RECALL, RECOGNITION, AND THE MEASUREMENT OF MEMORY FOR PRINT ADVERTISEMENTS

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ABSTRACT

The recall and recognition of people for 95 print ads were examined with an aim toward investigating memory structure and decay processes. It was found that recall and recognition do not, by themselves, measure a single underlying memory state. Rather, memory is multidimensional, and recall and recognition capture only a portion of memory, while at the same time reflecting other mental states. When interest in the ads was held constant, however, recall and recognition did measure memory as a unidimensional construct. Further, an examination of memory over three points in time showed considerable stability. The findings are interpreted from the perspective of recent research in cognitive psychology as well as current thinking in consumer behavior and advertising research.

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INTRODUCTION

Investigations of the readership of print advertisements date back to the very beginnings of advertising research (Wood 1961) and remain the basic and most widely used source of information about consumer response to advertising in print media. Throughout much if not most of the history of readership research there has been a continuing controversy about the relative merits of the two types of measures most often collected in these studies: recall and recognition (Copland 1958, Lucas and Britt 1963). Recall is the mental reproduction of some target item experienced or learned earlier, while recognition is the awareness of having previously experienced that stimuli. Operationally, in recall some contextual cue is provided and the respondent must retrieve the target item from memory. In recognition, the target item is provided and the contextual circumstances of the earlier event or experience must be retrieved.[1] Do recall and recognition scores behave in a manner consistent with interpreting them as measures of memory? Is recognition a less demanding but more error-ridden test of memory than recall? Do they measure common or distinct memory processes? Concern with these and related issues persists in advertising (Clancy, Ostlund, and Wymer 1979; Krugman 1972, 1977), but the available literature reflects little influence of relevant developments in psychological theory and research on human memory where there has been a long-standing concern with a very similar set of questions (Craik 1979, Murdock 1974). The present paper represents an effort to bring the latter perspective to bear on the aforementioned problems in advertising research.

We begin with a review of the arguments and evidence from previous research bearing on the convergent and discriminant properties of recall and recognition measures. Next, we discuss some models and findings relating to memory structure from research in psychology and consider their implications with regard to how recall and recognition represent memory processes. We then propose a set of hypotheses about the construct validity of recall and recognition as measures of advertisement rememberance. Empirical tests of the hypotheses are reported based on a re-analysis of recall and recognition data from the Advertising Research Foundation's (1956) well-known study of advertising readership measures using structural equation methods. As will be discussed below, this study has had a considerable influence on thinking about advertising readership and the data base it provided remains unique in that it includes measures of both recall and recognition for the same cross-section of print advertisements and allows the short-term time path of memory to be examined. In the final section of the paper, we interpret our findings from the perspective of recent research in cognitive psychology as well as current thinking in consumer behavior.

RESEARCH IN ADVERTISING

Memory phenomena have long occupied a central place in thinking about the process and effects of advertising. The various hierarchy of effects models (Ray, 1973) that have been proposed to represent the mental stages consumers pass through in response to advertising all acknowledge the role of memory. Generally, these conceptual schemes assume a common sequence of initial phases or steps. Thus, it is believed that exposure to an advertisement leads first to perceptual activities, then information processing, and finally a memory trace. Memory of an ad, in turn, has often been depicted as following a decreasing exponential "forgetting" function (Lodish 1971), similar to that first used in Ebbinghaus' (1885) classic work to show that memory initially declines rapidly but then more slowly as time passes. This notion of memory decay, "old advertisements never die -- they just fade away" (Waugh 1958,

p. 204), is one of the principal behavioral rationale underlying the study of carry-over effects in advertising (Sawyer and Ward 1979).

Despite this emphasis, there has been little effort directed toward the development of an explicit or formal model of memory. Rather, the tendency has been to view it as a black box. Attention has been focused on the output of memory without regard to its internal structure or processes. Indeed, early work saw recall and recognition as parallel measures of one underlying memory state (Burtt and Dobell 1925). However, in the 1960's several important pieces of empirical evidence were reported which indicated that recall and recognition measures behaved quite differently.

The most influential findings were those that emerged from the Advertising Research Foundation's (ARF) study of "Printed Advertising Rating Methods"(PARM). The original PARM investigation produced recall and recognition scores for the same cross-section of ads that had appeared in a single issue of _Life_ magazine. Lucas (1960) examined how the _mean_ level of these scores varied as the interval between the respondents' last reading of the issue and the time of the readership interview increased. He observed that "Recognition ratings showed no consistent tendency to drop off with the elapse of time; yet recall scores fell off very substantially as the interval increased" (Lucas 1960, p. 14). (The mean recall and recognition scores are shown in Table 1 below.) Arguing "memory should decline with the passage of time," Lucas concluded that recall could be considered a measure of memory but recognition should not. Lucas (1960) expressed the view that "rationalization of what is measured by the recognition procedure is likely to be inconclusive," (p. 15) but went on to suggest that "recognition ratings are a rough indicator of reader behavior, perhaps a guide to some kind of psychological contact more substantial than more visual exposure" (p. 17). Neu (1961) disputed Lucas' interpretation and cited evidence from magazine readership surveys conducted by the Starch (1958) organization which showed that recognition scores did decline with the passage of time.

Wells (1964) carried out some further analyses of the PARM data which provided support for the position that recall and recognition were not measures of the same construct. In addition to recall and recognition, the PARM study had also obtained measures of reader interest for the same set of ads from a separate mail survey. Wells found that reader interest was more strongly correlated (across ads) with recognition than with recall. He also showed that recognition scores were more sensitive to the ad size and the use of color than were recall scores. Other evidence reported by Wells indicated that ratings of an advertisement's "attractiveness" were more highly correlated with recognition than recall while the reverse was true for ratings of "meaningfulness." On the basis of these findings and Lucas' (1960) earlier analysis, Wells (1964, p. 8) concluded that "Recognition scores have little if anything to do with memory," and suggested such measures be regarded as a "respondent's subjective estimate of the probability that he looked at the ad when he went through the issue." Wells (1964, p. 8) concurred with Lucas' interpretation of a recall score as a measure of memory, adding that "recall scores are more objective and therefore more trustworthy than recognition scores."

Other studies have documented the presence of a large component of systematic error in recognition scores. An experiment conducted by Appel and Blum (1961) demonstrated that recognition scores are inflated by false reporting of seeing ads and that the tendency of respondents to over-report recognition is related to their interest in the product advertised, past or intended purchasing, number of magazines read, and familiarity with editorial content. Evidence of false recognition claims has been found in other studies (Clancy, Ostlund, and Wymer, 1979), and methods have been proposed for minimizing and/or adjusting for its presence (Appel and Blum 1961, Davenport, Parker and Smith 1962, Smith and Mason 1970). Interestingly, a study by Simmons and Associates

(1965) showed that mean recognition scores for magazine advertisements, adjusted by an estimate of incorrect claims, decreased with the passage of time following exposure. It appears that there has been very little investigation of the presence of systematic errors in recall scores although at least one published study of newspaper advertising reported evidence of a substantial level of erroneous recall claims (Bogart and Tolley 1964).

Krugman (1972, 1977) has discussed the role of advertising memory in connection with his theory of how involvement affects the process of learning whereby the effects of mass media advertising occur. He postulates that quite distinct perceptual and memory processes underly the "low" involvement learning said to characterize much television advertising as compared to the "high" involvement learning generally associated with print advertising. In the latter case, Krugman suggests that what is stored in memory is verbal, or words, the retention of which can be suitably measured by recall methods. On the other hand, with television commercials, Krugman (1977) argues that it is a picture or "image memory, without words" (p. 9) that is stored and therefore recognition is a more appropriate measure of memory for television commercials because what is retained is essentially non-verbal and will not necessarily be recalled. Failure to appreciate what recall and recognition measure has given rise, according to Krugman, to widespread acceptance in advertising circles of the "myth" that without repeated exposure, advertising is rapidly forgotten:

> It is this myth that supports many large advertising expenditures and raises embarrassing and, to some extent, needless questions about unfair market dominance.
>
> The myth about the forgetting of advertising is based primarily on the erosion of recall scores. Yet the inability to recall something does not mean it is forgotten or that it has been erased from memory. The acid test of complete forgetting is that you can no longer <u>recognize</u> the object (Krugman 1972, p. 14).

To illustrate his point, Krugman went on to cite some data for television commercials indicating that recognition scores were much higher than recall scores. It appears that Krugman's views on these matters have gained some acceptance. Zielske (1982), for example, has interpreted Krugman's position as being that "recall understates true remembrance of advertising" and used Krugman's analysis of verbal versus image memory as a rationale for going a step further and suggesting that, as a copy-testing procedure, "day-after recall may penalize 'feeling' ads as opposed to 'thinking' ads" (p. 19). Based on an informal analysis of the elevation of recognition scores over recall scores for the same set of six television commercials and six magazine advertisements, Zielske advocated the use of recognition rather than recall methods to obtain measures of remembering suitable for comparing the performance of "feeling" and "thinking" television commercials. His results implied that such a differential choice of methods was not required for magazine advertisements.

The tendency for recognition levels to exceed those of recall for the same advertising stimuli has long been observed in studies of print advertisements (e.g., Bogart and Tolley 1964, Lucas 1960) but is not, of course, inconsistent with the proposition that both measure a common underlying memory state since the absolute magnitude of such scores are known to be sensitive to a variety of methods factors such as the specific questionnaire wording and probing methods used (Lucas 1960). Rather, the crucial questions are why and how do these two measures <u>covary</u>? If two methods are measuring totally separate or independent constructs, one would not expect to observe them to be highly correlated (Campbell and Fiske 1959). However, substantial correlations have been reported between recall and recognition scores in cross-sectional studies of print advertisements where both measures were obtained for the same stimuli from separate samples of respondents (Wells 1964; Bogart, Tolley and Orenstein 1970). Given that the use of recognition measures in testing television commercials has not been common, evidence bearing on the covariation of recall and recognition measures for television commercials comparable to that cited above for print advertising does not appear to be available presently. While Zielske's (1982) aforementioned study reported recall and recognition scores for only six commercials, a strong monotonic relationship is also discernible in those data. Thus despite their considerable history of controversy and substantial practical significance, fundamental questions about the substance and measurement of advertising memory remain unresolved. Bettman (1979), Mitchell (1980), and Olson (1978) among others have called attention to the relevance to marketing researchers of modern psychological theories of memory. In the next section, we briefly consider some of this work and its implications concerning how recall and recognition may capture consumer memory of advertising.

RESEARCH IN PSYCHOLOGY

Memory Structure

Psychologists have offered a number of conceptual models of memory. Most of thes view memory as a multicomponent entity consisting of organized and associated networks of information (Bower 1967). Theorists differ, however, on the number and nature of the components. At perhaps the highest level of abstraction, memory has been represented as a sequence of three stages (Atkinson and Shiffrin 1968). Briefly, this paradigm maintains that external information is first recorded in a sensory register which temporarily holds the information in verdical form until it can be matched to meaningful concepts in a sub-process know as pattern recognition. Successful encoding by the sensory register results in further processing in stage two: short term memory (STM). The STM performs the functions of converting raw sensory information to meaningful codes, which are largely thought to be acoustical no matter what are the physical characteristics of the stimulus information. Further, STM is believed to provide a tempory store of coded information, to perform some limited processing (e.g., chunking, rehearsal), and to transfer the information to long term memory (LTM), which is the third and final stage in the paradigm. In LTM, information is stored more-or-less permanently, and in effect, becomes one's depository of human learning. Information is believed to be coded in LTM either visually, auditorily, or semantically. Klatzky (1980) provides a summary of research from this "sequence of stages" paradigm.

