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AN INVESTIGATION OF SOURCE MEMORY IN LEARNING DISABLED CHILDREN

A Thesis

Presented to the

Department of Special Education

and Communication Disorders

and the

Faculty of the Graduate College

University of Nebraska

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

University of Nebraska at Omaha

by

Roseanne Hatt Ewing

August 1992

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THESIS ACCEPTANCE

Acceptance for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements for the degree Master of Science, University of Nebraska at Omaha.

Committee

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7/22/92
Date

ABSTRACT

Recognition memory and memory for source information were examined in learning disabled (LD) and nondisabled (NLD) children in two experimental conditions. In the listen-listen condition (external source monitoring), subjects watched a videotape in which two girls completed sentences that were constructed so as to highly constrain a terminal noun. In the think-listen condition (reality monitoring), subjects were asked to imagine themselves completing some sentences and to listen as a girl on the videotape completed other sentences. In each of the two experimental conditions, half of the stimuli were presented once, and half were presented twice. Recognition memory and source memory were tested for each of the terminal nouns.

This study observed that, while no differences were found between groups in regard to recognition memory, LD subjects were generally less able to discern the source of their memories than their NLD counterparts. These results confirm the hypothesis of Lorsbach et al. (1991) that, at least with verbal information, LD children possess a generalized deficit in remembering the source of their memories. The results also revealed that recognition and source memory were dissociated by the effects of population and acquisition condition. These dissociations support the

proposition that recognition and source memory are based on different mechanisms (Johnson & Raye, 1981).

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I find myself deeply indebted to the two Omaha-area school districts who participated in the study and to all of the special education administrators, principals, secretaries, teachers, parents, and student subjects who generously and graciously afforded me their full cooperation in data collection. This study could not have progressed beyond the proposal stage without them.

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I cannot resist this opportunity to thank my parents for the lifelong encouragement and support that has brought me to this point, and I wish to dedicate this work to the memory of my late father, whom I know would be very proud. I also would like to publicly thank my husband's parents for nearly two decades of unconditional faith in me. Finally, I wish to formally thank my husband, Lon, who relieved me, as much as possible, of practical matters so that I could delve into the theoretical; and my two young sons, Eric and Bryan, who respected my long hours of writing, tolerated my frequent inattentiveness, and succeeded in inventing the most humorous methods of distracting me when I needed it most.

Roseanne Hatt Ewing
July 23, 1992

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CHAPTER ONE

Introduction

The degree to which an individual is able to function in daily life depends, to a great extent, upon that individual's capacity to remember past happenings in the environment as entities that are separate and distinct from his or her own past thoughts, ideas, and plans. For example, when an individual fails to remember a certain event (e.g., a melody, a written passage, or an idea) as having been perceptually presented by a source outside of himself or herself, it is then possible for that individual to recreate that event with the belief that he or she has produced an original work. Depending on the particular circumstances, such oversights may result in disrupted personal relationships, workplace disputes, or even, by way of extrapolation, major legal allegations, such as in copyright infringements.

Even when an individual succeeds in recognizing the origin of a memory as one that was presented outside of himself or herself by the environment, he or she may experience difficulty in attributing that memory to a specific source. For example, a waitress may not remember which of two customers at a table ordered a steak cooked rare and which one ordered a well-done steak. Or, a librarian may not remember which of two students asked to reserve a particular book. A complex variation of this type of discrimination forms the basis for eyewitness testimonies in courts of law. For instance, a person who has witnessed an incident may subsequently be exposed to an inaccurate account of that same incident. Thus, the potential exists for some persons to confuse information contained in the erroneous account with the original, personally-witnessed information (see Cohen & Faulkner, 1989; Loftus, 1979). Thus, as with differentiation errors in memories for externally-perceived versus internally-generated events, errors in discriminating between the memories for several externally-perceived events may also carry consequences with serious implications.

Similarly, failure to discriminate between memories of internally-generated events has the potential to cause chaos in an individual's life. Many adults may ask themselves such questions as, "Did I unplug the coffeepot or did I only think about doing it?" or, "Have I already asked for tomorrow off or did I only plan on doing so?" When a memory is not clear, individuals may act according to decisions they make about certain characteristics of the memory. A person may reason that his/her memory of unplugging the coffeepot is so vague that it was probably only a thought that went unactualized. In contrast, an individual who is unsure of having talked with his or her boss may subsequently recall what the boss was wearing at the time of the conversation or the tone of his or her voice.

In each case, the actions being considered by the individuals are based on their conclusions about their memories and may be subject to further criteria in which the potential consequences of the actions are examined. For instance, the person who concluded that the coffeepot is still plugged in may or may not be worried enough about the possibility of a fire to return home to unplug the pot. Likewise, the individual with the work dilemma will need to evaluate whether it would be more damaging for him or her to erroneously decide that approval for the day off had already been obtained or to suffer the embarrassment of repeating something that had already been done.

A framework for memory discrimination (source monitoring) and related decision processes has been provided by the reality monitoring model of Johnson and Raye (1981). This model has been used to explain memory differences between a variety of populations, including manic and schizophrenic patients (Harvey, 1985); field dependent and field independent individuals (Durso, Reardon, & Jolly, 1985); and children and adults (e.g., Foley, Johnson, & Raye, 1983; Johnson, Raye, Hasher, & Chromiak, 1979; McIntyre & Craik, 1987). Additionally, the reality monitoring model has recently been applied to learning disabled populations (e.g., Lorsbach, Melendez, & Carroll-Maher, 1991).

Statement of Purpose

The purpose of the present study is to investigate whether a deficit exists in the source monitoring abilities of learning disabled children in two areas of discrimination: (1) discrimination between memories of self-generated, covertly expressed ideas and memories of external perceptions and (2) discrimination between memories of two external perceptions. Demonstration of these specific deficits, together with results of previous research, would provide strong evidence for the hypothesis that LD children possess a generalized deficit in remembering the source of memories containing verbal information (see Lorsbach et al., 1991).

Significance of the Problem

The proposed study has implications for a better understanding of specific memory difficulties of LD children. The consequences of the particular types of inaccurate source memory investigated in this study may affect the lives of LD children on a daily basis. For example, imagine that an LD child responds with the answer "13" to the problem 8 + 3. This student may persist in that response, even after teacher correction, if he or she is unable to accurately identify the source of the response as one that he or she provided and not one that the teacher had provided. Likewise, the same situation exists if the student hears an incorrect response generated by a classmate: If the LD student is unable to identify the source of the incorrect response as a classmate and not the teacher, he or she may persist in that error, even after teacher correction. Therefore, an impaired ability to trace information to appropriate sources may play a critical role in the learning difficulties of LD children. When the source is lost, LD students may perseverate their own miscues or miscues generated by classmates, even after teacher correction. The previous statements assume that appropriate decision processes and response biases are intact in this population, when, in actuality, these dimensions are also in need of further study.

CHAPTER TWO

Review of Related Research and Literature

Johnson and Raye's Reality Monitoring Model

Johnson and Raye (1981) coined the term "reality monitoring" to reflect their model's incorporation of components of the theories of reality testing and memory monitoring. Reality testing refers to the process of distinguishing current real events from present imaginations, whereas reality monitoring makes comparisons between memories of past perceptions and past imaginations. Also incorporated into the reality monitoring model is a concept from Hart's (1967) memory monitoring theory that judgments can be made about information in memory.

On a practical level, reality monitoring can be the process by which an individual is able to distinguish his or her own ideas, thoughts, and plans from those shared with him or her by others (e.g., "Is that *my* idea or have I seen it somewhere before?"). Sometimes, when the reality monitoring process goes awry, confusion is the result (e.g., "That's not *your* idea! I came up with it two weeks ago at our planning meeting.").

In their theoretical model, Johnson and Raye address possible reasons for confusion in reality monitoring. They contend that the accuracy of reality monitoring is influenced by two factors. First, reality monitoring depends upon the specific characteristics of the memory traces. Characteristics of memory traces are described as varying according to whether the memory resulted from an internally-generated idea or an externally-perceived event. According to Johnson and Raye (1981), memory traces resulting from perceptions have more spatial, contextual, and sensory attributes and more semantic detail. In contrast, internally generated memories "may typically have more [cognitive] operational attributes (coded in the trace)" (p. 71).

The second factor that affects the accuracy of reality monitoring is the decision strategies and biases which are derived from metamemory assumptions and applied to information in memory. The findings of Johnson and Raye (1981) indicate that ". . . subjects' assumptions about how their memories work will play a critical role in decision strategies and biases operating during reality monitoring" (p. 80). One such metamemory assumption is manifested by "the generation effect," an expectation by subjects that memories of self-generated events will be more vivid than memories of events that have external derivations (Slamecka & Graf, 1978). This assumption is displayed in the operation of a bias which Johnson and Raye (1981) have called "'it-had-to-be-you' ('I'd remember if it were me')" (p. 80). Research with different populations has found biases that are manifested and operate under a variety of conditions. For example, Cohen and Faulkner (1989) observed that elderly subjects were biased to decide that false positives (i.e., new actions incorrectly remembered as old actions) were watched instead of imagined. Foley, Johnson, and Raye (1983) observed that 9-year-old children in a say-listen condition were biased to attribute false positives to an external source, rather than to themselves. However, 6-year-olds did not demonstrate this bias. Instead, they were equally likely to attribute unfamiliar words to either source.

Review of Reality Monitoring Research

One of the key predictions of the reality monitoring model is that it should be easier to discriminate memories of different classes (e.g., telling a joke vs. hearing one) than to discriminate memories within the same class (e.g., thinking of telling a joke vs. actually telling one). A study by Raye and Johnson (1980) investigated the degree to which this may be true. In Experiment 1, a sample of college students was divided into four small groups and assigned various roles. In each group, two students were designated as speakers, two as recorders, and two or three students as listeners. All subjects thought that the speakers and recorders were serving as experimenters and that the listeners were the subjects, who would be given a memory test after the research task had been completed. Each small group was given a one-word topic (e.g., snow) as a point of departure for the "conversation" that was to follow. Individuals in each speaker pair were to alternate and produce a chain of words in which each response was highly related to the one which preceded it. Subjects were instructed to use common words and to respond quickly. For example, for the stimulus "snow," Speaker A might respond "white,"; Speaker B might counter A's response by saying "black," to which Speaker A might respond "coal," and so forth.

