Typicality and Familiarity Effects in Children's Memory: the Interaction of Processing and the Knowledge Base.

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TYPICALITY AND FAMILIARITY EFFECTS IN CHILDREN'S MEMORY: THE INTERACTION OF PROCESSING AND THE KNOWLEDGE BASE

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TYPICALITY AND FAMILIARITY EFFECTS IN CHILDREN'S MEMORY: THE INTERACTION OF PROCESSING AND THE KNOWLEDGE BASE

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in

The Department of Psychology

by

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B.A., Louisiana State University, 1976
M.A., Louisiana State University, 1980
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Abstract

Third- and sixth-graders and adults participated in an experiment based upon Hunt and Einstein's (1981) theory which relates study activities or processing task to subsequent memory performance. Participants performed a processing task designed to emphasize either relational or item-specific information. In addition, the information about the words available in each subject's knowledge base was measured in two ways: relational information was assessed with a typicality rating task and item-specific information was assessed with an attribute listing task. The experiment consisted of three phases. In the first phase subjects performed one of two processing tasks on a list containing typical, atypical and unfamiliar exemplers of a semantic category. One group of subjects sorted the words into categories (the relational task) the other group rated the words for pleasantness (the item-specific task). In the second phase, subjects' memory for the words was tested on a free recall test. In the third phase the knowledge base assessment tasks were performed. The knowledge base measures indicated: the relative amount of relational versus item-specific information available for typical, atypical and unfamiliar words is different for each type of word and
that amount of relational and item-specific information in the knowledge base changes with age. As predicted by the theory, recall was influenced by the interaction of word type with processing task. Finally, parallels between free recall results and the knowledge base measures indicated that knowledge base development interacts with the processing task to influence what is recalled at the three age levels tested.
Purpose and Overview

In a recent series of studies, Hunt and Einstein proposed a theory in which memory is influenced by the type of encoding activity (study method) a subject performs and the manner in which that activity complements information in his/her knowledge base (see Einstein and Hunt, 1980; Hunt and Einstein, 1981; Einstein, McDaniel, Bowers and Stevens, 1984; Hunt and Seta, in press). Depending upon to-be-remembered (TBR) list structure and how that structure is mapped on to the knowledge base, a particular encoding activity can either facilitate, have no effect on, or hinder rememberance. According to the theory, different processing activities focus attention on either the relational or individual-item aspects of list items during encoding.

Relational processing is "interrelating an item with another in memory" (Ritchey, 1980) or encoding the "similarities among a class of events" (Einstein and Hunt, 1980). Individual-item processing is attending "to the features that are unique to each separate event" (Einstein and Hunt, 1980). The information encoded into the memory trace as a result of these two types of processing serve different functions during retrieval (recall or recognition). Hunt and Einstein contend that
relational information is highly useful in generating a retrieval scheme. In a recognition task, however, a retrieval scheme is less important (see Woodward, Bjork and Jongeward, 1973; Craik and Jacoby, 1979) and a premium is placed upon discriminating list items from lures (non-list items); therefore, individual-item information becomes more valuable in a recognition test.

Utilizing constructs such as processing type, structure of the knowledge base, typicality of exemplars, etc., Hunt and Einstein have successfully predicted differences in recall and recognition performance. They have also demonstrated that effects of encoding tasks depend on aspects of one's knowledge base such as familiarity of items or typicality of instances of a category. The present study extends their previous work on interactions between encoding and typicality. Here, the Hunt and Einstein research paradigm is applied to three types of exemplars (typical, atypical and unfamiliar instances of common semantic categories).

The present study also investigates areas of the theory that previously have been ignored. In much of the cognitive literature, it is assumed that adults have a similar, well-developed semantic store (dictionary of word meanings and their relationships) as a part of
their knowledge base. Hunt and Einstein stated that certain processing type by list type interactions occurred because of the way in which the "average" adult store was organized. Moreover, Hunt and Einstein proposed that the utility of each type of processing was dependent on semantic information in the knowledge base.

Hunt and Einstein's theory has successfully formalized relationships between processing types and the knowledge base for adults. The present study will examine the ability of the theory to predict children's memory as well. When applying the theory to children the assumption of a well-developed semantic store cannot be made. It has frequently been demonstrated that the associative strength between items varies with age and that children tend to give syntagmatic rather than paradigmatic associations (Bousfield, Esterson and Whitmarsh, 1958; Ervin, 1961; Entwisle, Forsyth and Muuss, 1964; Rosch, 1976). Thus, the structure of a child's semantic memory, in particular the child's knowledge words and the meaning of words, appears different from an adult's. If as Hunt and Einstein claim, certain aspects of information processing are structurally based, then the relative lack of such structure in children could have great explanatory value for a wide variety of observed age differences in recall.
and recognition (see Mandler, 1979, Chi and Koeske, 1983).

Hunt and Einstein propose that an adult's highly articulated knowledge base increases the "automaticity" of processing, while a more rudimentary knowledge base places limits on children's spontaneous encoding (see also Brown, 1975; Mandler, 1979). Previous research has implicated such structural differences in a number of mnemonic effects in adults and children (Chase and Simon, 1973; Chi, 1978; Lange, 1978; Lindberg, 1980; Chi and Koeske, 1983). The developmental literature, however, has generally minimized the influence of the knowledge base on rememberance, since it is difficult to separate such influences from processing effects. The present study provides a paradigm to separate the influence of knowledge base structure from processing task on memory.

Statement of the Problem

The theoretical issues under study can be presented as the following problems:

Problem I: Can Hunt and Einstein's theory be applied to predict interactions between the type of exemplar (typical, atypical and unfamiliar) and the processing task in recall?
Problem II: Will similar interactions between processing task and materials occur in children and adults?

Problem III: Can knowledge base development account for differences in the adult versus children’s recall performance?

The review of the literature will be divided into three sections. The first section will present a historical background of pertinent issues in the adult literature and a detailed description of Hunt and Einstein’s theory and research on individual-item and relational processing. The second section will review the literature concerning the development of memory and the semantic knowledge base. The final section of the review will integrate the concepts presented and introduce the current study.

Relational and Item Processing

Early Research On Organizational and Relational Processes. George A. Miller (1956) provided an early statement of the power of organization in human memory with his "unitization hypothesis". Organization can be defined as a: "process by which information to be placed in memory is grouped or rearranged in a new or more optimal manner" (Ellis and Hunt, 1983, p. 248). Thus, the organizational approach emphasizes: "encoding
relational information, information common to the input elements or events..." (Hunt and Einstein, 1981, p. 497). Since Miller proposed the unitization hypothesis, numerous studies have explored organizational factors in a wide variety of memory tasks (e.g., Tulving, 1962; Bower, 1970, 1972; Roediger, 1973; Palmer, 1975; Buschke, 1977; Pellegrino and Ingram, 1979; Reddy and Bellezza, 1983). Organizational principles have been apparent in every major model of semantic memory (e.g., Mandler, 1968; Quillian, 1968; Anderson and Bower, 1972; Smith, Shoben and Rips, 1974; Collins and Loftus, 1975) and organization will, no doubt, continue to be of high explanatory value in future theories as well.

In the field of verbal learning, George Mandler has been organization's most vigorous proponent (Mandler, 1967, 1969, 1972, 1974, 1980). In his initial statements, Mandler (1967, 1969), viewed organization and memory as "nearly synonomous". He stated that only TBR materials that are organized could be retrieved. Other researchers expressed reservations about this "strong view" of organization (see Postman, 1972). Postman wrote that other processes, in addition to organizing information contributed to the retrievability
of a memory trace. These other processes were essentially ignored in early organizational theories.

Another and currently more accepted, explanation for the efficacy of organizational processes is embedded in Tulving and Thompson’s (1973) principle of encoding specificity. The encoding specificity hypothesis states that retrieval cues will function effectively if and only if they have been stored or related to that particular memory trace at input (see Tulving, 1984). Tulving, his coworkers and others have demonstrated that the encoding specificity principle holds for a wide variety of processing tasks and retrieval situations (see Tulving, 1972, 1979; Tulving and Thompson, 1973; Jacoby, 1974; Bellezza, Cheesman and Reddy, 1977; Fisher and Craik, 1977; Mathews, 1977; Flexser and Tulving, 1978; Stein, Morris and Bransford, 1978; Reddy and Bellezza, 1983). Thus, attending to shared features of the items in the process of organizing them ensures that these common attributes will serve as powerful retrieval cues for these items in later recall.

Just as the literature on organizational processing makes clear that organizational processing does indeed affect the encoding of words, it also makes clear that a good deal of information about words not directly related to the processing task also gets encoded. For
example, in the Tulving and Psotka (1973) study, data indicated that categorical retrieval cues (relational information) for TBR items could be encoded implicitly, without actively focusing on this information during processing (see also Dong, 1972). Mathews (1977) comments on a similar effect in his article (p. 173). These studies provide support for what was referred to as "automatic" processing effects by later authors (e.g., Lange, 1978; Craik and Jacoby, 1979; Mandler, 1979). The thesis that relational information can be encoded "automatically" is basic to Hunt and Einstein's paradigm, and a central argument of this paper.

In the next subsection, we will focus attention on the levels of processing literature and its contributions to understanding item-specific processing.

Early Research On Levels of Processing: Item Processing. While organizational theorists favor relational processing methods, the levels of processing approach to memory utilizes processing tasks that emphasize encoding of properties specific to a particular TBR word. Thus, in contrast to the emphasis of organizational theory, levels of processing theory emphasizes encoding unique information about individual items.
Craik & Lockhart formalized the levels approach to rememberance in a series of studies (Craik & Lockhart, 1972; Craik & Watkins, 1973; Lockhart, Craik & Jacoby, 1976). They concluded that deeper levels of analysis (those which activated semantic information about the words) culminated in a stronger trace than other levels of analysis which were more superficial (i.e., attending to the nonsemantic aspects of the words during encoding).

A large body of subsequent research explored the effects that semantic processing tasks (e.g., rating a word's pleasantness) and/or nonsemantic tasks (e.g., searching the word for a particular letter) have on free recall, cued recall and recognition (see Till and Jenkins, 1973; Walsh and Jenkins, 1973; Jenkins, 1974; McDaniel and Masson, 1977, 1978; Batig, 1979; Hunt, Elliot and Spence, 1979; Owens and Baumeister, 1979). Generally these studies show that semantic processing tasks result in better memory performance than nonsemantic tasks.

Later models, which developed from the levels of processing approach, emphasized the encoding of elaborative information; particularly information which makes TBR items distinct from each other. Craik and Tulving (1975) hypothesized that semantic orienting
activities elaborate the basic meaning of an item more often than nonsemantic ones and that this is the basis of the advantage semantic processing has over nonsemantic processing (see also Anderson and Reder, 1979). Their experiments and subsequent work supported the elaborative explanation of processing effects in a variety of situations (see also Moscovitch and Craik, 1976; Craik and Jacoby, 1979).

Elaboration facilitates retrieval in two ways. First, it relates a to-be-remembered event to information that is already known about that event (Ellis and Hunt, 1983), providing the event with retrieval cues (the encoding specificity explanation). Secondly, elaborative processing "helps one realize the unique significance or nonarbitrary nature of target items..." (Bransford, 1979, p. 80). Thus, an item is linked with distinct information during processing, making it easy to distinguish the item from non-target words (the distinctiveness explanation). For a more in-depth discussion of the distinctiveness explanation, see Eysenck, (1979), Jacoby and Craik, (1979), Hunt and Elliot, (1980) and Winograd, (1981). A brief summary of the material presented so far follows.

Summary. Earlier work in memory has demonstrated that attending to two types of information, during study
helps a learner remember the material. One type, relational information is information that the TBR word shares or has in common with other items in the list. The second type of information, individual-item information, is information unique or distinct to a particular TBR word. These two types of information are thought to serve different functions in memory. Relational information serves a more "generative" function, cueing retrieval, while item-specific information helps to discriminate a TBR instance from other items (distractors).

