DOCUMENT RESUME

ED 334 608 CS 507 506

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TITLE Message Processing Research from Psychology to Communication.
PUB DATE May 91
NOTE 38p.; Paper presented at the Annual Meeting of the International Communication Association (41st, Chicago, IL, May 23-27, 1991).
PUB TYPE Speeches/Conference Papers (150) -- Information Analyses (070)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Audience Analysis; *Cognitive Processes; Communication (Thought Transfer); *Communication Research; Epistemology; Interdisciplinary Approach; *Models; *Psychological Studies
IDENTIFIERS *Message Processing

ABSTRACT

Information processing theories have been very useful in psychology. The application of information processing literature to communication, however, requires definitions of audiences and definitions of messages relevant to information-processing theories. In order to establish the relevant aspect of audiences, a multiple-stage model of audiences is presented which includes attention, initial processing, semantic and heuristic processing, judgments, affective evaluation and memory. A model of relevant message attributes are also identified: modality, features, content, complexity, and affect. Comparing how each of these stages of processing may be affected by each of these dimensions of messages is the next necessary step in applying psychological theories of information processing to communication messages. It is an important step in developing a common theory of message processing. But since messages can be identified along infinite dimensions, identifying whether particular attributes are relevant raises debate about what constitutes a message. (Two tables and 2 figures are included; 101 references are attached.) (Author)

Message Processing Research from Psychology to Communication

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May 25, 1991

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Abstract

Information processing theories have been very useful in psychology. The application of information processing literature to communication, however, requires definitions of audiences and definitions of messages relevant to information-processing theories. In order to establish the relevant aspect of audiences, a multiple-stage model of audiences is presented which includes attention, initial processing, semantic, heuristic processing, judgments, affective evaluation, and memory. A model of relevant message attributes are also identified -- modality, features, content, complexity, and affect. Comparing how each of these stages of processing may be affected by each of these dimensions of messages is the next necessary step in applying psychological theories of information processing to communication messages. It is an important step in developing a common theory of message processing. But since messages can be identified along infinite dimensions, identifying whether particular attributes are relevant raises debate about what constitutes a message.

Message Processing Research from Psychology to Communication

Categorizing communication research according to the mass versus interpersonal dichotomy, or by topics such as politics, health, or youth is a simple but troublesome heuristic (Wiemann, Hawkins & Pingree, 1988). Although topical organization makes classification of research easy, it obscures the similarities that run across several lines of research within and outside the field of communication. Also, topical organization fails to address the omnipresent discovery of individual differences that moderate the effect of messages (Cushing & Douglas-Tate, 1985). That is, there is no way of knowing whether these individual differences are particular to each topic, or systemic across all areas of communication research.

Information processing theories from the field of psychology offer an important perspective with which to examine variables that moderate the influence of messages, as well as the processes by which understanding and interpretation of messages take place. These cognitive theories also offer the potential of a common ground, both between the interpersonal and mass areas within communication (Berger & Chaffee, 1988; Reardon & Rogers, 1988), and between psychology and communication. This understanding, of course, is based at the individual level of analysis.

Information processing theories, I will argue, have a place in both psychology and communication. The main reason for investigating these theories within the field of communication is to allow communication to examine important message variables. Although not strictly true, it is useful to say that psychology often concentrates on the differences between people and relegates the differences between messages to be error variance; in communication; conversely, communication often concentrates on the difference between messages and treats the differences between people as error variance. So while psychology's main interest is in examining how messages are processed within an individual, communication can focus on the effect of messages, and more largely, the process of communication between people (Bradac, Hopper & Wiemann, 1989).

The ability to focus on different aspects of the information processing paradigm also causes each discipline to operate on a different types of "information." In an attempt to simplify research, psychology examines these processes by using simple stimuli. Examples of such stimuli include lights (Cohn & Lasley, 1985), letters or numbers (Triesman), and boxes or lines (Duncan, 1984). Results of this research makes it clear that the nature of information processing, is, to some extent, dictated by the nature of the stimuli. So, without investigation it is unclear the processing of flashing lights differs from the processing of real-world messages. But because communication is interested in the processing of communication messages, it should examine realistic and meaningful stimuli. While Batra and Ray (1983) suggest that it is important to test information processing theories in real-world situations, it is also important to test these theories with real-world stimuli.

To the extent that psychology and communication can investigate both mechanisms of individuals and characteristics of stimuli, a "message processing literature" can exist. Before psychological theories of information processing can be applied to communication messages and research, however, there are at least two important pieces of information that must be considered. First, such an application requires a definition of audience that categorizes people's psychological processes and explains how message processing operates. Second, the application of psychological theories requires definitions of messages appropriate to the examination of psychological processes. Specifically, this application means a definition of media messages beyond the scope of their usual classifications (Reeves, 1989). Besides defining messages by categories such as type (news, entertainment, or commercials), medium (newspaper, radio, or television), or length (30-, or 60-second), definitions should also make use of attributes appropriate to the psychological theories which are being examined -- modality, features, content, complexity, and affect. Thus, both message categories and attributes should serve as the message variables for communication research (Bowers, 1989).

Psychology: Theories about processing systems

There are many theories about human and computer information processing systems. It useful to categorize these theories according to the particular processes that these theories attempt to explain. This individual stage approach to processing, while not strictly true, will help to organize the literature, findings, and current thinking for the purpose of developing definitions of audience and media appropriate to psychological theories.

I have proposed a general model of message processing which combines each of these "processes." An organization of these stages is illustrated in Figure 1. A brief discussion of the "stages" that make up an audience's processing which may bear on how audiences comprehend messages is discussed below.