Although the sequence of stages paradigm is useful for conveying the steps through which information processing procedes and has stimulated considerable research, there are a number of other viewpoints which provide a more specific rationale for our hypothesis that memory is multidimensional and that recall and recognition represent in some ways distinct and some ways overlapping aspects of memory.[2] Consider first what might be termed the "dual process hypothesis". In this model, recognition is believed to consist of a process whereby a stimulus piece of information is matched or compared to the contents in memory. Recall, in contrast, is thought to entail recognition plus an additional step. That is, a stimulus cue is thought to first generate a set of concepts which are mentally associated with the cue and next comparisions or matching between the cue and set of concepts are performed until the proper one is "recognized". Some authors add a decision stage to recognition and recall whereby the outcome of matching becomes identified, acknowledged familiar, etc. (c.f., Glass et al. 1979). The recall process sketched above has been termed the "generate and recognize" model in the literature (Anderson and Bower 1972, Mandler 1972; for a critique and defense, see Broadbent and Broadbent 1977; Rabinowitz, Mandler, and Patterson 1977a, b). This model will be shown below to suggest differing implications for recall and recognition.

The "levels of processing theory" offers still another multidimensional model of memory (Craik and Lockhart 1972, Craik and Tulving 1975, Lockhart, Craik, and Jacoby 1976). Rather than construing memory in terms of separate components, the theory proposes that information is processed at varying "depths". The physical or visual aspects of a stimulus are processed at the shallowest level (e.g., the shape of the letters in a word). Auditory stimuli receive somewhat deeper processing (e.g., whether a word rhymes or not with another word). Finally, the deepest level of processing occurs at the semantic level (e.g., the meaning of a word). Although not without its critics (Baddeley 1978, Nelson 1977), the levels of processing theory will be used below to suggest differing outcomes for recall and recognition in certain instances.

Finally, Tulving's (1972) distinction between episodic and semantic information and Paivio's (1969, 1971, 1978) "dual-coding theory" also imply that memory is multidimensional. One may define episodic memory as stored information which is context specific to one's personal history or experiences. Semantic memory, in contrast, houses information dealing with meaning in a general sense and is not tied to particular episodes in one's life. The dual coding theory hypothesizes that people represent information in one or both of two forms: verbally or as images. Verbal codes may be concrete or abstract, while images are generally concrete. In addition to suggesting the multidimensionality of memory, Tulving's information distinctions and the dual-coding theory will be used to contrast and compare recall and recognition.

Implications of the Multicomponent Theories for the Representation of Recall and Recognition

One way to examine similarities and differences in recall and recognition is to analyze their structures, determinants, and consequences within the contexts of the four multicomponent views of memory defined above. To begin with the dual process hypothesis, it can be seen that recall and recognition of a stimulus should covary because both share a common process: namely, the matching of a stimulus to content in memory. However, two factors make the extent of covariation problematic.

First, one might expect the covariation to decline with an increase in the complexity of the stimulus. For example, it would be expected that the recall and recognition of a brand name would generally covary at a higher level than, say, the recall and recognition of a print ad. Because a print ad usually has many objects, words, and colors in it, it is probable that recognition would be affected more by a different subset of the copy than would recall. A brand name is a simpler, more homogeneous stimulus, and relative to the print ad, should produce a higher covariation in recall and recognition (for a different prediction, see argument below, however).

Second, the covariation between recall and recognition should be reduced to the extent that the networks of associations in memory that are triggered by recall and recognition cues differ. One would expect that the overlap in the set of concepts engendered by recall cues consisting of, say, brand names and organizations versus the set of concepts generated by recognition cues of actual print ads would be less than perfect. Further, the strength of associations among concepts within the recall set should in general be different than the strength of associations among concepts within the recognition set. This is a consequence of differential repetition, familiarity, salience, and similarity that is sure to arise between the recall and recognition cues. Hence, while recall and recognition may share common mental processes and content, the extent of their correlation will vary depending on the circumstances and the structure in memory. For a view of memory termed the associative-network model that somewhat supports our rationale for predicting contingent covariation between recall and recognition, see Anderson and Bower (1972, 1973).

Notice that the associative-network model could conceivably predict greater covariation between recall and recognition for more complex ads. If we assume that more complex ads are encoded as many interconnected nodes, then later stimulation of one or more nodes through a cue would enhance both recall and recognition because of a spreading activation of nodes emanating from the cue. Only one or a few nodes might be necessary to achieve full recall or recognition of the complex ad. A simple ad, in contrast, has a smaller number of nodes with which one can access the entire memorized structure of information. Further, the strength of association among nodes is a factor potentially enhancing or depressing recall and/or recognition, depending on the stimulus cue.

The levels of processing theory also has implications for the representation of recall and recognition. In particular, it has been found that both recognition and recall increase as the depth of processing increases (e.g., Craik and Tulving, 1975). The effect has been obtained in controlled experiments using both print advertisements and television commercials (Saegert 1978, Saegert and Young 1981, and Reid and Soley 1980). The rationale is twofold. First, more associations among concepts are generally formed the deeper the level of processing. Second, deeper levels of processing typically result in more differentiation, and hence discriminability, than shallower levels. The net result is that the deeper levels of processing enhance the probability that a recall or recognition cue will be identified. As a result, one might predict that the covariation between recall and recognition should vary as the depth of processing varies between the objects associated with recall cues and the objects associated with recognition cues. Recall and recognition should covary more highly if both are processed semantically than if one is processed visually and the other semantically, for instance.

Tulving's semantic/episodic information distinction offers somewhat similar implications as does the levels of processing theory. Namely, recall and recognition should covary more highly to the extent that the cues and/or the objects to which the cues refer are both semantic or are both episodic. If one is semantic and the other episodic, then the covariation should be reduced.

The dual-coding theory also suggests that recall and recognition should covary, depending on the conditions. If the original stimulus information is represented concretely as images and both the recall and recognition cues are connected to these images, then recall and recognition should covary to a greater extent than, say, if the information associated with the recall cue were represented abstractly in a verbal code and the information associated with recognition were represented concretely as an image code. Moreover, the theory would seem to predict that recall and recognition would covary most highly when information was represented in both a concrete and abstract way.

Finally, other research indicates that recall and recognition can sometimes differ as a function of their antecedents. For instance, Godden and Baddeley (1975) found that the learning context differentially influences recall and recognition. When the environment in which material was originally learned was changed for tests of recall and recognition, only recall was affected. That is, material was recalled more accurately in the environment in which it was first learned, while recognition remained the same under both conditions. One interpretation of the findings is that the environment served as a necessary generative cue for recall but did not influence the matching or identification process. For research supporting the view that the conditions or setting at encoding affect later retrieval through the degree of correspondence between the episode cue at a later point in time and the original encoded episode, see Kintsch (1974) and Flexser and Tulving (1978). Kintsch (1970) also found that recall and recognition differ, depending on the nature of the stimulus information. Recall of frequent words (i.e., those that appear often in written English) was better than recall of infrequent words, while recognition of frequent words was worse than infrequent words. These results have been taken to refute the "threshold" hypothesis of memory which claims that the threshold for recall is higher than the threshold for recognition (e.g., McDougall 1904). The evidence, however, also suggests that recall and recognition will not necessarily covary at a high level.

In sum, research indicates that recall and recognition should covary as a function of their common content (i.e., the matching process) but that the degree of covariation will depend on various factors such as the complexity of the stimulus information, the network of associations among concepts in memory, the nature of the learning experience (e.g., repetition, salience of information, the context), depth of processing, and type of memory code. It should be noted that the above hypotheses represent our interpretation of the implications of basic research in human memory and have not been investigated in either the psychology or marketing literature.

The discussion so far has focused primarily on the presentation of the structure of memory. We turn now to changes in memory over time, with an aim toward shedding light on recall and recognition processes.

Memory Decay

Our knowledge of the powers and limitations of human memory is extensive and owes its origins to the early work of Ebbinghaus (1885). Generally, it has been found that recognition occurs at a higher level and persists longer than recall. Indeed, the power of human recognition is often phenomenal. Shepard (1967), for example, showed over 600 colored pictures to individuals and found that they could subsequently recognize 97 percent of them. Further, he found that recognition was still an impressive 58 percent even after 120 days. Standing, Conezio, and Haber (1970) observed a 90 percent recognition rate by subjects after they viewed 2,560 slides, with each slide seen for only 10 seconds! Similarly, Bahrick, Bahrick, and Wittlinger (1975) discovered that the percent of correctly recognized pictures of friends or groups of people remained at a constant level of about 90 percent over a period of 34 years. Free recall was neither as high nor as stable, being at about 77 percent at 3 months and declining to about 40 percent after 34 years. Overall, despite some decay, human memory shows a remarkable durability (Squire and Slater 1975).

Why does human memory decay over time? A number of explanations have been offered (e.g., Bennett 1975, Glass et al 1979, Klatsky 1980). Perhaps the simplest explanation is that memory decays passively over time due, for instance, to inherent physiological characteristics of the brain. Peterson and Peterson (1959) and Reitman (1974) present evidence supporting a natural decay process. However, other researchers have observed that no natural decay occurs, but rather, inferference effects produce a decline in memory as a consequence of the competition ocurring among new and old pieces of information in memory (Keppel and Underwood 1962, Waugh and Norman 1965). The interfence is manifest as either proactive-inhibition (i.e., a decrement produced when information learned at one point in time subsequently interferes with information learned at a later time) or retroactive-inhibition (i.e., the detrimental effect of recently learned information on previously acquired material). Significantly, Shiffrin and Cook (1978) recently found evidence that both passive decay and interference may be operative as causes of a decline in memory over time.

The mechanisms for interference -- whether for proactive- or retroactive-inhibition -- appear to be of two kinds (Dillion 1973, Dillion and Thomas 1975). First, interference can occur as a function of errors in decisions concerning the identification of potentially remembered information. The greater the number of similar pieces of information in memory compared to information to be identified, the higher the probability of an error in identification. Second, interference can occur as a result of a failure to retrieve or access previously learned information. This, in turn, may be a consequence of a variety of factors including, among others, brain damage, emotional blockage, time pressure, and information overload.

The aforementioned research on decay and interference was performed primarily in STM contexts. Nevertheless, similar processes have been identified in LTM situations as well. In general, memory decay (or forgetting, as it is sometimes referred to) can be caused by natural decay, destruction such as due to a physical injury or emotional trauma, interference effects, innacurate or incomplete encoding, retrieval failures, or further processing which acts upon the information to alter it in some way (e.g., through construction processes, inferences, generalization, etc.). A brief discussion of a number of the leading theories of decay in LTM follows.