Given that item and relational information fulfill different functions in memory, one would expect the two types of encoding to differentially affect memory performance under different retrieval conditions. Such interactions between encoding and retrieval are the focus of the next subsection of the review.

The Interaction of Processing Activity and Retrieval. One commonly found interaction between processing task and retrieval condition concerns two types of memory tests, recall and recognition. Free recall tests present a subject with TBR items during a study phase in the experiment. The subject then must produce the learned material without any experimenter-provided cues during the subsequent free
recall phase of the procedure. Recognition, on the other hand, involves showing the subject the items during the study phase and then asking if items presented during the recognition phase are "old" (i.e., were there during the study phase) or "new" (i.e., were not there during the study phase). Typically an interaction occurs in that organizational processing facilitates free recall more than it does recognition; conversely, item-specific processing aids recognition more than it does recall (e.g., Morris, Bransford and Franks, 1977; Begg, 1978).

The explanation for this interaction is that a retrieval scheme is vital to free recall performance but it is less important in recognition (Tulving, 1964; Woodward, Bjork, and Jongeward, 1973; Craik and Jacoby, 1979; Mandler, 1979). A retrieval scheme is a particular plan for searching memory and locating the TBR information. In contrast to recall, the items are present on a recognition test. Since relational information provides the basis of a retrieval scheme, it is less important in recognition. On the other hand, recognition performance is more dependent on discriminative (item-specific) information.

Another example of a processing-by-retrieval interaction is present in Arbuckle and Katz's (1976)
experiments. The experiments explored Craik and Lockhart's (1972) conclusion that semantic processing is superior to nonsemantic processing. Arbuckle and Katz cite instances where cued recognition following nonsemantic processing was as high as cued recognition following semantic tasks. They found that the effectiveness of a semantic versus a nonsemantic orienting task depended (in part) upon the type of cue (semantic or nonsemantic) that was presented at retrieval. The results agree with the principle of encoding specificity, and demonstrate the value of retrieval cues.

The Effects of One's Knowledge Base on Rememberance. Tulving and his coworkers have thoroughly researched processing by retrieval measure interactions. He has also commented on the role that semantic memory plays in processing information for later retrieval (Tulving, 1979). Semantic memory often influences the effectiveness of elaborative processing.

The effect of the semantic lexicon is evident in the "congruity effects" Craik and Tulving (1975) reported while studying elaboration. They found that the implicit retrieval cues generated by processing semantically congruent phrases such as "gold is a mineral" promote higher levels of subsequent cued recall
than those derived from processing semantically incongruent phrases such as "gold is not an animal". Gold and mineral have many key semantic elements in common in a person's semantic knowledge base and the encoded relationship makes sense. Meaningful commonalities between the other pair (gold and animal) are relatively scarce. Congruity effects convincingly demonstrate that the factual knowledge a person has (i.e., semantic memory) influences both processing and retrieval.

Other studies of elaboration offer additional insight into how the knowledge base influences what is remembered. Bransford and Stein suggested that otherwise semantically congruous elaborations can hinder retention if elaboration does not add distinct information to the trace (see Stein, Morris and Bransford, 1978; Bransford, Stein, Vye, Franks, Auble, Mezynski, Perfretto, 1982). McDaniel, Friedman, and Borne (1978) and Chiesi, Spilech and Voss, (1979) arrived at a similar explanation for their results. In addition, Stein (1978) has also suggested that when the information being elaborated is unfamiliar to the rememberer it will be of limited value.

At this point, a comment must be made about "automatic" encodings. A good deal of information
enters the memory trace during processing. Automatic encodings can be defined as that information entering the memory trace which differs from the focus of the learner's mental activity during processing (see Nelson, Reed and McEvoy, 1977). In essence even though a processing task concentrates on one type of information (e.g., is the word spelled correctly) the learner may also automatically process other information which is not related to the processing task (e.g., that the word is printed in blue ink). An adult's knowledge base is a rich source of automatic encodings.

Craik and Jacoby's (1979) research provides a good illustration of automatic encoding. Their research is particularly relevant to the current investigation. During their studies, information was actively encoded by the processing activity and also encoded automatically based upon pre-existing associations between a cue and its TBR target. When the effects of active and automatic encoding were compared, the automatic encoding of a cue/target relationship had a greater effect on recall than did the processing task (see experiment 1). For other evidence of the effects of automatic encoding see Coltheart (1977), Stein (1978), Hunt, Elliot and Spence (1979), Hunt and Elliot (1980) and Mathews, Lee and Rosenthal (1984).
Hunt, Elliot and Spence (1979) examined the effects of process and structure. They concluded that "the memory trace may contain more than just those features congruent with the orienting task and, consequently, that encoding must be conceptualized in terms of both process and structure" (p. 339). They linked structural effects to automatic encoding, and linked automatic encoding to the organization of semantic memory (p. 290).

**Summary.** Research has indicated that the type of information encoded will have markedly different effects depending upon whether a recall or a recognition instrument tests memory. The difference seems to depend on the relative importance of the retrieval scheme (relational information) versus the discrimination phase (item-specific information) of retrieval in a particular testing situation (e.g., recall and recognition). In addition to the relational/individual-item processing by memory test (recall versus recognition) interaction, congruity effects were also discussed. Processing semantically congruent relationships led to better rememberance than processing incongruent ones. These studies, and experiments where automatic encoding occurred, provide strong evidence that the structure of
the knowledge base plays a vital role in determining what is remembered.

Hunt and Einstein (1981) integrated the concepts of semantic structure, item-specific and relational information and the notion of encoding/retrieval interactions into their theory. These themes recur throughout their experiments. A description of their theoretical rationale, theory and experiments follows.

Hunt and Einstein's Theory and Research

The Need To Examine Interactions. Hunt and Einstein advocate a more molecular view of human memory than is currently popular. Their theory acknowledges the probability that interactions occur between processing, list structure (preexisting knowledge in the semantic lexicon) and the retrieval test used during rememberance. These interactions often receive only minimal attention in other paradigms. Interactions may be so pervasive, however, that they are the rule rather than the exception (see Jenkins, 1984).

Several aspects of Hunt and Einstein's theory must be clarified before proceeding. First, their definitions of relational and individual-item processing should be restated. Relational processing is processing the "similarities among a class of events," while individual item-processing attends to the "features that
are unique to each separate event" (Einstein and Hunt, 1980).

Secondly, Hunt and Einstein propose that particular processing activities focus on either a word's item-specific or relational features, but the difference is one of degree. Relational and individual-item processing will overlap on some features. Further, automatic encoding processes operate in memory and these processes supplement the information introduced to the trace via the processing task. For example, the processing task of using a Likert scale to rate items for how pleasant they are is presumed to emphasize item-specific information. However, if a categorized list is being rated, relational information may be encoded automatically as well (see Hunt and Einstein, 1981). Thus, the information going into a trace always contains a mixture of individual-item and relational information, derived from task-focused and automatic encoding.

Third, Hunt and Einstein assign different functions to relational and item-specific information in remembering. Specifically, they view relational (interitem) information as more important to the "generative" aspects of retrieval and item-specific information as being more vital to retrieval's
"discriminative" aspects. However, neither type of information is viewed as sufficient in and of itself for rememberance; some degree of both must be encoded.

Finally, according to Hunt and Einstein, the informational content of automatic encodings are determined by the structure of the TBR stimuli and their relation to information in semantic memory (the knowledge base). Related lists will automatically activate more relational information than unrelated lists; and unrelated lists will automatically activate more item-specific encodings than related lists.

Since both relational and individual-item information are necessary for rememberance, the nature of the processing task can interact with a particular type of list. Given that a memory trace is determined both by the processing task and the structure of the list (e.g., relatedness or unrelatedness of the list), a processing task that introduces information into a trace which complements the automatic encoding (i.e., which introduces individual-item information to a related list, or relational information to an unrelated list) should produce higher levels of recall than a task which emphasizes the same type of information which is encoded automatically. Thus, memory will be highest when the
processing task complements the automatic encoding elicited by the stimulus list.

The main findings from Einstein and Hunt's (1980) research which support their theory are the following:

Einstein and Hunt predicted that processing would interact with list structure to determine retrieval outcomes. Complementary processing (i.e., processing which focused on information not automatically encoded due to the list's structure) did produce the highest levels of recall in each case during their experiments. For additional support of the complementarity hypothesis see Epstein, Phillips and Johnson, 1975 and Begg, 1978.

Einstein and Hunt (1980) verified that relational and item-specific information are both important in remembering related TBR materials. Their findings stand in contrast to an earlier study in which Bellezza, Cheesman and Reddy, (1977) concluded that individual-item information was of limited value. The Bellezza et al. study used an unrelated list of words whereas Einstein and Hunt used a related list. Einstein and Hunt found that semantically processing both the relational and the item-specific aspects of each word produced higher levels of free recall and recognition than any single processing task.
Einstein and Hunt’s results indicated that item-specific and relational processing differed in their effect on recognition. Item-specific tasks (e.g., rating the pleasantness of a word or rating the ease with which a rhyme can be found for it) reduced the number of false positives (words falsely remembered as old) that occurred on a recognition test. On the other hand, relational processing (e.g., organizing words on the basis of their meaning, or their first letters) did not facilitate recognition performance. Further, the categorization task (when performed on a related list) resulted in the highest levels of false positives in that study; apparently, semantically processing the relational features of categorically related items hinders their subsequent discrimination from non-list items on a recognition test.

Hunt and Einstein’s research also provides evidence that relational and item specific processing affect clustering. Clustering is a measure of the amount of organization present in recall based on the order in which items are recalled (Bousfield, 1953; Tulving, 1962). If organization (relational processing) was the only factor in free recall, then the number of words recalled should have been highly correlated with the organization (clustering) present in recall. The
correlation between clustering and recall, however, was not significant. Frase and Kamman (1974), reported a similar divergence of recall and clustering in their study. The effect is quite common. Clustering data for these experiments also provide evidence for automatic encoding processes. Clustering scores indicated that a significant amount of relational information was being encoded during the item-specific (pleasantness-rating) task.

In addition, Einstein and Hunt (1980), Hunt and Einstein (1981) reported the results of several experiments in which both a related and an unrelated list were processed. The unrelated list did have an underlying categorical structure, but it was much less salient. Each subject performed either a relational or an item specific task on one of the lists. Categorical labels were provided for the relational tasks. The results of these experiments supported the complementarity hypothesis. There was no "best" type of processing for both of the lists (no main effect for processing occurred). There was, however, a highly significant interaction between processing and list type. Recall of the related list after individual-item processing was reliably superior to recall following relational processing of these items. For the unrelated
materials, relational processing was significantly more effective in producing high free recall scores.

**Typicality effects.** In two experiments, Hunt and Einstein (1981) examined the effects that relational and individual-item processing have on typical and atypical members of the same semantic categories. These experiments will be discussed in detail because typicality effects are the focus of the present study. While there are different theoretical explanations for typicality effects (e.g., Collins and Loftus, 1975; Smith, Shoben and Rips, 1974), Hunt and Einstein selected Glass and Meany's (1978) "mixed model" as their theoretical model.

Glass and Meany (1978) hypothesized that highly typical instances of a category (e.g., *robin* from the category *bird*): "are closely associated to a semantic description similar to the category's description" (p. 622). They state that items can be rated as atypical for two reasons:

One type of low-typicality instance (e.g., *penguin*) is closely associated to a description that is not similar to the category's description.... i.e., penguins do not fly, most other birds do. The other kind of low-typicality instance (e.g., *grackle*) is remotely associated
to a description that identifies the category of which it is a member, but contains little or no additional information. (p. 622)

Glass and Meany label the former an "atypical instance" of a semantic category, the latter as an "unfamiliar instance" of a semantic category.