Recorder A was instructed to write down all of the words that Speaker A said, and Recorder B was to record all of Speaker B's words. The listeners were told to pay close attention since they would receive a memory test later. The task ended when each speaker had generated 15 words.

After attending a 1-hour lecture, <u>all</u> subjects (contrary to what they had been told) were paced through a memory test. Speakers were asked to identify the origin of words they remembered as either self-generated or having been produced by the other speaker; recorders and listeners were asked to attribute the source of words they remembered to one of the two speakers. The role of recorders resembled that of speakers in that recorders overtly produced half the words and performed a covert task (listening) in response to the other words. However, unlike speakers, recorders did not generate the words they produced overtly.

Data collected during this experiment revealed similar outcomes in both recognition and source identification for listeners and recorders, the two groups who discriminated between two external sources. However, speakers, who discriminated between self-generated and externally-presented words, were better at identifying the origin of words than any of the other subjects. According to the reality monitoring model, subjects distinguishing between an internal and external memory (speakers) would be expected to be better at identifying the origin of words than subjects discriminating between two external sources (recorders and listeners). This hypothesis was confirmed by the experimental data.

Raye and Johnson (1980) contend that their findings support the proposed differences between the two classes of memories. When memories come from different classes, the discrepancies between them are more apparent than when memories originate within the same class. The distinctiveness of between-class memories may, in part, be due to the cognitive operations information contained in internally-generated ideas. This information is typical of memories for internally-generated ideas and is noticeably deficient in memories of externally-perceived events. Such a discrepancy may be used as a cue in external-internal discriminations that is not available for discriminations involving memories of the same class.

Raye and Johnson (1980) further defined the characteristics of memory traces by examining memories for internally-generated and externally-presented events for differences in idiosyncratic value. It was proposed that memories of internally-generated ideas would contain a higher degree of "biographical information or information relevant to the 'self'" (p. 406). This proposition was investigated in a second experiment, where the words that were generated were highly constrained by cues, thereby eliminating as much as possible any idiosyncratic information that would otherwise be available.

Using all new subjects, Experiment 2 utilized the same role assignments as for the first experiment with the addition of a director. The director presented the items of the acquisition task to the speakers and indicated which speaker was to answer, the type of question (opposites or category instances), and the first and last letter of the answer. For example, the director might indicate that Speaker A was to answer the following question on opposites: "'What is a word that is the opposite of fast, beginning with s and ending with w?'" (Raye & Johnson, 1980, p. 406). The outcome of interest was whether subjects discriminating between internal and external memories would continue to show superior origin identification even when idiosyncratic cues were eliminated.

As in Experiment 1, speakers in Experiment 2 were much better than listeners and recorders at identifying the origin of responses. This result rules out the possibility that the superior performance of speakers in Experiment 1 can be entirely attributed to the idiosyncratic value of the response since responses in Experiment 2 were, for all practical purposes, devoid of such information. Although idiosyncratic cues would be a logical component of reasoning processes in reality monitoring, the results of this experiment "are consistent with the possibility that, independent of the personal significance of what an individual says, the cognitive operations that go into generating information persist in memory and become potential cues as to the origin of that information" (Raye & Johnson, 1980, p. 408).

Another interesting result was that directors were as good as other subjects at recognizing items as old, even though they were less able to identify the origin of these old items. According to Raye and Johnson (1980), this finding suggests that "simply attending to the items does not guarantee correct identification of origin. The dissociation of memory for occurrence and identification of origin indicates they are not based on exactly the same information or mechanism" (p. 407).

The dissociation of memory for occurrence and identification of origin was further corroborated by Lindsay and Johnson (1991). The essential point of this study was "that the conditions that led to superior recognition performance were precisely those that led to inferior source monitoring performance" (p. 205). College-aged subjects were assigned to two conditions, deep-deep and deep-shallow. Each subject was presented with cards from two sets, with words from one set being introduced on the left and words from the other set being introduced on the right. Subjects in the deep-shallow condition were asked to make up a sentence for each word presented on the left and to count the number of "E"s in words presented on the right. Subjects in the deep-deep condition were asked to make up sentences for both sets of words, regardless of the site of presentation.

Half of the subjects in each condition were subsequently given a recognition test in which target words presented on the right were intermixed with new items. The remaining subjects were given a source monitoring test, consisting of 20 words presented on the right intermixed with 20 words presented on the left.

Experimental results indicated that subjects were better at discriminating the origin of words when they had processed the words on each side in different ways than when they had performed the same task for all the words. Lindsay and Johnson (1991), therefore, concluded that " . . . it appears that subjects can use information about the kinds of cognitive operations associated with potential sources to identify the source of memories" (pp. 204-205). In regard to recognition of target items, words that were processed deeply were better recognized as old than words that had only been processed at a shallow level. Lindsay and Johnson (1991) contend that their findings "demonstrate that the aspects of memories that support recognition judgments are not necessarily the same as those that support source monitoring judgments . . ." (p. 205). Thus, the results of this experiment corroborate the findings of Raye and Johnson (1980).

A 1979 study by Johnson, Raye, Hasher, and Chromiak investigated the question of whether repeated imaginations could alter the memory trace of an internal generation to such an extent as to make it resemble the memory of a similar externally-perceived event. In the following experiment, the researchers expected that, if repeated imaginings were being confused with external presentations, subjects would give inflated estimates of the number of times external presentations had occurred.

Subjects at each of four grade levels (second, fourth, sixth, and college) were individually tested. Pictures of common objects that children would recognize were photographed, made into color slides, and assigned to each of nine conditions that were produced from the combination of three presentation frequencies (1, 2, and 3 times) and three imagination frequencies (0, 1, and 3 times). During the study phase of the experiment, subjects were presented with alternating blocks of eight slide presentations and eight imagination trials. In a subsequent recognition test, subjects were shown each picture and asked to make a judgment about how many times the picture had been presented.

In this experiment, Johnson et al. (1979) expected that "children would be more likely to confuse their thoughts with external events and, thus, show more confusion about how often they had seen things" (review by Johnson and Foley, 1984, p. 41). Experimental data revealed several interesting patterns in reference to this expectation. First of all, judgments of all subjects across all age levels appeared to be appropriately affected by the number of times a slide was presented (i.e., judging the more frequently presented slides as having been presented more frequently). Secondly, the effects of imagination frequency on judgments of presentation frequency were analyzed. All subjects gave inflated estimates of actual presentation frequency for slides that were imagined more frequently. This was a surprising outcome in that, contrary to what was anticipated, children displayed no greater confusion than adult subjects (Johnson & Foley, 1984).

Johnson, Raye, and Durso (1980) explored a related condition by examining whether repeating subject-generated information would have the effect of increasing the sensory attributes of the corresponding memory traces to such a level as to make them resemble memories for external events. Subjects were presented with an audiotape of sentences lacking a terminal noun. The sentences were composed so that the last word was highly constrained by the context (e.g., "A chair is a piece of _________."). Sentences were randomly selected and assigned to each of four conditions: generation by the subject one time, generation by the subject two times, presentation by the experimenter one time, and presentation by the experimenter two times.

Only sentences that produced complete agreement among pilot subjects were included in the study in an effort to control to the greatest degree possible the responses subjects would generate. For half of the sentences, subjects listened as an experimenter supplied the answer, and for the other half, subjects covertly generated the response. Shortly after the end of the acquisition phase, subjects were given a recognition test in which they indicated whether items on a list had been self-generated or experimenter-presented or were completely new.

The premise underlying this experimental procedure was that repeating subject-generated words would increase the amount of their sensory attributes, thus altering them to resemble experimenter-presented words and leading to confusion. However, the data did not bear this out. Repetitions actually reduced the tendency of subjects to wrongly identify self-generated words as experimenter-presented items. Johnson et al. (1980) hypothesized that instead of altering memories for self-generated ideas, repetitions reinforced those characteristics of the trace that made them identifiable as internally generated. Repetitions, therefore, increased the chances that the subject had the necessary information to identify the trace as internally generated. Results of this study revealed that, for externally-presented items and internally-generated items alike, repeating an item increased correct origin decisions. Johnson et al. (1980) concluded that

> Since there was virtually no opportunity for idiosyncratically meaningful responses in these highly constrained contexts, the most reasonable explanation

> for the results is that origin decisions were based in part on information about cognitive operations, and repeating an operation increased its availability. (p. 403)

Subjects in this experiment also showed a bias toward identifying unfamiliar items more often as externally presented than internally generated. This phenomenon has been called by Johnson and Raye (1981) "'it-had-to-be-you' ('I'd remember if it were me')" (p. 80).

These results seem to contradict the findings of Johnson et al. (1979), in which repeated imaginations of externally-presented stimuli resulted in confusion over the actual number of presentations of the stimuli. It must first be noted that the Johnson et al. (1979) study analyzed frequency confusion, whereas Johnson et al. (1980) investigated source confusion. Additionally, the two studies utilized fundamentally different experimental tasks. The experimental task of Johnson et al. (1979) required subjects to repeatedly imagine events that were originally externally-presented, a far different task than repeatedly imagining events that were initially self-generated, as in Johnson et al. (1980). Therefore, a logical explanation for the seeming contradiction between the findings of the two studies is that thinking of events that were previously perceived may be different than thinking of events that were initially self-generated.

Johnson, Raye, Foley, and Foley (1981) later used the technique of response constrainment to investigate whether the amount of cognitive operations information included in a memory trace could be limited by the automaticity of a response. They theorized that the more strongly a response is indicated by a given stimulus, the more automatic that response is, and the less that memory will include information about cognitive processes such as search and decision making. The results of this study were consistent with the theory proposed: As cognitive operations increased, the accuracy of identifying the origin of the words increased.

The first of three experiments in this study involved three between-subjects factors: type of material (category instances vs. opposites), type of expression (overt vs. covert), and type of cue (first letter vs. no letter). Externally-perceived versus self-generated response was a within-subjects factor. All subjects were undergraduate student volunteers.