Attention

Psychologist's speculation about attention goes back at least as far as 1890 and William James (Norman, 1976). The research which has followed has attempted to resolve the details and mechanisms of attention. In general, people's sensory systems are constantly sampling the surrounding environment. Attention, therefore, will be considered to be a person's selection of particular material from these sensory systems.

Early research conceptualized attention as a precursor to a sequence of message processing events (Craik & Lockhart, 1972; Harris, 1983; Norman & Bobrow, 1975). Much of this research in attention grew out of Cherry's "cocktail party problem," the number of conversations you can pay attention to at one time (Eysenck, 1982). This problem led to the belief that people are limited-capacity information processors. A belief in limitations of capacity led, in turn, to investigation of where the limitation or specific "bottleneck" occurred. Broadbent believed it occurred early in the processing of information, Triesman believed the bottleneck occurred later, and Deutsch & Deutsch felt that the location of the bottleneck may change (Allport, 1989; Eysenck, 1982).

Later theorists have come to believe that there is not necessarily a particular bottleneck (Allport, 1989), but that the selection of material from among sensory channels depends on either the nature of the task (Schneider & Shiffrin), the channel (Allport et al.), or the stimulus (Triesman). The flexibility of attentional demands led psychologists to propose a "two-process theory." According to Schneider & Shiffrin (1977) and other theorists including Posner & Snyder and Gelade, some attentional processes are automatic, others demand control (requiring attention themselves) (Eysenck, 1982). That is, bottom-up processes are data-driven, and require considerable attention to each bit of data, like an early selection device; top-down processes are conceptually-driven, with concepts that serve to automate the attentional process and organize the incoming material with less effort and attention (Norman & Bobrow, 1975).

Sensory processing

The first processing step after attention is conceived to be the initial or sensory processing stage (Mitchell, 1983). Baddely and Hitch were responsible for the notion of the "central processor" having a limited processing capacity (Eysenck, 1982). Johnson & Heinz then proposed that human information processing is flexible, also suggesting that there is no specific attentional bottleneck prior to processing. Instead, they felt that splitting attention between several channels (several conversations are posed to the same ear or in the same voice) demands greater processing capacity than attending to a single channel (different ears or voices). That is, Johnson & Heinz felt that attending to more inputs demanded more processing capacity. They tested these assertions by measuring task completion time and secondary reaction task time. Other research has investigated the decrement in performance caused by completing tasks in multiple modalities (Mulligan & Shaw, 1981).

The results of this line of research caused Navon and Gopher to propose that there are multiple attentional and processing resources which are even more flexible than

previously proposed. For example, Norman and Bobrow (1975) believe that processing limitations can be determined by the data themselves or by a conceptually-driven criterion. Data-driven processes require considerable resources to attend to all of the incoming material and are, therefore, resource-limited. Conceptually-driven processes are making expectations about the data and, therefore, are efficient so long as they provide a workable organizing scheme for this material. In reality, however, these two processes probably operate simultaneously (Norman, 1976) or in a problem-solving approach (Geiger, 1988).

Earlier research conceptualized initial processing as being accomplished separately for each modality. But there are multiple examples of this not being the case. For example, the "Stroop test," can boggle the processor. Here, written information such as "red" conflicts with the color in which the word is written. People find it extremely difficult to perform a discrimination task such as naming either the color ink or the written color. In this case, even though the conflicting information comes from different channels -- visual and semantic -- a top-down "color" schemata may be linking the two pieces of information without conscious effort.

A general understanding of resource allocation can be envisioned via a computer metaphor. The architecture may be serial or parallel. A serial processor can only do one job at a time; a parallel processor can attend to many input devices, but requires considerable resource allocation to do so. In addition, the processor only has a certain amount of resources in use at any given time -- 8-, 16-, or 32-bits. And the total resources that are available are limited by the overall capacity of the system. This metaphor, as well as the associated research, suggests that resource limitations may occur at several different stages.

Depth of processing

Craik & Lockhart (1972) established the notion of "depth of processing." Deep processing was associated with the semantic analysis of material, while shallow processing involved physical analysis (Eysenck, 1982). The processing mode itself was determined by attentional resources, compatibility with analyzing structures, and processing time available.

Several researchers in attitude change have shown that two similar distinctive processes take place in the analysis of persuasive communications. These processes are described as either thoughtful consideration of propositions or of the use of simpler cues or heuristics (Batra & Ray, 1983, 1985; Chaiken, 1987; Petty & Cacioppo, 1981, 1985, 1987). For these researchers the processing mode is determined by motivation, interest, or involvement.

It is interesting to note that since higher levels of attention or processing time allocations that are discussed by the memory researchers might also predict the higher levels of motivation, interest, or involvement that are discussed by the persuasion researchers, these four processes -- deep/shallow and thoughtful/heuristic -- do not appear to be unrelated. Deep processing is probably similar to thoughtful processing, while shallow is probably similar to heuristic processing.

The actual separation mechanism and the architecture of separate processing systems have not been resolved, however. Specifically, Petty & Cacioppo seem to imply that their central/peripheral routes are mutually exclusive, while Chaiken's systematic/heuristic model is posed as parallel (Chaiken, 1987). For our purposes it is also important to examine the nature of these potentially independent processing strategies. Because of the larger literatures, however, we compare textual, affective, and heuristic analysis.

