collaborative highlighting and annotation component of Pano was largely successful. Altogether, users added an average of 22 highlights per article, meaning that there were 22 separate statements in which users detected the presence of moral framing and acted upon it - this number is much higher than we expected. The tags in the highlights were generally accurate with the actual moral frames of the article statements. Furthermore, what was even more surprising was the level of user interaction with all highlighting and annotation features. In our user study, we instructed users to add at least two contributions to a page - either through highlighting/annotation, tagging, upvoting, or commenting. As shown in table 4.7, users actually had an average of over 5.04 interactions per user per article - over double the number they were tasked to do. This significant difference in actual interactions versus instructed interactions suggests that users were highly engaged and actively participating in the process of collaborative highlighting and annotation.

As covered in more detail in section 4.6, users reported that the highlighting and annotation process was "easy" and "intuitive" to use, and that spotting opportunities to tag framing were also generally easy. Sentiment on the feature was mixed: a few users reported they weren’t sure what the point of the moral framing was, while others reported that they found it "interesting". This suggests that more work on the learnability of the intent of Pano is important, or a more extensive briefing and/or onboarding process in the initial adoption of Pano are areas for improvement in the future.
5.1.2 Page Summaries

Across the board, for all articles participants were provided, each page summary was only edited a grand total of once. Once a page summary was initially added, users did not edit the summaries any further. In conceptualizing the representation of the page summary as similar to a mini-Wikipedia about the page, it makes sense that the vast majority of users would only consume the summary; only the early landing users would feel the need to add a summary since they are faced with an empty summary and a prompt for them to add one. Furthermore, this supports prior research that people are unwilling to edit other peoples’ work [51].

In the future, building an incentive structure for people to want to contribute to page-level summaries can boost engagement with the feature. For instance, providing users guided prompts upon viewing the summary such as "Do you agree with this summary?" "Is this summary accurate?", etc. can be ways to challenge users’ thinking about the contents of the summary and force them to discover inconsistencies or issues with it.

User feedback supports the page summary as a useful feature, with a user reporting that it would be useful for him/her if he/she were in a rush. However, we also note that pursuing active learning through collaborative summary-building may not be the best approach because of the difficulty of encouraging users to engage with it. Thus, we focus on the collaborative highlighting and annotation as the main means for active learning through Pano.

5.1.3 Tag Comments

Few comments were left on tags - each article had an average of fewer than 0.1 comments per tag, and some articles even had no tag comments. Users likely did not notice the comment feature or did not feel the need to leave comments. However, we noticed multiple users in both the control and treatment extension conditions utilizing
the Eyebrowse bulletin board feature as a way to leave general comments about their thoughts on the articles, indicating that people want to discuss and argue about the issue as a whole. However, lack of usage of the highlight-and-tag-level commenting feature suggests that they are not interested in discussion on the granular level of individual claims, moral values, and statements.

5.2 Field Study Results

While our evaluation results did not attain statistical significance toward our hypotheses, we do note that the direction of change is indeed positive - experimental groups G2 and G3 achieved increases in empathy scores in almost all cases for each of the four issues and for an averaged index score across all selected issues, with the change observed in G3 being generally larger than the change observed in G2. This evaluation used a small sample size of approximately 10 participants per group, too little to achieve any statistical significance; moving forward, in section 5.4, we discuss the prospect of a second field study with a larger population size.

The qualitative analysis also suggests movement in the positive direction of improved tendency to reframe arguments in the moral foundations of the audience. Again, due to small sample size, we cannot draw any conclusions, but we hope to revisit the reframing hypothesis as well in a future study.

The process of conducting the field study and analyzing the results also provided insights for areas of improvement in the design of a future field study. For one, a few users reported in the optional "Any feedback about this study?" at the end of the post-study survey that this study was a lot of work to complete, or that they felt rushed to complete tasks such as the article briefings every two days. Future studies should operate on a wider time scale, and consider ways to reduce the amount of writing a participant must complete or integrate written responses into the experience of using the system, e.g. using an in-extension journal.
Furthermore, some participants took a different interpretation to the pre- and post-study survey question prompts than we intended. For example, when prompted to give a first impression of a person’s perspective on an issue, some participants wrote about their own opinion on the matter, rather than how they viewed the person in question. This could be mitigated in future studies by providing a description of the intended response, or sample responses as style examples.

Finally, although we did not collect data on this, we are interested in re-exploring the design of the Moral Foundations education via explanation of survey results. Participants were instructed to read through and understand their survey results from the Moral Foundations questionnaire (section 4.3.1) in order to learn about moral framing. However, there was no way to ensure participants read or understood the material. Moving forward, a more interactive design, such as a tutorial that a user must walk through in order to get their survey results, may be more effective as a means of moral foundations education.