In the first-letter condition for each type of material, subjects used a response sheet that included the first letter of both E (experimenter-presented) and S (subject-generated) items. Subjects in the overt condition recorded their answers on the response sheet; subjects in the covert condition indicated with a checkmark or a zero whether or not they had generated a response. Subjects were instructed to give common responses that they thought most other people would give and were told that all responses were equally important. Subjects were not warned about a subsequent recognition test.

After the acquisition phase, response sheets were collected and subjects were asked to recall their responses in any order. A cued recall test was also given in which subjects were asked to write the responses that went with the presented stimuli and to indicate whether they had heard the response on the tape or had generated it themselves.

The first question investigated was whether increasing automaticity of a self-generated response would limit the amount of cognitive operations in the response to such an extent that the memory trace would resemble, and be mistaken for, an externally-presented item. The data revealed that, for self-generated responses in the category condition, first-letter cues resulted in fewer correct identifications of origin.

As predicted by the reality monitoring model, memories for self-generated ideas can be confused with memories of perceived events if the amount of cognitive operations information coded in the memory trace is limited. In the opposites condition, the same pattern was not observed. However, this seeming discrepancy has a reasonable explanation: Responses in the opposites category were already constrained to a high degree by virtue of the condition and stimulus. Their production would, therefore, not require much in the the way of search and decision processes in the first place, even without the first-letter cues.

A second pattern of results emerged in a materials by origin interaction. In the opposites condition, E items were more easily identified than S items, whereas in the category condition, the reverse was true. This polar result could be attributed to the effect of the "it-had-to-be-you" bias operating in the opposites condition. Whenever subjects were unsure of a response, they were more likely to call it E and thus raise the identification score for E items. The bias was operative in the opposites condition and not in the category condition because generating opposites produced less cognitive information which, in turn, presented the subject with the opportunity to use decision-making processes where the bias would unwittingly be applied.

A third pattern of results revealed superior identification of origin for overt items as compared to covert items. This was a surprising finding because, according to Johnson et al. (1981),

> It would seem that writing down both E and S items would _reduce_ the discriminability between the two by increasing the overlap in similar information stored with each event, compared with simply listening to E items and silently generating S items. (p. 46)

One explanation for this phenomenon is that writing the item merely rehearses the initial generation, which would be characteristically different for E and S items. According to Johnson et al. (1981),

> . . . as the subject writes down an E item, it is done with reference to the original external experience, and thus the memory of the external experience is being rehearsed (or the initial experience is extended). In contrast, as the subject writes down an S item, it is done with reference to the original internal event, and thus the internal event is being rehearsed. (p. 46)

Therefore, a subject's accuracy in origin identification was found to be influenced by type of production (overt vs. covert).

A fourth finding was related to the "generation effect." A phenomenon previously noted by Slamecka and Graf (1978), the generation effect refers to the finding that recognition of memories for self-generated information is superior to the recognition of memories for externally-perceived information. The generation effect was observed to be operative in covert and overt conditions alike, thereby substantiating the theory of Johnson et al. (1981) that

> . . . the locus of the advantage [for self-generated information] is in the generation process itself and does not, for example, depend upon overt expression of the generated item and consequent sensory components (e.g., hearing one's own voice or seeing one's own handwriting), or on some combination of generation and sensory components. (p. 46)

In the second experiment of this study, Johnson et al. (1981) investigated the nature of the generation effect and the limits of the retention period. In the first phase of the experiment, subjects saw a stimulus and 1st-letter cue for both category and opposite items. For half the items, the response was given and for the other half, the response was to be subject-generated. For category items, half of the instances were the most common instance (e.g., fruit-apple) and half were less common instances (e.g., animal-pig). These stimuli with their 1st letter cues were given to the subject on a response sheet, where he or she was asked to write down the response given by the experimenter or to generate one. Subjects were again instructed to give common responses. Ten days later, subjects were paced through a recognition test in which they were asked to identify each response as experimenter-presented (E), subject-generated (S), or new (N). Subjects were also asked to indicate their confidence in the accuracy of each response.

The results of this experiment yielded that, even after 10 days, S items were easier to identify than E items. This finding was corroborated by high confidence ratings obtained for these items. Further, when new items were mistakenly identified as old, the generation effect manifested itself in the "it-had-to-be-you" bias (calling items E instead of S).

The third experiment of this series investigated the cotemporal generation of ideas to external event stimuli. This condition has direct relevance to real life in that an idea is often formulated in response to an external stimulus (e.g., as in conversations) from which one may later wish to distinguish it. In this experiment, subjects were asked to generate responses to E items according to three conditions: first letter (e.g., apple-airplane), meaningful relationship (e.g., apple-earth), and unrelated (e.g., apple-clown). Immediately after the acquisition phase, subjects were asked to recall as many of their responses as they could. One week later, subjects were paced through a surprise recognition test in which they were asked to indicate the origin of each item as experimenter-presented, self-generated, or new, and to describe how they were able to identify the sources of the items.

Johnson et al. (1981) noted that

> Interestingly, subjects tended to mention sensory cues more often with respect to E items ("I differentiated words which you said by remembering your pronunciation," "I could visualize your saying it," or "The words which the E stated were remembered in her voice"). Cognitive processing, additional information, and semantic content were mentioned more in conjunction with S items ("When I was very sure [about my words] I could remember I had a very specific reason for making the association. If the word [only] seemed familiar, I would say that it was the experimenter's word," "I made the decision by knowing what my train of thought was during the exercise," "Sometimes the words I chose went together with a certain scene, i.e., pond, cloud, tree, etc. And, when I saw the words again I tried to remember if they fit in any of the images I had"). (p. 58)

Overall results of the Johnson et al. (1981) study yielded that in the first-letter condition and unrelated condition, subjects had superior memory for S items over E items, both in immediate recall and after a 1-week retention period. In contrast, poor reality monitoring was observed when S and E items were highly related semantically. The "it-had-to-be-you" bias was also apparent: "When a completely new item was thought to be old, the subjects in all three conditions were about three times more likely to attribute it to an external source than to say they generated it themselves" (Johnson et al., 1981, p. 59).

<u>Conclusions of Reality Monitoring Research</u>

Reality monitoring research with normal young adult subjects has reported a number of useful findings by which the theoretical model is assumed to operate. The following list summarizes the primary observations of the reality monitoring model:

1. Characteristics of memory traces. Characteristics of memory traces vary according to whether the memory trace originated from an internally-generated idea or an externally-perceived event (Raye & Johnson, 1980).

2. Characteristics of memories by class. Memory traces resulting from perceptions have more spatial, contextual, and sensory attributes and more semantic detail whereas internally-generated memories have more information about cognitive operations coded in the trace (Johnson et al., 1980; Johnson et al., 1981; Lindsay & Johnson, 1991; Raye & Johnson, 1980).

3. Between-class versus within-class distinctions. It is easier to discriminate between memories of different classes than to discriminate between memories within the same class (Raye & Johnson, 1980).

In addition to describing the general dimensions of the reality monitoring model, the available literature seems to suggest a number of variables that may affect reality monitoring performance. These are enumerated in the list that follows:

1. Dissociation of occurrence and identification. Memories for occurrence and identification of origin are not based on exactly the same information or mechanism (Lindsay & Johnson, 1991; Raye & Johnson, 1980).

2. "It-had-to-be-you (I'd-remember-if-it-were-me)." The superior memorability of self-generated information in recognition and recall is called the generation effect (Slamecka & Graf, 1978). Manifestation of the generation effect is observed in the presence of the "it-had-to-be-you" bias during source decisions. Aptly described by the phrase "it-had-to-be-you (I'd-remember-if-it-were-me), the bias is demonstrated by an increased likelihood that subjects will identify the origin of unfamiliar items as externally presented rather than self-generated (Johnson et al., 1980; Johnson et al., 1981; Raye & Johnson, 1980).

3. Automaticity. Information about cognitive operations can be limited by the automaticity of initial processing (Johnson et al., 1980; Johnson et al., 1981; Lindsay & Johnson, 1991).

4. Idiosyncratic value. Idiosyncratic value, although a logical component of internally-generated memories, is not a major cue in origin discrimination (Raye & Johnson, 1980).

5. Frequency. Repeatedly thinking about events that have been perceived may result in inflated estimates of the number of times the event was actually perceived or actually happened. This tendency is not subject to developmental differences (Johnson et al., 1979).

6. Repetition. Repeated imaginations of pictorial generations, as well as repeated verbal generations, do not increase sensory information in the trace that would make the trace resemble an external memory. In contrast, both types of repetition reinforce the characteristics of the original trace, making that information more available for discriminations and resulting in increased accuracy of origin identification (Johnson et al., 1979; Johnson et al., 1980).

7. Mode of expression. Rather than obscuring the differences between internally-generated and externally-perceived events, overt expression of both types of events increases the accuracy of origin identification. The

beneficial effect of overt expression upon source monitoring presumably is due to the rehearsal of the memory of the original experience. In this case, rehearsal serves to strengthen those features that enable the individual to subsequently discriminate between the two kinds of events (Johnson et al., 1981; Raye & Johnson, 1980).

8. Semantic relationship of stimulus and response. If external stimuli and internal generations are highly related semantically, reality monitoring will be compromised (Johnson et al., 1981; Raye & Johnson, 1980).

Developmental Differences in Source Monitoring

The effect of aging on source monitoring. Source amnesia and source forgetting are distinctive memory failures distinguishable by the following: Source amnesia refers to the failure of a subject to recognize that a particular fact had been learned as part of an experiment (occurrence); source forgetting, on the other hand, refers to the case when a subject is able to remember that a fact came from the experiment but is unable to identify the source (origin) of the information (i.e., which of two experimenters presented it) (Schacter, Harbluk, & McLachan, 1984). Research experiments do not necessarily generate both kinds of information simultaneously, unless they are designed to do so.

Several studies have investigated the effects of normal aging on source amnesia and source forgetting in older adults (e.g., Cohen & Faulkner, 1989; Hashtroudi, Johnson, & Chrosniak, 1989; McIntyre & Craik, 1987; Rabinowitz, 1989). In comparing source monitoring abilities in younger and older adults, McIntyre and Craik (1987) concluded that "with real-life factual material that is familiar to older people, the older subjects showed superior knowledge, equivalent episodic recall, but poorer memory for the source of new facts" (p. 183).