One set of theories emphasizes the role of interference in forgetting, particularly that associated with proactive- and retroactive inhibition. Interference may occur as a result of varying strengths in associations of multiple concepts with a focal concept. When a person is asked to remember a concept connected to the focal concept, he or she will most likely identify the one with the strongest degree of association. In effect, there is "response-competition" among all concepts associated with the focal concept, and the one with the greatest strength "wins" (McGeoch 1942). The response-competition hypothesis has been extended to include interference as a consequence of competition among entire sets of responses and not merely among concepts connected to a single focal concept (Postman, Stark, and Fraser 1968). Finally, some research supports a learning theory interpretation of interference (see Klatsky 1980, 281-287; Postman and Underwood 1973). Briefly, the hypothesis is that early associations between a focal concept and other concepts are extinguished as new concepts become attached to the focal concept. This is due primarily t the concomittant lack of reinforcement experienced by the earlier associations.

Perhaps the most relevant theory of forgetting in LTM for our purposes is the "constructive processing" theory. This perspective hypothesizes that information processing is an active or even interactive operation whereby the perception and interpretation of material is formed through an on-going construction of reality. The information ultimately encoded and remembered is a combination of the actual physical aspects of the material, one's past history, and current interpretations; the latter are continually being reshaped -- much as hypotheses are generated, tested, and reformulated in scientific inquiry. Early statements of the theory were formulated in the context of perception (Gibson 1966) but have also been integrated somewhat into the broader framework of human memory (e.g., Neisser 1976).

Errors in recall or recognition can occur as a result of constructive processes in a number of ways, although the processes are technically not the same as forgetting. Specifically, construction-based inaccuracies can arise during encoding (e.g., Branford and Franks 1971, Spiro 1977) or retrieval activities (e.g., Dooling and Christiaansen 1977), but probably not autonomously during mere storage (Riley 1962). The inaccuracies might stem from distortions, false inferences, errors made in forming associations among ideas, or other constructive acts. This seems to occur especially when the meaning of stimuli are encoded and processed further. Given that one's memory for content is generally better than that for form (e.g., McKoon 1977, Sachs 1967), one expects varying rates of decay for different information, and therefore, different performance on recall and recognition tasks, depending on what had been originally encoded and on the correspondence to the recall and recognition cues. Moreover, given that one's needs and motives interact complexly with information processing and its meaning, it is probable that information first learned will be recalled or recognized differently or less well at a later time. As a matter of course, advertisements contain many stimuli with complex meanings for people, and constructive processes are probably extensive. If the information contained in recall cues differ or only overlaps partially with information contained in the recognition cues, then one might expect (1) different construction processes to occur, (2) different retrieval outcomes, and (3) a resulting divergence in recall and recognition performance.

HYPOTHESES

With the above as background we are now in a position to present our hypotheses. As a point of information, it should be noted that the hypotheses will be tested on data consisting of recall, recognition, and interest measures obtained from separate samples of respondents obtained at three points in time for a total of 95 print ads.

Hypothesis 1. As a baseline model, it is hypothesized that recall and recognition will both measure one underlying memory state. This might be expected, given that recall includes recognition as a sub-process. However, based on the research showing that memory is multidimensional and given our arguments for suspecting that the representation of information in memory will be accessed differently, and may be even coded differently for recall vs. recognition cues, we anticipate that the hypothesis of unidimensionality will be rejected. In other words, recall and recognition measures are predicted to contain unique as well as shared variance.

Hypothesis 2. If we restrict our inquiry temporarily only to measures of recall and recognition, it is possible to represent the effects of the unique variation in responses by allowing the error terms of measures in the model hypothesizing unidimensionality to covary freely. In effect, correlated errors capture the influence of exogenous processes, although, of course, the identity of these processes remains unknown. The exact analytical representation of these effects is shown under Method. Basically, it is hypothesized that recall and recognition measure a single memory state, once the exogenous processes have been methodologically controlled for.

Hypothesis 3. Given that correlated errors suggest that recall and recognition also measure other phenomena, it would be interesting to discover whether one, or more than one, additional processes are indicated. Unfortunately, as a consequence of informational limitations, it is only possible to test the hypothesis maintaining that one unmeasured factor accounts for the correlated errors. A failure to reject this hypothesis provides the researcher with a means to assess the proportion of variation in responses to recall and recognition that are due to (1) a single underlying memory state, (2) the single unmeasured additional phenomenon, and (3) random error. A rejection of the hypothesis suggests that two or more unmeasured factors are operative. The specific means to test this hypothesis is described under Method.

Hypothesis 4. For many years, advertising researchers have suspected that factors such as "reader interest" contaminate measures of recall and recognition (e.g., Appel and Blum 1961, Maloney 1961, Wells 1964). Although the exact nature of reader interest remains to be specified, it is reasonable to expect that interest harbors or is highly correlated with a person's needs, motivation, attitude, or affective involvement with the content of an ad. From one orientation, it can be argued that recall and recognition measures reflect emotional reactions of respondents to ads as well as their cognitions. Hence, it would be useful to be able to model both responses, or alternatively to represent the thinking side of memory, while holding constant the affective component. Therefore, it is hypothesized that recall and recognition measure a single memory state when interest is controlled.

As a corollary to each of the foregoing hypotheses, the decay of memory will be examined to ascertain its path. Because the research investigated 95 print ads which differ considerably in terms of their content (range of products) and composition, no firm predictions can be made *a priori* as to the extent of decay, if any. As noted in the literature review, the stability of memory is affected by the specific nature of the stimuli (e.g., their complexity), the observation conditions (e.g., the amount of repetition, extent of viewing, time delay for assessment, etc.), and the relationship of these to recall and recognition cues and the representation of information in memory. Hence, recall and recognition of each ad by each individual respondent should vary greatly. Unfortunately, the data do not permit an analysis of respondents within ads. Rather, the analysis had to be conducted across ads.

METHOD

Data Base

The PARM Study. The data analyzed here were originally collected by the Advertising Research Foundation in their "Study of Printed Advertising Rating Methods"-- hereafter referred to as the "ARF PARM Study." The project, planned by a committee appointed by the ARF and carried out by the Politz Research Organization, was undertaken as "a methodological study of different techniques of measuring the readership and remembrance of printed advertisements" (*Advertising Research Foundation,* Vol. I, 1956, p. 1). Three methods of measuring the readership of print advertisements were investigated: aided recall, recognition, and reader interest. The aim was "to provide data, collected under uniform and controlled conditions, for comparing measurements obtained by different methods and for discovering the variations in ratings that are associated with particular factors which are thought to influence the measurements" (*Advertising Research Foundation*, Vol. I, 1956, p. 1). The project was designed so as to obtain readership estimates for the advertisements appearing in the May 16, 1955, issue of Life magazine by each of the three aforementioned methods. In conducting the study, care was taken to duplicate the data collection procedures used at that time by the leading commercial practitioners of each method: Gallup and Robinson, Inc. (aided recall), Daniel Starch and Staff (recognition), and Readex (reader interest). The Advertising Research Foundation in 1956 issued a five volume report containing numerous tabulations of the raw data and invited others to carry out further analysis of the material. The ARF reports were the source of the statistical information employed here (Advertising Research Foundation, Vol. I-V, 1956). As background for what follows, it will be helpful to describe briefly certain features of the PARM study and the data from it which are utilized in this paper.

Sample Designs. The aided recall and recognition data were collected in personal interviews conducted with two separate but equivalent area probability samples drawn from the same universe which was defined as "all persons aged 18 and over and living in private households." In each survey, approximately 13,000 occupied dwelling units were visited by field workers who interviewed slightly more than 6,000 respondents (one per dwelling unit), roughly 600 of whom turned out to be "readers" of the particular issue of Life studied. The latter figure, the number of issue readers interviewed, is the sample size on which the readership proportions for the individual ads are based.

Consistent with practices then followed in commercial readership research, somewhat different procedures were used to identify an "issue reader" in the two surveys. Under the recall method, to qualify as an issue reader, a respondent first had to claim that he/she had "looked through or read" the issue when shown the cover and then be able to describe at least one item found in that issue of the magazine without being shown any of the inside pages. The recognition survey employed a less stringent definition of an issue reader. Here a respondent qualified as an issue reader if, after being shown the cover, he/she claimed to have "seen or read any part" of the issue and then repeated the claim after inspecting the issue.

In both the recall and recognition surveys, respondents who qualified as issue readers were asked: "About how long has it been since you last looked into the issue?" Responses to this question were used to classify each issue reader into one of the three categories defined by intervals of the following durations (days): 0-2, 3-6, and "more than 6." The maximum possible interval that could have been reported was 16 days since the May 16 issue of Life was released on May 12 and all interviews were conducted between May 13 and 28. Table 1 shows the distributions of issue readers in the recall and recognition samples across these three "intervals since last reading." The aforementioned differences between the operational definitions of issue readership employed in the two surveys appear to be of consequence inasmuch as a χ^2 test indicates that the hypothesis that the distributions of the recall and recognition samples across the three time intervals are similar can be rejected (χ^2 = 14.03, df = 2, p < .001). Respondents falling into the recall sample faced a more taxing test of their memories to qualify as issue readers than did their counterparts in the recognition sample and accordingly, claims of remembrances of issue exposure in the most distant time interval were less likely to be made by the recall sample than by the recognition sample.

(Insert Table 1 Here)

In a separate phase of the PARM project, a mail survey was undertaken to obtain measures of "reader interest" for the ads in the same issue of Life which was the focus of the recall and recognition studies. A questionnaire was mailed to a random sample of 2,011 Life subscribers, 818 or 40.7 percent of whom returned completed forms. From these replies, 249 were selected at random and subjected to analyses. No precise controls were exercised over the selection of respondents within the subscribing households who received the mail questionnaire.

Aided Recall Scores. Cards displaying the names of brands and organizations advertised in the issue were presented to respondents who had established themselves as issue readers, and they were asked to indicate the ones for which they remembered having seen advertisements in the *Life* issue. After having gone through the cards, respondents were requested to "playback" everything they could remember about each advertisement they claimed to have seen. These responses were then used to calculate a "Proved Name Registration" (PNR) score for each advertisement -- the percentage of issue readers who associated the brand or advertiser with some specific feature or sales point contained in the advertisement. In short, the Proved Name Registration score "includes only those who correctly identified the ad, offered some evidence of recalling its contents, affirmed that they had that particular ad in mind, and reported not having seen it in any other magazine" (*Advertising Research Foundation*, Vol. I, 1956, p. 3).

Recognition Scores. Respondents qualifying as issue readers were shown each page in the issue and asked to identify which specific ads they could "definitely remember having seen or read." Following such a claim, the respondent was questioned about which parts of the ad he/she remembered having seen or read. The principal concern of the PARM analysis was the "noting" score (NOT): the proportion of issue readers who recognized an ad as one they had seen before in the issue under investigation.

