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This paper reviews research and theory on human memory, emphasizing key findings and concepts of importance to marketing and consumer choice. Several implications for promotional decisions are discussed. It is hoped that this review will stimulate further research on, and applications of, memory principles in marketing.

# MEMORY FACTORS IN CONSUMER CHOICE: A REVIEW

MEMORY plays a major role in consumer choice. The specific inferences drawn by consumers from product stimuli, advertising, word of mouth, and other sources of product-related information are heavily dependent upon what data are in memory and how they are organized. Important questions to which research on consumer memory can contribute insights include (a) What is remembered from an advertisement or a product-related conversation; (b) Under what conditions do consumers tend to emphasize information on packages or stored in memory when they are in the store; (c) How much time is necessary for consumer to learn some piece of information from an ad; (d) How many repetitions are needed before a consumer can remember a piece of information; (e) What can be done to facilitate in-store recognition of a brand by consumers; and (f) What types of new information, claims, and so on are easier for consumers to remember, given their current knowledge about a product.

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Despite its potential importance, research on consumer memory is a relatively neglected area. The purpose of this paper is to present a survey of the literature on the structure and operation of memory and some implications of the memory principles uncovered by the survey (see Olson 1978b for another review of memory notions as related to consumer choice).

## Overview

One concept of memory that recently has been very influential is the multiple-store approach. It is postulated that there are different types of memory storage systems, each with different functions and properties. A typical model of this type hypothesizes a set of sensory stores (SS), a short-term memory store (STS), and a long-term store (LTS) (Atkinson and Shiffrin 1968).

In the basic processing sequence, information passes from the sense organs to the appropriate sensory store which is hypothesized to be very short-lived, losing information within fractions of a second unless the information is further processed (i.e., unless attention is allocated to the stimulus). If the information is attended to and processed, it is transferred to the STS.

The STS has a limited capacity and information can be kept active in it by further processing. Information which is active in the STS can be retrieved quickly and almost automatically. Information in the LTS may be brought into the STS as needed to interpret the input information. Thus the STS is the locus of current processing activity, where information from the sense organs and long-term memory can be brought together and processed. Finally, a portion of that information, if adequately processed (a discussion of the meaning of "adequate" in this context is given below), can be transferred to the LTS which is hypothesized to be essentially unlimited in capacity and a permanent repository of information. Although the above discussion, if taken literally, implies that there are several physically distinct memory stores, the separate *functions* of these are the crucial element of the multiple-store viewpoint.

In addition to this characterization of the basic structure of memory, one must also consider how individuals *use* memory. Individuals have various strategies for how and what to process, for what to store in long-term memory and how to store it, and for how to retrieve information from long-term memory. Such strategies are often called control processes (Atkinson and Shiffrin 1968). Although in many cases, storage of and access to items in memory may be nearly automatic, retrieval and storage also can be involved and difficult processes.

In consumer choice there is an *external* memory, in many cases, where information is available without needing to be stored in the consumer's memory. Package information, shopping lists, buying guides, or ads clipped out by the consumer and brought to the store are part of this external memory system.

Thus there is a memory system and a set of control processes which can be used to interact with that system. In general, two very basic kinds of memory usage occur. In one case, information which is currently in long-term storage or external memory must be retrieved *from* the memory to be used in interpreting incoming information or in current processing. In the second case, incoming information is processed and stored *in* memory for later use. These two functions are, of course, not independent; they simultaneously occur at almost all times.

Some basic memory concepts are now presented in more detail: multiple store and other views of memory, control processes; properties of short-term and long-term memory, and the impact of different types of consumer choice tasks on memory usage. In examining memory research, one general caveat should be considered. Much of the experimental research studies situations where individuals are *trying* to memorize (for texts which review this research, see Loftus and Loftus 1976; Crowder 1976; Norman 1976). Consumers also may deliberately try to remember things at times, but in many situations what consumers remember may be incidental rather than deliberate. This difference needs to be considered in attempting to apply any experimental results, and suggests that future research on consumer memory might emphasize incidental memory (McLaughlin 1965; Postman 1975).

## Basic Concepts of Memory

### Multiple Store and Other Approaches to Memory

As noted above, one prevalent view of memory is the multiple-store view. However, recent research has begun to cast doubt on the strict interpretation of this concept, particularly the distinction between the LTS and the STS as separate memories. Postman (1975) provides a thorough and critical summary of the evidence and concludes that the distinction is not well supported. Other conceptions of memory have been advanced which do not postulate separate multiple stores.

Craik and Lockhart (1972) propose that individuals have limited processing capacity which can be allocated to processing incoming information. In particular, they argue that capacity can be allocated to yield various *levels of processing* which might range from simple sensory analysis (e.g., noting that the information is printed in red type) to more complex semantic and cognitive elaborations of the information (e.g., relating it to other information in memory and seeing how it fits with previous beliefs). Presumably the "lower" levels of processing (e.g., sensory analyses) would require less allocation of capacity than the "higher" or "deeper" levels (e.g., semantic analyses). It is then hypothesized that the level of processing attained determines the future retention of the information. In particular, "deeper" levels of processing (and hence greater use of processing capacity) are hypothesized to be associated with more elaborate and longer lasting memory for the information. For example, consumers who only process an advertisement's sensory features (e.g., a waterfall, a pretty scene, or a well-dressed spokesperson), without processing the semantic information in the ad and relating it to what they know about the product category, presumably will not recall the claims presented when they attempt to make a choice. In that sense, advertisements can err in actually *encouraging* sensory rather than semantic processing by their very nature (i.e., the "background" of the ad may divert attention from the message). Although this issue of background diversion is not new,

examining it from the viewpoint of research on memory can suggest approaches for studying such diversion—researching which parts of an ad are processed, and with what degree of elaboration; and what information, images, and reactions to the various parts of the ad are stored in memory after exposure.

Since there is limited overall processing capacity to be allocated, only a small amount of information can be processed in depth at any one time. Rather than postulating several distinct memories, the levels of processing theory assumes one memory, an overall processing capacity, and the ability to engage in different levels of processing. Although this theory is quite provocative, it also has some serious problems. Some have suggested that *spread* of processing (i.e., the degree of elaboration used in coding the information) is more important than depth alone (Craik and Tulving 1975). Others note that there is a substantial problem with measuring depth of processing in some a priori and independent fashion (Nelson 1977; Baddeley 1978). Most research simply uses types of processing that seem intuitively to differ in depth, without attempting any formal measure of depth. These critics are quite persuasive, so the fate of levels of processing approaches is not clear at present, although research continues (Jacoby, Bartz, and Evans 1978; Saegert 1979; Seamon and Virostek 1978; Cermak and Craik 1978). Until these problems are resolved, however, this approach might best be regarded with caution.