Hashtroudi et al. (1989) concluded from experiments using verbally-presented word acquisition lists that older adults have a specific rather than a generalized source monitoring deficit. Older adults did not demonstrate difficulty in reality monitoring; i.e., discriminating memories for self-generated information from memories for externally-perceived information. However, Hashtroudi et al. (1989) note that

> . . . older adults showed marked deficits in discriminating between two memories of the same class (external and internal source monitoring). It should be emphasized, however, that age deficits in source monitoring would not necessarily be limited to within-class discriminations. As noted earlier, if the external and the internal sources are very similar on a

> number of dimensions, then there might be an age difference in reality monitoring as well. (p. 110)

Rabinowitz (1989) obtained results consistent with the above findings in two experiments with younger and older adults using word fragments. He proposed that "the locus of the age-related deficit in discrimination may be the decision process" (p. 266). Rabinowitz based this proposition on particular observations within Johnson and Raye's reality monitoring model (1981). Specifically, these observations were that cognitive operations would be the primary cue for discriminating between general classes of memories and that semantic, sensory, and contextual information would be less effective. Rabinowitz theorized that less accurate reality monitoring could be expected from older adults if they relied on the less effective types of cues more than younger adults. He accepted the observed operation of the "it-had-to-be-you" bias in younger adults and not in older adults as evidence that his theory was correct. Rabinowitz maintained that, lacking any memory of cognitive operations, younger adults made the decision that the origin of a memory is external by default. However, as mentioned previously, older adults did not demonstrate this bias; instead, a neutral bias or a bias toward self-generation was in evidence. Therefore, if older adults based origin decisions on different information than younger adults, the absence of cognitive operations information would not induce them to conclude that the memory was of an external event.

Cohen and Faulkner (1989) extended the effect of normal aging on source forgetting to action materials. Three groups of subjects were compared: a young group ($\underline{M}$ age = 31), a young-old group ($\underline{M}$ age = 65), and an old-old group ($\underline{M}$ age = 76). Subjects responded to cards indicating an action involving common objects arranged on a grid and one of three commands (perform, watch, or imagine). In perform trials, subjects performed the action; in watch trials, subjects watched as the experimenter performed the action; and in imagine trials, subjects were to look at the objects mentioned and imagine performing the action. Subjects expected a memory test of the actions that had occurred during the experiment but did not expect that the source of the actions would be tested. Nonetheless, in the subsequent recognition test, subjects were asked to identify the source of each experimental action as performed, watched, imagined, or new.

With regard to source amnesia, Cohen and Faulkner's (1989) results showed "no age decrement in ability to recognize old actions . . ." (p. 13). However, evidence of source forgetting was apparent. Compared to younger groups, the old-old group was more likely to identify imagined items as ones they watched and watched actions as ones they performed, although accuracy was better for watched and performed actions compared to imagined ones. As noted by Cohen and Faulkner (1989), "This pattern of errors reflects both failures to distinguish between internal and external sources and failure to distinguish between self- and other-generated actions" (p. 13).

Child development and source monitoring. The reality monitoring paradigm was applied to source monitoring in children in a multiexperiment study by Foley et al. (1983). In the first experiment, 6-year-olds, 9-year-olds, and 17-year-olds were compared across two conditions, say-think and say-listen. In the say-think condition, subjects were directly asked to pronounce some words aloud and to imagine themselves saying other words aloud. Subjects in the say-listen condition were asked to either pronounce words aloud or to listen to words being pronounced by a second experimenter. Words chosen for the study were common nouns from children's storybooks.

After the completion of the acquisition phase, a memory test was given. The experimenter read each word aloud and asked subjects in the say-listen condition whether the item was a word they had said, a word they had listened to, or a completely new word. Subjects in the say-think condition were asked whether each word was one they had said, one they had thought, or completely new.

Experimental results revealed that 9-year-olds performed as well in the say-think condition as in the say-listen condition. However, 6-year-olds gave unequal performances across those two conditions, as did 17-year-olds. Although 6-year-olds were as good as 17-year-olds in discriminating the origin of memories between classes (say-listen), this youngest age group demonstrated much greater difficulty in discriminating words they said from those they thought (an overt vs. covert within-class distinction). Results in the say-listen condition are consistent with earlier research (Johnson et al., 1979), suggesting that the ability to discriminate the origin of memories of different classes is well-developed by second grade. It additionally suggests the possibility that between-class discrimination abilities may be in place at a somewhat earlier age.

A second experiment was conducted to investigate whether the apparent difficulty of 6-year-olds in the say-think condition in the first experiment would be observable in a covertly expressed between-class discrimination task and in a within-class discrimination task of externally-perceived stimuli.

The basic procedures and materials were the same as for the first experiment, except that 17-year-olds were not used in the sample. In a new condition, the listen-listen condition, children were instructed to listen while the experimenter asked two adults to pronounce words out loud. In another new condition, think-listen, subjects were instructed to imagine themselves saying some words and to listen while another person said other words. Children in the say-think and say-listen conditions were given the same instructions for the acquisition phase and recognition test as in the previous experiment.

Results of the first experiment were replicated in that 6-year-olds had a difficult time discriminating in the say-think but not in the say-listen condition. In addition, results obtained with 9-year-olds across experiments did not support the prediction that the say-think condition would be more difficult than the say-listen condition (Foley et al., 1983).

If 6-year-olds have difficulty in the say-think condition because younger children have trouble with within-class discriminations, then it would also be expected that this age group would experience difficulty in the listen-listen condition. In contrast with this expectation, results of the second experiment indicated that 6-year-olds performed as well as 9-year-olds in the listen-listen condition. Further, the 6-year-olds performed as well in the think-listen condition of this experiment as they did in the say-listen condition. Thus, 6-year-olds did not demonstrate difficulty in discriminating memories of their thoughts from their memories of external perceptions. Additionally, identification of origin was good even when the generation was covert.

The Johnson-Raye model would predict a difference between the say-listen and listen-listen conditions because within-class distinctions should be more difficult to make than between-class distinctions. As expected, subjects earned higher scores in the say-listen condition, the condition calling for a between-class discrimination.

> According to the model, the greater difficulty of the listen-listen condition is because subjects have to rely on specific memory attributes of their experiences such as the speaker's voices or contextual attributes such as where the speakers were seated in the room to help them differentiate among their memories for who said what. In contrast, in the say-listen condition, subjects can take advantage of the several general dimensions on which the classes of internally and externally derived memories differ, such as, self-generated memories usually are richer in information about cognitive operations that occurred when the memory traces were established. (Foley et al., 1983, p. 56)

Another possibility to consider would be that 6-year-olds are unable to discriminate memories of their thoughts from any other category. However, results of the think-listen condition rule out this explanation. Six-year-olds were at no disadvantage compared with 9-year-olds in discriminating between words they thought and words they heard. This outcome suggests that some distinctions may emerge sooner than others (e.g., the distinction of self vs. others may emerge sooner than the distinction of one's thoughts vs. one's actions).

According to Johnson and Foley (1984), the ability of 6-year-old subjects to discern memories in the think-listen condition but not in the say-think condition

> . . . is important for several reasons. It shows that the disruption in children's performance in the say-think condition is not based on a general deficit in making decisions involving memories for imagined events. It also suggests that young children can understand instructions to identify imagined items. Finally, the results for the think-listen condition argue against Piaget's proposition that children have no idea about the origin of their own thoughts . . . The 6-year-olds' deficit . . . was specific to distinguishing their own thoughts about an action from their own actual actions--at least in the case of

thinking about speaking versus actually speaking (p. 43).

Further research investigated whether this deficit would generalize to different types of activities. Foley and Johnson (1985) paralleled the say-listen, listen-listen, and say-think conditions with the activity-related conditions of do-watch, watch-watch, and do-pretend. Six-year-olds, 9-year-olds, and college-aged students were randomly assigned to one of the three conditions and responded to the appropriate "do," "watch," or "pretend" commands for a range of activities. After the experimental task was completed, subjects were given a test of free recall, as well as a recognition test. In the recognition test, subjects were read a list of actions by the experimenter and asked to identify them as old or new. Whenever subjects identified an action as old, they were then asked to identify the origin of that action.

Analysis of the results indicated that children did not differ from adults in their ability to discriminate their own actions from the actions of others (do-watch); or in their ability to discriminate between the actions of two other people (watch-watch). These results were similar to those obtained with verbal materials in the say-listen and listen-listen conditions of Foley et al. (1983). However, a difference was noted between the say-think condition of

Foley et al. (1983) and its action parallel, the do-pretend condition of Foley and Johnson (1985). In the say-think condition of Foley et al. (1983), 9-year-olds were better than 6-year-olds in discriminating what they said from what they thought. In contrast, Foley and Johnson (1985) found that both 6-year-olds and 9-year-olds had difficulty in discriminating what they had done from what they had imagined doing.

In summary, findings obtained by Foley and Johnson (1985) regarding activity-related source monitoring paralleled findings obtained by Foley et al. (1983) with verbal materials. Additionally, the internal source monitoring difficulties demonstrated by 6-year-olds with verbal materials in the Foley et al. (1983) study were extended to 9-year-olds in the Foley and Johnson (1985) study when action materials were used. Thus, the findings of Foley et al. (1983) were found to be highly generalizable to a wide range of activities.

Further, results obtained by Foley and Johnson (1985; Experiment 1) with adult subjects were consistent with results obtained by Anderson (1984; Experiment 1) as part of a series of source monitoring experiments in which action materials were utilized with college students. In the first of five experiments of this study, subjects were asked to trace, imagine tracing, or look at line drawings and words.