Glass and Meany contend that typicality effects occur because of differences in the "feature bundles" (Tulving and Watkins, 1975) that represent a word in semantic memory. These bundles have greater or lesser amounts of relational information (linking them to a category and other items in it) and greater and lesser amounts of individual-item information about the word itself. It follows that relational and individual-item processing can interact with the typicality of TBR stimuli and that processing type would cause variations in the number of typical and atypical list members recalled.

Hunt and Einstein contend that the level of relational information encoded into a trace influences whether or not it becomes part of the retrieval plan; and that sufficient amounts of such information must be included in a trace for the item to be recalled. Typical category exemplars have a high level of relational information linking them to the semantic
category and other members of it. Unfamiliar items are known to be members of the category, but little else is known about them. In contrast, atypical instances are familiar (i.e., the person has a good deal of information about them), but they share few features with other members of that category. They are not strongly linked to the semantic category.

Relational processing focuses on encoding categorical information. Hunt and Einstein hypothesized that if the task focuses on categorization, then the quantity of relational information going into the typical, atypical and unfamiliar traces would be sufficient to integrate each into a retrieval plan; that is, relational processing would produce similar levels of free recall for all three types of instances.

They predicted another outcome when typical, atypical and unfamiliar items were processed via an item-specific task. As mentioned previously, unfamiliar words possess relatively few item-specific features. Little information about the unfamiliar word is available except its category name. For example, most people can classify a grackle as a bird, but cannot furnish much specific information about grackles. Hunt and Einstein hypothesized that, lacking item-specific information, unfamiliar instances would not be recalled
well after an item-specific task. In comparison, typical and atypical instances (which have higher levels of item-specific information than unfamiliar words) would be recalled well. Hunt and Einstein predicted (personal communication), that after item-specific processing, typical and atypical category members would have enough individual-item information to function during the discriminative phase of free recall, but that unfamiliar words would not. Therefore, they expected the recall levels of typical and atypical words to diverge from recall level of unfamiliar words following an item-specific task.

In the Hunt and Einstein (1981) study, a reliable interaction between processing type and typicality was observed. Recall levels of typical and atypical words were similar after relational processing, but diverged after item-specific processing. However, Hunt and Einstein's stimulus list did not differentiate atypical items from unfamiliar items (see Glass and Meany, 1978). Certain of Hunt and Einstein's "atypical items" were really unfamiliar instances of a semantic category. Thus, the interaction they reported confounded the effect of atypicality with unfamiliarity.

The present study will discriminate between these two types of instances, and examine the effects that
they exert on memory, as well as apply Hunt and Einstein's relational/item-specific distinction towards understanding some aspects of the development of memory. A review of related issues in the developmental literature comprises the next section.

**Four Developmental Perspectives On Retrieval**

Three viewpoints have dominated the literature concerned with the development of memory. Two of them, the organizational and the levels-of-processing perspectives, extend adult theoretical principles to children. The other, the metamnemonic approach, is unique in that it is based upon developmental research. Metamemory refers to a person's knowing about or being aware of the factors that influence storing and retrieving information from memory. In addition to the three dominant orientations, another theoretical viewpoint has recently emerged. This viewpoint stresses knowledge base development as a determinant of what is remembered. Each perspective will be discussed in the following pages.

**The Organizational Viewpoint.** Just as Mandler (1967) proposed that organization influences what an adult remembers, he also applied organizational principles to children's recall and recognition (see Mandler, 1979). Organizationalists propose that
limitations in children's relational encoding account for developmental trends in memory. A good deal of empirical evidence has supported the view that organization/relational information facilitates children's recall (see Cole, Frankel and Sharp, 1971; Ornstein, Naus and Liberty, 1975; Bjorklund, Ornstein and Haig, 1977; Permutter and Meyers, 1979).

Since organizational strategies (e.g., sorting TBR items into groups) improve recall from a surprisingly early age, most researchers agree that children can process relationships among the stimuli they study and utilize this information at retrieval (see Lange and Hultsch, 1970; Worden, 1974; Worden, Mandler and Chang, 1975).

Mandler (1979) implied that as children develop they become better at organizing TBR stimuli, and as organizational skills sharpen, their mnemonic capabilities increase. If this reasoning is valid, clustering should be evident at an early age and continuously increase as the child develops. There is some support for these notions (e.g., Bousfield, Esterson, and Whitmarsh, 1958; Rossi, 1964; Rossi and Rossi, 1965; Wachs and Gruen, 1971), but other studies (e.g., Steinmetz and Battig, 1969; Cole, Gay, Glick and Sharp, 1971) provide conflicting evidence as to when
clustering appears and how it develops. Garrett Lange (1978) has explained the contradictions in terms of the development of automatic and task-focused relational encoding. It is an issue that directly relates to the present study.

Lange (1978) proposed that two phenomena underlie clustering in children and adults. First, Lange believes that learners cluster material because they actively reorganize loosely structured or unstructured materials. The memorizer consciously transforms the materials to "search for or impose optimal input organizations of the stimuli on the basis of the definitions of his own permanent knowledge structures" (p. 124). This is task focused relational processing and is a form of strategic behavior that does not occur until late childhood.

The second kind of clustering is automatic and present from at least two years of age (see Rossi and Rossi, 1968). Lange describes this type of clustering in terms that are similar to the automatic relational encoding mentioned by Hunt and Einstein (1981). He states that when the structure of the to-be-remembered list approximates the underlying organization of the items in the knowledge base, clustering will automatically occur. This kind of clustering seems to
increase with age. Thus, increases in clustering during development may reflect two factors: 1) differences in strategic behavior, or 2) "changes in the definition of permanent knowledge structures" which influence automatic processing (Lange, 1978 p. 123).

A study by Ornstein, Naus and Miller (1977) provided evidence that children do automatically process the relationships between words as Lange has suggested. Ornstein et. al. concluded that when a "potential organizational scheme" was explicit (i.e., the materials were highly related) children did not need to rehearse TBR items as much as when the items were unrelated. Thus, even young children make use of implicit relational information. However, whether they make as efficient use of the organization that is inherent in structured materials as adults do is debatable. Lange and many other researchers have provided evidence that children do not make as effective use of interitem relations as adults do—especially when the relations are less salient (see Wicklund, Palermo and Jenkins, 1965; Denny and Zibrowski, 1972; Tighe, Tighe and Schechter, 1975; Corsale and Ornstein, 1980).

The Levels of Processing Viewpoint. Children process individual-item information as well. Their capacities in this regard are evident when levels of
processing effects are studied developmentally. Studies of recall in children have generally found semantic tasks to result in higher levels of recall than nonsemantic tasks (e.g., Murphy and Brown, 1974; Waters and Waters, 1976; Yusen, Levin, DeRose and Ghatala, 1976; Weiss, Robinson and Hastie, 1977; Sophian and Hagen, 1978; Ghatala, Carbonari and Bobele, 1980). Further, when Geis and Hall (1976) had different age groups perform the same processing tasks (process to the same depth) developmental differences in recall disappeared. These results (and similar studies) led researchers to hypothesize that older children tend to elaborate TBR materials more effectively than younger children and that this accounted for developmental increases in memory capacity.

The levels paradigm "views memory as the assimilation of incoming information into one's current knowledge base, the implication is that a child's existing semantic knowledge determines in a real sense what is remembered" (Naus, Ornstein and Holving, 1978 pp. 227-228). Thus, a learner always interprets (processes) information on the basis of what they already know.

The Metamnemonic Viewpoint. Metamemory as defined by Flavell (1977, 1981) is knowledge that a memorizer
has about him/herself, the task, processing strategies, and how these factors interact with each other. To illustrate, metamnemonic knowledge includes (among other things) the fact that recall is generally more difficult than recognition. Metamnemonic knowledge about strategies includes such information as when organizational processing is appropriate and when it is not. Since no strategy is appropriate in all situations, metamemory does not emphasize either item-specific or relational processing.

Based upon their paradigm, Flavell and his associates have focused their attention on the strategic or metamnemonic (control process) changes of childhood. Studies representative of this tradition are Flavell, Beach and Chinsky, 1966; Daehler, Horowitz, Wynns and Flavell, 1969; Appel, Cooper, McCarrell, Sims-Knight, Yussen and Flavell, 1972; Kreutzer, Leonard and Flavell, 1975 and Flavell and Wellman, 1977. Their research has continued the organizationalist tradition of viewing the learner as an active agent in processing materials for later retrieval; and the levels of processing concern with how previously learned material (e.g., strategies and when to apply them) influences what is remembered.
An important principle has emerged from metamnemonic research. A child is often capable of more sophisticated mnemonic behaviors than he or she will utilize in a given situation. The term "production deficiency" is employed in a situation where children can use a strategy effectively when made to, but fail to generate it by themselves (Flavell, Beach and Chinsky, 1966). Adults can and will generate appropriate strategies in mnemonic situations whereas children often will not.

Flavell and Wellman (1977) write that the "basic processes" underlying rememberance (e.g., representing an object that is absent, processing associates, cues etc.) occur unconsciously. Further, they contend that these processes mature by the time a child is two. Their research deemphasizes the influence the "basic processes" have in memory. While Flavell and Wellman state that the "basic" mechanisms that automatically associate related words do not change after two years of age, they ignore the fact that the number of words that can and are associated by these "basic processes" change very markedly as the semantic knowledge base develops.

The Knowledge Base. Flavell's explanations for production deficiencies center around metamnemonic maturity, yet there is also evidence that the knowledge
base is involved in which strategy is implemented during rememberance. For example, Mandler and Robinson (1978) found that ten year olds' use of an organizational strategy was tied to the characteristics of the TBR list. They used organization when the relationships among the items were apparent, but later abandoned the strategy when processing another stimulus list where the relationships between list members were obscure.

In contrast to adults, a child's semantic knowledge may be structured differently. Chi (1976, 1977, 1978, 1981), hypothesized along these lines in her investigations of developmental differences in the way knowledge is structured. Chi's definition of "structure" derives from network models of memory (e.g., Anderson, 1972, 1976; Collins and Quillian, 1969; Norman and Rumelhart, 1975). In these models, a word's semantic attributes are represented in a network structure. This network can vary with respect to the number of links between the nodes, the strength of the links, or the cohesiveness of the collection of nodes attached to an item. Chi's results implied that there are fewer relationships among words in a child's knowledge base and that the relationships among the concepts are less valid.
Chi also suggested that the network of relations between concepts in semantic memory (i.e. the structures in the knowledge base) depend on the learner's familiarity with those concepts. The results of her study of recall of chess positions (Chi, 1978) support this notion. Chi found that it was experience with the game, not age, that determined recall of organized chess pieces. In agreement with her hypotheses, chess-playing children recalled more of the chess positions than did adult novices. However, adults remembered more items when the to-be-remembered stimuli were numbers. Adults are far more experienced with numbers than children.

Later, in a single subject design, Chi and Koeske (1983) came to the same conclusion. They examined a child's memory for dinosaur names. After objectively assessing the child's familiarity with each instance that was tested, Chi and Koeske found that recall and clustering of a more familiar set of dinosaur names was significantly superior to a less familiar set of names. A familiarity effect was also apparent in earlier data reported by Lindberg (1980). Lindberg's data are particularly relevant. His methodology is typical of most experiments which study the development of free recall and shares several design features of the present study.
Lindberg (1980) investigated free recall of a categorized list in third graders and college students. The same list was used for all subjects. Each category in the list was either highly salient to the children (e.g., cartoons, games) or the adults (e.g., occupations, earth formations). Not surprisingly, recall and clustering of child-salient categories was significantly higher in children than in adults. The typical age pattern emerged, however, when the adult-salient list items were examined.

A later study by Bjorklund and Thompson, (1983) investigated the effect that categorical structure (as measured by the typicality of TBR items) had on a cued recall task in children and adults. They found that a child’s knowledge of a TBR word’s typicality significantly affected the probability that it would be recalled following a categorical cue. Their results indicated that children’s cued recall was significantly impaired (relative to adults’) because they did not realize that certain atypical words were members of the semantic category (the category label served as the cue during the recall test). The results of Chi (1978), Chi and Koeske (1983), Lindberg (1980) and Bjorklund and Thompson, (1983), argue strongly that knowledge base
structure has a significant effect on strategic behavior.