Another general conception of memory which does not require multiple stores is the activation model. In this model, there is one memory store, but only limited portions of that store can be activated at any one time. Only the activated portion can be used for current processing. Activation is temporary and will die out unless further effort is devoted to maintaining it. The exact nature of activation is typically unspecified; however, the concept is one of rate or intensity. Therefore, notions of effort (Kahneman 1973) or allocation of processing capacity also can be viewed as concepts of activation. A general model of this type is outlined by Collins and Loftus (1975) and considered in more detail below. The limited capacity for dealing with incoming information which led to postulation of the STS is thus handled in this model by the limitation on total amount of activation.

The three models described to this point, multiple-store, levels of processing, and activation, do not seem incompatible. The multiple-store theories do not strictly require that there be physiologically separate stores; the *functions* of each store are important. Shiffrin and Atkinson (1969, pp. 179-180) note that their system is "equally as consistent with the view that stores are separate physiological structures as with the view that the short-term store is simply a temporary activation of information permanently stored in the long-term store." Bower (1975) makes the same point. Thus, the multiple-store model can be viewed as an activation model. A liberal view of the Craik and Lockhart (1972) model also allows it to be viewed as an activation approach, since the allocation of processing capacity is a major mechanism of the model.

It seems that all three models of memory are consistent with the principles of a limited processing capacity and a single memory store with allocations of that capacity to the processing of incoming information. The phenomena of the limited STS seem perfectly explainable in these terms, since there is a limitation on the total amount of processing capacity available for allocation. In examining the properties of memory below, the terminology of short-term memory (STM) and long-term memory (LTM) will be utilized to escape from the notion of separate stores, rather than defining new terms for the currently activated portion of memory and the entire memory itself. These terms are to be understood in the light of the above discussion.

As noted above, external memory devices ranging from package information to detailed shopping check lists are often available. The presence of an external memory can serve to reduce the burden on the consumer's internal memory. That is, both internal memory and external memory can be viewed functionally as sources of information. In some cases, it may be easier to encode and process information from a package when making product comparisons than to try to retrieve and process these same data, perhaps fallibly, from internal memory. The consumer also may not try to store complex data internally if these data are available in external memory. The use of information in internal memory may be necessary to interpret such externally available data when they are processed, of course, but overall the burden on internal memory seems smaller if an external memory exists. Thus, the availability of external memory in any particular choice situation can be an important characterizing factor.

### Memory Control Processes

Memory control processes are the strategies used by humans to control the flow of information in and out of memory (Atkinson and Shiffrin 1968). These processes can be under the active control of the individual. There are certainly many habitual, nearly automatic processes used by individuals in inputting and outputting information. However in some cases, such conscious decisions are made, so an understanding of the strategies involved is important. In the following, several such strategies are discussed.

*Rehearsal.* After a stimulus has entered short-term

memory, processing effort, called rehearsal, may be needed to further analyze it. The two roles usually assigned to rehearsal are maintenance of information (keeping it activated) in the STM and ultimate transfer of information to the LTM.

The initial concept of rehearsal was that of rote repetition of the information in STM, usually verbal in memory experiments. That is, the individual was viewed as silently repeating the information being considered. Retention in LTM was postulated to be a direct function of the amount of time spent in rehearsal. However many studies have shown that retention in LTM does not necessarily vary directly with amount of rehearsal time. Instead, retention can vary with the form of the rehearsal itself (Woodward, Bjork, and Jongeward 1973; Postman 1975), whether mere repetition (less retention) or more detailed analysis (more retention). Thus, rehearsal can probably best be characterized as allocation of processing capacity, which will be done in accordance with the goals of the individual and the requirements of the task at hand. For example, consumers may remember a price or the value of some other product attribute not so much by rote repetition of the attribute value to themselves, but by mentally relating the value to what they already know (e.g., this price is a few cents more than the cost of my regular brand).

*Coding.* Coding refers to the way the individual *structures* information for rehearsal. It is now well known that subjects in verbal learning studies use mnemonics, associations, images, and many other strategies of encoding the inputs received to facilitate memory (Bower 1970; Reitman 1970). In attempting to remember the name of a new brand from an ad, the consumer may also associate the brand name with some mental image that suggests that name. For example, a consumer may remember Autumn margarine by associating it with a fall scene. The ads for this margarine use such scenes to try to encourage this process (see Lutz and Lutz 1977).

*Transfer.* A third control process is the transfer process which governs *what* is stored in memory and the form in which it is stored. Information which is important for attaining goals and/or easily stored is likely to be given highest priority (Shiffrin and Atkinson 1969). These properties need not coincide; that is, information needed for goals may be difficult to process. For example, a consumer may be very interested in nutritional information, but may not be able to store USRDA ratings. Trade-offs must be made in such a case, with the consumer perhaps only attempting to store whether or not the food is basically nutritious.

What is to be stored and the form of storage will thus depend on what the individual expects to do with the information, it such expectations are present. More or less detail may be required depending upon the task to be performed when the information will be used. If the individual plans to compare foods on nutritional content in the store using package information, then only the brands to be compared need be put into memory. However, if the information is presented in an ad and not on the package, the consumer may put more into memory. In situations where individuals do not have firm expectations about how the information will be used, the easiest transfer strategy will probably be used. Events which are surprising, novel, inconsistent with expectations, and so on will often be given priority for processing and storage (e.g., a new price may be stored).

*Placement.* Placement deals with where an element is stored. This depends upon the existing organization of memory and the particular associations utilized in coding the item. In this sense, the "where" question does not refer to a physical location, but the association structure developed when the item was processed. This structure is affected by the context of presentation: for example, if words are presented in categories, recall tends to be grouped by those same categories (Bower 1970). The importance of the placement decision is that later retrieval may depend upon the likelihood that the particular placement strategy can be reconstructed. In addition, a placement decision may lead to *reorganization* of a portion of memory.

*Retrieval.* Retrieval of items from memory is a crucial control process. Retrieval processes can range from almost immediate access for familiar items to involved problem solving search processes for other items. The control processes discussed above interact with retrieval. If the basis used for coding, transfer, and placement cannot be retrieved, the item itself may not be accessible. Forgetting is seen, in light of the permanence of the LTM, as a failure of the retrieval process rather than a decay or loss of items. The basic underlying notion can be best seen intuitively by considering cases where an item cannot be remembered, and then some event occurs which gives the "clue" needed to immediately retrieve the item. For example, a consumer may remember needing some item not on his/her shopping list, but not the item itself. While in the store, the item or a related product may trigger remembrance. This retrieval problem is of course central to disputes over the definition of impulse purchases.

Such phenomena imply that the correct retrieval strategy just could not be found at first. Failure of the retrieval process may result from searching in the wrong "part" of memory (i.e., in the wrong set of associations), running out of time to perform the search, or losing one's place in the search. This latter possibility reflects the limited capacity for STM which

may result in one's not being able to keep track of one's place in a complex search for a hard to retrieve item (Olshavsky 1971). Use of some external device (e.g., paper and pencil) as a memory aid is often tried by individuals in such cases.