Although the aforementioned aided recall responses contain somewhat more information than the free recall reports typically obtained in verbal learning studies, two points should be made. First, in terms of cues presented to the respondent, the aided recall method discussed above supplies considerably less information than does the recognition procedure. Second, all recall methods, even "free recall" procedures, provide an informational cue tied to the learned material. Therefore, in the sense of *tasks* used to measure memory, one should consider recall and recognition as end points on a continuum (Murdock 1976, p. 121). For the measures employed in our study, aided recall scores are closer, on the continuum, to so-called free recall scores than they are to the recognition scores. Further, from a conceptual standpoint, the concepts of recall and recognition can be thought to overlap under certain conditions. For example, in those situations where recognition and recall both involve retrieval, reconstruction, or generative/associative processes (see for example, Anderson 1976, Lockart, Craik, and Jacoby 1976, Collins and Loftus 1975), the underlying dynamics, but not necessarily outcomes, are similar in recall and in recognition. Nevertheless, the processes of recall and recognition can differ when recognition involves an immediate matching of cue to information in memory, without retrieval, reconstruction, or generative/associative processes necessarily taking place. The recognition scores used in the present study are suggestive of the matching situation, while the recall scores require retrieval, reconstruction and/or generative/associative processes. Consequently we argue that the aided recall scores are not recognition scores, but rather the two measurements are consistent with task and theoretical distinctions made in the psychological literature on memor

Reader Interest Scores. The data used to calculate the reader interest scores were obtained by sending the sample of subscribers discussed above a copy of the May 16, 1955, issue of Life along with a request that they go through the entire issue and mark with a crayon each item and advertisement that they "remembered" as being of "interest" when they "first" looked at the issue. The reader interest score for an ad is the proportion of returned copies in which the ad was properly marked.

The analysis undertaken here makes use of data on the 95 ads, full page or larger, for which all three of the above measures were available. Table 2 presents the variance covariance matrix, correlation matrix, and means for the recall, recognition, and interest measures performed at the three points in time. These values are based on an arcsin transformation ($x = \sin^{-1}\sqrt{p}$, degrees) applied to the original observations (proportions, p's) for purposes of stabilizing their variance.

(Insert Table 2 here)

Statistical Models

Hypothesis 1. Figure 1 illustrates the causal model for the hypothesis maintaining that recall (PNR) and recognition (NOT) measure the same underlying memory state (M). In this and each succeeding figure, the conventions of path analysis are followed whereby theoretical constructs are drawn as circles, their measures are shown as squares, causal and measurement relations are represented as arrows, and parameters to be estimated are depicted as Greek letters. The integers -- 1, 2, and 3 -- denote the order of the time intervals.

(Insert Figure 1 about here)

The hypothesis entailed by Figure 1 can be written algebraically as follows:

$$\underset{\sim}{x} = \underset{\sim}{M} + \underset{\sim}{\delta} \tag{1}$$

$$\underset{\sim}{y} = \underset{\sim}{\lambda}\,\underset{\sim}{M} + \underset{\sim}{\varepsilon} \tag{2}$$

where the vectors $\underset{\sim}{x}'$ = (PNR1, PNR2, PNR3), $\underset{\sim}{y}'$ = (NOT1, NOT2, NOT3), $\underset{\sim}{M}'$ = (M1, M2, M3) $\underset{\sim}{\delta}' = (\delta_1, \delta_2, \delta_3)$, $\underset{\sim}{\varepsilon}' = (\varepsilon_1, \varepsilon_2, \varepsilon_3)$ and the matrix $\underset{\sim}{\lambda} = \mathrm{diag}\,(\lambda_1, \lambda_2, \lambda_3)$. The $\underset{\sim}{x}$, $\underset{\sim}{y}$ and $\underset{\sim}{M}$ are taken to be measured as deviations from their respective means. Equations (1) and (2) express the observed measures x and y, respectively, as the sum of true-score (M) plus random error (δ,ε). In this sense, they are equivalent to that found in classical test-score theory except that the addition of the parameter, λ, provides an indication of the degree of correspondence between measurement and true-score, a feature not found in classical test-score theory. The equations might be termed, "measurement equations," to reflect the fact that they specify the form of the relationship of observations to their true, underlying variables.

With $\underset{\sim}{z} = (\underset{\sim}{x}', \underset{\sim}{y}')'$, the variance-covariance matrix of observations is

$$\underset{\sim}{\Sigma} = \begin{bmatrix} \underset{\sim}{\phi} + \underset{\sim}{\theta}_\delta & \underset{\sim}{\phi}\,\underset{\sim}{\lambda} \\ \underset{\sim}{\lambda}\,\underset{\sim}{\phi} & \underset{\sim}{\lambda}\,\underset{\sim}{\phi}\,\underset{\sim}{\lambda} + \underset{\sim}{\theta}_\varepsilon \end{bmatrix} \tag{3}$$

where $\underset{\sim}{\phi}$, $\underset{\sim}{\theta}_\delta$, and $\underset{\sim}{\theta}_\varepsilon$ are the variance-covariance matrices of $\underset{\sim}{M}$, $\underset{\sim}{\delta}$, and $\underset{\sim}{\varepsilon}$, respectively. The latter two matrices are diagonal, implying that the error terms of measures are uncorrelated. Finally, the specification of the model of Figure 1 is complete with the following equation, which indicates the path of M over time:

$$M_{i+1} = \beta_{i+1} M_i + \zeta_{i+1} \tag{4}$$

for $i = 1,2$. The parameter, β, might be thought of as a measure of stability (or conversely $(1-\beta)$ as a measure of decay) in the hypothesized memory state over time. Equation (4) is a first-order autoregressive model which implies that the variance-covariance matrix of $\underset{\sim}{M}$ can be expressed as

$$\underset{\sim}{\phi} = \begin{bmatrix} \phi_1 & & \\ \beta_2\phi_1 & \phi_2 & \\ \beta_2\beta_3\phi_1 & \beta_3\phi_2 & \phi_3 \end{bmatrix} \tag{5}$$

where $\phi_1 = \text{var } M_1$, $\phi_2 = \text{var } M_2$, and $\phi_3 = \text{var } M_3$.

To determine the degree of identification for the model of Figure 1, one must examine the equations and matrices noted above and explicitly show how each parameter can be computed. This is done in the Appendix where it can be seen that each parameter is identified, and the entire system of equations has 7 over-identifying restrictions.

To estimate parameters, one may use the program, LISREL, developed by Jöreskog and Sörbom (1978). This program finds maximum-likelihood estimates and computes an overall χ^2 statistic for testing the goodness-of-fit of a model. More specifically, the χ^2 statistic can be used to test the model of Figure 1 as a null hypothesis against the most general alternative hypothesis that $\underset{\sim}{\Sigma}$ is any positive definite matrix (i.e., it is an unconstrained positive definite matrix). The program also provides standard errors of estimates. Finally, the p-value associated with the χ^2 test indicates the probability of obtaining a larger value for the test statistic, given that the hypothesized model holds.

Hypothesis 2. Figure 2 shows the model hypothesizing that recall and recognition measure the same underlying memory state when the errors among measures of recognition are allowed to be correlated.[3] The specification of this model is identical to that presented in equations (1) - (5) except that $\underset{\sim}{\theta}_{\varepsilon}$ -- the variance-covariance matrix of $\underset{\sim}{\varepsilon}$ -- is now permitted to be full in order to allow for the intercorrelations among error terms. Correlated errors imply that one or more unmeasured variables exist explaining variation in NOT1-NOT3, in addition to the hypothesized memory state, M.

(Insert Figure 2 About Here)

Using a procedure similar to that shown for the identification of the model of Figure 1 (see Appendix), one may demonstrate that the model of Figure 2 has 4 over-identifying restrictions. The program, LISREL, can be used to estimate parameters and test the null hypothesis implied by Figure 2.

Hypothesis 3. To test the hypothesis that a single underlying methods factor (MF) accounts for the excess systematic variation in recognition not accounted for by $\underset{\sim}{M}$, the model of Figure 3 can be examined. The hypothesis entailed by Figure 3 can be written algebraically as

$$\underset{\sim}{x} = \underset{\sim}{M} + \underset{\sim}{\delta} \tag{6}$$

$$\underset{\sim}{y} = \underset{\sim}{\lambda}\,\underset{\sim}{M} + \underset{\sim}{\Gamma}\,MF + \underset{\sim}{\varepsilon} \tag{7}$$

where $\underset{\sim}{\Gamma}' = (\gamma_1, \gamma_2, \gamma_3)$, MF is a hypothesized methods factor, and the remaining parameters are as defined earlier. Equation (6) is again a true-score model; while equation (7) is an augmented true-score model in that it also contains a term (i.e., MF), producing systematic variation in y, in addition to the terms for trait (M) and error (ε) variances.

The variance-covariance matrix of observations for this model is

$$\underset{\sim}{\Sigma} = \begin{bmatrix} \underset{\sim}{\phi} + \underset{\sim}{\theta}_{\delta} & \underset{\sim}{\phi}\underset{\sim}{\lambda} \\ \underset{\sim}{\lambda}\,\underset{\sim}{\phi} & \underset{\sim}{\lambda}\underset{\sim}{\phi}\underset{\sim}{\lambda} + \underset{\sim}{\Gamma}\underset{\sim}{\Gamma}' + \underset{\sim}{\theta}_{\varepsilon} \end{bmatrix}. \tag{8}$$

Equations (4) and (5) remain the same as before and complete the specification.

(Figure 3 about here)

The model of Figure 3 is overidentified with 4 degrees of freedom. As with the previous models, LISREL can be used to estimate parameters and test hypotheses.

It should be noted that the model of Figure 2 is analytically equivalent to the model of Figure 3. However, the latter provides the advantage of offering a means to partition the total variation in responses due to trait, method, and random error. For example, the variations in the i^{th} measure of recognition due to trait, method, and error are, respectively, λ_i^2, γ_i^2, and θ_{ε_i}.

The models of Figures 2 and 3 differ with respect to their substantive interpretation. The correlated errors shown in Figure 2 could arise from one or more unmeasured factors. In contrast, the methods factor introduced in Figure 3 hypothesizes that a single unmeasured variable accounts for the correlated errors. Ultimately, one would like to identify the specific causes of correlated errors because this is necessary for the development of a true theory of memory processes and because it would provide diagnostics for improving the measurement of variables. Hypothesis 4 represents a step in this direction.

Hypothesis 4. Figure 4 illustrates one way to take into account systematic bias in recall and recognition due to differential interest (INT) in the ads in question. The hypothesis is that recall and recognition measure the same underlying memory state when interest in the ads is held constant. In Figure 4, interest is shown operationalized with a single measure (INT), and the intercorrelations between the hypothesized memory states and interest are indicated as ψ_{ij}. The equations for the model of Figure 4 are similar to those presented earlier except that $\underset{\sim}{\psi}$ is a full matrix containing elements for the ψ_{ij}, and a seventh equation for the measurement of INT is included. The model contains 11 overidentifying restrictions, and LISREL can be used to estimate parameters and test the null hypothesis.

(Insert Figure 4 about here)

RESULTS

Hypothesis 1

As predicted, one must reject the hypothesis that recall and recognition measure the same underlying memory state ($\chi^2 = 17.44$, df = 7, $p \doteq .01$). The first column of Table 3 lists the parameter estimates for this model. Although most values are in the predicted direction and are at least twice their standard errors, the model does not capture a sufficient amount of variation in responses to provide a satisfactory fit.

Hypothesis 2

When the error terms of the measures of recognition are allowed correlated, as shown in Figure 2, one can not reject the hypothesis that recall and recognition measure the same memory state (χ^2 = 1.90, df = 4, p ≃ .75). The second column of Table 3 presents the parameter estimates for this model where it can be seen that all parameters are in the expected direction and are at least twice their standard errors. Column one in Table 4 shows the variances of the memory states at three points in time. Column two in Table 4 gives the squared correlations (i.e., stabilities) of the memory states from one occassion to the other. The squared correlations are quite high, indicating a considerable amount of stability in memory over the period in question.