Stanley A. Kuczaj II, (Kuczaj, 1982) has presented a series of strategies and principles which he believes model the development of the semantic knowledge base. He states that early in language development the relationships formed between items will be "same" or "different". Further, he proposes that certain types of relationships between words are added to semantic memory before others. For example, most "different relationships" (e.g. "hot" is the antonym of "cold") are added to the knowledge base before "same relationships" (e.g. "human" is similar to "person").

Kuczaj proposes that the acquisition of "same" relationships (i.e. relational information) follows a developmental sequence as well. Certain "same" relationships between words are added to semantic memory before others. The work of Eleanor Rosch and her coworkers illustrates one aspect of Kuczaj's developmental scheme for "same relationships" (see Rosch, 1973a; 1973b; 1975; 1978; Rosch and Mervis, 1975; Mervis and Rosch, 1981). Research with children has indicated that the type of relational information necessary to categorize material into "basic level" categories (e.g. dog, cat) is present at an earlier
stage of development than the relational information necessary to organize material into superordinate categories (e.g. animals), see Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976, L. B. Cohen and Strass, 1979, Daehler, Lonardo and Bukatko, 1979 and Mervis and Crisafi, 1982. Thus, superordinate relational information (information which allows the learner to group verbal stimuli based upon more abstract relationships) is less available when young children try to learn verbal materials. Numerous measures of both sorting behavior and categorical clustering also support this thesis (e.g. Bousfield, Esterson and Whitmarsh, 1958; Wicklund, Palermo and Jenkins, 1965; Vaughn, 1968; Moely, Olson, Halwes and Flavell, 1969; Schaeffer, Lewis and Van Decar, 1971; Denney and Ziobrowski, 1972; Smith, 1979; and Corsale and Ornstein, 1980). Children rarely reach an adult level of competence in organizing the TBR materials on the basis of superordinate relational information.

Summary. Studies of the development of memory following the organizational orientation have demonstrated that relational information functions in children’s recall and that it can enter a trace automatically, or as the result of strategic behavior, just as in adults. Levels of processing research has
demonstrated that item-specific information is important in children's retrieval, and that the concepts of elaboration and development of the knowledge base must be considered in any examination of how memory develops.

Flavell and his coworkers have demonstrated that metamnemonic variables (e.g., self, task and strategic information) have high explanatory value in studies of children's memory. In their view, memory matures as the child gains the ability to apply the mnemonic strategy that is appropriate in a particular situation. One of their most widely replicated findings is that children exhibit "production deficiencies". While Flavell explains such deficiencies metamnemonically, he may have overlooked the fact that strategies ultimately depend upon the knowledge that is available. Thus, the knowledge base can determine the success or failure of a strategy, as well as the learner's ability to use it.

Kuzjac (1982) has proposed a theory of knowledge base development based upon same/different relations. He hypothesizes that superordinate relational information (which is desirable in formulating a relational retrieval plan) is integrated into the knowledge structure later than other, simpler types of relationships between words. Developmental studies of
superordinate and basic level categorization support this idea.
THE PRESENT STUDY

The present study is an attempt to integrate several important themes that have emerged in the adult and developmental memory literature. This review has made it apparent that three factors: 1) knowledge base structure (typicality and familiarity), 2) the type of processing performed and 3) the environment in which retrieval occurs (i.e. recall or recognition) determine the outcome when memory is tested. The present study will focus on two of these factors (knowledge base structure and processing task) and examine the developmental changes in each factor and their interaction.

Hunt and Einstein (1981) have demonstrated that in adults, the highest levels of free recall occur when the processing task focuses on information that complements the information which the list (knowledge base) structure automatically activates. They have uncovered a pattern of interactions that characterize adult recall and recognition of typical and atypical/unfamiliar stimuli following relational and item-specific processing tasks. They also state that retrieval requires both types of information and imply that some minimal level of relational and item-specific information is necessary to recall or recognize an item.
The present study will utilize Hunt and Einstein's (1981) interactive framework for research, applying it to the development of memory. The study will assess the level to which a subject's knowledge base matches the "typical adult" structure. The development of the knowledge base will be monitored with two measures. The first is a measure of the learner's knowledge of item typicality with respect to his/her semantic categories. To obtain this measure each subject will rate fifteen of the list items on a Likert scale for typicality. The second measure will evaluate the learner's familiarity (in the Glass and Meany, 1981 sense) with list items. Each subject will be asked to list as many attributes or features for the remaining fifteen list items as they can. The total number of attributes listed for each type of list item (typical, atypical and unfamiliar) will be used as the measure of item familiarity. It is assumed this measure will tap the total quantity of item and relational information available in the learner's knowledge base. Both the familiarity and typicality measures will be obtained for each subject subsequent to the collection of memory data for that subject. The same list words will be used for the memory and knowledge base assessment phases of the experiment.
Kuzjac (1982) and others (e.g. Chi, 1978; Lange, 1978; Lindberg, 1980; Bjorklund and Thompson, 1983) have argued that an adult's knowledge base has a richer relational structure than a child's, or as Chi has stated: "a more appropriate or valid set of relations among the concepts as well as a greater number of relations" (Chi, 1978, p. 74). This should be a factor in retrieval. It may be more difficult for children to reach the minimal level of relational information necessary for free recall of the items. In addition, levels of processing researchers have argued that a child's item-specific (elaborative) abilities are also limited by their knowledge base. These differences imply that the typical adult pattern of interactions between processing task and retrieval test will not occur in children.

Integrating Hunt and Einstein's (1981) research with the literature on the development of the knowledge base leads to the following hypotheses concerning adult retrieval and retrieval differences in children and adults.

Hypotheses

Hypothesis I: It is anticipated that an interaction will occur between the type of processing (item specific versus relational) and the type of word (typical,
atypical and unfamiliar) in adults; and that the interaction will parallel the interaction reported in Hunt and Einstein's (1981) experiments.

Hypothesis II: It is anticipated that a similar pattern of results will occur with children. However, some differences may occur between the adult and child pattern of results. If differences in the interaction of processing and type of word do occur, than these differences should be reflected in the knowledge base data.
METHOD

Pilot Study to Develop Instrument

In order to generate a list of TBR stimuli, a preliminary study was conducted. A pool of ninety items was selected. The ninety words were judged by the experimenter to include six typical, six atypical and six unfamiliar instances of each of five semantic categories based upon Glass and Meany’s (1978) criteria.

In order to empirically demonstrate that a pilot word was in fact either a typical, an atypical or an unfamiliar instance of a category, the pilot list was distributed to twenty undergraduate students enrolled in an introductory psychology course at Louisiana State University.

Printed on another sheet was a written description of Glass and Meany’s distinctions between typical, atypical and unfamiliar instances of a semantic category and two examples of each type of word. The instruction sheet for the pilot study is presented as Appendix A. Subjects were asked to read the words and select the four words that were most typical of that category, the four words that were most atypical and the four words that were most unfamiliar and indicate their choices in the appropriate space provided on the sheet.
The number of subject's classifying each word as typical, atypical or as unfamiliar are presented in Appendix B. As indicated by the Appendix, there was a high level of agreement with respect to those items that were selected as most typical, most atypical and most unfamiliar. The four most typical, atypical and unfamiliar items from each category were then reviewed by a member of the Education faculty at Louisiana State University who was knowledgable about the grade level of words. He was asked to select the two typical, atypical and unfamiliar words from each category he thought were most likely to be in a third graders' vocabulary. The thirty items that he selected appear in Appendix B with an asterisk and served as the TBR list in the experiment.

Phases of the Experiment

The experiment can logically be divided into three separate parts or phases. The first was the study phase, where the subject processed the TBR words. They utilized either Hunt and Einstein's (1981) incidental relational (categorizing) or incidental item-specific (pleasantness-rating) processing task. The second phase of the experiment tested the subject's memory for the TBR items with a free recall test. The final phase of the experiment took place on the day following phases
one and two. This phase measured the subject's knowledge for words. This included measures for typicality and familiarity of the words used in the study.

**Design.** The design for the study included between and within-subjects factors, depending on the dependent measure. As a result, separate analyses were used for each of the dependent measures. Three separate mixed ANOVAs were performed on subject's recall, typicality and attribute listing data. A fourth ANOVA was used to analyze the clustering data.

**Materials.** The TBR list consisted of thirty words. These words were two typical, two atypical and two unfamiliar exemplars of each of five categories obtained from the pilot study. The TBR list was typed on a duplicating address label template, one word per label, so that multiple copies of the list could be produced on self-sticking labels. Each subject received one of two randomly ordered sets of labels. These two random list orders are presented as Appendix C. In addition to the labels, each subject received a blue posterboard tablet measuring twenty-eight by eleven inches. At the top of the tablet either the five category headings (fruit, sport, furniture, animal, vehicle) or five pleasantness ratings (very unpleasant to very pleasant) were printed.
on white labels in black ink. All but the top (labeled) portion of the posterboard was covered with a sheet of glossy white paper. The paper was divided by four vertical lines into five fields of equal size corresponding to the five labels at the top of the posterboard. The free recall test consisted of a lined sheet of paper with the numbers 1-15 printed near the left margin and the numbers 16-30 printed in a column near the center of the page.

Knowledge Base Measures. On the day following learning the words, each knowledge base measure was obtained on half of the list words. Subjects rated the typicality (typicality measure) and listed as many attributes as they could for a set of fifteen of the TBR words. The list was divided into A and B halves such that both halves contained one typical, one atypical and one unfamiliar item from each category. The words within lists A and B were placed in two random orders. Subjects performed the typicality task on one of the random orders of list A then received one of the random orders of list B for the attribute listing task. Subjects who performed the typicality task on one of the random orders of list B then performed the attribute listing task on one of the A lists. Thus, a TBR word was either rated for typicality, or was part of the
attribute listing portion of the experiment. The four orders in which the words were presented during the knowledge base assessment portion of the experiment are given in Appendix D.

**Typicality Knowledge Base Measure.** In order to make the typicality task suitable for different age levels, separate forms were utilized for children and adults.

Adults were given a typicality measure consisting of fifteen of the TBR list items, each TBR list item was connected to its appropriate category heading by two dashes. In addition, a Likert scale ranging from "Very Bad to "Very Good" appeared at the top of the page. The numbers 1 through 5 were printed to the right of each pair of words (item—category heading). The numbers corresponded to the columns in which the Likert scale at the top of the page was printed. An example of an adult typicality rating form appears as Appendix E.

The adult typicality form was modified for the younger age groups. These modifications consisted of eliminating the written Likert scale at the top of the adult form, and replacing the numbers 1 through 5 on the adult form with the five schematic faces (a schematic Likert scale). Thus, the children's typicality measure consisted of a sheet of paper with the fifteen item-category pairs and fifteen sets of schematic faces.
to the right of each pair. An example of the children's typicality rating sheet appears as Appendix F.

**Familiarity Knowledge Base Measure.** The level of information in the learner's knowledge base for each word was tested with the remaining TBR words. Each of these fifteen words appeared on a label, one label to a page, in a booklet. The booklet consisted of fifteen blank lined sheets of looseleaf paper (8 1/2 by 11 inches). One of the four list orders used for the typicality rating task was used to determine where each word appeared in the booklet.

**Subjects.** The subjects were: fifty-two third graders (mean age 7.83, range 7 to 8), fifty-six sixth-graders (mean age 10.77, range 10 to 11), and forty-seven college students (mean age 19.47, range 17 to 32). Elementary school-aged subjects were obtained at the Louisiana State and Southern University laboratory schools. College level subjects were enrolled at the Baton Rouge Campus of Louisiana State University. They were tested at the beginning of the fall semester of the school year.