Results revealed that the origins of tracing and looking at items were more consistently identified than those of imagining. One explanation for this result is

> the memory code of imagining may contain some attributes that can be interpreted as evidence for tracing and some that can be interpreted as evidence for looking. In this case, imagining may be less identifiable in memory than either tracing or looking, whose memory codes contain attributes that are consistent with only one other activity. (Anderson, 1984, p. 599)

Brief summary and synthesis. A brief synthesis of research reviewed thus far would describe superior source monitoring in normal young adults relative to between-class discriminations, where the presence or absence of cognitive operations information is a major determinant in the judgment of whether a memory was internally generated or externally perceived. Of the possible within-class discriminations, young adults had the most difficulty differentiating the origins of words they said from words they thought. Source monitoring patterns with verbal materials were found to be generalizable to action materials, with young adults finding it most difficult to discriminate what they did from what they imagined doing. The superiority of memories for self-generated information (the generation effect) was found to manifest itself in a bias which caused young adults to judge the origin of memories of which they were uncertain as having been externally presented.

When compared with younger adults, older adults were found to demonstrate specific deficits in within-class discriminations, but not in the reality monitoring of verbal materials. With action materials, both within-class and reality monitoring deficits were observed with older adults. Additionally, there is some evidence "that naturally occurring errors in reality monitoring increase after the age of 70" (Cohen & Faulkner, p. 14).

The generation effect was observed in this population also, but when the origin of memories was unclear, older adults demonstrated a different type of bias in their decision making. While younger adults may judge a memory that lacks cognitive operations information as externally perceived, older adults demonstrate a neutral or opposite bias. Such biases may be the result of the combined use of cognitive operations information with less effective types of information (e.g., sensory) in the decision process.

Using young populations in order to obtain a developmental perspective, Foley et al. (1983) found that, when compared to older children, only 6-year-olds had specific deficits with verbal materials in discriminating words they said from those they imagined themselves saying (say-think condition). When action materials were used, both 6-year-olds and 9-year-olds had difficulty in discriminating imagined versus performed actions (do-pretend condition). The generation effect and apparent operation of normal biases were also observed with children as young as 6 years old.

Individual Differences in Source Monitoring

Source monitoring research with psychotics.

While deficits in source monitoring have been associated with some types of memory disorders (e.g., Alzheimer's disease and amnesic patients [see Cohen & Faulkner, 1989]), an interesting pattern of source monitoring deficits has also been found with various thought disorders.

Results obtained by Harvey (1985) indicated that non thought-disordered (NTD) schizophrenic and manic patients had no difficulties in source monitoring with word list materials. However, both groups of thought-disordered (TD) patients demonstrated varying source monitoring deficits. Thought-disordered schizophrenics experienced difficulty in discriminating within-class self-generated memories, particularly in the case of distinguishing memories for thoughts from memories for words they said (say-think condition); they simultaneously performed as competently as normal subjects in discriminating information from two external sources (listen-listen condition). In contrast, TD manics demonstrated a specific deficiency in discriminating external within-class memories.

The primary finding of this study was the discovery of a difference in the response biases of NTD and TD individuals. Both normal adult subjects and NTD patients demonstrated a response bias in the think-listen condition toward misidentifying the source of list items and new items mistaken for old as words they thought rather than said. However, TD patients did not demonstrate this bias. Instead, TD patients erred in the direction of believing to have said information they had only thought.

Harvey (1985) emphasizes the importance of the response bias by alluding to the developmental research of Foley et al. (1983), in which a deficit in the say-think condition was demonstrated by 6-year-olds. Harvey (1985) argues that the difference between normal 6-year-old children and TD schizophrenics, both of whom demonstrate difficulty in discriminating the memories of their thoughts from memories of what they said, is that 6-year-olds

> tend to err in the direction of incorrectly reporting that they thought information, while TD patients err in the opposite direction . . . [The errors of 6-year-old children,] like those of normal adults, reflect a bias

that would not lead to the erroneous assumption that never-presented information has been said" (p. 72).

Source monitoring research with learning disabled children. Lorsbach et al. (1991) examined source memory in LD and NLD children enrolled in grades 2 and 6. A series of sentences was constructed that highly constrained terminal nouns (e.g., "Kermit is the name of a ________.").

An equal number of LD and NLD subjects at each grade level were randomly assigned to one of two conditions, say-think and say-listen. In the say-think condition, subjects were presented with incomplete sentences that were missing the terminal noun and were cued by an experimenter to complete each sentence by saying the word aloud or by thinking of themselves saying the word aloud. In the say-listen condition, subjects were cued to complete each sentence by saying the word aloud or by listening as the person on the tape completed the sentence.

In the subsequent recognition task, the experimenter read a list of words consisting of the nouns used in the acquisition task plus new words that served as control items. Upon hearing a given noun, subjects were asked to decide whether the word had been used to complete one of the previous sentences. In addition, if subjects indicated that a particular noun had been used to complete a sentence, they were then asked to decide whether they had said the word aloud or imagined saying it (for the say-think condition) or whether they had said the word aloud or listened to it on audiotape (for the say-listen condition).

Results of this study indicated that the recognition performance of NLD subjects was significantly higher than LD subjects. In addition, within their respective populations, sixth-grade subjects demonstrated better recognition than second-grade subjects. Within-class discrimination (say-think) was more difficult than reality monitoring (say-listen) for all groups. These results also indicate that, with the exception of the youngest LD children, subjects benefited by overtly saying words as compared with covertly thinking them. The discovery of an advantage for overt expression over covert is consistent with results obtained by Raye and Johnson (1980), who had made a similar observation relative to college-aged populations.

The results of previous research suggest that LD children possess a generalized deficit in the source monitoring of verbal information. The present study seeks to examine the generalizability of the memory deficit by examining two other conditions: Listen-listen (a within-class discrimination between two external sources) and think-listen (a between-class discrimination with covert generation). Deficits demonstrated in these two conditions, together with previous research, would strongly suggest a generalized deficit in the source monitoring of LD children, at least in memory for verbal information.

CHAPTER THREE

Methodology

Subjects

Thirty-eight learning disabled (LD) sixth-graders and 36 nondisabled (NLD) sixth-graders were selected randomly from two predominantly white, suburban school districts in Omaha, Nebraska. Twenty-eight boys and 10 girls comprised the LD group, and 24 boys and 12 girls were in the NLD group. The mean chronological ages for LD and NLD subjects were 12.13 (SD = .51) and 11.98 (SD = .41), respectively.

LD children were previously identified by school district personnel as learning disabled and as receiving services at the time of testing. Verification of a learning disability by school district personnel was based primarily upon two criteria. First, the child's full scale IQ was above the -1 standard deviation level on an individually administered intelligence test. For those children who had a discrepancy between composite scores that was greater than 1 standard deviation, the higher score was used as the index of ability. The mean Verbal, Performance, and Full Scale IQ scores for the LD group were 99.25 (SD = 12.42), 107.41 (SD = 10.55), and 103.05 (SD = 9.80), respectively. Secondly, the child's standard score in one or more academic areas was 1.3 standard deviations or more below the child's ability level and fell at or below 90 standard score points. The mean standard scores in reading and math achievement in the Wide Range Achievement Test-Revised (Jastak & Wilkinson, 1984) were 82.97 (*SD* = 13.58) and 79.48 (*SD* = 12.22), respectively.

The selection of NLD students excluded those students who were receiving remedial services, as well as those who were enrolled in programs for gifted and talented students. No standard test scores were available pertaining to the cognitive abilities of the NLD sixth-grade students.

Design

The design for this experiment was a 2 x 2 x 2 factorial. Population (LD and NLD) and acquisition condition (think-listen and listen-listen) were the between-subjects variables, with stimulus repetition (once-presented and twice-presented) being the within-subjects variable. The think-listen condition was represented by 19 LD and 18 NLD subjects. The listen-listen condition was represented by 19 LD and 18 NLD subjects.

Materials

Materials for this experiment were adapted from those developed by Lorsbach et al., 1991. In that study, 32 sentences were constructed so as to highly constrain a terminal noun (e.g., "We wear shoes on our _______."; "Jack and Jill went up the _______."; "I have two sisters and one _______."). The terminal nouns within these sentences were selected so as to possess high concreteness ratings in existing word norms (M = 6.3; SD = .36) (e.g., Gilhooly & Logie, 1980; Paivio, Yuille, & Madigan, 1968; Toglia & Battig, 1978). Each terminal noun was used only once and was not used in any of the remaining sentences. Highly predictable sentences were utilized in order to exert maximum control over the nouns that subjects generated for think items in the think-listen condition. Half (16) of the 32 sentences were designated randomly as being either Set 1 or Set 2.

In the present study, two versions of the original presentation list were created for each of the two acquisition conditions. In the think-listen condition, Version A was developed by omitting the terminal nouns of the 16 sentences in Set 1 (think items) and presenting the 16 sentences from Set 2 in their completed form (listen items). Conversely, Version B was created by presenting the 16 sentences from Set 1 in their completed form and the 16 sentences from Set 2 in their incomplete form. Sentences were ordered randomly, but with the restriction that no more than 3 sentences from either Set 1 or Set 2 be presented consecutively.

The development of Versions A and B in the listen-listen condition followed the same procedure. In Version A, sentences from Set 1 were completed by one girl (Annie), and sentences from Set 2 were completed by a second girl (Sarah). Conversely, Version B was developed by presenting sentences from Set 1 to the second girl (Sarah) for completion and sentences from Set 2 to the first girl (Annie) for completion.

Included within the design of this experiment was the factor of stimulus repetition. The variable of stimulus repetition was manipulated within subjects by presenting half (16) of the sentences in each study list once and the remaining half (16) twice. An entire list of 48 sentences was presented in a random manner, with the restriction that there be at least 6 intervening sentences between the repetition of a given sentence. In order to assure that each sentence was presented equally often across the conditions of the experiment, stimulus repetition was counterbalanced with acquisition condition. Counterbalancing was accomplished by constructing 2 sublists for Version A (A1 and A2) and 2 sublists for Version B (B1 and B2). The construction of 2 sublists from each version resulted in one-half of the items in Sublist 1 being presented one time and those same items in Sublist 2 being presented two times. Conversely, those items that were presented once in Sublist 2 were presented twice in Sublist 1. An attempt was made to assign subjects within each population to each list about equally often.

In addition to the 48 critical sentences, 3 buffer sentences were included at the beginning and end of the presentation list to reduce the possibility of primacy and recency effects in the subsequent recognition task. Thus, a total of 54 sentences were presented to each subject. Sentences were read aloud by an adult female Caucasian and were recorded on videotape for presentation at 10s intervals.