Semantic processing

The evidence suggests that semantic processing can take place regardless of whether the modality of input was written or verbal. Specifically, Triesman and Davies have shown that there appears to be separate visual and auditory channels, but a shared semantic analysis mechanism (Eynseck, 1982). Starting with Bartlett in 1932, various schema-based approaches have come to dominate theoretical discussions of text processing (Rumelhart, 1980). van Dijk and Kintsch, for example, propose that the outcome of text processing is a subjectively reorganized and interpreted semantic representation of the input material (Berger, 1989) Schank & Abelson (1977) have also explicated the use of scripts in text comprehension. So the general research findings are that mental schematic structures are organized in a superordinate and subordinate hierarchy, that people make inferences about the text while interpreting it, and that these inferences are then inseparable from the text itself (Berger, 1989).

The implications of this person- and schema-based textual representation is that many inferences are available only to the processor. That is, a receiver's perspective can alter the message insightfully or distortional to change the recipient's understanding of the information (Kellerman & Lim, 1989). Two interesting types of text-based inferences that might be made by information processors are drawing causal inferences or evaluations of the material (Kellerman & Lim, 1989).

Affective processing

Zajonc believes that "affective qualities in impression formation are processed differently and perhaps separately from the cognitive content (1980). Based on various research findings, he proposed two specialized processing mechanisms. Lazarus (1972), however, rejected the notion of these independent processors. But Zajonc (1984) defended his proposal with a biological evolution argument, to which Lazarus (1984) again disagreed based his research findings.

Additional research (e.g., Batra & Ray, 1983, 1985; Levinson, 1989) seems to suggest that emotion can be observed and experienced with no cognitive awareness. Given these and other findings, as well as the distinctive literature on affective processing, it would seem to suggest that affective processing is different, if not separate, from textual processing (Lutz, 1985). Additional research would be helpful, however.

Judgments

Kahneman & Tversky (1973) have shown that judgments do not necessarily follow probabalistic logic. Instead, people tend to use one or more heuristics to judge a situation's likelihood. These heuristics continue to be applied even after explanations and training would tell the evaluator otherwise. Such heuristics are probably applied in a short-cut technique, separate from rational or affective processing. In addition, an availability, or top-of-the-head, heuristic sometimes operates when people make evaluations based on early information or information that is cued (Tversky & Kahneman, 1973). There are numerous other heuristics that have been investigated. But since the use of such heuristics in judgments is "indisputable," further examination of their form and means to study them would be beneficial (Cappella & Street, 1989).

Fishbein & Ajzen's (1975) theory of reasoned action proposes that people combine information about the likelihood and evaluation of an event to develop behavioral intentions. In addition, beliefs about social norms and others" motivation to comply is also evaluated. This theory suggests a rather rational approach to judgment and action. Such a system involves the combination of rational and affective components into an overall evaluation. Therefore, it is quite different from Kahneman and Tversky's (1973).

Research has also examined another factor related to judgments. Hastie and Park (1986) have noticed that there is generally a weak relationship between judgment and memory. The weakness of the relationship suggests that a judgment and a memory are probably separately existing entities. One determinant of the nature of this relationship is

when the judgment is made. If a judgment is made at the time of initial message processing ("on-line") it tends to not be related to memory for the content of messages; if it is made after the message is processed, or "memory-based," then there is a stronger relationship between the judgment the memory of the message (Hastie & Park, 1986; Lichtenstein & Srull, 1985). These findings suggest that there are two distinct routes to making judgments. One route makes a judgment on incoming information. The other route retrieves a textual representation and then assesses a judgment.

Memory

Despite a "dual-code" theory of memory by Paivio, considerable evidence has accumulated to suggest that memory structures are similar regardless of their initial modality. For example, semantic descriptions have been shown to enhance or alter memory for pictures (Anderson, 1985). Also, memory for meaning is consistently better than memory for actual wordings. Sachs (1974) found paraphrases are difficult to detect only 80 seconds after the original sentence was presented. This decay in original structure was found regardless of what modality the sentence was originally presented in -- audio or visual. This finding suggests that regardless of the initial sensory processing, information is stored (and possibly even processed) similarly. Memory, therefore, appears to be a reconstructive process (Clark & Clark, 1977) based on a mental model of the original material.

Research has investigated the nature of memory structuring. There are three main results. First, memory appears to make use of schemas for organization. Information which is schema consistent (or extremely inconsistent) is well remembered. That which is moderately inconsistent is poorly remembered. Second, "spreading activation" research has shown faster processing time for items that are semantically or temporally related to one that is "primed" (Anderson, 1985; Collins & Loftus, 1975). Third, retrieval has also been

shown to be context dependent or "mood congruent," so that recall is better when conditions at retrieval match those at storage (Bower,1981).

This research suggests three ways in which memory traces may be indexed to one another. Specifically, as a result of schematic organization, spreading activation, or mood congruity effects, memory from one form of processing -- for example, the textual representation -- may cue the other representation -- heuristic -- to be activated or retrieved. Rummelhart & McClelland's parallel distributed processing (PDP) model suggests the architecture of such a system.

Research has also begun to investigate the nature of distortions between mental models and their sources. There is considerable evidence of primacy and recency effects in memory (Schacter, 1989). For example, material presented early or late is often better recalled than that presented in the middle. There are several theories which attempt to explain this phenomenon. In addition, these distortions may arise from the fact that affect and judgments appear able to be stored and retrieved from long-term memory, suggesting that affective and heuristic representations may influence or interfere with semantic memories (Petty & Cacioppo, 1987).