Hypothesis 3

One can not reject the hypothesis that a single methods factor accounts for the unexplained variation in recognition (χ^2 = 1.90, df = 4, p ≅ .75). The third column in Table 3 presents the relevant parameter estimates for this model where, as before, all values are in the proper directions and are twice their standard errors. Hence, the results are consistent with the hypothesis that the measures of recognition contain one systematic contaminating factor in addition to variation due to trait variation and random error. A partition of the variance due tc trait, method, and error can be found in Table 5. Notice that the measures of recall exhibit no methods variance and a moderate amount of random error, while the measures of recognition contain relatively low amounts of both methods variance and random error. The contributions due to traits for recall and recognition are moderate to high in magnitude.

Hypothesis 4

The hypothesis that recall and recognition measure a single memory state when interest in ads is held constand cannot be rejected, as predicted (χ^2 = 17.70, df = 11, p ≅ .09). The fourth column of Table 3 summarizes the relevant parameter estimates for this model. All values are consistent with predictions and are at least twice their standard errors. The third and fourth columns of Table 4 present the variances of hypothesized memory states and the squared correlations (stabilities), respectively, for this model. Notice that, once interest has been factored out of the analysis, memory is nearly perfectly stable over time. Table 6 illustrates the partitioning of variance in recall and recognition due to trait and error (methods variance was negligible). Random error for recall is moderate to high in value. In contrast, random error for recognition is low. These findings concerning the stability and reliability of recall and recognition for print ads are consistent with other evidence reported in the advertising research literature on these types of measures (Appel and Blum 1961, Lucas 1960, Maloney 1961). With interest held constant, then, recognition provides a strong indicator of memory, while recall is somewhat less well measured. This can be seen in the trait values shown in Table 6.

(Insert Tables 3-6 Here)

SUMMARY AND DISCUSSION

In this section we summarize the key findings reported above and consider their implications for a number of current and longstanding issues related to the design of advertising retention studies and the use of measurements obtained from such investigations to support decisions.

1. Do Recall and Recognition Measure Memory?

Our results bearing on this question are two-fold. First, we find evidence that memory of advertising is multidimensional and that while recall and recognition capture a portion of memory, these measures also reflect other mental states. Secondly, it appears that cognitive memory can be validly represented as a unidimensional construct operationalized with standard measures of recall and recognition. To do so, however, requires that either the external contaminators be controlled methodologically or else the non-cognitive dimensions of consumer responses (e.g., affect) be modelled explicitly as covariates. To omit such controls and adjustments results in less interpretable constructs.

Why should the control of reader interest result in a unidimensional cognitive memory? One possibility is that interest is a proxy for affective reactions which might or might not covary with cognitive content, depending on the ad or circumstances. Hence, holding interest constant can remove a confound. A second related possibility is that interest perhaps reflects more the aspects of semantic memory and less the aspects of episodic memory, and by holding interest constant, one obtains a "purified" measure of episodic memory. That is, the cognitive information in the ads might have been relatively more context specific than the affective information contained within them. One would expect the cognitive content of ads to generally refer to specific product attributes, price, availability, etc., unique to the ads, while affective content would refer to general or basic needs and desires common to many brands and even product classes in ads seen over the years. Memory for the former is relatively more episodic and ad specific while that for the latter is relatively more semantic and non-ad specific. By holding interest (and presumably semantic content) constant, one may remove the affect from the measures of recall and recognition. The contamination of the context specific cognitive information arises from the fact that semantic information in the ad becomes confounded with existing semantic information already held in memory; and because the latter exists in different degrees within people and across ads, measures of recall and recognition are systematically affected in a detrimental way.

The above set of conclusions imply that the polarized views held about recall and recognition measures that were reviewed at the beginning of this paper ought to undergo some revision. In particular, what should be discouraged is the practice of interpreting the small magnitude and/or decline over time of recall scores in absolute terms as evidence that the advertising has been widely ignored and/or memory of it "decays" rapidly. Dismissing recognition scores as invalid indicators of true exposure and retention levels would also appear to be unwarranted. As one moves beyond contrasting the absolute magnitude of recall and recognition scores to examining their covariation across ads and over time against the background of psychological memory theory, then a deeper understanding of the properties of these two types of measures begins to emerge.

2. How Fallible are Recall and Recognition Measures?

The findings also shed some light on the adequacy of widely used measures of recall and recognition. Recall measures contained considerable amounts of random error and achieved somewhat less than desirable (i.e., less than 50 percent) trait variation, even after methods factors and reader interest had been taken into account. Recognition measures, on the other hand, showed very low levels of random error, relatively low levels of methods variation, and adequate trait variation. Indeed, when interest was held constant, trait variation exhibited by recognition measures was impressive, ranging from about 67 to over 80 percent. The control of interest seems to be a viable means to enhance measurement of recognition but not necessarily recall.

Perhaps the most basic use of such test scores is to compare the performance of alternative stimuli. Increases in the magnitude of variation in observed scores due to random measurement error as opposed to true variations among the stimuli reduces the power of statistical tests (Cochran 1968) and thereby increases the threat to the validity of conclusions about the presence of true differences in performance drawn from the application of standard statistical tests to observed test scores. Thus, these estimates (Table 6) imply that the ability to discriminate correctly among alternative stimuli is greater for recognition than for recall when the effect of interest is controlled.

It should be stressed that these findings were based on single recall and single recognition measures obtained for print advertisement at three points in time. Future research should address the same issues with reference to measures of television commercial viewership and should employ multiple measures of both recall and recognition at each point in time to provide a stringent test of construct validity. Among other ways, this might be accomplished by obtaining measures of components of a stimulus ad such that each response to a component serves as an additional indicator of the construct modeled (e.g., recall). A multitrait multimethod matrix analysis could then be performed. Use of a dissimilar variety of procedures for recall and for recognition would be desirable, but such a tactic does not appear to be possible given the current technology. Still another procedure that might be tried would be to have respondents report their remembrance, interest, etc. for each of a set of ads. Then three-mode factor analysis (respondents x traits x ads) could be employed to model recall and recognition.

3. How Rapidly is Advertising Forgotten?

The results obtained indicated that memory is remarkably stable over the two short time intervals analyzed here. It should be noted that stability here refers to the magnitude and constancy of estimates of the slope parameter, β_{i+1}. It measures the period to period relationship in memory across ads where the memory level for individual ads are expressed as deviations from the mean memory across all ads for that period. Hence, estimates of β_{i+1} do not reflect absolute shifts over time in mean memory levels across all ads.

Referring to estimates presented in Table 3 for the model shown in Figure 4, we see that the values of the first-order autoregressive parameters for the two time intervals ($\hat{\beta}_2$ = .918 and $\hat{\beta}_3$ = .946) are very similar and differ by less than two standard errors. This stability is consistent with the assumption of exponential forgetting frequently made in modelling advertising response, since a first order autoregressive model (equation 4) with β fixed is the discrete analog of a continuous exponential decay process. Relevant empirical studies of advertising memory over time are scarce, but three published estimates were uncovered where exponential decay-type assumptions had been used to obtain estimates of a weekly retention parameter.[4] Since the time intervals associated with β_2 and β_3 were each roughly 3-5 days in duration, we take the product $\hat{\beta}_2\hat{\beta}_3$ = (.918)(.946) = .846 as an approximation of the weekly retention rate implied by these data. The most directly comparable estimate is the weekly retention value of .75 that Lodish (1971) calculated from a re-analysis of recognition scores (adjusted for incorrect claims) for magazine ads originally reported by Simmons and Associates (1965). For recall of television commercials, Zielske and Henry (1980) obtained a weekly retention estimate of .908 and Wells (1975) has reported a summary figure of .8 retention per four weeks from an undisclosed set of proprietary studies which implies a weekly retention rate of .95 under the exponential decay assumption. Thus the estimates of retention obtained here appear to fall within the range of the handful of estimates available from other studies, all of which covered time intervals considerably longer than that encompassed by the present data.

Why should memory for ads remain so stable? A number of explanations can be offered. First, the stability is not too surprising, given the aforementioned studies indicating the ability of the human memory for storing information over at least short periods of time. Second, because the unit of analysis was an aggregate measure based on proportions of readers, it is likely that changes at the individual level had been obscured. Rather, the analyses reflect the history of remembrance for ads and not for the individual viewers of ads. Third, given this unit of analysis, it is possible that two counterbalancing phenomena occurred to produce the observed stability. On the one hand, some individuals who had remembered the ads at the earlier point in time might have forgetten them at the later times due to natural decay or interference processes. Others, however, as a consequence of construction processes, might have actually remembered ads at the later times that they had reported earlier as "forgotten." When the responses of both classes of individuals are combined at the aggregate level, the net effect is an observed stability. A fourth reason for the stability is a consequence of the depth of processing and multiple coding engendered by many ads. The composition and content of ads are such as to result in at least moderately deep processing and multiple coding of images and verbal content. When this happens along with the conveyance of semantic information and the stimulation of needs, motives, or desires, the possibility for leaving a memory trace is enhanced. These conditions may have resulted in the present study, at least to the extent necessary to produce a memory duration of the six or so days observed. Unfortunately, the nature of the data do not provide an opportunity to test these possibilities.

The research reported herein suggests that memory for ads is complex, yet can be validly monitored. But much remains to be learned. One direction for inquiry is the opportunity to look deeper into memory structure and thought processes. While recall and recognition indicate a single cognitive dimension of memory at a molar level of information processing, it would be interesting to model internal representations and changes at a more micro level. For example, rather than construing consumer attitudes in a unidimensional sense as the sum of the products of beliefs times evaluations, it may be fruitful to examine attitudes as multidimensional constructs consisting of networks of interconnected beliefs and evaluations. Such a viewpoint recognizes that products are complex and that people react to them in unique and intricate ways. A second line of study might focus on the structure of affect in memory and investigate the relative contributions of affect and rational judgments on choice behaviors. Similarly, the interactions or ordering of affect and cognitions in response to ads deserves examination. We know very little about the internal reactions of consumers to marketing stimuli and how these moderate choice.

Psychological research provides a useful starting point for approaching the study of memory for ads. However, much of this work has been limited to the study of intentional, verbatim, and verbal learning. Everyday reactions to advertisements seem to be more incidental, non-verbatim (e.g., memory for gist, meaning, or gestalts), and visual -- aspects of learning largely neglected by psychologists. The need and opportunity for research in the study of advertising effects are thus very real ones and the challenge is now only beginning to be met.

A final caveat is in order as to the use of interest in the present study. Although we speculate that interest is correlated with liking or affect toward the ad (Silk and Vavra 1974), the product category and brand (Silk and Geiger 1972), or all three, its meaning is ambiguous. In addition to positive emotional reactions, one might be interested in an ad because of curiosity, the dissonance it instills, or its negatively arousing features. Further research and conceptualization of the nature of the contaminating influences on recall and recognition is needed to identify which if any of these factors are at play. For some recent ideas on this, see Bower (1981).