The stimuli used on the item recognition test consisted of the 32 terminal nouns from the preceding sentence list and 32 unrelated nouns that served as control items. None of the new nouns had been used in the construction of the preceding sentences. Old and new nouns were presented randomly, but with the restriction that no more than three old or three new nouns appear consecutively. The mean concreteness ratings of old and new nouns were equivalent (6.3 [*SD* = .36] and 6.2 [*SD* = .41], respectively).

Procedure

Children were tested individually and were initially presented with the sentence completion task. Subjects assigned to the listen-listen condition were informed that they would be viewing a videotape in which a teacher would be presenting to two girls a series of incomplete sentences that were missing the final word (e.g., "Kermit is the name of a ______."). Subjects were further told that each girl would be called upon to complete sentences and that the subject's job was to help the experimenter check the responses of each girl. For each sentence, subjects were instructed to indicate by a nod of the head whether they agreed or disagreed that the word provided by the girl was the one most people would use to complete that sentence. The agree/disagree response was elicited as a cover task to ensure attention to the words generated by the two girls.

Children in the think-listen condition were also informed that they would be viewing a videotape in which a teacher would be presenting a series of incomplete sentences that were missing the final word. Subjects in this condition were asked to play a game in which they imagined themselves sitting in an empty chair that was placed on one side of the teacher in the videotape. Also present in the videotape was a girl, who was sitting on the other side of the teacher. Subjects were told that both they and the girl would be called upon to complete sentences with the word most people would use to complete that sentence. Prompts to either imagine saying the word or to listen to the girl on the videotape say the word were given by the teacher on the videotape in the form of a hand gesture just prior to the presentation of the sentence. The teacher cued the subject by directing her hand at the empty chair (think) or at the girl on the videotape (listen). Mention was not made of the subsequent recognition task in either condition.

Upon completing the general instructions, children in each condition were given 6 practice sentences to familiarize them with the task and its requirements. In the think-listen condition, the videotape was paused after the practice sentences to verify that the "think" instructions were being followed. Subjects were asked what they did when thinking of themselves saying a word that completed one of the practice sentences (e.g., broom). If subjects responded that they thought of a broom, the instructions were repeated to emphasize that they should actually think of themselves *saying* the word and not think of the object they were naming.

Following the completion of the 54 sentences, each subject was given a digit-symbol substitution task (*Wechsler Adult Intelligence Scale*). The purpose of this 3-min filler activity was to remove the most recently presented sentences from immediate memory.

The final experimental task measured the child's memory for the occurrence of terminal nouns in each sentence, as well as the child's source memory for those nouns. The experimenter read aloud the 64-item list containing the old and new nouns and recorded the subject's decisions. The presentation rate of these nouns was subject-paced. Upon hearing a given noun, subjects were asked to decide whether the word had been used to complete one of the previous sentences. In addition, if subjects indicated that a particular noun had been used to complete a sentence, they were asked to decide upon its source. Subjects in the think-listen condition were asked whether they had imagined themselves saying a word or had listened to the word on the videotape. Children in the listen-listen condition were presented with a photograph of each of the two girls who had completed the sentences on the videotape. For those words that were judged to be old, source attributions were made by instructing subjects to point to the picture of the girl who originally said the word.

Finally, to make certain that the anticipated words had been generated during "think" instructions, subjects in the think-listen condition were given a post-experimental manipulation check. Responses to the 16 "think" items were verified by reading the incomplete sentences aloud and requesting the child say the word that completed the sentence.

LD subjects were administered the Reading and Arithmetic subtests of the Wide Range Achievement Test at the end of the testing session.

CHAPTER FOUR

Results

Old-New Recognition

Overall recognition. Recognition tests were scored without regard for correct identification of source to determine the number of hits ("old" responses to old items), misses ("new" responses to old items), false alarms ("old" responses to new items), and correct rejections ("new" responses to new items). Hit rates (i.e., the proportion of old items that were correctly remembered as being old) and false alarm rates (i.e., the proportion of new items that were incorrectly remembered as being old) were used to compute discrimination index (d') scores for each subject in each of the repetition stimulus conditions.

Discrimination index scores (d') are a part of a recognition memory model known as signal detection theory (Green & Swets, 1966). In signal detection tasks, subjects are exposed to two types of trials: Ones in which signals are present and ones in which they are not. Trials which do not contain signals are said to be presentations of "noise." When signals are provided in trials, they are presented in addition to the existing background of noise. Signal detection analysis compares the normal distributions of the two types of stimulus situations that a subject may encounter: One of these distributions represents noise and the other represents signal plus noise. The distance between the means of these two distributions in standard deviation units is measured by the discrimination index (d'). The greater the value of d', the greater is the distance between the means of the distributions, and the better is the subject's ability to discriminate between targets and distractors. Likewise, a d' value of 0 indicates complete overlap of the distributions and a total failure to distinguish targets from distractors. The d' value is accepted as a measure of pure discrimination sensitivity separate from the effects of biases subjects may have used in their decision-making (Klatzky, 1975).

Table I provides mean d' scores according to population, acquisition condition, and repetition stimulus. The d' scores resulting from the hit rate and false alarm rate for each subject were submitted to a 2 X 2 X 2 mixed design analysis of variance (ANOVA), with population (LD or NLD) and acquisition condition (think-listen or listen-listen) as the between-subjects variables, and repetition stimulus as the within-subjects variable. This analysis revealed a main effect of repetition $\underline{F}(1,70) = 55.112$, $\underline{MSe} = .138$, $\underline{p} < .001$. The discrimination performance of subjects in both populations was significantly more accurate for those items for which two presentations were provided ($\underline{M}$

Table I

Recognition Performance of LD and NLD Children According to Acquisition Condition

	LD		NLD	
	Once	Twice	Once	Twice
Think-Listen				
d'	1.82 (.69)	2.26 (.62)	2.06 (.65)	2.45 (.51)
beta	4.92 (3.53)	4.85 (3.25)	6.43 (2.97)	5.81 (2.71)
ln beta	1.41 (.79)	1.24 (.98)	1.73 (.54)	1.63 (.55)
Listen-Listen				
d'	1.75 (.67)	2.28 (.71)	1.94 (.57)	2.38 (.58)
beta	4.47 (2.88)	3.78 (3.08)	6.29 (2.85)	5.68 (3.29)
ln beta	1.26 (.74)	.96 (.93)	1.69 (.62)	1.49 (.85)

Note: Standard deviations are in parentheses.

= 2.34) as compared to those for which only one presentation was provided (M = 1.89). None of the remaining main effects or interactions were found to be significant. Noteworthy is that the d' scores of LD and NLD children did not differ significantly, $F(1,70) = 1.867$, $MSe = .665$, $p = .172$. In spite of the fact that the means of the two groups move in the same direction as those of Lorsbach et al. (1991), they did not attain statistical significance.

A second feature of recognition memory, response bias, was examined through an analysis of beta scores. Beta scores are mathematical representations of the criterion adopted by individual subjects in deciding whether signals were presented or not. The performance of subjects who have adopted a strategy of maximizing their hits but minimizing their false alarms can be assigned a beta value of 1.0. Beta values less than 1 are indicative of a lax decision criterion in which an item requires little strength to be reported as old. Consequently, subjects who have adopted this liberal criterion will respond "old" very frequently to both old and new items. This type of bias results in a high hit rate accompanied by a high false alarm rate. Conversely, beta values greater than 1 are indicative of a stringent decision criterion in which an item requires great strength to be reported as old. The performance of subjects adopting such a conservative decision rule is characterized by low hit rates, along with low false alarm rates. Such a pattern is attributable to the subject's reluctance to identify an item as a signal unless he or she is quite sure (Klatzky, 1975).

Table I provides mean beta scores according to population, acquisition condition, and repetition stimulus. Because beta scores have assymmetric distributions, these values were expressed as natural logarithms, which have normal distributions more amenable to statistical analyses. The means of these transformed data are also reported in Table I.

The transformed data were submitted to a 2 X 2 X 2 mixed design ANOVA, with population (LD or NLD) and acquisition condition (think-listen or listen-listen) as the between-subjects variables, and repetition stimulus as the within-subjects variable. This analysis revealed a main effect of population, $F(1,70) = 5.786$, $MSe = 1.103$, $p = .017$, with NLD subjects ($M = 1.635$) adopting a decision criterion that was significantly more conservative than that of their LD counterparts ($M = 1.217$). There was also a significant effect of repetition, $F(1,70) = 15.545$, $MSe = .090$, $p < .001$. In this case, the response bias of subjects in both populations was significantly less conservative for those items for which two presentations were provided ($M = 1.33$) as compared to those for which one presentation was provided (*M* = 1.522). No other main effects or interactions were found to be significant.

It is difficult to explain why subjects would shift their response criterion for repeated items. Such a result cannot be readily explained by any known theoretical framework. Typically, there are experimental variables or events that somehow bias responses. However, a critical examination of the materials used in the present study did not reveal any such artifacts. Therefore, the shift in beta revealed in the present analysis remains without explanation. Noteworthy is that the reliability of the d' analysis is not compromised in any way by this spurious result.

Recognition according to item type. Previous research has shown self-generated information to have a benefit in memory for adults (e.g., Johnson et al., 1981), NLD children (Foley et al., 1983), and LD children (Lorsbach et al., 1991). This dimension of recognition memory is known as the generation effect and has been previously described by Slamecka and Graf (1978). To investigate whether a generation effect was operative in the present data, d' scores were examined. Table II provides mean d' scores by item type for each acquisition condition. These d' scores were analyzed separately in each acquisition condition using a 2 (population) X 2 (item type) X 2 (repetition stimulus)

Table II

Recognition Performance (d' Scores) of LD Children and NLD Children According to Item Type in Each Acquisition Condition

	LD		NLD	
	Once	Twice	Once	Twice
Think-Listen				
Think Items	1.82 (.72)	2.15 (.64)	2.06 (.64)	2.55 (.60)
Listen Items	1.80 (.75)	2.35 (.70)	2.07 (.88)	2.37 (.56)
Listen-Listen				
Annie Items	1.85 (.73)	2.25 (.75)	1.93 (.65)	2.40 (.70)
Sarah Items	1.68 (.80)	2.26 (.72)	1.95 (.60)	2.34 (.56)

Note: Standard deviations are in parentheses.

mixed design ANOVA. Analysis of the think-listen condition indicated that there was only a main effect of repetition stimulus, $F(1,35) = 26.826$, $MSe = .238$, $p < .001$, with twice-presented items being more memorable than once presented items. The population X item type X repetition stimulus interaction fell just short of the traditional level of significance, $F(1,35) = 3.656$, $MSe = .102$, $p = .061$, and is best viewed as a trend in the data. In this case, there was a tendency for NLD subjects to remember twice-presented think items better than LD subjects.

