MEMORY DEVELOPMENT IN CHILDREN

edited by
PETER A. ORNSTEIN

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Preface

Although the first studies of children's memory appeared in the literature almost 100 years ago, systematic research in this area began only recently. It is, in fact, only within the last 10 or 12 years that concentrated work on memory development has been reported. Given the marked increase in research in children's memory over the past decade — and the importance of this work for an understanding of the human memory system as well as the broader field of cognitive development — a decision was made to assemble a group of active workers in the field so that current trends could be assessed and debated. With this in mind, a conference on the development of memory in children was held at the University of North Carolina at Chapel Hill on May 13–14, 1976. The present volume stems from this conference.

The conference was structured as a working meeting. The aim was to have a relatively small number of formal paper presentations so that there would be sufficient time for group discussion following each paper. Furthermore, ample time was reserved for a final extended discussion of the critical themes and issues that arose during the presentation and critiques of the papers. The 11 chapters of this book are a direct result of these 2 days of presentation, discussion, and debate. Chapters 2 through 7 are substantially revised versions of the six papers presented at the conference. In contrast, the topics represented in Chapters 8 through 11 were not formally treated at the meetings. These chapters are "position papers," whose origins can be traced to the final discussion of critical issues. At the conclusion of the meetings, conference participants interested in particular issues agreed to take responsibility for preparing these chapters. The initial chapter of the book represents an attempt by the editor to provide a very brief historical

context for the remaining papers. It is hoped that this volume will provide a useful summary and assessment of current activity in the important area of memory development in children.

It is difficult to plan a conference and to put together a book such as the present one without substantial help, and it is a great pleasure for me to acknowledge my indebtedness at this time. For their enthusiastic support of this venture, I am most grateful to W. Grant Dahlstrom, former chairman of the Department of Psychology at the University of North Carolina at Chapel Hill, Robert B. Cairns, director of the developmental psychology program here at Chapel Hill, and Lawrence Erlbaum, our publisher. I am also indebted to David F. Bjorklund, Kathleen Corsale, Eugene R. Long, Mary J. Naus, and Barbara Prince Stone for help in planning the meetings and in the processing of manuscripts. Appreciation must be extended as well to Frederick J. Morrison for his editorial assistance and commentary. Finally, for understanding and encouragement during a period of frequent absence from family activities, special thanks are extended to my wife, Marilyn, and my daughters, Miriam and Naomi.

Chapel Hill, North Carolina PETER A. ORNSTEIN

Contents

Preface *vii*

1 Introduction: The Study of Children's Memory
Peter A. Ornstein

Influences from Experimental Psychology *2*
Influences from Developmental Psychology *5*
The Current State of the Art *7*
The Present Volume *11*

2 Developmental Changes in Visual Information Processing
Kenneth L. Hoving, Terry Spencer, Katherine Y. Robb, and Duane Schulte

Preliminary Description and Data Base *21*
Why Iconic Memory Is Important *33*
Brief Review of the Developmental Literature *35*
Methodological Considerations in Developmental Studies *46*
Developmental Studies Using These Methods *50*
Conclusions and Suggestions *62*

3 Rehearsal Processes in Children's Memory 69
Peter A. Ornstein and Mary J. Naus

In What Ways Does Rehearsal Change With Age? *71*
Is Recall Affected by Training in Rehearsal? *76*
What Is the Locus of the Effects of Rehearsal? *85*
Is Item Retrieval an Important Component of Active Rehearsal? *89*
Does Active Rehearsal Lead to the Generation of an Organizational Plan? *92*
Summary *96*

4 Organization-Related Processes in Children's Recall 101
Garrett Lange

Some Features of the Organization Approach to Memory *103*
Classic Organization Paradigms and the Developmental Questions They Address *105*
The Source of Children's Organization Failures *111*
The Effects of Organization Training *115*
Age-Related Changes in Children's Categorization Criteria *118*
Children's Conceptions of the Role of Organization in Recall *121*
Summary Statement *123*

5 The Development of Inference and Transformation as Memory Operations 129
Scott G. Paris

The Constructive Perspective *130*
Inferences, Comprehension, and Memory *133*
Young Children's Failures to Transform and Construct Relationships in Memory *145*
Conclusion *153*

6 The Representational-Development Hypothesis 157
Stephen Michael Kosslyn

Overview of the Paper *158*
The Representational-Development Hypothesis *158*
Conceptual Difficulties in Studying the Representational-Development Hypothesis *165*
Evidence for Representational Development *168*
A New Approach to the Picture Metaphor *178*
Conclusions *184*

7 Memory in the Years from Two to Five 191
Nancy Angrist Myers and Marion Perlmutter

General Method and Procedure *193*
Overview of Recognition *194*
Overview of Recall *196*
Recognition–Recall Contrasts *198*
Knowledge Effects *204*
Summary *214*

8 Developmental Implications of Multistore and Depth-of-Processing Models of Memory 219
Mary J. Naus, Peter A. Ornstein, and Kenneth L. Hoving

A Multistore View *219*
A Levels-of-Processing Approach *221*
Application of the Memory Models to Developmental Data *225*