CONCLUSIONS

This study has endeavored to cast some new light on an old question: what do recall and recognition measure? Contrary to the view held by many in the advertising research community, re-analysis of the ARF PARM data produced results consistent with the hypothesis that recall and recognition measure a single memory state when the effect of variation in reader interest is controlled. Furthermore, memory for print advertisements appears to be highly stable over time in the sense that ads which scored high (low) on recall and recognition at one point in time also tend to score high (low) at a later point in time. Both these findings appear compatible with the views of human memory found in cognitive psychology which offers a potentially valuable perspective for future work on the role memory processes play in consumer response to advertising.

APPENDIX

To ascertain the degree of identification for the model of Figure 1, one must show that all parameters are uniquely determined by $\underset{\sim}{\Sigma}$. This can be accomplished by examining the information provided by the observed variances and covariances and comparing this systematically to the specification of the model. The objective is to compute each parameter uniquely as a function of the observed variances and covariances.

This may be accomplished as follows. First, note that the observed variance-covariance matrix of observations can be partitioned as

$$\underset{\sim}{\Sigma} = \begin{bmatrix} \underset{\sim}{\Sigma}_{xx} & \\ & \\ \underset{\sim}{\Sigma}_{yx} & \underset{\sim}{\Sigma}_{yy} \end{bmatrix}$$

where, for convenience, the elements of $\underset{\sim}{\Sigma}$ can be expressed as

$$\underset{\sim}{\Sigma}_{xx} = \begin{bmatrix} \sigma^{x}_{11} & & \\ \sigma^{x}_{21} & \sigma^{x}_{22} & \\ \sigma^{x}_{31} & \sigma^{x}_{32} & \sigma^{x}_{33} \end{bmatrix}$$

$$\underset{\sim}{\Sigma}_{yx} = \begin{bmatrix} \sigma^{xy}_{11} & & \\ \sigma^{xy}_{21} & \sigma^{xy}_{22} & \\ \sigma^{xy}_{31} & \sigma^{xy}_{32} & \sigma^{xy}_{33} \end{bmatrix}$$

$$\underset{\sim}{\Sigma}_{yy} = \begin{bmatrix} \sigma^{y}_{11} & & \\ \sigma^{y}_{21} & \sigma^{y}_{22} & \\ \sigma^{y}_{31} & \sigma^{y}_{32} & \sigma^{y}_{33} \end{bmatrix}$$

and the σ_{ij} and σ_{ii} are the observed variances or covariances for the respective matrices. Further, from equations (1) and (2), it can be shown that

$$\underset{\sim}{\Sigma}_{xx} = \underset{\sim}{\phi} + \underset{\sim}{\theta}_{\delta} \tag{a1}$$

$$\underset{\sim}{\Sigma}_{yx} = \underset{\sim}{\lambda}\,\underset{\sim}{\phi} \tag{a2}$$

$$\underset{\sim}{\Sigma}_{yy} = \underset{\sim}{\lambda}\underset{\sim}{\phi}\underset{\sim}{\lambda} + \underset{\sim}{\theta}_{\varepsilon} \quad . \tag{a3}$$

Substitution in (a1) for its components yields:

$$\begin{bmatrix} \sigma^x_{11} & & \\ \sigma^x_{21} & \sigma^x_{22} & \\ \sigma^x_{31} & \sigma^x_{32} & \sigma^x_{33} \end{bmatrix} = \begin{bmatrix} \phi_1 + \theta_{\delta_1} & & \\ \beta_2\phi_1 & \phi_2 + \theta_{\delta_2} & \\ \beta_2\beta_3\phi_1 & \beta_3\phi_2 & \phi_3 + \theta_{\delta_3} \end{bmatrix} .$$

Hence, $\sigma^x_{21} = \beta_2\phi_1$ and $\sigma^x_{31} = \beta_2\beta_3\phi_1$; and from these equations it is possible to identify β_3 as

$$\beta_3 = \frac{\sigma^x_{31}}{\sigma^x_{21}} \quad .$$

Similarly, since $\sigma^x_{32} = \beta_3\phi_2$, ϕ_2 is identified as

$$\phi_2 = \frac{\sigma^x_{21}\ \sigma^x_{32}}{\sigma^x_{31}}$$

Substitution in (a2) for its components produces:

$$\begin{bmatrix} \sigma_{11}^{xy} & & \\ \sigma_{21}^{xy} & \sigma_{22}^{xy} & \\ \sigma_{31}^{xy} & \sigma_{32}^{xy} & \sigma_{33}^{xy} \end{bmatrix} = \begin{bmatrix} \phi_1\lambda_1 & \beta_2\phi_1\lambda_1 & \beta_2\beta_3\phi_1\lambda_1 \\ \beta_2\phi_1\lambda_2 & \phi_2\lambda_2 & \beta_3\phi_2\lambda_2 \\ \beta_2\beta_3\phi_1\lambda_3 & \beta_3\phi_2\lambda_3 & \phi_3\lambda_3 \end{bmatrix} .$$

This implies that $\sigma_{22}^{xy} = \sigma_2\lambda_2$, and thus λ_2 is identified as

$$\lambda_2 = \frac{\sigma_{22}^{xy}\ \sigma_{31}^{x}}{\sigma_{21}^{x}\ \sigma_{32}^{x}} .$$

From (a5), $\sigma_{21}^{xy} = \beta_2\phi_1\lambda_2$ and $\beta_2\phi_1\beta_3\lambda_3 = \sigma_{31}^{xy}$. Solving these two equations simultaneously and substituting the previously derived quantities for β_3 and λ_2 gives

$$\lambda_3 = \frac{\sigma_{31}^{xy}\ \sigma_{22}^{xy}}{\sigma_{21}^{xy}\ \sigma_{32}^{x}} .$$

Further, because $\sigma_{33}^{xy} = \phi_3\lambda_3$, it is possible to identify ϕ_3 as

$$\phi_3 = \frac{\sigma_{33}^{xy}\ \sigma_{21}^{xy}\ \sigma_{32}^{x}}{\sigma_{31}^{xy}\ \sigma_{22}^{xy}} .$$

Returning to (a4), it can be seen that $\sigma_{22}^{x} = \phi_2 + \theta_{\delta_2}$ and $\sigma_{33}^{x} = \phi_3 + \theta_{\delta_3}$. As a consequence, the identification of θ_{δ_2} and θ_{δ_3} becomes

$$\theta_{\delta_2} = \sigma_{22}^{x} - \frac{\sigma_{32}^{x}\ \sigma_{21}^{x}}{\sigma_{31}^{x}}$$

$$\theta_{\delta_3} = \sigma_{33}^{x} - \frac{\sigma_{33}^{xy}\ \sigma_{21}^{xy}\ \sigma_{32}^{x}}{\sigma_{31}^{xy}\ \sigma_{22}^{xy}} .$$

Substitution in (a3) for its components gives

$$\begin{bmatrix} \sigma^y_{11} & & \\ \sigma^y_{21} & \sigma^y_{22} & \\ \sigma^y_{31} & \sigma^y_{32} & \sigma^y_{33} \end{bmatrix} = \begin{bmatrix} \phi_1\lambda_1^2+\theta_{\varepsilon_1} & \beta_2\phi_1\lambda_1\lambda_2 & \beta_2\beta_3\phi_1\lambda_1\lambda_3 \\ \beta_2\phi_1\lambda_1\lambda_2 & \phi_2\lambda_2^2+\theta_{\varepsilon_2} & \beta_3\phi_2\lambda_2\lambda_3 \\ \beta_2\beta_3\phi_1\lambda_1\lambda_3 & \beta_3\phi_2\lambda_2\lambda_3 & \phi_3\lambda_3^2+\theta_{\varepsilon_3} \end{bmatrix} .$$

Because $\sigma^y_{31} = \beta_2\beta_3\phi_1\lambda_1\lambda_3$ and $\sigma^y_{32} = \beta_3\phi_2\lambda_2\lambda_3$, one may determine the identification of λ_1 -- after substitution of previously determined parameters -- as follows:

$$\lambda_1 = \frac{\sigma^y_{32}\ \sigma^y_{21}\ \sigma^x_{32}\ \sigma^x_{21}}{\sigma^y_{31}\ \sigma^x_{31}\ \left(\sigma^{xy}_{22}\right)^2}$$

From (a5), $\sigma^{xy}_{11} = \phi_1\lambda_1$. Therefore, it is possible to identify ϕ_1 as

$$\phi_1 = \frac{\sigma^{xy}_{11}\ \sigma^y_{31}\ \sigma^x_{31}\ \left(\sigma^{xy}_{22}\right)^2}{\sigma^x_{32}\ \sigma^x_{21}\ \sigma^x_{32}\ \sigma^x_{21}}$$

since λ_1 has been previously determined.

From (a4), given that $\sigma^x_{11} = \phi_1 + \theta_{\delta_1}$ and $\sigma^x_{21} = \beta_2\phi_1$ from (a4), one may write θ_{δ_1} and β_2, respectively, as

$$\theta_{\delta_1} = \sigma^x_{11} - \frac{\sigma^{xy}_{11}\ \sigma^y_{31}\ \sigma^x_{31}\ \left(\sigma^{xy}_{22}\right)^2}{\sigma^y_{32}\ \sigma^y_{21}\ \sigma^x_{32}\ \sigma^x_{21}}$$

$$\beta_2 = \frac{\left(\sigma^x_{21}\right)^2\ \sigma^y_{32}\ \sigma^y_{21}\ \sigma^x_{32}}{\sigma^{xy}_{11}\ \sigma^y_{31}\ \sigma^x_{31}\ \left(\sigma^{xy}_{22}\right)^2} .$$

And finally from (a6), given that $\sigma^y_{11} = \phi_1\lambda_1^2 + \theta_{\varepsilon_1}$, $\sigma^y_{22} = \phi_2\lambda_2^2 + \theta_{\varepsilon_2}$, and $\sigma^y_{33} = \phi_3\lambda_3^2 + \theta_{\varepsilon_3}$, one may express θ_{ε_1}, θ_{ε_2}, and θ_{ε_3}, respectively, as

$$\theta_{\varepsilon_1} = \sigma^y_{11} - \frac{\sigma^{xy}_{11}\ \sigma^y_{32}\ \sigma^y_{21}\ \sigma^x_{32}\ \sigma^x_{21}}{\sigma^y_{31}\ \sigma^x_{31}\ \left(\sigma^{xy}_{22}\right)^2}$$

$$\theta_{\varepsilon_2} = \sigma^{y}_{22} - \frac{\sigma^{x}_{31}\left(\sigma^{xy}_{22}\right)^2}{\sigma^{x}_{21}\,\sigma^{x}_{32}}$$

$$\theta_{\varepsilon_3} = \sigma^{y}_{33} - \frac{\sigma^{xy}_{31}\,\sigma^{xy}_{22}\,\sigma^{xy}_{33}}{\sigma^{xy}_{21}\,\sigma^{x}_{32}} \quad .$$

In summary, because each of the 14 parameters to be estimated is uniquely determined, the model is identified. The model as a whole is, in fact, overidentified as can be seen in the following equation derived by Jöreskog (Jöreskog and Sörbom, 1979, p. 150).

$$2m^2 - 4m + 1 = \text{d.f.}$$

$$2(3)^2 - 4(3) + 1 = 7$$

where m = number of time periods. It should be understood, of course, that to exploit fully the ability of structural equation models to represent stability over time and measurement error, more points in time than three are needed.