Thirty subjects from the third grade were assigned to the pleasantness-rating task, twenty-two were assigned to the categorization task. In the sixth grade thirty-one subjects were assigned to the
pleasantness-rating task, twenty-five the categorization task. Finally, twenty-one adults performed the pleasantness rating task, the remaining twenty-six categorized the words.

Procedure. Adults were tested in groups that ranged in size from eight to sixteen. Children were tested in groups that ranged from two to six children. When the subjects entered the laboratory or were visited in their classroom, they were randomly assigned to either a categorize or pleasantness-rating group. The groups were given the appropriate task instructions which appear below.

Subjects in the categorize condition were presented with the labels and a board with the category headings at the top. The experimenter then read a set of instructions to the subjects. In general terms, the instructions informed them that they were to group the items which belonged with one another together on the board. They were asked to place each grouping under the appropriate category heading. The directions varied slightly for adults and children in order to take advantage of the verbal abilities of each age group. Examples of the procedure were given. Specific instructions are presented as Appendices G and H.
After the instructions were given, the experimenter read the category headings aloud and the experimental session began. During the session, the experimenter read the word that appeared on each label to the subjects and waited for them to position that item on the tablet. When the label had been placed, the experimenter read the next word and so on until the list was complete.

Those subjects who did not participate in the categorization task, performed the pleasantness-rating procedure. Subjects in this condition were presented with the labels and a board with the pleasantness dimensions at the top. They were informed that the labels were to be evaluated on the basis of the pleasantness-rating scale. In general terms, they were instructed to think about a word and let their feelings about it determine where they placed it on the board. Once again, the directions utilized for adults and children varied slightly to take advantage of the differing verbal abilities of each age group. Specific instructions are presented as Appendices I and J.

After the pleasantness-rating instructions were read, the experimenter read the pleasantness dimensions aloud and the experimental session began. During the session, the experimenter read the word that appeared on
each label, waited for the subjects to position the item and then went on to the next word. The experimenter continued through the list until the last word was reached.

Free Recall test. When all of the subjects in a group had completed the task, the tablets were turned face down and subjects wrote their name, their age and their teacher's name on the back of the tablet. This procedure served as a short term memory buffer, to eliminate recency effects. After the information was written, the tablets were collected and the free recall tests were distributed. The free recall instructions were also slightly different for adults and children, they are presented as Appendices K and L. Upon completion of the recall test, materials were collected and testing was complete for that day.

Knowledge Base Assessment Instructions. Both the relational measure and the typicality measure were obtained the next day. College-aged subjects were required to report back to the University's learning laboratory and were tested there. Children were tested in their schools. The typicality measure was performed prior to the attribute listing measure in every case. The experimenter randomly assigned a subject one of the four A or B forms of typicality measure. After the
materials were distributed, the appropriate age-graded instructions were given in written form to the adults or read to the children.

Adults were told to rate each item in terms of how good an example it was of the category to which it was connected. They were instructed to indicate their ratings by circling one of the numbers to the right of each word pair. Ratings were based on the five point Likert scale which was printed at the top of the page. The scale values were "Very bad", "Bad", "Okay", "Good" and "Very Good". The scale ranged from 1 (is a very bad example of the category) to 5 (is a very good example of the category). A copy of the written instructions appears as Appendix M.

Instructions for the children's typicality task were patterned after Bjorklund and Thompson's (1983) "spaceman" procedure and were read aloud to the children prior to testing. Children were instructed to pretend that a person from outer space was visiting the Earth. This person knew nothing at all about the Earth but they could help him understand our planet by answering some questions for the experimenter. They were told that they were going to rate the items on the typicality sheet in terms of how good an example each one was of its category; and that this would help the spaceman
understand the Earth better. To make the typicality task easier for the children, they were instructed to circle one of five schematic faces that appeared next to each item-category pair on the sheet. Each of the five faces displayed a different expression. The face with a broad smile printed on it corresponded to a "very good" thing to show the spaceman, one which would be very helpful in getting the spaceman to understand what the category was. It was explained that the smiling face indicated that the word was a "good" thing, but not the best thing to show him. The children were told that the straight face corresponded to an "okay" category exemplar, one that would help the spaceman somewhat in understanding the category, but not as much as other things they could think of; in addition, they were told the frowning face corresponded to a "bad" category exemplar, items that were category members but would not help the spaceman understand the category very well. Finally, it was indicated that the face with the broad frown corresponded to a "very bad" category exemplar, one that would confuse the spaceman as to what the category was. Children were told not to rate the items in terms of how much they liked them, but only in terms of how well it would help the spaceman understand the category. Each child rated all of the items.
The experimenter asked if there were any questions, and proceeded to read an example to the children. Afterwards, another word was read, and the experimenter asked the children's help in rating its typicality. Finally, the experimenter read the five category headings to the children, questions were solicited and testing commenced. During the test, the experimenter read each word-category pair aloud. When all of the children finished circling a face the next pair in the list was read. The words were read aloud in this manner until the list was exhausted. An example of the children's typicality instructions are included as Appendix N.

After the typicality instrument was completed, subjects received the attribute listing measure. Attribute listing instructions were presented in written form to the adults and verbally to the children.

Adults were asked to list as many specific attributes of each item as they could on the appropriate page. When they felt they could not list any more attributes, they were to proceed to the next page and follow the same procedure for the word appearing there. They were asked to write each attribute of the word on a separate line of the page. An example of the procedure was provided in the instructions for a sample word.
Elementary school subjects followed a similar procedure, but the experimenter read the instructions to each subject. Both the adults and the children were allowed as much time as they wished to complete the attribute listing procedure. The adult instructions appear as Appendix O and the verbal instructions given to the children as Appendix P.
Results

In order to test the assumption that children could classify most of the words as category members, the mean number of errors made for those subjects who performed the categorization task was computed for each grade level. The mean number of errors were 4.72 for the third grade, 1.72 for the sixth grade and 0.92 for adults.

Before specific data analyses are discussed, the overall pattern of results should be noted. The overall pattern for recall, typicality and attribute listing indicate that developmental changes in the knowledge base (typicality deviations and attribute listing) are related to changes in free recall. See Appendices Q, R and S for the figures which demonstrate these trends.

Recall data

The mean number of words recalled by task and type of word (typical, atypical and unfamiliar) for each grade level are presented in Table 1. These data were analyzed in a $3 \times 2 \times 3$ (grade x processing task x type of word) mixed analysis of variance, where the first two factors were between-subjects factors and the last factor was a within-subjects factor. The analysis indicated a significant main effect for grade, $F(2, 149) = 79.17, p < .001$. Duncan’s post hoc procedure showed
Table 1

*Mean Number of Words Recalled by Task and Type of Word for Each Age Group*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Orienting Task</th>
<th>Type of Word</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Typical</td>
<td>Atypical</td>
<td>Unfamiliar</td>
<td></td>
</tr>
<tr>
<td>Third Grade</td>
<td>Pleasantness</td>
<td>5.57</td>
<td>3.00</td>
<td>1.83</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rating</td>
<td>(1.96)</td>
<td>(1.51)</td>
<td>(1.34)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Categorization</td>
<td>6.50</td>
<td>2.55</td>
<td>1.77</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.71)</td>
<td>(1.37)</td>
<td>(1.54)</td>
<td></td>
</tr>
<tr>
<td>Sixth Grade</td>
<td>Pleasantness</td>
<td>7.26</td>
<td>4.10</td>
<td>3.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rating</td>
<td>(1.65)</td>
<td>(1.86)</td>
<td>(1.52)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Categorization</td>
<td>6.56</td>
<td>4.12</td>
<td>3.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.63)</td>
<td>(1.73)</td>
<td>(2.04)</td>
<td></td>
</tr>
<tr>
<td>Adults</td>
<td>Pleasantness</td>
<td>9.10</td>
<td>5.14</td>
<td>4.62</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rating</td>
<td>(0.77)</td>
<td>(1.62)</td>
<td>(1.66)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Categorization</td>
<td>6.46</td>
<td>6.77</td>
<td>6.23</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.98)</td>
<td>(1.96)</td>
<td>(1.58)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Standard deviations are given in parentheses.
that the mean recall scores for each grade (third grade $M = 3.53$, sixth grade $M = 4.85$, adult $M = 6.40$) differed significantly from the others. Neither the processing task, nor the task x grade interactions were significant.

The within-subjects factor for word type was significant, $F(2, 298) = 200.75$, $p < .001$. Duncan's procedure indicated that the mean recall levels for typical, atypical and unfamiliar words were significantly different (typical $M = 6.83$, atypical $M = 4.26$, unfamiliar $M = 3.54$). All of the interactions involving type of word were significant as well. Both the interactions of type of word x processing task, $F(2, 298) = 9.14$, $p < .001$, and type of word x grade level $F(4, 298) = 5.13$, $p < .001$ were significant. In addition to these two-way interactions, the three-way interaction for type of word x processing task x grade level was also significant, $F(4, 298) = 13.16$, $p < .001$.

Several aspects of the pattern of results illustrated in Table 1 are interesting. First, notice that recall of typical words within the relational processing task (categorization) is relatively stable across grade levels (e.g. the means are: third grade = 6.50, sixth grade = 6.56 and adult = 6.46). However, there are large differences in recall of these same
words across grades when the processing task emphasized encoding item information (pleasantness-rating). These means were: third grade = 5.57, sixth grade = 7.26 and adults = 9.10.

Generally typical words were recalled much better than atypical and unfamiliar words, with one major exception which can be predicted by Hunt and Einstein's theory. Specifically, the recall of adults who performed the relational processing task did not differ significantly (M = 6.46, M = 6.77 and M = 6.23) for the typical, atypical and unfamiliar words, respectively. While there was also an overall significant difference between recall of atypical (M = 4.26) versus unfamiliar words (M = 3.54) indicated by a Duncan's Multiple Range test, the differences were generally small. When analyzed within-grade and within-task, the only significant difference between these two types of words was in the third grade pleasantness rating task, (M = 3.00 versus M = 1.83) while all other means differed by only about half a point.

Clustering data. The measure of clustering used was the Adjusted Ratio of Clustering (ARC) from Roenker, Thompson and Brown (1971). This measure has a range of -1 to 1, where 0 equals a chance level of clustering. The mean ARC scores are presented in Table 2. Although
Table 2

Mean Adjusted Ratio of Clustering (ARC) Score for Each Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Orienting Task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pleasantness Rating</td>
</tr>
<tr>
<td>Third Grade</td>
<td>.334 (.411)</td>
</tr>
<tr>
<td>Sixth Grade</td>
<td>.329 (.332)</td>
</tr>
<tr>
<td>Adults</td>
<td>.337 (.225)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are given in parentheses.
a 3 x 2 (grade by processing task) analysis of variance revealed no significant effects, the means in Table 2 suggest an interesting pattern. With the pleasantness rating task, the means in all three grades were very similar (.329 to .377). With the categorization task, the means changed in an increasing pattern across grades (third grade = .151, sixth = .290, adult = .444); although, the interaction of grade by task was not significant.

Correlations between recall and clustering by grade and task were also calculated (a full matrix of grade by task intercorrelations of the dependent measures is presented in Appendices T - V. Significant correlations occurred only for adults. There was a significant negative correlation between recall and clustering when adult subjects performed the individual-item processing task, \( r(21) = -.43 \) and a significant positive correlation for adult's recall and clustering when they performed the relational processing task, \( r(26) = .47 \).

**Knowledge_Base_Data**

**Typicality measure.** In order to measure the development of structural relationships among items of a category, each subject's typicality rating was transformed into a deviation score by subtracting it from norms obtained in a pilot study. The pilot study
utilized an independent sample of adult subjects. These norms represent the mean typicality rating for each word on a five point scale. The norms appear as Appendix U. The absolute value of the deviation of each subject’s typicality rating from the norm for each word was calculated. These scores were summed for each word type and this sum served as the typicality accuracy score for each word type.