What we need to know about audiences

There are several important things that this research tells us about communication audiences. First, this model suggests that attention is a filter which allows in a certain number of channels of information. This filter may or may not be moveable. Its movement may be the discretion of the individual or under the organization of schemas. Second, the central processing takes place on each of the channels admitted to the processor. The more channels admitted and the greater the data-based processing necessary, the more processing capacity is required. Third, the processor splits output information between semantic and heuristic processing units. The semantic processing units involve "deeper processing". Fourth, schemata (from the individual) are used to

organize and store the text of the message. Judgments are based on both the heuristic processing and the schematic textual analysis of the message. Finally, these textual representations can be stored and retrieved from long-term memory. The affective and heuristic judgments also appear to be retrievable.

There are several conclusions that can be drawn from information processing literature. First, that information processing can be thought of as "a series or hierarchy of processing stages" (Craik & Lockhart, 1972). In reality, however, many processes probably not only overlap, but occur simultaneously and with feedback from one "stage" to another.

Second, attention and processing capacity are limited. The exact architecture is not known. In general, however, it appears that there are several channels available for information input and to the extent that attention is divided between active channels, performance suffers. This degradation shows up as lower processing capacity, measured as increasing task completion time, or increasing reaction time to a secondary task.

Third, three main processing modes have been investigated -- textual (or possibly rational), affective, and heuristic. Different selection criteria are posited by researchers. There is, however, a general conceptualization of processing as thoughtful versus non-thoughtful. Semantic processing is considered to be distinct from affective evaluation and heuristic judgments. It also appears likely that these different processes would require different mechanisms. In addition, there is information on the operation of biases in both heuristic and semantic information processing. For example, primacy and availability effects occur in impression formation where early or cued information becomes more important than later or uncued information in making judgments.

Fourth, memory appears to be organized schematically with strong primacy and recency effects. The multiple-store model suggests that various components may be stored separately. Spreading activation theories and PDP architectural models, however, suggest that the activation of one of these memories may activate other associated memories. So,

while evidence suggests that affective memories and judgments are less retrievable than the textual representations, these various memories appear to be linked. The implications of this linking for communication research suggest that when information has been presented in multiple modalities, activation of one modality may activate information from the other modality. For example, there may be linkages between memory for the visual and audio modes of television, or between an affective state and brand-name information in a commercial.

Communication: Theories about messages

How messages are processed probably depends not only on aspects of the processor, but aspects of the message as well. An important aspect of message processing, therefore, is how people deal with complex real-world stimuli. This interest in messages themselves, their characteristics, and how particular aspects of messages affect message processing is the domain of communication research. The ability to understand which aspects of messages affect how they are processed, however, is hinged on the ability to classify what is actually in a message. That is, before we can understand how messages affect processing strategies we need to be able to describe what is actually "getting in" to message processors and what makes up the message itself.

The application of information processing theories to communication messages also opens the door to investigations of communication as process (Cappella, 1977). For example, the investigation of the various steps in program selection and viewing (Watt, 1979) or persuasion (Petty & Cacioppo, 1986) may involve several different studies. In these instances information processing theories may offer insights in how and where to measure indicators of the intervening processes that occur. The following discussion, therefore, will focus on what aspects of messages communication researchers must be able to understand in order to make use of, expand, and widen our understanding of the various psychological processes that have been identified so far.

Specifically, we propose to examine which aspects of messages are essential for an investigation and understanding of the psychological processes involved in communication. From the psychological theories described above traditional classification schemes such as genre (sit-com, game show, western, etc.), medium (interpersonal, newspaper, radio, television, etc.) or length (20-, 30-, 60-second, 30-, or 60-minute) are not useful. Instead, a classification scheme needs to make use of message variables relevant to the dimensions used in message processing theory (Reeves, Thorson & Schleuder, 1986). In addition, these dimensions would be most useful if they cut across the different media and various forms of messages (newspaper news stories, radio entertainment programs, television commercials, etc.).

The literature in communication (based on information processing models) is beginning to examine messages along these lines. For example, there have been a number of communication studies that have categorized object attributes of television commercials. These attributes include information content, brand/product information, setting, visual or auditory devices, music and characters (Thorson, 1989). In addition, other studies have begun to look at the effect of message variables such as content, complexity, and affect on message processing.

This is not, however, an attempt to propose a shopping list of conceptualizations of message variables. To do so would be of limited utility at best (Cappella & Street, 1989). Instead, this is a suggestion for a number of categories which are suggested by theories of information processing. Armed with this background and theories of message processing, we are seeking a general scheme for classifying all forms of communication messages. These aspects of the message include modality, form, content, complexity, and affect. In addition, a clearer understanding of each of these message attributes is necessary in attempting to understand the nature of message effects in communication research (Reeves, 1989).

Modality

The nature of messages, or course, depends on the medium in which the message is transmitted. The medium determines the modality or modalities which may be used by the message. The modality of messages can be conceived of in two ways. The first approach is to consider the limitation of particular medium to carry particular modalities. Radio, for example, can only carry auditory information, but television may carry video, auditory, and even written material. A breakdown of these potential modalities are given for several media in Table 1.

TABLE 1:

Potential modalities of media

Medium	Written	Visual	Audio
Teletext	X		
Books	X	x	
Newspapers	X	x	
Magazines	X	X	
Billboards	x	X	
Telephone			X
Radio			X
Face-to-face	?	x	X
Film	x	X	X
Television	x	X	X

Note: Principle modalities in upper case X, secondary in lower case x.