5.3 Design Implications

People are inclined to engage in discussion - we observed that when given a system to use while reading news, users wanted to use the system to talk about their thoughts. While users did not use the discussion feature we intended (discussion on highlights and tags), users still found a way to utilize the system to leave their views on the page through the Eyebrowse bulletin board feature. However, the bulletin board feature was also not conducive to discussion, as visually on the interface, the feature is small and can only display one or two comments at a time. As a result, we believe that inclusion of general discussion features is important to the design of such a system and that guiding that discussion around moral framing can be a useful way to further engage users with moral frames. Discussions could be guided by visual reminders of moral frames present in articles, such as with our page summary tab feature (see
The recommended pages feature was also generally well-received - of the users who actively used the extension popup tab, the resounding favorite feature was recommended pages (see section 3.4 for reference). This indicates that people are interested in discovering and reading new articles similar to topics they consume. Thinking forward to the deployment of Pano in the wild, because the recommended pages feature is a passive feature in that users must discover and use it on their own with no prompting from the system, we presume users would only seek to use recommended pages when they are in a diversity-seeking mindset. Our suggestion for the design of recommendation systems moving forward is for moral values to be taken into account when building recommenders - either by incorporating similarity of moral framing into the recommendation algorithm, or surfacing moral framing information as cues.

Finally, using a moral framework to structure annotations on highlights was relatively effective for provoking users to think deeper about moral framing and was generally well-received. While some felt that having to choose from a specific set of tags was constraining, they still appreciated the ability to do so in the first place. Several users reported being forced to confront the arguments presented in articles in new ways - they thought more about the moral framings being used and what it revealed about an author or the way stories would be received. Users also found it very valuable to be able to see how others tagged arguments. The constrained nature of the design of tagging and annotation also removed the potential for certain types of Internet trolls and bad actors since freeform input was disallowed. We suggest using collaborative highlighting and annotation for active learning of various frameworks, even those outside of moral framing. For example, using topic-based or sentiment-based tag frameworks may also help users think more about the way articles and opinions are written.


5.4 Future Work

In the future, we aim to conduct a larger field study drawing from a more diverse population of users - a wider spread across the left-right political spectrum, as well as more diversity in age, since our study tended toward younger users and liberal-leaning ideologies. This broader study would allow us to more accurately test our hypotheses, as well as gain further insights from different types of users than the ones in our first study. Furthermore, in designing a larger field study, we may discover and test new methods on integrating the usage of Pano into users’ lives more seamlessly, as the first user study environment was more controlled than a pure field study.

Our insights from this work’s evaluation also informed directions for further design and development of Pano. A stronger initial onboarding experience and better learnability into the purpose behind Pano would provide users more context for what their usage of Pano is meant to accomplish. User feedback and engagement metrics also indicate a continued focus on active learning through collaborative highlighting and annotation as the means for education about moral values.

Encouraging the social aspects of Pano such as collaboration, discussion, and sharing is still an integral part of the system, necessary for effectively achieving Pano’s goals, as our study showed that people liked interacting with others’ annotations and that people want a place to be able to voice their thoughts. Conducting user interviews focused on framing and education of framing for the role of discussion in a system like Pano may give more insight into where and what the discussion should be centered around - our approach in Pano was discussion on the highlight and tag level, but low engagement with this feature suggests discussion would be best placed and focused elsewhere.

In summary, the direction of our future work focuses on firstly, a user study to gain further understanding of the quantitative impact on users’ empathy, and secondly, re-
designing Pano to provide an even stronger learning experience around moral framing with an improved onboarding process, further social interaction capability, and guided page-level discussion.
6

Conclusion

In our increasingly ideologically divided society today, as we are surrounded by homogeneity of opinion and perspective in online filter bubbles, it is clear that we must establish mutual understanding across the aisle. In this thesis, we have presented Pano - a system for bridging the ideological divide by surfacing moral framing in news. Pano has provided a way to educate consumers of online news to think in a moral framework of shared human values, challenging their understandings of views held by those different from them. Through collaborative highlighting and annotation of moral framing in text, as well as an array of other features meant to bring about awareness of moral framing in online news, users engage and interact with moral framing of perspectives in arguments, gaining familiarity with a new way of thinking.

We demonstrated through our evaluation of Pano in a 10-day field study that this system has brought about positive change in the reported empathy of users, as well as improvements in ability to re-frame arguments directed toward the other side in a more constructive way - framing in the values and concerns of the other side. We also discovered that Pano did indeed affect how users thought about news. Users became more aware of moral framing in online news, thought deeper about the values authors had and gained realization about the ways in which statements can have multiple meanings and interpretations.
One user shared a particularly positive experience with Pano:

"[Pano] made me think about the values each author had and was trying to highlight in their article. It also made me realize that multiple framings can be applied to the same statements, and made me realize how many perspectives and meanings can be embedded into a certain statement. These meanings aren’t always intended by the writer too—the readers and their experiences and perspectives influence the framings identified in each article."

The experiences of this user and others in our field study give us hope in the potential of Pano as a system for bridging the ideological divide. Moving forward, we hope to improve Pano and bring about more experiences similar to the one above—to change users’ frame of mind and close the divide of people talking past each other, one inch at a time.
Bibliography