*Response Generation.* A final control process is response generation. Many theorists view remembering as a constructive process where items are reconstructed from memory. Partial recollections are used as the basis for reconstructing what "must have been." Items are *not* stored in memory exactly as they were entered and aroused in toto when desired. Neisser (1967, pp. 285-86) calls this latter view the "reappearance hypothesis," and rejects it in favor of a constructive approach: "The present proposal is, therefore, that we store traces of earlier cognitive acts. . . . The traces are not simply 'revived' or 'reactivated' in recall; instead the stored fragments are used as information to support a new construction." Jenkins (1974) and Cofer (1973) summarize research supporting the constructive approach. This view implies that memory may be subject to biases, since reconstructions will be based partly on what was and partly on individuals' expectations or schemes for what "must have been" (D'Andrade 1974). A consumer may not remember the actual details of an interaction with a salesperson, for example, but may decide that there "must have been" deceptive statements if he/she is not pleased with a purchase.

## Properties of Short-Term Memory

Properties fall into two major categories: capacity and the times needed to transfer information to LTM.

*Capacity.* As discussed above, the STM is of limited capacity.[1] Miller (1956) first formulated the hypothesis that STM was limited, and reviewed evidence showing that approximately seven chunks of information could be processed at any one time. The number of items is limited because the attention or processing capacity necessary to rehearse these items is limited. Recent evidence (Simon 1974) suggests that a four- or five-chunk capacity seems more likely. A chunk was defined as a configuration that was familiar to an individual and could be manipulated as a unit, in essence an organized, cognitive structure that could grow as information is integrated into it.[2] For example, a brand name can summarize a good deal of more detailed information for a consumer familiar with that brand, hence the name and all it stands for can be thought of as a chunk. The actual amount of underlying material that can be processed simultaneously can be expanded by formation of larger chunks (e.g., by associating several attributes with a brand name so that the mere mention of the name elicits an entire "gestalt"), although the consumer may presumably reach a point where he or she is unable to further expand a chunk due to difficulties in dealing with more and more complex configurations of information or other factors.

This notion of a capacity for chunks is consistent with a memory model where the constraint is on processing capacity or amount of activation if the assumption is made that the processing capacity needed to manipulate a chunk is independent of its size. That seems to be the essence of the chunking concept; it is the organization of the chunk that allows for ease in processing.

The capacity of STM is lowered if other processing demands are made. This follows immediately from the notion of the limits on STM as processing capacity limits. If part of total capacity must be used for another task, that leaves less for processing chunks of information. The normal capacity may be reduced to a capacity of two or three chunks if other tasks are undertaken simultaneously (see Newell and Simon 1972).

*Transfer Times.* Another property of STM concerns the amount of time required to transfer an item from STM to LTM, assuming suitable processing is performed (i.e., if the type of coding needed to allow retention in LTM is performed, or if the form of rehearsal leads to retention, as discussed above). Simon (1969, pp. 35-42) and Newell and Simon (1972, pp. 793-96) cite evidence that suggests that approximately five to 10 seconds are required to fixate one chunk of information in LTM if one must later *recall* it. If only *recognition* is required, two to five seconds may be needed (Simon 1969, p. 39; Shepard 1967). This task difference follows from the fact that for recognition, only discrimination of the item from others is needed, not reconstruction of the information. The times above are rough guides rather than precise estimates, and refer to deliberate rather than incidental learning.

If information is not rehearsed at all, it is lost from STM in about 30 seconds or less (Shiffrin and Atkinson 1969). Whether this loss is due to decay or displacement by new items is still under debate (Postman 1975).

## Properties of Long-Term Memory

The LTM is hypothesized to be an essentially unlimited, permanent store with semantic and some auditory and visual storage. The basic properties of LTM are the types of elements stored and the organization of that storage.

*Elements in Long-Term Memory.* There seems to

[1]The notion of the STM as a "box" with a fixed number of "slots" has also been used, but is rejected on the basis of the arguments above denying the need for the distinction between the long-term and short-term stores.

[2]Bower (1975) points out that this definition is circular: a chunk is something that can be processed as a unit, and the capacity of STM is inferred from examining units of information that are processed, which units are then called chunks.

be some agreement that an important part of what is stored in LTM are semantic concepts and the associations among them (e.g., Quillian 1968; Anderson and Bower 1973). Concepts may include events, objects, processing rules, and attributes of objects and events. Underwood (1969) particularly emphasizes that various attributes of objects and events, such as temporal sequence information, spatial aspects information, modality through which the information was obtained (e.g., audio, visual, smell, etc.), affective data, and contextual data, potentially can be stored. This notion of contextual data, particularly time context, has been suggested by several authors (Russo and Wisher 1976; Hintzman and Block 1970). Such time-line memory is essentially similar to Tulving's (1972) notion of episodic memory—memory for past episodes and events.

Another important type of information in memory, related to chunks, is memory schemata. A schema is "an internal structure, developed through experience with the world, which organizes incoming information relative to previous experience" (Mandler and Parker 1976, p. 39). Thus it is an organized pattern of expectations about the environment. One might have schemata about what salespeople are like or how various product attributes interrelate. These schemata can obviously play a powerful role in how consumers perceive the events in their environment. Abelson (1976) considers the related notion of scripts, expectations about how various types of events will unfold (see Wyer and Srull 1979).

Processing rules also are elements of LTM. Newell and Simon (1972) hypothesize that processing rules can be stored in the memory data base and operated on and activated like any other type of information in memory. In addition to memory for semantic concepts, there is substantial memory for visual images and auditory events in LTM, but the mechanisms are currently not well understood (Paivio 1975).

*The Structure of Long-Term Memory.* There is also general agreement on the structure of the storage of semantic information in LTM. This storage is thought to be organized as a network of nodes and links between nodes, with the nodes representing concepts and the links denoting relationships among concepts; or as some organization which is structurally equivalent to a network formulation (Frijda 1972).[3]

Collins and Loftus (1975) present a network model, originally based on Quillian's (1968) work, in which there are nodes representing concepts and several links between concepts. Each link has a strength corresponding to how essential it is to the meaning of the concept. Processing a concept corresponds to activating the node corresponding to it with activation spreading through the network along the links. Collins and Loftus (1975) show how the theory can explain results on the effects of perceptual set and other data. Anderson and Bower (1973) also see memory as a network of nodes interconnected by associations and use the notion of activation. Finally, within the marketing literature, Nakanishi (1974) proposed a contiguous retrieval model. In this model, concepts are stored in clusters rather than in lists. Their retrieval is based upon their closeness of association or contiguity in the cluster. This model is essentially equivalent to the Collins and Loftus (1975) model, in that the cluster of concepts can be defined by nodes and links, with the notion of closeness or contiguity being modeled by the strength of the links.