The second approach to the question of modality is to define modality based on those being used in a particular message. For example, a magazine cigarette ad may contain written material superimposed upon a picture of a man and a woman running on the beach. By this definition, both written and visual modalities are present. From the view of

message processing literature a focus on the information coming in to the processor is the most worthwhile. So, for the purposes of examining message processing, we should not examine the modalities of the medium, but the modalities exhibited by particular messages. This allows information from each modality to be presented independently to recipients for research purposes. Two experimental procedures which have made us of this independence include restricting a message to one or more modalities (e.g., Reeves, Thorson & Schleuder, 1985) and varying the content independently across modalities (Hoffner, Cantor & Thorson, 1989). Both of these approaches offer insights into how messages are evaluated.

Features

Communication research has observed that information processing theories predict that various features may affect attention. Specifically, audio or visual features such as loud noises or light flashes caused by scene changes may cause an automatic orienting response (Reeves, Thorson & Schleuder, 1986; Lang, 1990). For this reason, research has examined the role of several message features on attention to television. These features include production or formal variables which affect the way the message is presented (Husson, 1982; Watt, 1979). The research has focused on features such as auditory change, sound effects, and scene changes (Alwitt, Anderson, Lorch & Levin, 1980; Thorson, Reeves & Schleuder, 1985). Several of these factors have been shown to affect attention to or recall of these messages (Alwitt et al., 1980; Rotschild et al., 1986; Thorson et al., 1985).

Features may also make demands on processing capacity. Specifically, attention to a slew of features in multiple modalities may be the equivalent of performing multiple tasks. Processing capacity must be allocated to attention, and performance suffers. These capacity and performance decrements may appear as shallower processing, and, therefore poorer memory. Communication research has, therefore, examined how attending to

message features interferes with the ability to perform additional secondary tasks. Secondary tasks are used as a measure of available processing capacity, which, in turn, reflects on current demands (Reeves, Thorson & Schleuder, 1985, 1986). Importantly, while visual features do not appear to decrease capacity (measured as secondary reaction task time), audio features do.

The role of features in memory may also be explored. First, there is the possibility of features interfering with memory due to cognitive capacity overloads. Second, there is the question of humans' naturally occurring eye and head movements differing mnemonically from "artificial" ones such as zooms and cuts. Third, memory for point-of-view shots may differ drastically from memory for objective omniscient perspectives. And fourth, there may be better feature memory for more experienced viewers (e.g., advanced film students) than naive or younger viewers (although Collins' results of younger children with willy-nilly memories suggests otherwise).

Investigation of the effects of message features on attention, sensory capacity, depth of processing, and memory is warranted. However, since the ability to perform a task is shown to suffer more from being performed in the same modality than when it is performed in a different modality (Mulligan & Shaw, 1981), modality-specific interference is possible. The possibility of this within-modality interference, as well as a general concern for accurate analysis, makes it necessary to consider the examination of these features separately for each channel -- written, visual, and audio.

An analysis of written features, an interest of journalism and readability studies, suggest that we might consider the presence of specific words, headlines, bold, or underlined text, or word complexity. The examination of visual elements should include static features (such as background, foreground, characters, color, and lighting levels), as well as dynamic (over-time) features (such as camera motion, zooms, and edits) (Abelson, 1989; Alwitt, 1985; Lang, 1990). Audio features may include spoken words and other sounds. The features present in spoken words may include emphasis, intonation, pauses,

and accents. But other sounds -- background sounds, music, and effects -- may also be important aspects of audio content.

In addition, because the creation of certain "tones" or "moods," a group of production features sometimes occurs together. For example, a "sad" mood usually is portrayed in film and television with fewer (and hence, longer) shots, darker colors, less movement, and lower light levels. Therefore, some of message features appear to be correlated (Cappella & Street, 1989; Reeves, Newhagen, Maibach, Basil & Kurz, 1989). Research, therefore, may wish to consider a multivariate analysis of these variables or make use of experimental designs where the features are manipulated independently.

Content

Content is considered to be the thematic or semantic information in a message (Husson, 1982; Watt, 1979). Communication researchers have noticed that information processing theories predict that content differences may affect several outcomes. Specifically, content may alter attention (Alwitt et al., 1980; Lang, 1990; Reeves et al., 1985; Rotshild et al., 1989), or the depth of processing (Kellerman & Lim, 1989) in the forms of textual representations and heuristic judgments (Kahneman & Tversky, 1973). In addition, an ability to understand the content of messages is an important aspect of the analysis of textual representations and memory (Berger, 1989; Cappella & Street, 1989)

Based on information processing theories, communication research has examined several aspects of content. The definitions of content, however, have been as diverse as the presence or absence of particular types of characters (e.g., Alwitt, et al. 1980), versus whether the material was presented in normal or jumbled versions (Collins, 1979; Pingree, 1986). Despite the varying conceptualizations of content, relationships with attention and memory have been demonstrated (Collins & Wellman, 1982; Pingree, 1986).

For the purpose of classifying the information present in messages, in some cases the analysis should be divided into modality-specific content. In other cases, a global

measure of content may be more useful. Which measure of content is used, of course, depends on the specific research question. It would appear useful, however, to be consistent in what is called "content." Based on previous conceptualizations and to gain maximum contrast with features, content may be best defined as semantic or thematic aspects of messages

The information present in written messages may be coded in terms of the presence of words, word types, word or sentence counts, assertions, or conclusions. For example, the intensity of verbs, also called "action units" or "dominance" (Badzinski, 1989; Berger, Karol & Jordan, 1989; Planap, 1989) have proven to be useful independent variables. The number of constructs created ["differentiation"] and the ways statements were sorted ["representations"] have been shown to be a useful way of assessing the content of memories for written content (Daly, Bell, Glenn & Lawrence, 1985).