FOOTNOTES

1. Methods used to measure recall and recognition of print advertisements in commercial advertising research are described below in the section on "Methods."

2. For recent reviews of the literature on information processing, see Glass, Holyoak, and Santa (1979) and Lachman, Mistler-Lachman, and Butterfield (1979). The specific hypotheses we test are developed later in the paper.

3. For purposes of brevity, we present the model with correlated errors for the measures of recognition only. There are logical and empirical reasons to suspect that recognition would be more poorly measured than recall (e.g., Appel and Blum, 1961). Further, our empirical test of the model allowing correlated errors for measures of recall and measures of recognition reveals that only the latter achieve statistical significance. The reader interested in the specific analyses and findings can obtain them by writing the authors.

4. It should be noted that there are two other important published studies of retention of print advertising, one due to Zielske (1955, also see Simon 1979) and the other to Strong (1974). The pattern of retention observed over time in both studies did not appear to follow that implied by a simple exponential decay model and hence it is difficult to make straightforward comparisons of their results with other estimates. However, it would appear that in both cases, retention was somewhat lower than the estimates discussed above.

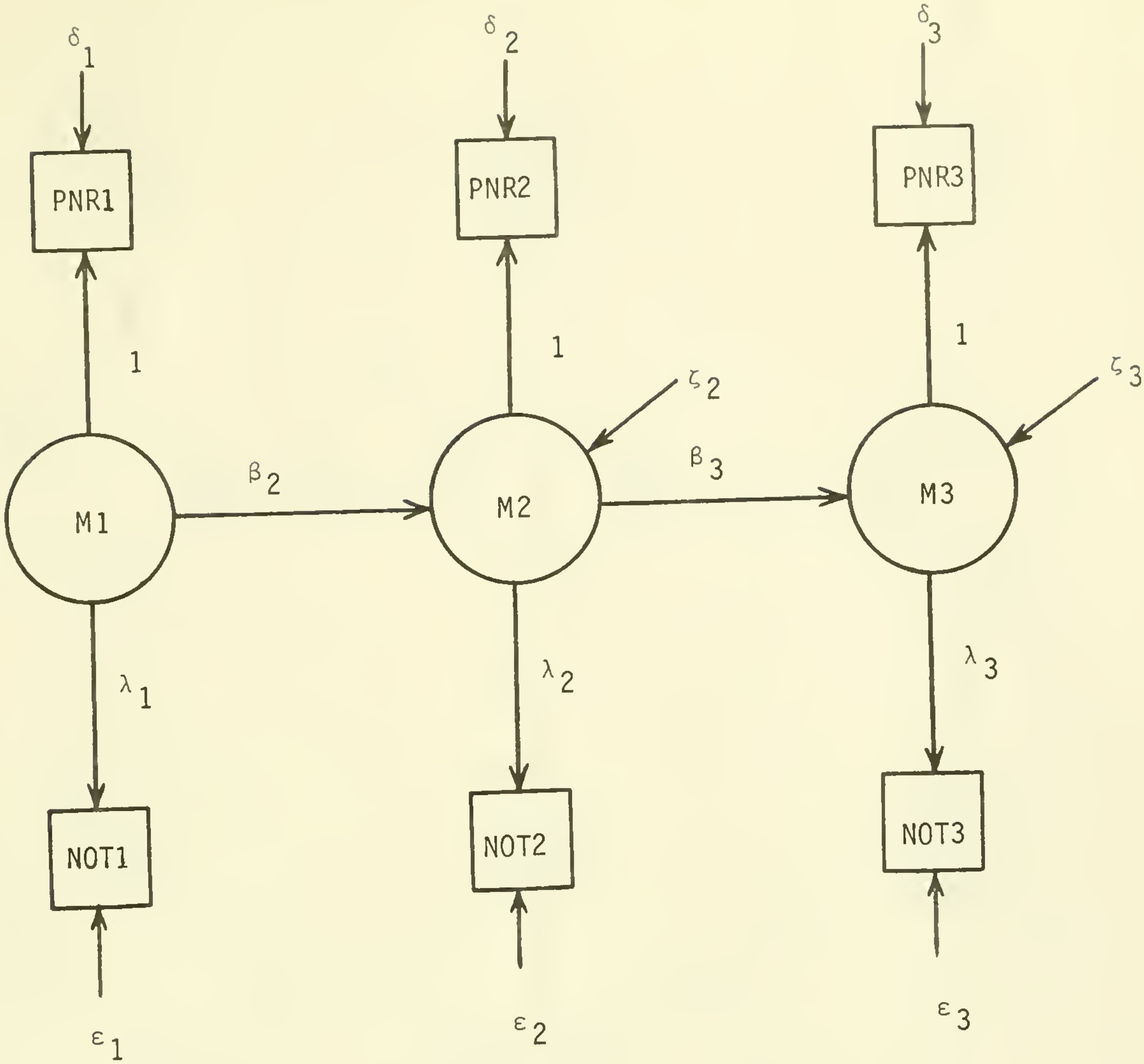

Figure 1. Causal Model Hypothesizing That Recall (PNR) and Recognition (NOT) Measure the Same Underling Memory State (M)

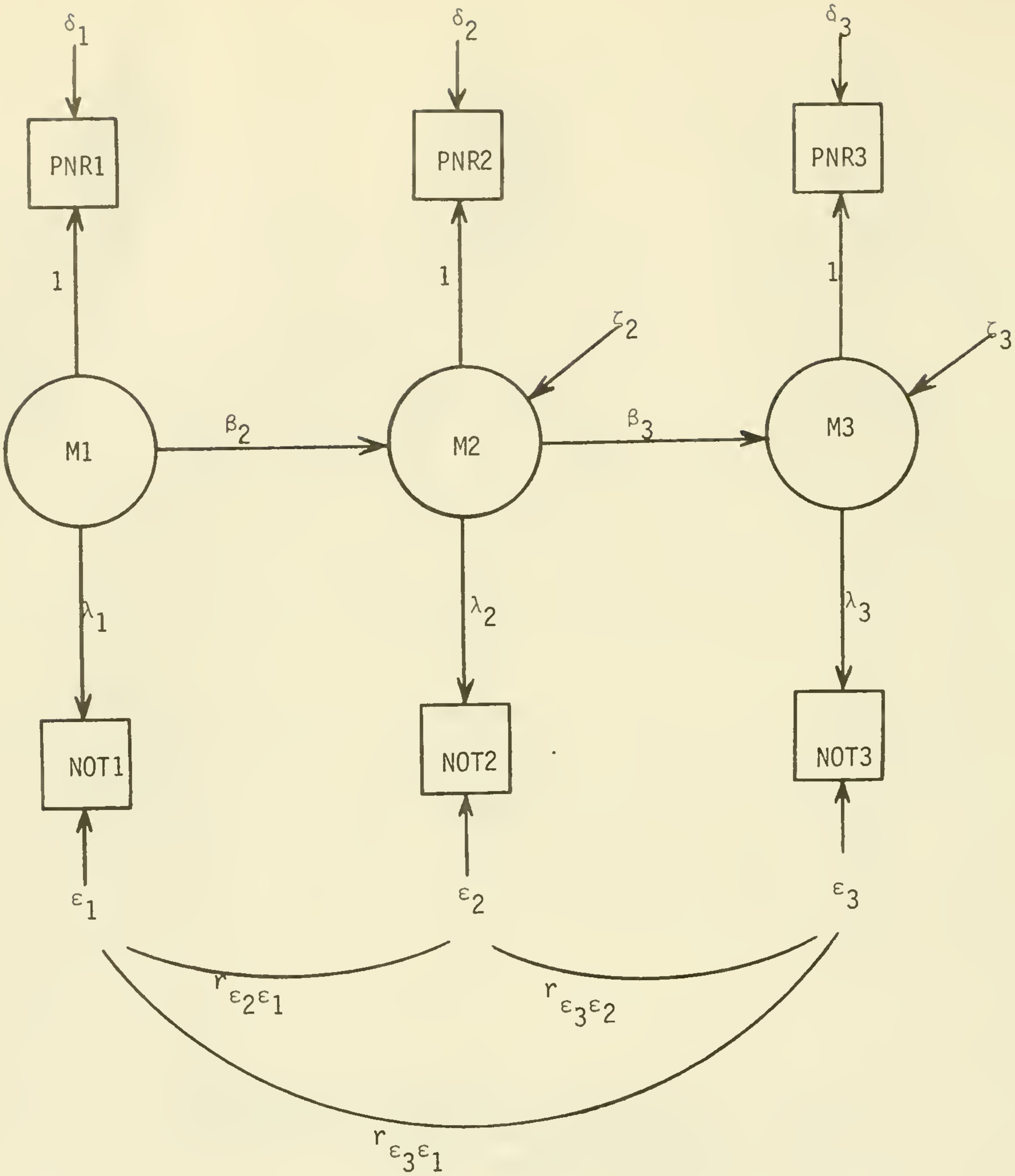

Figure 2. Causal Model Representing Correlated Errors Among Measures of Recognition