Other models also have been proposed, but they can be viewed as equivalent to network models. Newell and Simon (1972) see memory as an organization of list structures (a list whose elements can also be lists). A list structure can be transformed into an equivalent network. Smith, Shoben, and Rips (1974) present a set-theoretical model where concepts are described by a set of features or properties. As Hollan (1975) points out, their model also can be reduced to a network model. (See Smith 1978 for a more detailed discussion of theories of semantic memory.)

In network models, new information is integrated by developing a configuration of links between the new concept and already stored concepts, or by adding links to already existing concepts. Also, inferences can be made by following paths of links and nodes. Such inferences allow us to construct responses and test inputs for consistency with what we already know.

Such models can be extremely important for understanding consumer choice because they imply that consumers have organized systems of concepts related to various brands, ads, stores, and so on. The particular concepts included and the relationships among them can have a powerful effect on the inferences made by consumers based on these concepts (Olson 1978a). For example, if a ballpoint pen has an ultra-fine point, and a consumer links the ultra-fine point with greater writing effort, that consumer may infer that the pen requires greater writing effort and not purchase it, even if in fact greater effort is not required. Also, the inferences underlying the price-quality relationship have been studied a great deal in consumer research (Olson 1977). Thus, studying what concepts are in consumers' memories and exactly how they are linked can be extremely important for understanding consumer responses to products. This type of insight is one benefit of adopting a network view of memory, which provides a framework for *systematically* exploring the contents and interconnections in consumer memory.

[3]Wyer and Srull (1979) propose a content-addressable bin model of memory which departs somewhat from these network approaches.

## Consumer Choice Tasks and Memory

The range of choice tasks performed by consumers is very broad, with decisions not only being made at many levels (save vs. spend, trade-offs among attributes, store, and brand), but in very different task environments, ranging from reading *Consumer Reports* to watching television commercials, ordering from a catalog, or searching through a supermarket. There may also be great differences across tasks in the availability of external memories (e.g., store displays) and their usage. Such factors complicate the examination of memory research, since in general the results are specific to the type of task performed. Therefore, understanding what parts of the memory literature are most relevant for understanding consumer choice requires some notion of what consumer tasks are to be considered. In general, this notion of *task analysis* is important. Newell and Simon (1972) argue that a thorough task analysis yields a great deal of knowledge about how behavior must be structured to adapt to that task environment. Particular tasks impose particular constraints on the processing needed to perform them. Hence, a limited and brief view of some important consumer tasks is presented below, with particular emphasis on the areas of memory research implicated. This task analysis is limited to retail-outlet shopping situations, to some major types of tasks performed outside of the store environment, and to some major types of tasks performed in the store. The specific tasks considered were chosen because they seemed most closely related to consumer choice processes.

*Tasks Performed Outside the Store.* We consider three of the main types of tasks that may be carried on outside the store environment: receipt and processing of information, formation of rules or strategies for weighting attributes, and choice of an alternative.

The consumer receives information outside of the store from many sources, including commercials on television, advertisements, and word of mouth. This information may be presented to the consumer or may be sought by him/her. Important questions relative to the memory component are whether or not the information is stored, and if so, what is stored. Whether or not information can be stored may be in large part a function of not only the consumer's interest in the information, but also of how easy the information is to process. Factors impacting ease of processing include the organization of the information processed, the sheer amount of information presented, and any competing activities carried out while the information is presented (e.g., a consumer is talking while a television commercial is being shown). Competing activities may have less impact for print ads or for conversations where the consumer has some control over the rate of processing required, than for television or radio where such control is lacking. Finally, the modality of information presentation, visual versus auditory, and the amount of information repetition may impact degree of retention, since these factors also effect ease of processing.

What information is stored may depend in large part on the use, if any, to which the consumer intends to put it. The consumer may wish to use the information as a reminder of something when in the store, such as a brand, which implies that recognition of that brand on the shelf suffices. On the other hand, the consumer may want to decide before arriving at the store, so that recall will be required. An individual difference variable, the degree to which prior planning outside of the store and in-store decision making are used, may greatly influence the type of memory needed, whether for recognition or for recall.

A second out-of-store task considered is the formation of rules or strategies for weighting attributes. Formation of such rules requires information on attributes and the trade-offs among them. Information relevant for developing strategies may be obtained from such sources as ads, family members, product testing magazines, or friends. However, rules for weighting attributes seem to require recall more than recognition, since the rules per se are not usually found explicitly stated in the shopping environment. Thus, recall of evaluative and belief information from memory may be necessary, particularly recall of the rules for combining that information.

Finally, a third out-of-store task is choice of an alternative. As discussed above, the degree to which this occurs out of the store may be an individual difference variable. Choice in the store also occurs, probably more frequently. However, if choice outside the store is carried out, it may involve recall in matching brands against criteria, particularly if the matching is done incrementally as ads or other pieces of information are received. Such an incremental process may require at the very least a recall of the current stage of the process or the operations necessary to reconstruct that stage. In addition, how attribute and evaluative information is stored in memory can be important, since this can affect how alternatives are compared (i.e., whether information is recalled by attribute, across brands; or by brand, across attributes). Finally, external memory can be a factor for choice outside of the store if a display of information such as that in a *Consumer Reports'* table is available. Such displays might ease the need for recall of properties of the alternatives, but recall of factors relevant to weighting attributes might still be necessary.

*Tasks Performed Inside the Store.* One basic feature

that characterizes the in-store environment as a task environment is the external memory it provides. Brands are available for inspection, values for various attributes (e.g., price, nutrition) can be obtained from the package, displays may be available, and so on. Within this environment, two basic tasks are considered: formation of rules or strategies for weighting attributes and choice of an alternative.

As noted above, formation or usage of rules for weighting attributes seems to involve mainly recall, since such rules are not normally directly available in the external memory to be recognized. There can be some recognition component, in that examination of packages may remind the consumer of criteria to be used, but recall seems to be the major memory mechanism involved.

A second major in-store task is the choice of an alternative. Here the level of prior experience may be important. In a simple, habitual response situation, the consumer need only recognize what was bought previously, and may very well recall it. At the other extreme is extensive problem solving (Howard and Sheth 1969; Howard 1977), where weights for attributes are developed and processed in some detail. The discussion that follows is not as relevant for the habitual response case, but rather is more suited to decisions involving some problem solving.

Processing alternatives in the store may involve memory only to the extent of recognition of those brands to be processed further from some larger set of brands. However, some recall is probably involved. The particular product class being processed also will have an influence on use of recall versus recognition, since the completeness of the attribute information on the package varies over product classes. If little information is available from the external memory, recall may be more heavily implicated. Also, if no brands are known previously, then recall of information relevant to rules may be necessary. The type of decision being made, whether a choice between product classes or brands within a product class, may also influence use of recognition versus use of recall. For a choice between product classes, the physical setup of the store (e.g., the product classes are probably physically separated) implies that the external memory cannot be relied upon exclusively. Also, more abstract criteria may need to be developed and applied for choice among product classes than for choice among brands within a product class (Howard 1977). Thus recall may become relatively more important than recognition in choice among product classes. Finally, the context of the original learning about the brand is important, in that recognition or recall may be affected if the context in the store differs from the original learning context.