Measures of visual content may include objects, people, their pairings, implications, relative locations, and implied relationships between these objects. In addition, moving pictures require an additional level of measures including object movement, depth and dimensionality.

The information present in audio messages has two elements. First, there are equivalents of written content -- words, word types, sentences, assertions, or conclusions. Second, there is additional content relative to aural dimensions that may be important -- the implications that can be drawn from background sounds, music, effects, intonations, accents, and other speech characteristics. For example, one measure of audio content that has been used on several occasions is fluency -- measured as the number of pauses and false starts (Berger et al., 1989; Greene & Lindsey, 1989; Hosman, 1989).

Research which has not separated content into the different modalities can be considered to be more global measures of content. These assessments of content have often been done by raters. Examples of such content assessments include violence (Hansen & Hansen, 1990; Linz, Donnerstein & Adams, 1989; Perloff, 1989), kind or

cruel behavior (Hoffner, Cantor & Thorson, 1989), sexuality (Hansen & Hansen, 1989), sex-role stereotyping (Durkin, 1984) and message structure (Meadowcroft & Reeves, 1989). In most cases, the researchers were interested in the making comparisons between the presence and absence of a particular types of content. In other instances, the more tradtional measures of content (news, entertainment, advertising, etc.) may be important (McLeod & Pan, 1989). It is possible, however, that these content differences are also related with other differences such as the overlap described in the features section. More will be said about this possibility later, however.

Complexity

Because of the limitations in human information processing capacity, one of the most important effects of complexity could be the overload of the processing system. First, high levels of complexity may cause the audience to attentionally "sample" the messages. Second, complexity may interfere with the understanding of content. Before we can gain an understanding of processing capacity in message interpretation and how much information can be handled at a time, research needs to be able to evaluate the complexity of the message being input.

There are three places to start for the analysis of message complexity. First, one measure of complexity is based on Shannon & Weaver's theory of communication. Watt & Krull (1974) coded programs on five entropy measures which were then subjected to factor analysis, yielding two derived measures identified as dynamics and familiarity. These complexity measures, dynamics and familiarity, may then be examined over time (the first derivative?) to establish the ongoing complexity level of television material. Auditory and visual measures of complexity have been shown to predict children's attention to television commercials (Thorson, Reeves & Schleuder, 1985; Wartella & Ettema, 1974)

A second elaboration of complexity into static and dynamic complexity have been developed (Welch & Watt, 1982). Generally, static complexity refers to the complexity of a single frame, and dynamic relates to the amount of changes between frames. These two aspects of complexity were shown to have different effects on attention to and recall of messages (Watt & Welch, 1983). Geiger (1988) has proposed that static complexity is often viewed as synonymous with structural complexity (say, the number of features present) and structural complexity with semantic content. Although they may be a relationship between complexity, features, and content, these aspects are not synonymous, especially in television material.

Third, digital compression systems which characterize changes in scenes may also be used to derive complexity measures. That is, after an initial frame of video information is coded (pixel by pixel) only changes to those patterns are examined. Complexity would then be a measure of the amount of changes taking place in an image.

The complexity present in written messages is usually measured via propositional schema trees (Thorson & Snyder, 1984). Other measures which may be of use in estimating written complexity including average word length or average sentence length.

Measures of visual complexity may use any of the three approaches outlined above -- first, Watt & Krull's (1974) dynamics and familiarity measure over time; second, static and dynamic complexity (Rimmer, 1986; Welch & Watt, 1982); and third, changes in scenes. Each of these has a fundamentally different conceptualization of complexity, and should be considered accordingly.

Audio complexity must again be divide into its two component parts, spoken words and sounds. The complexity level of spoken material may be coded as it is in written measures, via propositional schema trees, or word and sentence length. The additional sound information -- background sounds, music, effects, intonations, and accents -- may be coded similarly to measures of visual complexity, static versus dynamic complexity or changes in audio background. The effect of musical complexity itself has also been

operationalized as "musical motion" (Cerulo, 1989). In addition, audio pacing (and video pacing) has also been manipulated via time compression (e.g., King & Behnke, 1989).

Multiple: Sometimes only a global measure of complexity is required. In these cases, the overall level of complexity may be based on some combined form of each modality, or estimated by raters. (Samter, Burleson & Murphy, 1989). In these cases, however, it is important to carefully understand and define the conceptualization of complexity beforehand before instructing coders. In addition, samples of conceptually defined "high" and "low" complexity messages may be presented to raters in order to help them understand the conceptualization and establish common "baselines."

Affective Content

The affective nature of a program may influence attention in at least two ways. First, a viewers may desire a particular mood state (Meadowcroft & Zillmann, 1985). This desire may require attention and processing effort in order to evaluate the incoming material and determine whether or not to terminate the exposure. Second, affective material may make particular demands on the processing systems of viewers. These processing demands, may, in turn, influence the attention available for other forms of processing.

It is also possible that an ad's affect determines the depth and nature of processing. According to "jungle theories," large levels of negative affect such as fear may override cognitive processing (Lang, 1990). Such affective processing may make use of a separate mechanism which may make large demands on processing capacity, possibly in a parallel system, which reduces capacity availabilities.