The actual range of typicality accuracy scores was from 1.50 to 14.19. The means of the typicality scores are presented in Table 3. When you inspect these means, remember that lower scores indicate more accurate typicality rating as compared to adult norms. A 3 x 3 (grade by type of word) mixed analysis of variance indicated a significant main effect for grade level, $F(2, 152) = 49.83, p<.001$. The adult’s mean typicality accuracy score for all types of words ($M = 3.46$) was lower than the mean typicality accuracy score for sixth graders ($4.34$) which was lower than the mean typicality accuracy score for third graders ($5.95$). A main effect was also present for the type of word being rated $F(2, 304) = 109.68, p<.001$. The typicality accuracy scores for typical words ($M = 2.86$) were lower than those for atypical words ($M = 5.28$) which were lower than those for unfamiliar words ($M = 5.68$). The grade x type of
Table 3

Mean Typicality Accuracy Score by Type of Word for Each Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Typical</th>
<th>Atypical</th>
<th>Unfamiliar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.59</td>
<td>6.94</td>
<td>7.32</td>
</tr>
<tr>
<td>Third Grade</td>
<td>(2.54)</td>
<td>(2.01)</td>
<td>(2.33)</td>
</tr>
<tr>
<td></td>
<td>2.68</td>
<td>4.97</td>
<td>5.37</td>
</tr>
<tr>
<td>Sixth Grade</td>
<td>(1.75)</td>
<td>(1.92)</td>
<td>(1.93)</td>
</tr>
<tr>
<td></td>
<td>2.29</td>
<td>3.82</td>
<td>4.27</td>
</tr>
<tr>
<td>Adult</td>
<td>(0.95)</td>
<td>(1.37)</td>
<td>(2.06)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are given in parentheses.
word interaction was significant, as well, $F(4, 304) = 4.14$, \( p < .01 \).

As stated previously, in all three grade levels, typical words were rated more accurately than atypical and unfamiliar words; however, this difference was most pronounced in the third and sixth grades. It should also be noted that sixth graders rated the typicality of typical words with as much precision as adults. For example, the Duncan’s Multiple Range procedure indicated that the $M = 2.68$ for sixth graders and $M = 2.29$ for adults were not significantly different. The next lowest score for typicality accuracy was the third graders’ ratings of typical words ($M = 3.59$) which differed significantly from both adult's and sixth graders' ratings. The overall pattern of the results suggests that adults and children are much more similar in their abilities to rate typical words as compared to atypical or unfamiliar words.

Attribute Listing Measure. The purpose of this measure was to examine the amount of item information available in the knowledge base as a function of grade and word type. In the attribute listing task, subjects listed as many attributes as they could for each word. The attribute listing score is the mean number of attributes listed for each word type. These means are...
presented in Table 4. All attributes listed by a subject were counted except for evaluative judgments (i.e. good/bad, like/dislike) or when the attribute listed was clearly wrong (e.g. rugby is a rug).

Scoring of the attribute listing protocols involved subjective judgments, therefore, interrater reliability coefficients were computed for 20 Ss on the attribute listing task. Scoring was highly reliable, interrater reliability coefficients (based upon Pearson's $r$) for the three types of words ranged from .95 to .97.

The attribute listing data were analyzed in a $3 \times 3$ (grade by type of word) analysis of variance with repeated measures on type of word. The main effect for grade level was significant, $F(2, 152) = 123.05$, $p < .001$. Type of word was also significant, $F(2, 304) = 321.80$, $p < .001$, as was the grade x type of word interaction, $F(2, 304) = 45.33$, $p < .001$.

A Duncan's Multiple Range test of the means in Table 4 indicated that the number of attributes listed for each type of word was significantly higher for adults than for both third graders and sixth graders. The Duncan's test also indicated that the sixth graders listed significantly more attributes for each type of word than the third graders. In addition, the Duncan's test revealed that all of the means within a grade were
Table 4

Mean Number of Attributes Listed on the Attribute
Listing Per Word for Each Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Type of Word</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical</td>
<td>Atypical</td>
<td>Unfamiliar</td>
<td></td>
</tr>
<tr>
<td>Third Grade</td>
<td>2.38</td>
<td>2.04</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.15)</td>
<td>(0.93)</td>
<td>(0.59)</td>
<td></td>
</tr>
<tr>
<td>Sixth Grade</td>
<td>3.75</td>
<td>3.10</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.59)</td>
<td>(1.34)</td>
<td>(1.02)</td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>9.48</td>
<td>6.88</td>
<td>3.48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.09)</td>
<td>(2.68)</td>
<td>(1.76)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Standard deviations are given in parentheses.
significantly different, except for the number of attributes listed by third graders for typical versus atypical words. Averaged across type of word, adults listed an average of 6.61 attributes per word, while sixth graders listed 2.75 attributes and third graders listed 1.66 attributes. Adults seemed to have considerably more item information available for all three types of words (see Table 4).

**Correlations between recall and knowledge base measures.** To explore the relationship between recall and the two knowledge base measures (typicality accuracy score and attribute listing score) Pearson product-moment correlations were computed between these measures within each grade. To avoid restricting the range in the variability of the knowledge base measures the data were combined across word type. These correlations are presented in Table 5. The correlation between the number of attributes listed and recall was significant in third grade (.335), marginally significant in the sixth grade (.248) and not significant for adults (.235). Typicality accuracy scores were significantly correlated with recall only for adults (-.383).
Table 5

**Intercorrelations Between Total Recall, the Knowledge Base Measures and Clustering (ARC) by Age Group**

<table>
<thead>
<tr>
<th></th>
<th>Total Recall</th>
<th>Total Typicality</th>
<th>Total Attributes</th>
<th>ARC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Third Graders (n = 52)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Recall</td>
<td>-.121</td>
<td>.335&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.084</td>
<td></td>
</tr>
<tr>
<td>Total Typicality</td>
<td>---</td>
<td>-.260</td>
<td>-.037</td>
<td></td>
</tr>
<tr>
<td>Total Attributes</td>
<td>---</td>
<td>---</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td><strong>Sixth Graders (n = 56)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Recall</td>
<td>.177</td>
<td>.248</td>
<td>.126</td>
<td></td>
</tr>
<tr>
<td>Total Typicality</td>
<td>---</td>
<td>-.155</td>
<td>-.148</td>
<td></td>
</tr>
<tr>
<td>Total Attributes</td>
<td>---</td>
<td>---</td>
<td>-.016</td>
<td></td>
</tr>
<tr>
<td><strong>Adults (n = 47)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Recall</td>
<td>-.383&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-.235</td>
<td>.226</td>
<td></td>
</tr>
<tr>
<td>Total Typicality</td>
<td>---</td>
<td>.135</td>
<td>-.302&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Total Attributes</td>
<td>---</td>
<td>---</td>
<td>-.066</td>
<td></td>
</tr>
</tbody>
</table>

Note: <sup>a</sup> = significant at $p<.02$.
Note: <sup>b</sup> = significant at $p<.01$.
Note: <sup>c</sup> = significant at $p<.04$. 
Discussion

Results from the present study are in agreement with those of Hunt and Einstein (1981) which predict that an interaction would occur between type of word and processing task with adult subjects. With relational processing (categorization), recall of typical, atypical and unfamiliar items was equivalent. However, with item-specific processing (pleasantness rating), recall of the typical words was much greater than recall of atypical or unfamiliar words. The only difference between the theory and the adult data was that Hunt and Einstein's theory predicted higher recall of atypical as compared to unfamiliar words following an item-specific processing task. Recall of these words did not differ significantly, although the means were in this direction (i.e., more atypical than unfamiliar words were recalled).

Hunt and Einstein's framework of distinguishing relational from item-specific processing appears very promising for understanding developmental changes in memory. Like adults, children (third and sixth graders) remembered many more typical as compared to atypical or unfamiliar words when they performed the item-specific task. Unlike adults, recall of atypical and unfamiliar words did not increase when children performed the
relational processing task. Analyses related to knowledge base suggest that the reason children's recall of these words was not enhanced by relational processing is that the relational information in the knowledge base for atypical and unfamiliar items is not fully developed in third and sixth graders. Since the means for these types of words are significantly less than for typical items.

These recall patterns for children parallel their performance in the tasks designed to assess the development of their knowledge base. Children were much less accurate in rating the typicality of atypical and unfamiliar words, indicating that the integration of these words into the relational structure of the knowledge base is incomplete. Numerous other studies have provided evidence that children tend to view atypical instances of a category as nonmembers more often than adults (see Saltz, Soller, & Sigel, 1972; Anglin, 1977; Duncan and Kellas, 1978). The data of this study indicate that even though children may recognize atypical and unfamiliar words as members of a category, they may have insufficient relational information for these words to benefit from relational processing. Children's attempts to process these words on the basis of relational information does not
facilitate recall as it does in adults. Thus, recall of atypical and unfamiliar items did not approach the level of typical items when children performed the relational task, as it did in adult subjects. It appears that adults have a more complex and highly developed knowledge base, with many more connections among items which leads to the differences obtained on the relational task.

It should be noted that the typicality task measured a learner's knowledge of the categories by comparing that knowledge to an adult standard. The data from this measure would probably have been different if a categorical structure typical of children had served as the standard for comparison (see Bjorklund and Thompson, 1983).

On the attribute listing task (which was designed to estimate the amount of information accessible from the knowledge base) children were able to list surprisingly few attributes of the words. Averaged across type of word, third graders listed only 1.66 attributes per word, sixth graders listed 2.75 attributes per word and adults listed 6.61 attributes per word. Even on the typical items, children could not list many attributes (M = 2.38 for third graders versus 3.75 for sixth graders and 9.48 for adults).
Clearly, children have more information about these words (especially typical items) in their knowledge bases than they are voluntarily able to access and produce on the attribute listing task. Studies of elaborative processing (e.g., Murphy and Brown, 1975, Yussen, Levin, DeRose and Ghatala, 1974) and metamemory (Flavell, Beach and Chinsky, 1966, Flavell and Wellman, 1977) have demonstrated that children often perform poorly on voluntary memory tasks. Thus, a child's inability to voluntarily access and encode item-specific information could be an important limitation in children's memory performance. This could explain why children recalled fewer typical words than adults after the item-specific processing task, but not after the relational processing task. It should be noted that the number of attributes listed was significantly correlated with recall ($r = .335$) only for the third graders. This finding suggests that encoding of item-information is an important individual difference among third graders which seemed to limit recall performance only in this age group.

The recall data also provide evidence that children spontaneously encode relational information for the typical items. With the item processing task, recall of typical items was greater than atypical or unfamiliar
items in all age groups. This difference in recall is assumed to reflect the abundance of relational information children possess about typical items, relative to atypical or unfamiliar items. Chi and others have repeatedly demonstrated that both recall and clustering are consistently higher when children process typical items (see Bjorklund and Ornstein, 1976; Lindberg, 1980; Chi and Koeske, 1983). Also, the ARC clustering scores for each age group were nearly identical following the item-specific processing task. This indicates that similar levels of automatic relational processing were occurring during the item processing task. This finding is evidence for what Lange (1978) has labeled automatic clustering, clustering that occurs without intentional processing when the structure of the list approximates the underlying organization of the knowledge base.

Finally, it was observed that ARC clustering scores correlated with recall only for adults. A positive correlation between clustering and recall occurred when adult subjects performed the relational processing task ($r = .47$). A significant negative correlation ($r = - .43$) was obtained when adults performed the item-specific task. This pattern of results for adult subjects suggests that relational processing of atypical
and unfamiliar items occurs only when the task emphasizes relational information. The negative correlation of clustering and recall after item-specific processing may indicate that those adults who encoded large amounts of item information were able to formulate an alternative (non-relational) retrieval scheme; and that this scheme proved more effective, especially for the atypical and unfamiliar items in the list. Once again relational processing of these items by children was not advantageous (there was no correlation between recall and clustering) because the structural relations of these words within the knowledge base were not yet fully developed.
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APPENDIX A

Pilot Study Instructions

If you have any questions at any time during the experiment, please don't hesitate to ask!