Noteworthy is the absence of a main effect of item type (i.e., think items more recognizable than listen items) and, consequently, the failure of a generation effect to be observed. The superiority of "think" items in this data would be strongly predicted by Slamecka and Graf (1978). Furthermore, a generation effect was observed by Lorsbach et al. (1991) in a say-listen condition utilizing identical materials. Consideration of this information leads to the speculation that failure of the present data to reveal a generation effect in the think-listen condition may be attributable to the inherent difficulty of assuring subject compliance in covert tasks. While a post-experimental error probe may serve to verify covertly-generated responses, it is based on the assumption that subjects accurately report the exact responses they generated during the task. This may not have been the case. It is also possible that subjects may not have generated responses in the precise manner directed.

Analysis of the listen-listen condition revealed only a main effect of repetition stimulus, $\underline{F}(1,35) = 31.596$, $\underline{MSe} = .245$, $\underline{p} < .001$, with twice-presented items being more memorable than once-presented items. There was no effect of item type ($\underline{F} < 1$). Because the students in the videotape were similar in physical appearance and attire, there was no reason to expect that one student's presentations would be more memorable than the other's.

Source Monitoring

Overall source. Each subject's ability to remember the origin of their memories was based only on old items that were remembered. The rationale underlying this approach is that a subject must first have remembered an item in order to be able to recall its source. Consequently, the resulting source monitoring data are free of any possible differences in recognition memory between groups.

Table III presents the mean source monitoring scores (d') according to population, acquisition condition, and repetition stimulus. The d' scores were computed separately for the two levels of repetition stimulus in each acquisition condition (think-listen and listen-listen). In the think-listen condition, a hit rate for each subject for

Table III

Judgment of Origin Performance for LD and NLD Children in Each Acquisition Condition

	LD		NLD	
	Once	Twice	Once	Twice
Think-Listen				
d'	1.50 (.71)	2.01 (.83)	1.84 (.48)	2.36 (.39)
beta	1.48 (.70)	1.37 (.51)	1.55 (.71)	1.33 (.68)
ln beta	.29 (.48)	.25 (.36)	.33 (.47)	.17 (.48)
Listen-Listen				
d'	1.08 (.87)	1.27 (.91)	1.22 (.83)	1.67 (.86)
beta	1.08 (.34)	1.17 (.34)	1.03 (.30)	1.12 (.39)
ln beta	.03 (.32)	.11 (.31)	0 (.26)	.06 (.32)

Note: Standard deviations are in parentheses.

each repetition stimulus was represented by a proportion of correct "think" judgments given for the total number of "think" items remembered. A false alarm rate for each subject for each repetition stimulus was represented by a proportion of incorrect "think" responses given for the total number of listen items remembered. Similarly, for the listen-listen condition, a hit rate for each subject for each repetition stimulus was represented by a proportion of correct "Annie" judgments given for the total number of "Annie" items remembered. A false alarm rate for each subject for each repetition stimulus was represented by a proportion of incorrect "Annie" responses given for the total number of Sarah items remembered. For each of the acquisition conditions, the decision as to which item type to use in the calculation of d' was totally arbitrary. For example, in the think-listen condition, "listen" items could just as easily have been used to determine the hit rate and false alarm rate of each subject.

The d' values were submitted to a 2 X 2 X 2 ANOVA with population (NLD or LD) and acquisition condition (think-listen or listen-listen) representing between-subjects factors, and repetition stimulus (once-presented or twice-presented) as the within-subjects factor. If fewer than two items were remembered for either item type in either acquisition condition (i.e., think or listen items in the think-listen condition or Annie or Sarah items in the listen-listen condition), the d' score for that subject was excluded in the analysis of source monitoring. Although it is possible to use this data, the decision was made to exclude it due to the concern that artificially high or low scores would add to the variance.

Analysis of the d' data revealed that NLD subjects demonstrated more accurate memory for source information than their LD counterparts, $F(1,65) = 3.885$, $MSe = .834$, $p = .05$. The mean d' scores for the NLD group and the LD group were 1.77 and 1.46, respectively. The main effect of acquisition condition revealed that both populations demonstrated more accurate source memory in the think-listen condition ($M = 1.925$) than the listen-listen condition ($M = 1.305$), $F(1,65) = 15.751$, $MSe = .834$, $p < .001$. Finally, there was a main effect of repetition stimulus, $F(1,65) = 18.010$, $MSe = .332$, $p < .001$. In this case, the source monitoring performance of subjects in both acquisition conditions benefited by a second presentation of the stimulus.

Beta values were analyzed to determine if there were significant differences in response bias. As with the preceding analysis of recognition memory performance, the analysis was based on the natural logarithms of the individual beta scores. These scores were submitted to a

2 X 2 X 2 ANOVA with population and acquisition condition representing the between-subjects factors, and repetition stimulus representing the within-subjects factor. This analysis revealed only a main effect of acquisition condition, $F(1,65) = 8.935$, $MSe = .172$, $p = .004$, indicating that subjects in the think-listen condition were more conservative than subjects in the listen-listen condition, $M = .26$ and $M = .05$, respectively.

Source attributions according to item type. Previous research (Johnson et al., 1980; Rabinowitz, 1989) has found that repetition may improve source memory for subject-generated information, yet have no effect upon source memory for externally-derived information. Therefore, a further analysis was conducted to determine whether repetition had a differential effect upon the origin judgments of self-generations (think items) and externally-derived information (listen items).

The number of correct source attributions for each item type were determined for each subject. Utilizing a method that has been employed by previous investigators (e.g., Johnson et al., 1981), the proportion of correct source decisions for each item type was computed for each subject. These source proportion scores were calculated by dividing the number of correct source attribution responses by the total number of remembered items. A score of 1.0 represents perfect source monitoring (e.g., the subject correctly responded "think" to all of the think items that were recognized as being old). On the other hand, a score of 0 indicates that the subject failed to remember the source of any of the items that were remembered (e.g., the subject did not respond "think" to any of the think items that had been recognized). The mean proportions of correct source judgments are given in Table IV according to population, acquisition condition, and number of presentations.

The source proportion data of each acquisition condition were analyzed separately utilizing a 2 (population) X 2 (item type) X 2 (repetition stimulus) mixed design ANOVA. The analysis of source proportion data in the listen-listen condition did not reveal any significant main effects or interactions. However, an analysis of the think-listen data revealed that the source memory of twice-presented items (M = .9) was significantly better than that of once-presented items (M = .84), $F(1,35) = 4.61$, $MSe = .022$, $p = .036$. The item type X repetition interaction fell somewhat short of traditional levels of significance, $F(1,35) = 2.996$, $MSe = .025$, $p = .088$. In this case, unlike listen items, there was a tendency for the source of think items to be more memorable following a second presentation. This trend is consistent with previous research (Johnson et al., 1980; Rabinowitz, 1989) which has

Table IV

Mean Proportions of Correct Judgments of Origin

	LD		NLD	
	Once	Twice	Once	Twice
Think-Listen				
Think Items	.73 (.27)	.85 (.20)	.78 (.18)	.86 (.20)
Listen Items	.91 (.23)	.90 (.23)	.97 (.08)	.99 (.03)
Listen-Listen				
Annie Items	.72 (.24)	.73 (.26)	.72 (.24)	.84 (.19)
Sarah Items	.68 (.31)	.71 (.21)	.78 (.17)	.81 (.18)

Note: Standard deviations are in parentheses.

shown that repetition improves source memory for think, but not listen items.

The effect of item type was also significant, $\underline{F}(1,35) = 10.162$, $\underline{MSe} = .067$, $\underline{p} = .003$. In this case, memory for source information was better for listen items ($\underline{M} = .945$) than for think items ($\underline{M} = .805$). This result may reflect the same tendency found with false positives in which subjects attribute items of weaker familiarity to external sources. If subjects were responding to the stimuli of the present study in this way, source proportion scores for listen items would be inflated as a result of the subjects' inclination to reply "listen" whenever items were weak in familiarity. This bias to respond "listen" may also have contributed to a ceiling effect for listen items. This ceiling effect was especially pronounced in the NLD group ($\underline{M} = .97$ and .99 for once and twice presented items, respectively).

False Positives

False positives are new items to which subjects mistakenly respond "old." Previous research (e.g., Foley et al., 1983; Hastroudi et al., 1989; Johnson et al., 1980) has identified a pattern in which subjects attribute false positives to external sources. The underlying metamemory assumption that influences subjects to respond in this way was originally described by Johnson and Raye (1981) as "'it-had-to-be-you' ('I'd remember if it were me')" (p. 80).

Employing methods utilized by previous investigators, source attributions for false positives were categorized by item type. For each subject, source attributions for false positives were counted in a simple tally. The resulting means for each item type are presented in Table V.

The data for each acquisition condition were analyzed separately using a 2 (population) X 2 (item type) mixed design ANOVA. In the think-listen condition, a main effect of item type emerged, $\underline{F}(1,35) = 5.952$, $\underline{MSe} = .727$, $\underline{p} < .018$. Subjects in the think-listen condition were more likely to attribute false positives to listen items ($\underline{M} = 1.21$) than to think items ($\underline{M} = .63$). This tendency is evidence of the operation of the "it-had-to-be-you" bias (Johnson et al., 1981).