The presence of affect with semantic material may alter memory effects. First, ads may be more memorable when retrieval conditions are consistent with storage conditions in a mood congruity effect (Reeves et al., 1989b). Second, semantic material may "trigger" affective reactions in a spreading-activation (or S-R) mechanism (Batra & Ray, 1983,

1985). Third, affective components of ads may help to determine judgments or influence the rate at which counterarguments are generated by audiences (Chaiken, 1987).

Before the effects of affect and affective messages can be investigated, however, the mood portrayed in messages must be estimated. This estimation may consider not only the message, but also the mood projected toward the product, brand, or model. So while affective evaluation of messages does appear to alter processing of information (Batra & Ray, 1983; 1985), objective evaluation of these affective components is difficult to establish.

In most instances of communication research, written, visual, and audio affect is usually assessed by raters or coders. One example of an affective evaluation in the audio modality performed by raters was done by Kellerman (1989). Evaluation of written and visual material is possible, too. Finally, general affect across mixed modalities may also be of value. The easiest method of evaluation is also via raters (Reeves, Lang, Thorson & Rotshild, 1989; Reeves, et al., 1989b).

What are media messages?

The important attributes of messages according to information processing theories appears to be classifiable according to modality, features, content, complexity, and affect. Each of these attributes takes many forms and may be measured in a variety of ways. Content, for example, has been conceptualized as both random versus mixed orders, and the presence or absence of people on the screen. The exact nature of the dimensions, however, cannot be established beforehand, but must be based on the specific research question at hand. Each of these aspects of messages may affect processing. An overview of the relationships that have already been examined in shown in Table 2. This table shows that communication research has concentrated on attention and memory as dependent variables, and the intervening processes, less so. This is probably because of both familiarity and ease in working with "outcome" measures. The relationships which have

not been investigated may also be useful in understanding how message variables may alter processing. Some of these are more immediately suggested than other (e.g., the relationship between complexity and semantic processing).

TABLE 2:

Investigated relationships between processing and message attributes

Process	Modality	Features	Content	Complexity	Affect
Attention		x	x	x	x
Sensory Processing	x			x	
Depth of Processing	x		x		
Semantic Processing			x		
Affective Processing					x
Judgments		x			
Memory	x	x	x	x	x

One important aspect of messages is the relationship between the different variables or message attributes. In some messages, there may be almost a perfect correlation between attributes, for example light flashes may synchronized with the appropriate sound effects. In other cases, these dimensions may be relatively unrelated, for example, the visual images may be overlaid with mood music. This relationship can probably be viewed as a continuum with the two poles being complete overlap between attributes versus their complete independence. Although in reality messages probably fall somewhere in the middle, the implications of each poles quite different.

In the first instance, where attributes are strongly correlated it may difficult to establish which attribute is responsible for an observed relationship. A sad program, for example, may exhibit fewer cuts, darker colors, sombre music, muted voices, and overall

lower complexity measures. In this case, an investigation which intends to focus on the effect of one of these aspects may actually be measuring effects attributable to a correlated aspect. For example, Armstrong and Greenberg (1990) found TV features interfered with 3 of 7 cognitive performance tasks. However, it is not clear which of these elements -- form, content, or complexity interfered with performance. Other research suggests that while visual "complexity" appears to lead to increased levels of attention (measured as secondary reaction task time), may have no effect on attention (Reeves, Thorson & Schleuder, 1986). An alternative explanation for this phenomenon is that increasing numbers of visual features leads to increased arousal, which enhances performance and lowers secondary task reaction time while increasing the audio complexity leads to increased arousal and processing demands, which reduces available resources and increases time needed to respond to a secondary task. Still other research fails to distinguish between the two concepts (Alwitt, 1985). In these approaches, all the usual admonitions about correlated variables are in order, including paying careful attention to what constitutes features, content, or complexity.

In the other instance, material which is presented in one channel may bear little relationship with that presented in another. Examples of independence between channels abounds. Three instances which come to mind include montages with background or "mood" music, news stories where there are varying levels of semantic overlap between channels, and conflicting information within a single advertisement. This question is reminiscent of the Stroop test (conflicting color information). In these cases it is difficult to predict what happens when processing a message with conflicting information. For example, imagine a cigarette ad with a visual image of two healthy people playing volleyball on the beach accompanied by a written Surgeon General's warning. It is not clear whether the visual and written information cancels, whether one modality overrides the other, or if the result depends on the individual. These situations provide interesting research opportunities into how attention, processing, and memory are affected by the

information in various modalities (Drew & Grimes, 1987; Hoffner, Cantor & Thorson, 1989).

The relationship, or lack thereof, between message attributes suggests that messages are more than the sum of their parts and raises the reductionist-wholist issues. As with the selection of message attributes and their conceptualization for study, the specific definition of interest depend on the research question. Messages can be described along infinite dimensions, only a few of which are germane to any given study. The relationship between message attributes suggests that not only might the failure to include a potentially confounding variable effect the findings, but even a multivariate analysis which included all potentially relevant variables may fail to adequately define what constitutes "a message."

Conclusion

Psychological research has developed several theories of information processing. Because these information processing models allow us to examine how people process and understand messages, these models are, and should continue to be, applied to communication research.

A communication model of message processing was also presented. Because of common background, these models makes use of the same general processes envisioned by the psychological model -- attention, processing, evaluation, and memory. Historically, the message processing approach in communication has focused on how message, source, or receiver variables and their interaction predicts attention, processing, evaluation, and memory for messages.