Five lists of words appear on the next few pages. Each list contains words that fall into a particular category. Your task will be to read each of the 18 words in a category and decide which of the words are the four most typical examples of that category, the four most atypical examples of that category and the four most unfamiliar examples of that category and indicate your choices on the list. To illustrate, consider the category "bird". To me, the word "robin" is highly typical of the category bird. "Robin" has almost every characteristic that I can think of a bird as having (for example, it has feathers, it can fly, it builds a nest etc.). At the same time, robin has very few (if any) characteristics that are unbird-like. It is hard to think of something about a "robin" that is not something you would expect to see in the typical bird. Contrast the typical bird "robin" with the atypical bird - "penguin". While "penguin" is a member of the category bird, and does have bird-like
characteristics, it is an atypical member of the category. There are many more unbird-like things about the word "penguin" than there are about the word "robin". For example, "penguins" cannot fly, they spend a good deal of their time swimming, etc. These are not characteristics that most birds have, or things that most birds do. Finally, I would like you to contrast the typical category member "robin" and the atypical category member "penguin" with the unfamiliar category member "grackle". I know very little about the word "grackle", aside from the fact that it is a bird. Aside from the fact that it is a category member, I could give few or no other facts about this term. Therefore, I would classify "grackle" as an unfamiliar example of the category bird. To provide another example, take the category "plant". To me a typical plant is a "flower", an atypical plant is "moss", and an unfamiliar plant is a "yucca".

Keeping these distinctions in mind, I would now like you to read the first list on the following page in its entirety, thinking about each word. Then I would like you to choose those four words that you think are the most typical "fruits" in the list. Please indicate your choices by putting a capital "T" for typical on the line
that appears to the right of the four words that you choose as most typical. Recall that:

**TYPICAL WORDS** THAT YOU CHOOSE SHOULD HAVE THE MOST CHARACTERISTICS OF THE CATEGORY AND THE FEWEST CHARACTERISTICS THAT ARE NOT NORMAL FOR THAT CATEGORY OF ANY OF THE WORDS ON THE LIST.

If you get confused, refer to the examples again, or to the definition above. Once you have chosen the four most typical fruits and indicated them in the spaces provided, go on to the next category "animals" and choose the four most typical animals in that list. Again, try to choose the typical words on the basis of your understanding of the definition and the examples given above. Proceed through the other lists until you have chosen the four most typical words from each category.

When you have completed choosing the typical words, I would like you to select the four most atypical words from each category, and indicate your choices by putting a capital "A" on the line that appears to the left of these four choices. Recall that:
ATYPICAL WORDS THAT YOU CHOOSE SHOULD BE MEMBERS OF THAT CATEGORY, BUT HAVE MANY CHARACTERISTICS THAT DEVIATE FROM THOSE THAT ARE NORMALLY THOUGHT OF WHEN YOU THINK OF A DESCRIPTION OF WHAT IS TYPICAL FOR THAT CATEGORY. THUS, ATYPICAL WORDS HAVE SOME CHARACTERISTICS THAT ARE TYPICAL OF THE CATEGORY, SOME THAT ARE NOT.

When you have made your choice of the four most atypical instances of the first category "fruit", proceed to the next category and choose the four most atypical from it. Continue this process until you have completed all five lists of words.

Next I'd like you to select the four most unfamiliar words in each category. Recall that:

YOU SHOULD KNOW THAT AN UNFAMILIAR WORD IS A MEMBER OF THAT CATEGORY, BUT KNOW VERY LITTLE ELSE ABOUT WHAT THAT WORD REFERS TO.

Once you have identified the four most familiar fruits in the first category, indicate your choices with a capital "U" to the right of each word. Then go on to the next list, and select the four most unfamiliar words from it. Follow these instructions until you have done all five lists of words.
Once you are satisfied that you have selected the four most typical, the four most atypical and the four most unfamiliar words from each list, return the sheets to me.

* Note: the categories used were fruit, sport, furniture, animal and vehicle.
Appendix B

Pilot Study Word List and Norms
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Label Orders

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Appendix D

Typicality/Attribute Listing Word Orders

(number one of four)

Mongoose -- Animal
Helicopter -- Vehicle
Footlocker -- Furniture
Cat -- Animal
Rickshaw -- Vehicle
Orange -- Fruit
Marbles -- Sport
Chair -- Furniture
Clam -- Animal
Football -- Sport
Persimmon -- Fruit
Car -- Vehicle
Watermelon -- Fruit
Clock -- Furniture
Rugby -- Sport
Appendix D

Typicality/Attribute Listing Word Orders

(number two of four)

Chair -- Furniture
Persimmon -- Fruit
Cat -- Animal
Rugby -- Sport
Footlocker -- Furniture
Orange -- Fruit
Car -- Vehicle
Clam -- Animal
Mongoose -- Animal
Watermelon -- Fruit
Marbles -- Sport
Clock -- Furniture
Football -- Sport
Rickshaw -- Vehicle
Helicopter -- Vehicle
Appendix D

Typicality/Attribute Listing Word Orders

(number three of four)

Coatrack -- Furniture
Sled -- Vehicle
Tomato -- Fruit
Telephone -- Furniture
Bed -- Furniture
Dog -- Animal
Worm -- Animal
Hunting -- Sport
Monorail -- Vehicle
Apple -- Fruit
Stickball -- Sport
Baseball -- Sport
Hedgehog -- Animal
Pick-up Truck -- Vehicle
Gooseberry -- Fruit
Appendix D

Typicality/Attribute Listing Word Orders

(number four of four)

Telephone -- Furniture
Baseball -- Sport
Gooseberry -- Fruit
Worm -- Animal
Stickball -- Sport
Pick-up Truck -- Vehicle
Tomato -- Fruit
Monorail -- Vehicle
Bed -- Furniture
Dog -- Animal
Hedgehog -- Animal
Hunting -- Sport
Sled -- Vehicle
Apple -- Fruit
Coatrack -- Furniture
Appendix E

Adult’s Typicality Rating Sheet
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Children’s Typicality Rating Sheet
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<tr>
<td>Dog</td>
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<tr>
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<tr>
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<td>Fruit</td>
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Appendix G

Verbal Instructions for the Categorization Procedure
(Adult Subjects)

You have in front of you a blue and white board and 30 peel-off labels.
Each of the labels has a word printed on it.
Your task in this experiment is to place each of the words into its proper category. I will read each word to you. After I have read each word to you, I want you to think about which category it belongs in. Then I want you to place it in the proper column on the board. You can do this by peeling the label off of its backing, and positioning it in the column which best fits the word that is printed on the label.
For example:
If you decide that the word on the label is a fruit, peel that label off and place it in the column headed "Fruit".
If you decide that the word on the label is a sport, peel that label off and place it in the column headed "Sport".
If you decide that the word on the label is furniture, peel that label off and place it in the column headed "Furniture".
If you decide that the word on that label is an animal, peel that label off and place it in the column marked "Animal".

If you decide that the word on the label is a vehicle, peel that label off and place it in the column marked "Vehicle".

If you change your mind about where a word that has just been read should be placed after you have stuck it on the board, you can peel it off the board and reposition it. If you do not know what a word means or are unsure about its' proper category, take your best guess as to what column it should be placed in.

Please think carefully about which category best fits the word that is read to you and place it in the proper column on the board. After I read a word to you, decide where it goes, place it and look up so that I will know that you are finished with the word and ready for the next one.

If you have any questions raise your hand and let me know.
Appendix H

Verbal Instructions for the Categorization Procedure (Children)

Experimenter introduces him/herself - try to make the children feel relaxed and comfortable. Tell each child that you are going to ask their help in playing some word games and that everyone in the class is going to play it too. Then read the following verbal instructions:

Now we are going to start the game. The first part of the game is called "what goes together". In this game you will be showing me which words go together. Each word is printed on one of these stickers. (Experimenter shows a strip of labels). I will read each word out loud to you. After I read each word, I want you to think about it and put each sticker where it belongs on the board. (Experimenter shows the board). The board has five different columns. The first column is for the words that are "Fruits". If the word that I read is a fruit, I want you to place it here on your board. If you decide that the word that I read is a "sport" I want you to place it here in the column marked "sport". If the word that I read is "furniture", then put it here in the column marked "furniture". If the word is an
"animal" then it goes here on the board, in the column marked "animal". Finally if I read a word to you that is a "vehicle", then put the sticker with the word in the last column here on the board. The one marked "vehicle". Remember not everyone will put each word in the same column. I want to know where you think the sticker goes, not what your friend thinks. *

Let's try some practice words now. Experimenter demonstrates. Let's pretend the word on the label is "tiger". Tiger is an animal, so I'll put it here (indicate the animal column). Now you try it. How about the word "fishing"? Where does it go? How about the word "bookcase"?

Okay, let's begin.

* If a child looks at somebody else's work please repeat the last two sentences to the student individually and discreetly.
Appendix I
Verbal Instructions For The
Pleasantness Rating Procedure
(Adults)

You have in front of you a Blue and White board and 30 peel-off labels. Each of the labels has a word printed on it.
Your task in this experiment is to decide how pleasant you feel the words are. I will read each word to you.
After I have read a word to you, I want you to think about how unpleasant or pleasant the word I read is.
Then I want you to place it in one of the unpleasantness/pleasantness rating columns on the board.
You can do this by peeling the label off of its backing, and positioning it in the column which best indicates how you feel about the word.
For example:
If you decide that the word on a label is very unpleasant, peel off and place it in the column headed "Very Unpleasant".
If you decide that the word on a label is unpleasant, peel that label off and place it in the column headed "Unpleasant".
If you decide that the word on a label is pleasant, peel that label off and place it in the column marked "Pleasant".

If you decide that the word on the label is very pleasant, peel that label off and place it in the column marked "Very Pleasant".

If you change your mind about where a word that has just been read should be placed after you have stuck it on the board, you can peel it off the board and reposition it. If you do not know what a word means, or are unsure how you feel about it, take your best guess as to which column it should be placed in.

There are no right or wrong answers in this task, I want your opinions about each word, please think carefully about each word and let how you feel about it determine where it goes on your board. After I read a word to you, decide where it goes, place it and look up so that I will know that you are finished with that word and ready for the next one.

If you have any questions please raise your hand and let me know.
Appendix J
Verbal Instructions For
The Pleasantness Rating Procedure
(Children)

Experimenter introduces him/herself - try to make the children feel relaxed and comfortable. Tell each child that you are going to ask their help in playing some word games and that everyone in the class is going to play them, too. Then read the following verbal instructions:

Now we are going to start the game. The first part of the game is called good/bad. In this game you will be showing me how pleasant (that is nice) you think a word is. Each word is printed on one of these stickers. (Experimenter shows the page of labels). I will read each word to you out loud. After I read the word, I'd like you to think about how pleasant that word is, and show me what you think by peeling the word off of the page, and putting it where it belongs on the board. (Experimenter points while saying the following): The board has five different columns. The first column is "very unpleasant". If you decide that the word that I read is very bad, I'd like you to place it here on your
board. If you think it's bad, but not that bad, I'd like you to place it here, in the column marked "unpleasant". If you neither like nor dislike the word that is read, put it here in the column marked "not pleasant or unpleasant". Let's suppose the word is one you like, then you should put it here in the column marked "pleasant". Finally, if you think the word is very good then put it here, in the last column marked "very pleasant". If you're not sure how you feel about the word then just guess. There might be some words you don't know. Guess for these words, too. If you make a mistake, peel the label off the board and put it where you really want it to go.

Remember this is a game. There are no right or wrong answers. I want to know what you think, not what your friend thinks. *

Let's try some practice words. (Experimenter demonstrates.) The word "spinach". I really don't like spinach at all, so I would put it in the column marked "very unpleasant". Now you try one. How about the word "ice cream"? Where would you put that? (pause) How about the word "cigar"? Where would you put it?
O.K. Let's begin.