In the listen-listen condition, false positive attribution data for Annie and Sarah items were also submitted to a 2 (population) X 2 (item type) mixed design ANOVA. This analysis did not reveal any significant main effects or interactions. Subjects did not show a bias to attribute new items to either Annie ($\underline{M} = .99$) or Sarah ($\underline{M} = .74$).

Table V

Mean False Positive Performance of LD and NLD Children According to Item Type

Condition	LD	NLD
Think-Listen		
Think Items	.63 (1.06)	.22 (.42)
Listen Items	1.21 (1.90)	.61 (.91)
Listen-Listen		
Annie Items	1.05 (1.43)	.94 (1.58)
Sarah Items	1.10 (1.28)	.38 (.77)

Note: Standard deviations are in parentheses.

CHAPTER FIVE

Discussion

The purpose of the present study was to investigate whether a deficit exists in the source monitoring abilities of LD children in two areas of discrimination: (1) discrimination between memories of self-generated, covertly expressed ideas and memories of external perceptions, and (2) discrimination between memories of two external perceptions. Demonstration of these specific deficits, together with results of previous research, would provide strong evidence for the hypothesis that LD children possess a generalized deficit in remembering the source of memories containing verbal information. This hypothesis was confirmed by the results of the present study in that LD children experienced significantly greater difficulty than NLD children with tasks that measured external source monitoring (listen-listen condition) and an alternate form of reality monitoring (think-listen condition). The source monitoring deficit was not altered by the repetition stimulus manipulation.

There are a number of possible explanations for the apparent deficit in source memory ability in LD children. One such explanation is that LD children may experience greater difficulty than NLD children in their attempt to evaluate the critical dimensions along which different classes of memories vary. For instance, the essential task in reality monitoring decisions (think-listen condition) is to evaluate the memory trace for the presence or absence of the cognitive operations that are characteristic of self-generated information. Raye, Johnson, and Taylor (1980) believe that memory for cognitive operations may be the most prominent indicator of self-generated memories. On the other hand, discrimination between external memories (listen-listen condition) is accomplished through the evaluation of spatial, temporal, semantic, and sensory information (Johnson & Raye, 1980). The results of the present study suggest that LD children may fail to store and/or access information associated with cognitive operations, as well as information about the contextual details of a prior verbal experience.

These results also seem to indicate that the source monitoring difficulties of LD children are not due to different response biases. Subjects in the reality monitoring condition (think-listen condition) attributed false positives to an external source, rather than to items they had generated previously. This pattern, described by Johnson and Raye (1981) as "it-had-to-be-you (I'd-remember-if-it-were-me)," was clearly observed in each population. Similar results were found by Lorsbach et al. (1991) and suggest that the inferior source monitoring of LD children cannot be attributed to atypical beliefs about how memory works.

In summary, the results of the present study are consistent with previous research that has found the source monitoring abilities of LD subjects to be inferior to those of NLD subjects. The current findings are also consistent with the observation that the response biases of LD children are similar to those of their NLD counterparts.

Although the source monitoring results of the present study are consistent with the research of Lorsbach et al. (1991) that was discussed previously, the findings of the recognition data are not. In the present study, LD subjects demonstrated recognition memory equal to that of NLD subjects. However, differences in the recognition performance of LD and NLD children were noted by Lorsbach et al. (1991) in a source monitoring and a reality monitoring task. The findings of the previous study are of special interest to the present investigation because both studies utilized identical stimulus sentences. The discrepant outcomes may be explained by one critical difference between the studies; i.e., the type of sensory information provided by their respective experimental tasks. In Lorsbach et al. (1991), stimuli were presented on audiotape; the present study utilized videotape, thereby adding a strong visual dimension to the sensory effects available to subjects. It is theorized that the visual dimension increased the attention of LD subjects and that, consequently, target items became more memorable to them. Therefore, the recognition differences found between groups by Lorsbach et al. (1991) may be explained in terms of reduced levels of attention in the LD group.

Such an explanation is consistent with one offered by Lorsbach et al. (1991). Those investigators interpreted observed recognition differences between groups within the framework of Mandler's (1980) theory of recognition memory. Mandler proposes that recognition decisions are based on dual processes that operate conjointly. One process evaluates the arrangement of sensory or perceptual cues within individual memories; a different process evaluates memories for elaborative/conceptual information and relationships to other memories. Lorsbach et al. (1991) contended that successful recognition performance in their experimental task "to a large extent depended upon the encoding and retrieval of the elaborative contextual information that accompanied terminal nouns in each sentence frame" (p. 145). The investigators of that study theorized that LD children may not have encoded terminal nouns within the context of their sentence frames, resulting in less distinctive encoding and depressed recognition. Further, LD children may have based their recognition decisions on perceptual and sensory information.

In the present study, it is possible that strong visual cues in the experimental task may have increased the attention of LD subjects to a level that made them available to the encoding of terminal nouns within sentence contexts. It is also possible that LD subjects took advantage of the strong visual dimensions of the experimental task and utilized the increased perceptual information to make successful recognition decisions. Therefore, discrepancies between the findings of Lorsbach et al. (1991) and the present study can be explained within the recognition memory theory of Mandler (1980).

Theoretical Implications

The reality monitoring model of Johnson and Raye (1981) provides a viable framework for interpeting the findings of research that examines the processes associated with reality monitoring. One observation of this model is that source discriminations for memories within the same class are more difficult than discriminations for memories of different classes (Johnson & Raye, 1981). The greater difficulty of within-class discriminations may be that source decisions are made by comparing the specific attributes of individual memories. For instance, for externally-derived memories, particular sensory attributes of the memories are compared (e.g., sound of the speakers' voices, their position in a room); for internally-generated memories, however, the comparison is based on particular dimensions of the cognitive operations information present. In contrast, between-class distinctions may be made by "tak[ing] advantage of the several dimensions on which the classes of internally and externally-derived memories differ" (Foley et al., 1983, p. 56). The advantage of between-class discriminations has been demonstrated in previous literature across a range of subjects and materials (e.g., Foley et al., 1983; Hashtroudi et al., 1989; Raye and Johnson, 1981). Results of the present study are highly consistent with those findings in that source decisions were more accurate in the think-listen condition (between-class discrimination) than in the listen-listen condition (within-class discrimination). Therefore, the present investigation confirms an important observation of the reality monitoring model.

A second observation of Johnson and Raye's reality monitoring model is that reality monitoring decisions are based on the characteristic differences that exist between the two classes of memories. In consideration of this observation, the reality monitoring model would predict repetition of an item to strengthen the attributes of a memory that identify it as a member of a particular class.

Results of the present study are highly consistent with this prediction in that source decisions improved with a second presentation of the stimulus item. This effect was evident across populations and conditions and was also found in the recognition data. Previous studies conducted with adult subjects that utilized repetition manipulations (Johnson et al., 1980; Rabinowitz, 1989) have found that repetition of stimulus items increases both source identification and recognition. The present study extends these results to children, including children with learning disabilities.

The effect of repetitions on the different items within each acquisition condition was examined separately in the present study. It was found that recognition memory significantly improved with repetition for both self-generated (think items) and experimenter-presented targets (listen items). This result was also obtained in an examination of a think-listen condition with adult subjects that Johnson et al. (1980) submitted to a repetition manipulation and in a study by Rabinowitz (1989) that applied a repetition manipulation to a read-generate condition, comparing performances of older and younger adults. These studies have also observed that, for source identification, repetitions affect only memories of generated items and have no effect on memories of externally-derived events. Johnson et al. (1980), for example, found that "repetitions had little effect, if any, on the subjects' tendency mistakenly to say they had generated external items, but it reduced their tendency to attribute their thoughts to external sources" (p. 403). Similarly, Rabinowitz (1989) found that "the repetition manipulation only affected the judgments of origin for generated items" (p. 264). In the present study, this pattern was evidenced by a trend for twice-presented "think" items to be more memorable than twice-presented "listen" items.

One of the more significant observations of the reality monitoring model is that recognition and source attribution are separate processes in memory. In the terminology of Johnson and Raye (1980), "the dissociation of memory for occurrence and identification of origin indicates they are not based on exactly the same information or mechanism" (p. 407). The idea of dissociation further emphasizes the underlying differences of the two processes, with recognition being based more on familiarity and source identification being based more on conscious retrieval of contextual information. As explained by Johnson and Raye (1981),

> Memory for occurrence and memory for origin sometimes do respond to the same variables . . . . In some cases, memory for occurrence and identification of origin

> appear actually to be affected in opposite ways by the same variable . . . . In summary, it does not appear to us that the information or processes that are important in discriminating the origin of information can be equated with those that produce voluntary recall or a feeling of familiarity." (p. 81)

The presumed independence of the memory processes of source monitoring and recognition has been confirmed in previous research that has examined this phenomenon across a variety of materials and range of subjects (e.g., Foley & Johnson, 1985; Lindsay & Johnson, 1991; Raye & Johnson, 1985).

In the present study, evidence for this observation comes from two observed dissociations. First, recognition and source identification were dissociated due to the effects of population. It was observed that LD subjects remembered items from each of the acquisition conditions as well as their NLD counterparts, but were much worse at identifying the source of these words. Second, recognition and source identification were dissociated by acquisition condition. While subjects recognized items from either condition equally well, they were much better at determining the source of items in the think-listen condition than in the listen-listen condition. The dissociation observed in these findings strongly supports the proposition that the two processes rely on different aspects of memory.

Conclusions

The present study has demonstrated deficits in the source monitoring abilities of LD children in both reality monitoring and external source monitoring. In both forms of memory monitoring, LD subjects were found to be much worse than NLD subjects at deciding the origin of their memories. This conclusion confirms the hypothesis of Lorsbach et al. (1991) that, at least with verbal information, LD children possess a generalized deficit in discriminating the source of their memories.

An important question for future research would be whether the source monitoring deficits demonstrated by LD students with verbal materials can also be observed with nonverbal materials (e.g., pictures, actions). Initial research with action materials has already been conducted with children without learning impairments (see Foley & Johnson, 1985). The findings of those experiments differed from previous results obtained with verbal tasks for the same population. Future research should focus on experiments utilizing a range of materials, especially those nonverbal in nature. The results of such investigations will be crucial to a deeper understanding of the many complex dimensions of memory as observed in normal children and learning disabled children alike.

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