Comparing Figure 1 with Figure 2, however, will demonstrate that while psychological models focus on the processes themselves, communication models typically examine how message, source, or receiver characteristics and their interaction affect these various processes. Although the two fields have slightly different focuses -- psychology

on people (and, in this case, processes within people), and communication research on the communication process and interpretations of various messages -- to a large extent, each discipline is investigating similar processes. It is likely that each discipline can inform the other. But this requires that the theories and research investigate both the details of information processing and the importance of message attributes.

One important aspect of a cross-fertilization is the definition of messages according to the dimensions used in message processing theory. Although the information-dense nature of messages leaves their selection and conceptualization to the discretion of the researcher (Cappella & Street, 1989), important attributes that are derived from information processing theory are their modality, form, content, and complexity and affect. Although these attributes are important, there are two significant reasons to focus on messages, and not their attributes as a research variable. First, potential relationships between these attributes makes it difficult to attribute findings to specific variables. Second, concentration on attributes themselves increases the likelihood of a type 1 error (Bradac, Hopper & Wienmann, 1989) and raises the debate on sampling (Jackson & Jacobs, 1983; Jackson, Jacobs & O'Keefe, 1988; Morley, 1988a, 1988b) and on the "size of containers (Reeves, 1989).

While the development of a message processing model in communication is no easy task, it offers the ability to investigate interactions between messages and processors. Specifically, how an audience member responds to a message may depend not only on aspects of the viewer or aspects of the message, but also on an interaction between viewer and message characteristics. For example, whether to process a political ad according for issue or image information is probably a function of the viewers involvement, which probably determines the viewer's willingness to tolerate a particular complexity level. As the fields now stand, the viewer differences may belong under the domain of psychology, message differences to communication, with the interaction effect falling between the cracks.

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FIGURE 1:
A psychological model of message processing

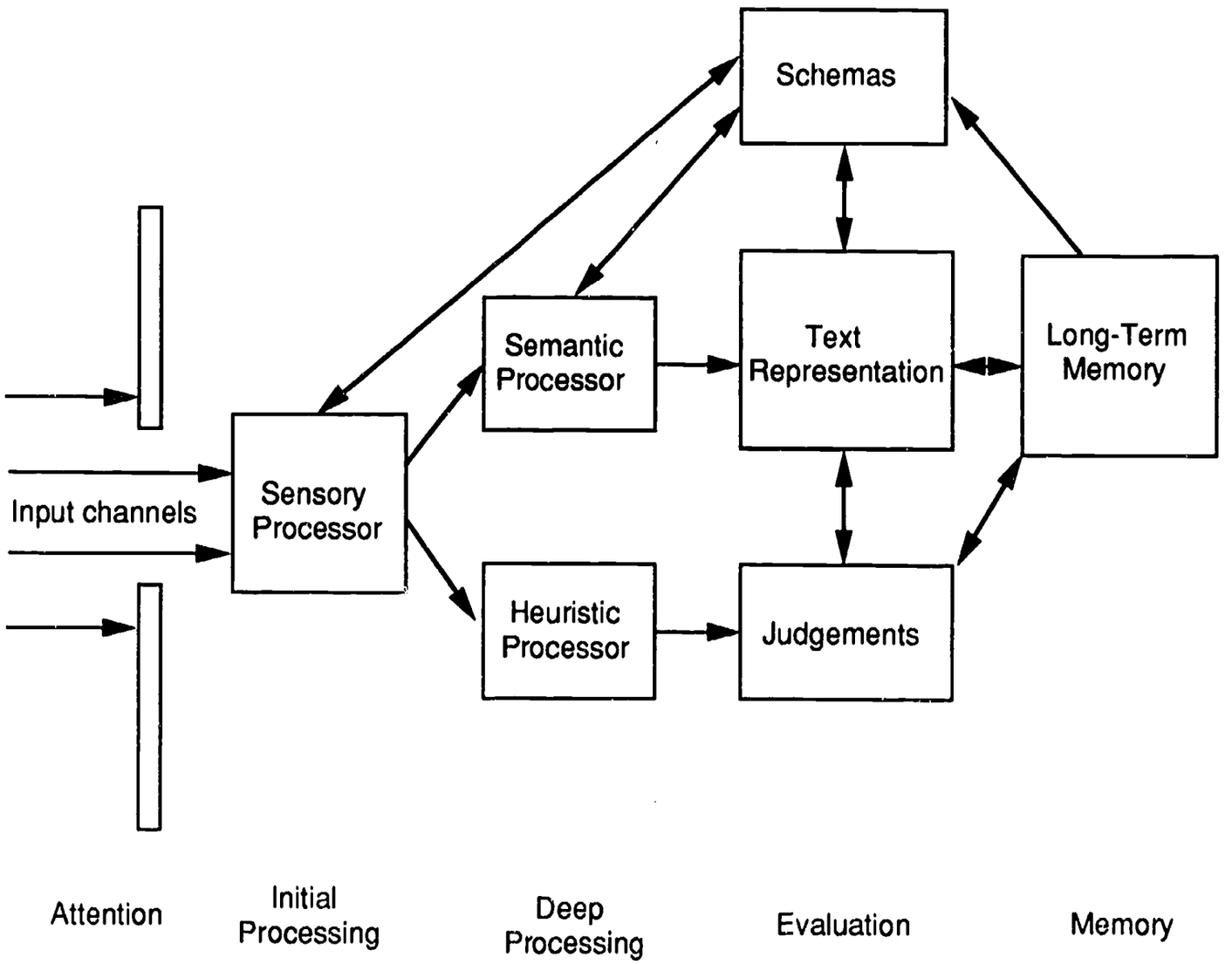

FIGURE 2:
A mass communication model of message processing