Thus, the major factors affecting memory involved in in-store tasks are the distinction between recognition and recall, and the effects of differences in context between receipt and attempted retrieval of information. This brief, simplified analysis of typical consumer choice tasks shows the complexity that rapidly arises in attempting to characterize task properties. It also points up the need for a systematic classification or taxonomy of consumer choice tasks, rather than the ad hoc scheme used here.[4] This is an important area for future research. Despite the limitations, several areas of memory research that seem particularly relevant for consumer choice are identified:

- Factors differentially affecting recognition and recall
- Organization of information when received by the consumer
- Effects of a difference in context between the receipt of and attempted retrieval of information
- Form of coding and storage for objects in memory
- Effects of total processing load on the individual
- Memory for rules and operations
- Effects of the modality of information presentation
- Effects of repetition of information

Before turning to a discussion of each of these areas, some perspective on the implications of this research should be given. The problems studied in memory research are often simplistic and narrowly focused, using digits, letters, nonsense syllables, or words as stimuli. As Wright (1974) notes, this research is deficient as far as being directly applicable to consumer research problems in the simplicity of the stimuli and the fact that the responses studied are not evaluative. Reitman (1970) also points out that humans outside the laboratory do not often deliberately rehearse and attempt to memorize items, and that laboratory tasks attempt (with limited success) to decouple the

[4]The concept of a task analysis seems somewhat different from the recent work on situational factors in consumer choice (Belk 1975). Belk (1975, p. 158) defines situational factors to be roughly those factors which are not inherent properties of the individuals or stimuli of interest. Within the context of this definition, task analyses are in some respects more narrow and in some ways more broad than research on situational factors. The task analysis notion is more narrow in the types of situational factors considered, with particular emphasis being placed upon those situational factors which will influence the type of information processing carried out. Thus, the situational factors considered in task analyses are a relatively circumscribed area within the broad range of factors one might consider. In addition, some factors important in performing task analyses may be properties of stimuli (e.g., how many attributes there are for brands in a product class, or the medium through which a particular piece of information is propagated), and hence would not be considered situational factors by Belk's definition. Thus task analyses are more broad in this sense than research on situational impacts alone.

study of memory from the strategies people typically use to remember. These strategies, of course, are of great interest for understanding how consumers make real-life decisions. Thus, the results to be presented below should be taken as *indications* of how various processes operate and should raise issues to be considered in the consumer research context. Actual applications of the results might require new research examining the relevant issues in more realistic consumer choice settings.

## More Detailed Memory Concepts

### Factors Differentially Affecting Recognition and Recall

In the following discussion, the focus is upon differences between recognition and recall. It has been noted above that recognition is in some sense "easier" than recall. Also, the tasks of recognition and recall differ in the basic type of processing that leads to effective performance. To recognize a stimulus from among a set of distracting stimuli, information allowing one to *differentiate* or *discriminate* the previously encountered stimulus is necessary. In recall, however, information allowing one to *reconstruct* the stimulus is required, since the stimulus itself is not present. This distinction between discrimination and reconstruction is implicated again and again in the findings discussed below.

*Frequency of Occurrence of Stimuli.* Words with low frequency of occurrence in normal text seem to be recognized better than words of high frequency, whereas the reverse is true for recall (Kintsch 1970; Shepard 1967; however, see Goldin 1978 for some contradictory evidence for visual stimuli—chess positions). This finding can be explained by noting that low frequency words, being unusual, are easier to discriminate from others; high frequency words, being familiar, are easier to reconstruct.

This could have implications for the types of brands chosen, depending upon whether choice is guided by recognition (e.g., in-store) or recall (e.g., planning outside of the store). A less frequently seen brand, even if attractive, might be chosen less frequently in the out-of-store situation (recall) relative to the in-store situation (recognition), with the reverse true for more frequently seen brands.

*Plans for Learning in Recognition and Recall.* The *plans for learning*, or how subjects go about the task, appear to differ between recognition and recall. Given the difference in the tasks themselves, with discrimination required for recognition and reconstruction for recall, this difference in plans should be expected if humans adapt to the task environment (Newell and Simon 1972). Subjects have been shown to encode information differently and to have different levels of recall and recognition accuracy depending upon whether they expected a recall or recognition task (Eagle and Leiter 1964; Tversky 1973).

Thus, the learning plans of the subject may be a function of expected task requirements, and effective plans may *differ* for recall and recognition. The consumer may encode incoming information with some task in mind. This may imply that in some cases the expectation of using recall or recognition procedures in shopping is set a priori, that consumers make this decision at the time of encoding. Since the learning plans may differ depending upon these task expectations and may influence how effectively information is processed, empirical study of this assumption of prior task expectations is desirable. Of course, an alternative hypothesis to setting expectations about use of recognition or recall a priori would be that the task itself determines whether recall or recognition is used, particularly the degree of difficulty involved. Simple tasks may stimulate more use of recall, and more complex tasks may lead to greater use of recognition.

*Rehearsal and Transfer Times.* Rehearsal may effect recognition and recall differently, although the research results to date are mixed. As noted above, rehearsal can vary from rote repetition to semantic elaboration. Woodward, Bjork, and Jongeward (1973) found that rote repetition rehearsal could improve recognition, but had no effect on recall. However, Chabot, Miller, and Juola (1976) and Nelson (1977) found improvements for recall as well. As noted above, the rough guide for the time required for transfer of a chunk of information to LTM differs for recognition (two to five seconds) and recall (five to 10 seconds). Thus, communications to consumers, particularly in the case of television or radio commercials where the consumer cannot control the rate of information presentation, may have very different effects depending upon whether recognition or recall is attempted.

*Effects of Arousal Level.* A final factor which may differentially affect recognition and recall is the level of arousal at the time the desired information is to be retrieved from memory (Eysenck 1976). This factor can be important for consumer choice in that arousal (defined by Eysenck 1976, p. 389 as "some elevated state of bodily function") may be characteristic of high time pressure or high conflict choice situations. Eysenck hypothesizes that high arousal may lessen the difficulty of retrieving readily accessible information, but increase the difficulty of retrieving less accessible information. Eysenck then argues that a recognition task, by providing the subject with the item, which then

must be judged "old" (recognized) or "new" (not recognized) involves in general more accessible information than a recall task. He summarizes research results which show, as predicted, that under high arousal recognition response speeds are facilitated, but recall response speeds are hindered. These findings could be important for consumer choice, since consumers who tend to use recall may be less able to operate effectively under time pressure or conflict than those who tend to use recognition. Perhaps, on the other hand, consumers choose to rely on either recall or recognition adaptively, choosing recognition more in situations where they feel time pressure, conflict, or some other source of arousal, and recall more for less demanding choice tasks.