* If a child looks at somebody else's work please repeat this paragraph to the student individually, discreetly.
Appendix K

Verbal Instructions For Free Recall

(Adults)

Now we are going to start the second part of the sorting experiment. I want you to try to remember as many of the words that you just sorted as you can. Write them on the paper in front of you. I want you to put the first word that you remember on line #1, the second word you remember on line #2, and so on, until you can't remember any more of the words. Please continue to try to remember the words until you notice that you have not been able to remember any new words for about three minutes. Please begin.
Appendix L

Verbal Instructions For Free Recall

(Children)

Now we are going to play a second part of the sticker game. I want you to try to remember as many of the words that were on the stickers as you can and write them on the paper in front of you. I want you to put the first word that you remember on the line near the number "1", the second word that you remember on the line marked "2" and so on until you can’t remember any more of the words. Go ahead and start.

When you notice that a child has stopped encourage him/her to continue with: "Sometimes you can remember some more words if you try a little more."
Appendix M

Verbal Instructions For The Typicality Task

(Adults)

The next page contains a list of 15 pairs of words, and 15 scales. The first word in the pair is an example of a category. The second word in the pair is one of five categories.

Your task in this part of the experiment will be to rate how well the first word in the pair fits into the category that follows it. In other words, you will be deciding how good an example the word is of the category that follows it. A good way to rate an example is to think in terms of having to explain the category to someone who does not know what the category is. Some examples of a category would be more helpful than others if you were trying to get a person to understand the category. In this part of the experiment, you will be deciding just how helpful each of the examples would be in getting the person to understand the category that follows it.
Let's illustrate the procedure, suppose that the first pair of words on the next page were:

Very     Bad     Okay     Good     Very
Bad       Good

Shirt—Clothing  1-------2-------3-------4-------5

Your task is to decide how good an example of the category "Clothing" the word "Shirt" is, and indicate your choice by circling one of the numbers on the scale to the right of the pair of words.

If you thought that the word "Shirt" was a very bad example of the category "Clothing", one that might not even fit into the category at all, you would circle the number "1" on the scale that follows the pair. This would indicate that you felt that a "Shirt" would be a very bad thing to show someone to help them understand the category "Clothing".

If you thought the word "Shirt" was a bad example of the category clothing, you would circle the number "2" on the scale. This would indicate that you felt that a shirt was a bad thing to show someone to help them understand "Clothing" but not the worst thing.

If you thought the word "Shirt" was just an okay example of the category "Clothing" you would circle the number "3" on the scale. This would indicate that you felt
that a shirt was an okay thing to show someone to help them understand "Clothing" but not as helpful as other things you could think of.

If you thought the word "Shirt" was a good example of the category "Clothing" you would circle the number "4" on the scale. This would indicate that you felt that a shirt was a good thing to show someone to help them understand the category "Clothing", but not the best thing.

Finally, if you thought the word "Shirt" was a very good example of the category "Clothing", you would circle the number "5" on the scale. This would indicate that you felt that a shirt is a very good thing to show someone to help them understand the category "Clothing", one that is almost perfect to help them understand.

Please rate each of the 15 examples in this manner, one word at a time. When you are finished, check to see that you rated each example, and return the sheets to the experimenter.
Appendix N
Verbal Instructions For The Typicality Task
(Children)

Experimenter introduces themself — try to make the children feel relaxed and comfortable. Tell each child you will be playing some word games and that everyone in class is going to play, too. Then read the following verbal instructions:

Let's pretend there is a person from outer space who knows nothing about the Earth. I'd like you to help the spaceman to understand our planet by answering some questions for me. I want the spaceman to understand some of our Earth words. To help him understand Earth words we're going to tell him what kinds of things belong together and what we call them. I want you to help me make the list by telling me how good you think each of the words I picked fit the name we call them. Let's pretend the word I'm interested in helping him understand is "clothing". One of the words in my list for clothing is "shirt". Is a "shirt" a "very good" thing to show the spaceman to help him understand what clothing is? If you think it is then circle the very happy face, here. (Experimenter point, circle with
finger). Or is "shirt" a "good" thing to show him, but not the "best". If you think it's good, but not the best, then circle this happy face. (Experimenter demonstrate.) Or is "shirt" just an "okay" thing to show the spaceman to help him understand what "clothing" is? If you think it is just okay, but not as helpful as other things you can think of, then circle the straight face. (Experimenter demonstrate.) Or is "shirt" a "bad" thing to show the spaceman what clothing is? If you think it's bad, then circle the frowny face. (Experimenter demonstrate.) If you think "shirt" is a "very bad" thing to show a spaceman because it really isn't clothing at all, then circle the Mr. Yuk face. So, if you think that the "shirt" would really confuse the spaceman, about what "clothing" is, then circle the very frowny face, here. (Experimenter demonstrate.)

Now we'll start the game. I want you to help me to help the spaceman understand some other words. They are "furniture", "vehicle", "fruit", "animal" and "sport". I'm going to read a word to you out loud and the name of the list I put it in. I want you to think how good the word is to help the spaceman understand the name we call it, or if the word would confuse him. I want you to circle one of the faces for each line. (Experimenter underscore each line with your finger for 4 to 5 lines).
Remember, this is a game, I want your ideas, not your friend's. *

Okay, let's begin.

* If a child looks at somebody else's work, please repeat this sentence to the student individually and discreetly.
Appendix O
Attribute Listing Instructions
(Adults)

You have been given a book with 15 words printed in it. Please WRITE YOUR FULL NAME AND ON THE FIRST PAGE OF THE BOOK.

Notice that one word appears on each page of the book. The purpose of the experiment is to measure your knowledge about each of the words in the book. Please use a separate line to write down each thing that you know about the word on that page.

Suppose that the first word in the book is "Spinach". I want you to write down each thing that you know about Spinach on a separate line of the page. For example, you know that Spinach is "green", so you could write "green" on the first line. You also know that Spinach is good for you, so you could write "healthy" on the second line. If you know that it tastes bad, you could write "tastes bad" on the third line, and so on, until you could not think of anything else to write about the word Spinach. Please try to make the things that you
list words or phrases, but use complete sentences if you feel they are necessary.

When you cannot think of anything else to write about the word, go on to the next word. After you turn the page to the next word, DO NOT GO BACK. It is not important if you remember something new about a word that you have finished with.

You may not know much about some of the words in the book, that's okay too, skip that word and go on to the next. When you reach the last page, please check to see that you have done all 15 words in the book.

If you have any questions see the experimenter, otherwise, begin the book when you are ready.
Appendix P

Attribute Listing Instructions

(Children)
Tell the children that they are going to play another spaceman game called "Tell me about it"! Read the following instructions to them:

The purpose of the game is to tell the spaceman all of the things that you know about the words in this book so that he can understand Earth words--- (Experimenter indicates the book). Each word is printed on a separate page. You can use a separate line to write down each thing you know about the word on that page (Experimenter points to the top line, then the second line, then the third line of the front page).

Let's suppose that you're playing the game with the word "Spinach". If the word spinach was on the page, you'd write "green" on the first line. If you know that it tastes bad, you could write "tastes bad" on the second line. If you know that it's good for you, you could write "healthy" on the third line, and so on, until you couldn't think of anything else to write about the word spinach. Spelling is not important, just write all that you know. When you can't think of anything else to write go on to the next page. After you turn the page to the next word don't go back, it's not that
important if you remember something new about an old word. You may not know much about some words in the book, that's okay too, skip that one. If you can't read a word, raise your hand. I will come and read it to you. Remember, the game is to tell me what you know about it, not what your friend knows about it. Okay, let's begin.

Hand out the books and start.

After a child is finished, make sure he/she has printed his/her full name and age on the first page of the book. Check to make sure that he/she has written something on each page. If a page is blank say the following: "Did you forget this page or don't you know anything about this word?" If they missed a page by accident then say "Please finish this page now". If they skipped it on purpose say: "That's okay, I just wanted to be sure, thank you."
Appendix Q

Mean Number of Words Recalled by Age Group

and Type of Word
Mean Number of Words Recalled as a Function of Age Group and Type of Word

AGE GROUP

Grade 3 Grade 6 Adult

TYPICAL

ATYPICAL

UNFAMILIAR
Appendix R

Mean Typicality Accuracy Score by Age Group
and Type of Word
Mean Typicality Accuracy Score as a Function of Age Group and Type of Word
Appendix S

Mean Number of Attributes Listed Per Word

by Age Group and Type of Word
Mean Number of Attributes Listed as a Function of Age Group and Type of Word

Mean Number of Attributes Listed Per Word

AGE GROUP

Grade 3  Grade 6  Adult

TYPICAL
ATYPICAL
UNFAMILIAR
Appendix T

Intercorrelations Between Total Recall, the Knowledge Base Measures and Clustering (ARC) by Task for the Third Grade

<table>
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<th>Total Typicality</th>
<th>Total Attributes</th>
<th>ARC</th>
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<tbody>
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<td></td>
<td></td>
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<tr>
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<td>.194</td>
<td></td>
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<tr>
<td>Total Typicality</td>
<td>----</td>
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<td>.021</td>
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<tr>
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<td>----</td>
<td>----</td>
<td>-.014</td>
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<table>
<thead>
<tr>
<th></th>
<th>Total Recall</th>
<th>Total Typicality</th>
<th>Total Attributes</th>
<th>ARC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categorization (n = 22)</td>
<td></td>
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<tr>
<td>Total Recall</td>
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<td>Total Attributes</td>
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Note: <sup>a</sup> = significant at p<.02
Note: <sup>b</sup> = significant at p<.05
Appendix U

Intercorrelations Between Total Recall, the Knowledge Base Measures and Clustering (ARC) by Task for the Sixth Grade

<table>
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<th>ARC</th>
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Categorization (n = 25)

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<th>Total Attributes</th>
<th>ARC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Recall</td>
<td>-.377</td>
<td>.432(^a)</td>
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Note: \(^a\) = significant at p<.04
Appendix V

Intercorrelations Between Total Recall, the Knowledge Base Measures and Clustering (ARC) by Task for the Adults

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<th>ARC</th>
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Categorization (n = 21)

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<th>Total Attributes</th>
<th>ARC</th>
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<td>.433&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.475&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>-.157</td>
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Note: <sup>a</sup> = significant at p<.05
Note: <sup>b</sup> = significant at p<.01
Note: <sup>c</sup> = significant at p<.02
Note: <sup>d</sup> = significant at p<.04
## Appendix W

**Word Norms Used For Scoring the Typicality Task**

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<th>Item</th>
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Vita

Gary Todd Rosenthal was born in Flushing, New York, on November 22, 1955. He attended Jamaica High School in New York until 1972. He entered Louisiana State University the spring semester of that year majoring in journalism. His experiences as an undergraduate, working in a psychiatric setting, influenced him to change his major to psychology and to pursue an advanced degree in the area. After receiving his Bachelor of Arts degree from LSU in December, 1976, he enrolled in the LSU graduate school. In 1980, he received his Master of Arts degree in General Experimental Psychology with a split minor in Experimental Statistics and Anthropology. Later, he taught his first undergraduate course at LSU and was employed as an instructor until his graduation.

Gary Todd Rosenthal is a candidate for the Doctor of Philosophy degree at the fall commencement, December, 1984. Beginning December 4, 1984 he will be employed as an Assistant Professor of Psychology at Louisiana Tech University in Ruston, Louisiana.
EXAMINATION AND THESIS REPORT

Candidate: Gary Todd Rosenthal

Major Field: Psychology

Title of Thesis: Typicality and Familiarity Effects in Children's Memory: The Interaction of Processing and the Knowledge Base

Approved:

Robert C. Matthews
Major Professor and Chairman

William...Dean of the Graduate School

EXAMINING COMMITTEE:

Matthew W. Goff

Peter C. Lemmon

David C. Smith

Jeff Edmond

Sharon J. Isad

Date of Examination:

November 30, 1984