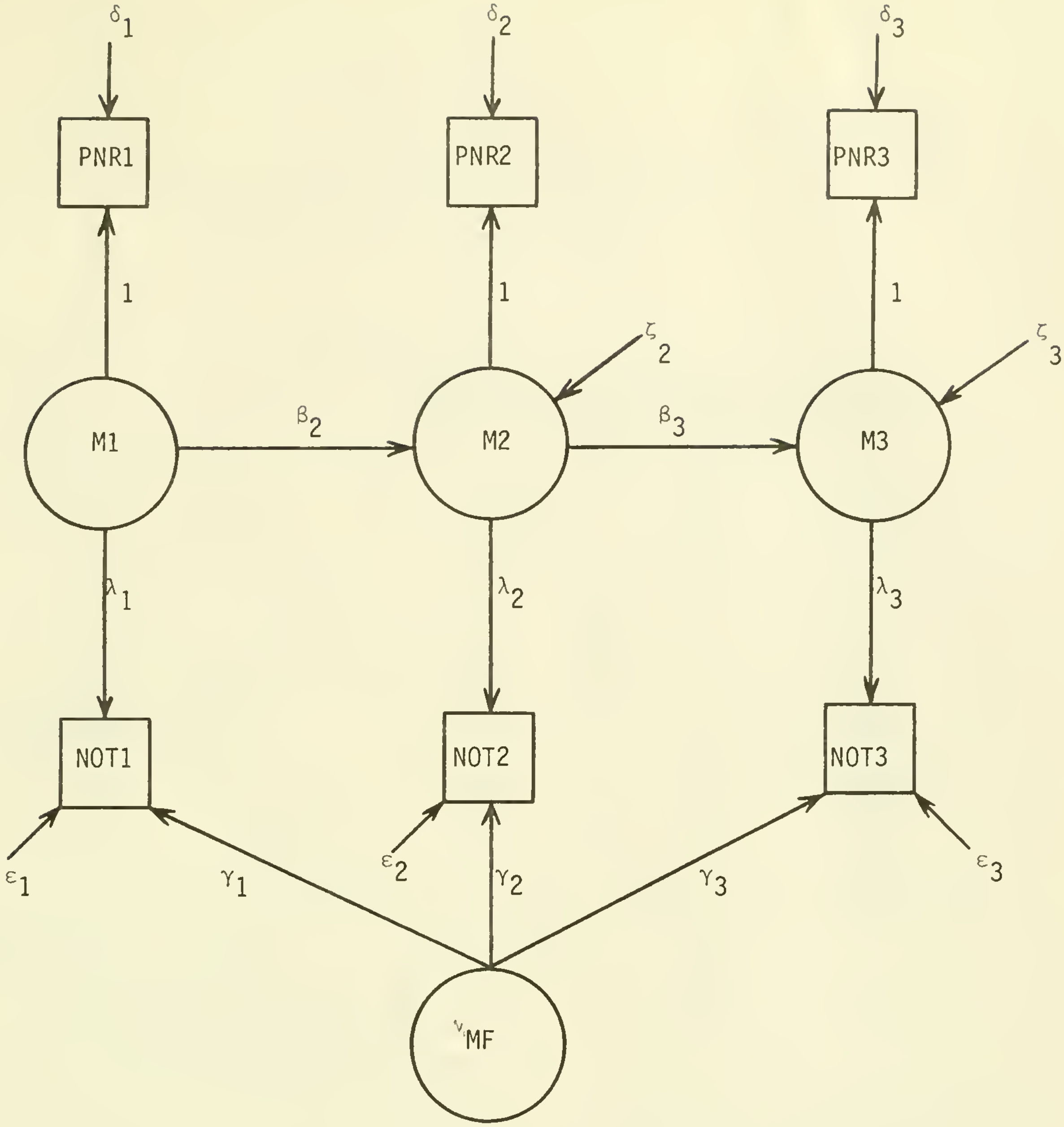

Figure 3. Causal Model Representing Explained Variation in Measures Due to Trait, Method, and Random Error

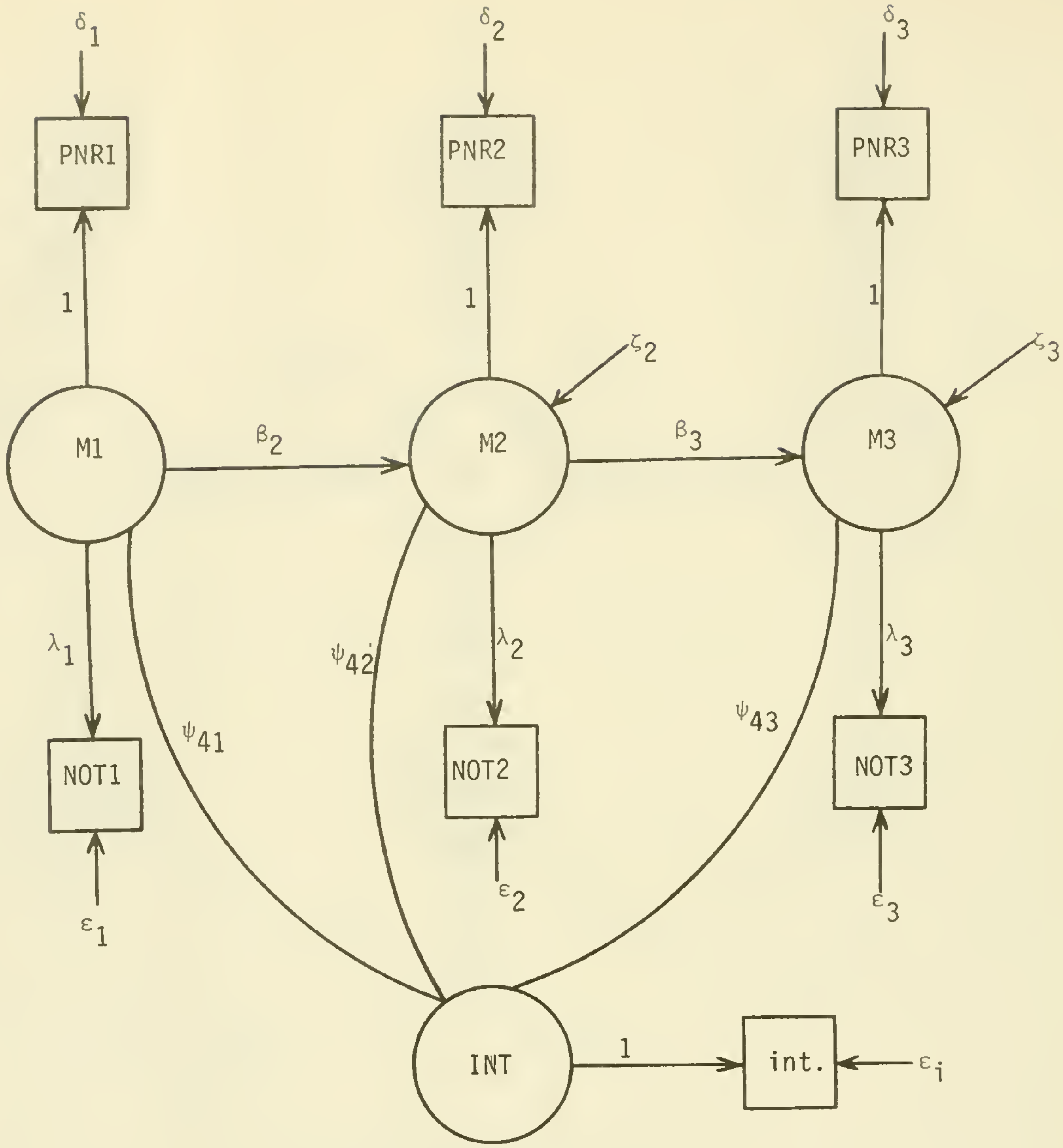

Figure 4. Causal Model Hypothesizing that Aided Recall and Recognition Measure the Same Memory State When Interest in Ad is Held Constant

Table 1

Readership Measurement Summary Statistics
For 95 Print Advertisements*

Measure (Proportion)		Interval Between Last Reading of Issue and Readership Interview (Days)		
		0-2	3-6	7-16
Recall (PNR)	Mean	.0369	.0251	.0210
	Std. Dev.	.0316	.0267	.0258
	Respondent Sample Size	283	213	103
Recognition (NOT)	Mean	.2055	.2396	.2217
	Std. Dev.	.1003	.1060	.1152
	Respondent Sample Size	212	223	135
Interest (INT)	Mean		.2177	
	Std. Dev.		.1044	
	Respondent Sample Size		249	

* The data underlying <u>each</u> mean and standard deviation shown in the above table are 95 proportions, one per advertisement. The respondent sample size is the number of respondents interviewed whose responses were used to compute the readership proportion for each advertisement.

Table 2. Variance-Covariance Matrix, Correlation Matrix, and Means for Recall, Recognition, and Interest Measures (Arcsin Transformation)*
(n = 95 advertisements)

	PNR1	PNR2	PNR3	NOT1	NOT2	NOT3	INT
PNR1	25.285	13.578	14.711	21.722	22.016	20.176	16.644
PNR2	.530	25.950	11.908	20.042	20.152	19.941	18.186
PNR3	.560	.448	27.276	17.767	19.914	19.402	15.966
NOT1	.611	.557	.481	49.965	40.635	44.095	29.755
NOT2	.604	.546	.526	.797	52.500	45.182	36.509
NOT3	.502	.490	.465	.781	.781	63.823	35.988
INT	.471	.508	.435	.599	.717	.641	49.387
MEANS	9.950	7.806	6.584	26.275	28.743	27.369	27.416

* The entries on the principal diagonal are variances. Covariances are shown in the upper right triangle and correlation coefficients are in lower left triangle. The last row in the table contains the means. Each statistic was computed using the arcsin transformed values of the original readership proportions for the 95 advertisements.

Table 3. Summary of Parameter Estimates and Goodness-of-fit Tests for Principle Models

Parameter	Model: Figure 1	Figure 2	Figure 3	Figure 4
λ_1	1.311* (.170)	.952* (.139)	.952* (.139)	1.312* (.170)
λ_2	1.438* (.209)	1.127* (.189)	1.127* (.182)	1.422* (.200)
λ_3	1.431* (.238)	.967* (.180)	.967* (.180)	1.437* (.238)
β_2	.909* (.167)	.833* (.138)	.833* (.138)	.918* (.165)
β_3	.957* (.190)	.987* (.175)	.986* (.175)	.946* (.185)
σ^2_{M1}	.466* (.128)	.651* (.154)	.651* (.154)	.466* (.124)
$\sigma^2_{\zeta_2}$	.005 (.029)	.022 (.039)	.022 (.039)	.004 (.029)
$\sigma^2_{\zeta_3}$	-.032 (.036)	.034 (.054)	.034 (.054)	-.031 (.036)
$\sigma^2_{\delta_1}$	.534* (.085)	.349* (.087)	.349* (.087)	.534* (.085)
$\sigma^2_{\delta_2}$	.610* (.094)	.526* (.094)	.526* (.094)	.603* (.091)
$\sigma^2_{\delta_3}$	.675* (.104)	.505* (.105)	.505* (.105)	.676* (.104)
$\sigma^2_{\varepsilon_1}$	.199* (.064)	.412* (.088)	.179* (.060)	.198* (.063)
$\sigma^2_{\varepsilon_2}$	.194* (.043)	.398* (.087)	.197* (.044)	.198* (.042)
$\sigma^2_{\varepsilon_3}$	.334* (.086)	.539* (.104)	.173* (.089)	.332* (.085)
$r_{\varepsilon_3\varepsilon_1}$	-	.620*	-	-
$r_{\varepsilon_2\varepsilon_1}$	-	.533*	-	-
$r_{\varepsilon_3\varepsilon_2}$	-	.585*	-	-
γ_1	-	-	.482* (.099)	-

(Cont'd)

Table 3 (Cont'd)

Parameter	Model Figure 1	Figure 2	Figure 3	Figure 4
γ_2	-	-	.448* (.091)	-
γ_3	-	-	.605* (.102)	-
ψ_1	-	-	-	.458* (.078)
ψ_2	-	-	-	.086* (.045)
ψ_3	-	-	-	-.037 (.034)
χ^2	17.44	1.90	1.90	17.70
df	7	4	4	11
p	.01	.75	.75	.09

n = 95

*Parameter at least twice its standard error. The figures in parentheses are estimated standard errors.

Table 4. Factor Variances and Squared Multiple Correlations for Memory Constructs (M)

Model			
Figures 2 & 3		Figure 4	
$\sigma^2_{M_i}$	R^2_i	$\sigma^2_{M_i}$	R^2_i
.651	-	.466	-
.474	.953	.397	.990
.496	.931	.324	1.000

Table 5. Partitioning of Variance Due to Trait, Method, and Error for the Model of Figure 3

Measure	Proportion of Variation Due to: Trait	Method	Error
PNR1	.651	-	.349
PNR2	.474	-	.526
PNR3	.495	-	.505
NOT1	.590	.231	.179
NOT2	.602	.201	.197
NOT3	.462	.365	.173

Table 6. Partitioning of Variance Due to Trait and Error for Model of Figure 4

Measure	Proportion of Variance Due to: Trait	Error
PNR1	.466	.534
PNR2	.397	.603
PNR3	.324	.676
NOT1	.802	.198
NOT2	.802	.198
NOT3	.668	.332

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