### Organization of Information Input

In tasks for which recall is the focus, subjects given instructions to recall as much as possible have been consistently shown to use memory strategies which concentrate on organizing, associating, and grouping together the items to be learned (Bower 1970; Buschke 1976). If groupings are already present in the materials to be learned, then this can greatly facilitate recall (Bower et al. 1969).

However, the effects of organization in the input may only be beneficial if this organization *corresponds* to the rules subjects might normally use to group the data. If the groupings or chunks in the input do not match those usually used by subjects in organizing their own memories, the input groupings may hinder recall performance (Bower and Springston 1970). The implication is that if an advertisement is to present information which is already "chunked" or "grouped" for the consumer, whether that structuring is helpful to the consumer or not will depend upon how consumers group or would tend to group the information.

### Effects of Context

The role of context has been investigated in memory studies. The encoding specificity hypothesis states that no context, even if strongly associated with a particular item or event, can be effective in aiding retrieval for that item or event *unless* the item or event was originally encoded in terms of that context (Thomson and Tulving 1970). Many studies have shown, for both recognition and recall, that changes in context are associated with poorer performance (e.g., Thomson 1972; Thomson and Tulving 1970). Although information may be *available* (in memory), in the wrong context it can be *inaccessible*.

Such effects of the relationship of the context at memory input to that when memory is to be accessed have not been specifically studied in consumer research. However, advertisements present information in a particular context which very often does not match the in-store context. Perhaps information usage, usage of particular attributes as criteria, or even recognition of brands is influenced by the degree to which the context posed in the ad is present in the actual choice situation. Thus, if in-store recognition is desired, the package should be shown in the advertisement. In one case, a cereal (Life) with a very powerful commercial (the "Mikey" commercial) ingeniously put a scene from the commercial on the front of the package.

### Form of Coding and Storage of Objects in Memory

A series of research studies has examined whether encoding and memorization of properties of objects are easier if all the attribute values of one object are presented at one time (object coding or brand coding), or if all the values on a particular attribute for the set of objects under study are presented at one time (dimension coding or attribute coding). Haber (1964) used a brief presentation (1/10 second) of cards portraying stimuli which varied along three dimensions, one of which was emphasized to the subjects as being important. Some subjects were instructed to use object coding, while others were instructed to use dimension coding. Haber found that dimension coders were slower and less accurate in recalling unemphasized dimensions. Lappin (1967) used different stimuli, again with three dimensions, and did not instruct his subjects on coding schemes. Rather, he tested recall by objects and dimensions. He found better recall for the three dimensions of each object than for the same dimension over three objects. Montague and Lappin (1966) found, in a replication of Haber's (1964) results, that object coding was faster than dimension coding. However, they did not find differences in accuracy, contrary to Haber's results. Johnson and Russo (1978) found that subjects tended to store information in the form it was presented to them, whether by object (brand) or by dimension (attribute). However, they did not find differences in time or accuracy depending upon the organization of the input. Thus, there is mixed support for the notion that when inputting data, coding by objects may be more effective for later recall.

### Effects of Processing Load

Studies cited earlier have shown that the effective capacity of STM is a function of the total processing load on the individual. If processing capacity is required for some activity which competes with a memory task, less capacity is available for memory processing. In addition, there may be task effects on memory processing. That is, the information input rate characteristic of a task or the processing rate required in performing that

task may affect memory. Seibel, Christ, and Teichner (1965) assert that the rate of incoming information itself is not the critical factor, but rather the rate of internal processing the task requires in analyzing and transferring the information into memory, in interaction with this presentation rate. This is completely congruent with a capacity allocation theory of memory. In this view, it is not the presentation rate per se that requires capacity, but the task to be performed. Thus, the more processing required by the task in a limited time period, the greater the effects on memory performance. If the tasks of monitoring and processsing the incoming data are not demanding, high input rates may be tolerable.

Since the tasks involved in consumer choice differ greatly across situations, the above considerations may be quite important for consumer choice. If advertisements presenting a great deal of information per unit time are shown to consumers, memory performance may depend upon what is required of consumers in processing the ad. For example, whether recall or recognition is used could be important. Recognition might be less affected by presentation rate than recall, since forming associations and other strategies for recall may require more effort than analyzing a single item for later recognition. Also, if a consumer is processing an ad by looking to see if certain elements are above a threshold (e.g., does this product have at least 25% of the U.S. Recommended Daily Allowance of vitamin C) this may be much easier than attempting to comprehend and learn actual parameters (e.g., 30% of the USRDA for vitamin C).

### Memory for Rules and Operations

In judging alternatives, consumers may combine evaluations on various attributes. The rules for combining evaluations are thus important aspects of the choice process. There are very few studies that examine memory for such rules. Dosher and Russo (1976) and Russo and Wisher (1976) show that in mental arithmetic tasks, memory for sequences of operations and intermediate processing details is better than memory for the actual original numbers comprising the arithmetic task. For example, intermediate subtotals in an addition and subtraction task are recognized, but the original numbers are not.

Johnson (1978), in an initial test of the impact of decision processes on consumer memory, used recall reaction times to study similar issues. His results resembled those noted above: final outcomes and intermediate processing results were recalled faster than the original data on the alternatives used. It is clear that more research is needed before any confident statements about consumer memory for rules and operations can be made.

### Effects of Input Modality

There is a great deal of research on differences in memory as a function of the sensory modality of the input (e.g., visual versus auditory). The findings have shown that for simple stimuli such as series of digits or numerals, there are modality effects on STM, but *not* on LTM. Penney (1975) reviews this research in some detail. The findings show that there consistently has been better short-term recall of auditory input, particularly for the most recently presented items. For lists where auditory and visual presentations are mixed, recall tends to be organized by modality of the input, and auditory recall is better. Recall performance is best when the initial presentation and test are in the same modality. When auditory and visual tasks compete in a mixed situation, the auditory task seems to have priority (Penney 1975). These findings, although based upon a great deal of research, may not be too applicable to consumer choice because of their emphasis on simple stimuli and STM phenomena. However, some ads may use simple digit stimuli (e.g., nutritional ratings) and the findings can serve as a source of hypotheses to be examined in a consumer context. For example, the notion that competing audio and visual portions of an ad will lead to downgraded recall of the visual information could be quite important for understanding the effects of proposals for presenting visual nutritional information in ads with competing audio portions (Bettman 1975). Also, the notion that the modes at presentation and at test should coincide may imply that points should be made visually that relate to in-store aspects of choice.

Although the above findings can serve as a source of hypotheses, they differ drastically from research involving more complex stimuli. Several authors have noted the powerful beneficial effects on memory of forming visual images involving the input stimuli (see Paivio 1971). Lutz and Lutz (1977) demonstrated such effects of visual imagery using advertisements as stimuli. In addition, Shepard (1967) demonstrated humans' remarkable recognition memory for pictures. Shepard used many ads for stimuli and found that subjects recognized, from a series of about 600 pictures, 96.7%, 99.7%, 92%, 87%, and 57.7% at test delays of zero, two hours, three days, seven days, and 120 days respectively. Finally, Rossiter (1976) shows that visual memory of the package may be quite important in children's cereal choices, and may also be important for adults. He found that cereal preferences assessed visually by using a drawing task differed from preferences assessed verbally.[8] Paivio (1975) argues

[8]Rossiter (1975) also found that musical imagery (jingles, songs in ads) was important for children.

that in general there is a dual coding system in memory — an imagery system that deals with nonverbal information, and a verbal system that deals with semantic concepts. Depending upon the task requirements, either or both systems may be utilized (other theorists do not subscribe to this view; see Kieras 1978 for a review and model of imagery effects). The nonverbal imagery system needs more research to determine its impact on consumer choice processes, as most research has concentrated on the verbal concept system (see Lutz and Lutz 1978).

### Effects of Repetition

One of the oldest notions in the memory literature is that repeated exposure to a stimulus enhances future recall or recognition of that stimulus. Most of the work on the effects of repetition has involved a passive view of human learning, with repetition serving to "stamp in" an item, to increase the strength of that item's memory trace. This research will be briefly reviewed and then the implications of viewing man as a more "active" learner are discussed.

Sawyer (1974) presents a good summary of the effects of repetition as related to marketing phenomena. The basic findings are that recall and recognition increase as a function of presentation frequency and that there are decreasing increments in memory performance as repetition increases (i.e., later exposures appear to add less and less to performance). Even rote repetition without more elaborative processing may improve recognition or recall (Chabot, Miller, and Juola 1976; Nelson 1977). Finally, for single series of stimuli, it has been shown that recall performance is better when a given number of repetitions is spaced or distributed rather than massed (Postman 1975, pp. 316-18). Zielske (1959), in a classic study in marketing, showed that for final level of recall, distributed presentation was better than massed presentation, but noted that the amount of final retention may not be the relevant criterion for the marketer. If maximum temporary response is desired, massed presentation may be better; if maximum average exposure is desired, distributed presentation was better.

This view of repetition ignores the notion of man as an active processor governed by plans and goals. In several studies cited above, it was noted that memory performance may depend upon the learning plans formed by the consumer. Krugman (1972) points this out, and rejects the notion that the effects of learning must be through "practice" alone. He asserts that the presence of interest or involvement is important, i.e., that the consumer has some plan or need for using the information in the ad. He then claims that three repetitions are enough: the first evokes a "What is It?" response, with a preliminary decision about whether the ad is of any use or interest; the second generates more detailed evaluative responses and planning for future actions if the preliminary decision was favorable; and the third becomes the reminder to carry out any plan formed in the second. Most people may screen out ads at the first exposure; however, if later an interest in the product category or brand is present, the person may see an ad for the 23rd time, but process it as if it were their *second* exposure (Krugman 1972, p. 13). Thus, for group data, different levels of interest in a product over time could lead to gradually increasing curves of response to repetition (because with increased repetition, the odds that someone who is interested would have had the first "What is It?" exposure increase), even though for the individual the response was in some sense more rapid. Goldberg and Gorn (1974) offer evidence consistent with Krugman's general notion, in that exposure to one commercial affects children's attitudes toward a toy and their persistence at a task to obtain the toy. However, an increase to three exposures did not change either attitude or persistence beyond the initial effect of the first exposure.

While the specific mechanisms and numbers of exposures proposed by Krugman may be debated, there may be a strong component of active planning and assessment in human learning. If an ad is seen as useful based upon interests, future choice tasks expected, or other factors, then consumers may use the information in the ad to generate partial plans for choice (e.g., "check this brand," "look at this new attribute in my decision," and so forth).[6] The important question then becomes whether sheer repetition has an effect on this process of forming plans, or functions solely to make sure information is available at the relevant time, when needed.

At this point, the evidence seems to be that both processes operate. As Krugman (1965) himself notes, low and high involvement learning may be governed by different processes. For low involvement learning, sheer repetition may have effects, particularly if recognition rather than recall is involved (Woodward, Bjork, and Jongeward 1973; Chabot, Miller, and Juola 1976; Nelson 1977; Postman 1975, p. 303). For learning under higher involvement, more elaborate and focused processing may ensue. (For some recent research on the kinds of processing which occur for different levels of involvement, see Gardner, Mitchell, and Russo 1978.)

[6]Of course, even when the consumer is trying actively to learn the information contained in an ad, if there is a great deal of information a number of repetitions may be necessary before the consumer can learn that information. Thus, the number of repetitions necessary for the consumer to carry out plans for learning may vary as a function of the information load in the ad.

## Implications for Marketing

The following discussion emphasizes some selected implications of memory principles for promotional decisions. (For further implications, see Bettman 1979, Chapters 10 and 11, particularly for discussion of the effects of the organization of information by brand or by attribute.) In the presentation below, factors influencing *where* and *how* to present information are emphasized.

It is necessary, before discussing these questions, to briefly consider the type of processing characterizing certain consumer decisions, since where and how to present information can depend upon the type of processing used. It has been hypothesized (Bettman 1979) that where consumers have little prior knowledge or experience or where the decision is difficult for some other reason, they will tend to process information in the store and use recognition rather than recall. Consumers with a good deal of experience or for whom the choice is easy will tend to process outside of the store environment and use recall. The basic reasoning behind these hypotheses is that consumers will only be *able* to recall information and make choices outside of the store where the choice is easy and familiar. For difficult choices, attempting to use recall or process outside of the store may be too hard. It should be noted that these hypotheses are speculative and greatly in need of empirical research. However, they seem plausible and are utilized in the following discussion.

### Where Information Should be Provided

Presentation of information in the store (on the package or through various forms of point-of-purchase displays) and presentation of information out of the store (television, radio, print, billboards) may in general have very different properties. In particular, the types of memory processing necessary for consumers to use the information may differ.

*Provision of Information in the Store.* One of the most salient features of providing information in the store is that the information on packages or other displays can serve as an external memory for the consumer allowing him/her to simply recognize rather than recall various pieces of information. A second characteristic of in-store information provision is that there may be more time available for processing the information, unlike radio or television advertising where there is limited processing time. Finally, it may be easier for consumers to make detailed comparisons among brands if information is provided on packages in the store than to compare brands using memory for the information presented in television advertising, for example.

Given these characteristics, under what conditions might the marketer wish to present information in the store? As noted above, consumers may tend to process in the store for decisions where they have little previous experience or knowledge or where the decision is difficult. Thus, a marketer of a product class characterized by low levels of consumer experience or by difficulty in choice might concentrate to a greater extent on in-store, point-of-purchase information displays or on greater amounts of package information. Even if consumers do have experience, the marketer may wish to encourage comparison of the product with others in the store, if it is a new brand or is believed to have some differential advantage, for example. Comparing package information is easier than making internal memory comparisons. Thus if the marketer feels consumers are processing in the store or wishes to encourage such processing, in-store information provision is needed.

*Provision of Information Outside the Store.* Presenting information outside the store may require the consumer to rely on his or her own memory to a greater extent. Although print ads can provide an external memory device (by clipping the ad), television, radio, and billboards do not provide an easy external memory aid.

The conditions under which marketers might wish to concentrate on presenting information outside of the store would tend to be the opposite of those for in-store presentation. In general, consumers may process outside the store for product classes where the choice is easy and they have a good deal of experience. Thus a marketer with a brand in a product class where consumers have a good deal of experience might concentrate more on out-of-store and less on in-store activity, since consumers will tend to decide outside of the store. Note that these prescriptions refer to the emphasis which might be appropriate for the marketer. It is not suggested that either the in-store or out-of-store method be used exclusively. Consumers will vary in their degree of prior experience, and the in- and out-of-store methods have different properties, so some combination of approaches will, in most cases, be the best strategy.

### How Information Should be Provided

In the following, two aspects of how to provide information are presented: facilitating use of recognition or recall, and how memory research can help in presenting information to special groups of consumers.

*Facilitating Use of Recognition or Recall.* Since consumers may attempt to use recognition more often in the store, the external memory provided by packages and in-store displays is a crucial consideration. Use of recognition presupposes some earlier presentation of

information, with later recognition of that information. Therefore, in general there may be some out-of-store presentation, with recognition cued by the package or display in the store. This implies that the information on the package or display should be the same or nearly the same as that presented in the out-of-store advertising. One typical method for ensuring this match is to show the package in the advertisement (if visual information can be presented, as for television and billboards). This need not be the only method, however. In the Life cereal case noted above, a scene from an ad was placed on the front of the cereal package, thus bringing the context of the commercial into the store. For radio commercials, either descriptions of the package ("Look for the red and yellow box") or slogans which would be repeated on the package might be used. Finally, if the marketer wishes to have particular claims recognized, they should be presented in the store on the package or in a display, as well as in the advertisement. Although the information on the package may trigger recall of associated information from memory, there is no guarantee that any particular claim will be recalled in this fashion.

For the consumer to use recall, the information presented should be relatively simple and congruent with what consumers know. Recall will tend to be used for familiar choice situations, so the consumer will attempt to fit the new information into an existing set of beliefs about the product class. As noted above, different modes of information presentation can affect the ease of recall of that information. For example, use of visual imagery is often a good way to enhance recall. Lutz and Lutz (1977) show that recall of brand names is higher for advertisements using certain types of visual imagery.

Whether consumers use recall or recognition, the ease with which the information presented can be processed will affect later usage. A general principle is that the amount of information which can be assimilated is a function of the time available for processing. For example, if recall is used, then the research on transfer speeds from short- to long-term memory (cited above) implies that roughly five to 10 seconds of time is required to memorize one chunk of information for later recall. Thus, the feasibility of processing the information and recalling it depends upon the amount of information presented relative to the time available for processing, and the ability of the consumer to organize the information into chunks. For example, if there are 15 seconds available for processing the information and capacity is fully allocated to that processing, perhaps two or three chunks could be recalled at a later time. For recognition, the transfer speeds are on the order of two to five seconds per chunk, so perhaps as many as eight chunks of information could be recognized later after a 15 second presentation.

Thus, the amount of information which may be acquired during the limited time available in a television commercial depends upon the ability of the consumer to chunk the information provided. The degree of chunking possible may depend largely upon the organization of the information in the ad and the degree of the consumer's prior knowledge and interest in it. If information is prechunked for the consumer by the way the ad is designed *and* if these chunks are consistent with the way the consumer categorizes, then "larger" chunks and hence more information could be processed per unit time. Also, if the individual has prior knowledge related to the information presented, so it can be integrated meaningfully with the existing knowledge, then more information in the ad can perhaps be chunked and processed per unit time. Therefore, there is a great effect on memory of the size of the "vocabulary" of chunks in memory. The greater the number of such chunks, the faster information can be processed.

The time available for processing can thus have important effects. For media where the time available for processing is limited (television or radio), the amount of information which can be presented may also be limited. For cases where the marketer wishes to present large amounts of information, or where the information is complex, either media which do not limit the time available for processing should be used (print, in-store), or the time given for processing should be expanded to meet processing needs.

*Presenting Information to Special Groups of Consumers.* In some cases, marketers may wish to present information to special groups of consumers such as children or the elderly. Such groups may be characterized by different memory properties which must be understood in order to present information effectively.

For example, research on the information processing characteristics of the elderly has tended to focus on memory abilities. Several studies have compared the abilities of groups of differing ages on various memory tasks, and have found that the groups of older subjects (generally over 60) performed less well than the younger subjects (generally in their 20s). These memory findings may have implications for the choice processing of the elderly. First, the elderly appear to have difficulties in making shifts in search (Welford 1962, p. 337) and difficulties in recall (Craik 1971). This may imply that attempting to make choices between product classes by recall would be more difficult for them. Second, tasks requiring rapid processing (e.g., viewing of television commercials which present a great deal of information) may be harder for older subjects due to their slower memory and visual search speeds (Anders

and Fozard 1973; Chiang and Atkinson 1976). Finally, tasks where distraction is likely to be present (e.g., viewing television commercials) would probably be difficult (Broadbent and Heron 1962). These findings may suggest greater use of in-store displays or print ads in communicating to elderly consumers, since these methods do not limit processing time and may facilitate use of recognition memory rather than use of recall (see Phillips and Sternthal 1977, for similar arguments).

## Directions for Future Research

It is obvious from the above that there is an enormous amount we do not know about consumer memory. However, certain areas seem to be of higher research priority. Basic information on what consumers have in memory and how it is organized is a high priority. As noted above, clarifying the "networks" of concepts and interrelations among them can have many implications for understanding consumer reactions to products. In addition, determining the "vocabulary" of chunks and schemas consumers use would be extremely helpful in addressing other issues, such as how rapidly consumers can process the information contained in ads and how the information in ads can best be organized for consumers. Current research on memory schemas (Markus 1977; Clary, Tesser, and Downing 1978; Kintsch 1978; Wyer and Srull 1979) may be helpful in attacking these issues.

A second major priority is analysis of the properties of various consumer choice tasks, particularly those affecting memory processing. Such factors as the extent of external memory available, time pressure, the organization of available information, and so on might be very relevant. As stated earlier, however, one major factor whose effect should be studied is whether the consumer is trying deliberately to memorize or is remembering items incidentally. Much of the research surveyed studied deliberate memorization. Future research should include studies carried out in consumer settings without explicit instructions to memorize to ascertain whether the conclusions of this prior research still hold.

Finally, research on when consumers use recognition or recall seems very important, since the properties of recognition and recall and the implications for how to present information differ. Thus, knowledge of consumer memory is important for both theoretical and pragmatic reasons. There are many issues to be investigated and work in these areas should be strongly encouraged.

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