9 The Semantic-Episodic Distinction in Memory Development 233
Katherine Nelson and Ann L. Brown

Major Uses of the Distinction in Theory Construction *233*
Confusions in the Use of Terminology *238*
Use of Semantic–Episodic Distinction in Developmental Research *239*
Developmentally Consistent Use of the Terms *240*

10 A Developmental Analysis of Recall-Recognition Distinctions 243
Marion Perlmutter and Garrett Lange

Models *244*
Children's Performance *247*
Developmental Implications *252*
Summary *255*

11 Coordination of Means and Goals in the Development of Mnemonic Skills 259
Scott G. Paris

Production and Mediation Deficiencies Reconsidered *260*
An Alternative Framework *263*
Implications for Research *270*
Conclusion *271*

Author Index 274

Subject Index 279

1 Introduction: The Study of Children's Memory

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Interest in the study of children's memory can be traced to the early days of psychology as an experimental discipline. Age differences in digit span were reported by Jacobs (1887), and Kirkpatrick (1894) found developmental changes in free-recall performance. Binet and Henri (1894a, 1894b) also studied children's recall and reported that memory for prose was substantially superior to that for lists of unrelated words. Furthermore, Hunter's (1913, 1917) research indicated that young children spontaneously looked for a hidden object in a delayed reaction task and that performance declined as a function of delay interval. However, despite these initial explorations of memory in children, memory development was not systematically studied by the early psychologists. Some research on memory span continued, but most of this work was directed to the possible relationship between memory span and intelligence (e.g., Clark, 1923; Humpstone, 1917, 1918; Terman, 1916; Whipple, 1915). Attention was focused on the diagnostic aspects of the memory span test, and it has only been within the past few years that there have been thorough attempts to understand the factors that might be responsible for age-related improvement in memory span (e.g., Belmont & Butterfield, 1969; Chi, 1976, 1977; Huttenlocher & Burke, 1976).

Renewed interest in children's memory was apparent by the middle 1960s, following developments within both experimental and developmental psychology. Research activity in this field began to accelerate by the early 1970s and was further stimulated by a symposium on memory development presented at the 1971 meetings of the Society for Research in Child Development (Flavell, 1971a). Currently, research on children's

memory constitutes a major area of inquiry within developmental psychology. The intensity of work can be indexed by the recent publication of several review papers (A. L. Brown, 1975; Hagen, Jongeward, & Kail, 1975; Ornstein, 1977) and a major book (Kail & Hagen, 1977) on memory development in children. The chapters in the present volume, which address a variety of important theoretical and empirical issues, also attest to the current level of research activity. To provide a historical context for these papers, a brief overview of the developments in this area is provided.

INFLUENCES FROM EXPERIMENTAL PSYCHOLOGY

The increased experimental interest in memory development during the past 15 years seems due in part to the influence of the growing cognitive orientation within experimental psychology (e.g., Broadbent, 1958; Miller, Galanter, & Pribram, 1960; Neisser, 1967). Interest in cognitive psychology, and especially in the study of the operation of the human memory system (e.g., Atkinson & Shiffrin, 1968; Peterson & Peterson, 1959; Tulving, 1962; Tulving & Donaldson, 1972; Waugh & Norman, 1965), created a climate which contributed to the emergence of research in the development of memory in children. In many respects, the first "modern" studies of children's memory resulted directly from an application of the findings, methods, and theories of experimental psychology to developmental questions. In particular, advances in the organizational analysis of recall, short-term memory, sensory memory, and models of the memory system all affected the course of developmental research in the 1960s and early 1970s.

Organization in Free Recall

The revival of interest in Gestalt approaches (e.g., Katona, 1940) to memory had a serious impact on the experimental psychology of human memory. In addition, these developments directly stimulated research on memory processes in children. Bousfield (1953) reported that even though adult subjects were free to recall categorically related items in any order, the output sequence was organized to some extent in terms of the list structure. This report of clustering in free recall sparked wide interest in the use of output order information to measure subjects' attempts at organizing to-be-remembered material, and Bousfield, Esterson, and Whitmarsh (1958) executed a pioneering experiment on perceptual and conceptual clustering in children. This was followed by considerable interest in the extent to which children of different ages would cluster in recall; under some conditions it was claimed that even preschoolers clustered at an

above chance level (e.g., Rossi, 1964; Rossi & Rossi, 1965). In addition, Tulving's (1962) demonstration that adults impose their own subjective organization on material, when the structure provided by the experimenter is meager, led to parallel experiments with children. Laurence (1966), for example, reported age changes in the recall of unrelated words, but no corresponding changes, over an age range of several years, in measured subjective organization. With these clustering and subjective organization paradigms, interest was clearly focused on children's organizational activities and the relationship between recall and organization in children's memory.

Short-Term Memory

Following the initiation of work on short-term (immediate) memory in adults (e.g., J. Brown, 1958; Peterson & Peterson, 1959), Atkinson, Hansen, and Bernbach (1964) introduced a probed recall task to study short-term memory processes in children. With this task, to-be-remembered items were presented one at a time and then placed face down in a row in front of the subject; the recall of one item from the list was subsequently probed, and then the procedure was initiated again with another series of items. Atkinson et al. (1964) were concerned with establishing a technique so that children's interest could be maintained under conditions of short-term retention testing. They were successful in this endeavor and reported that there was no indication of a primacy effect (i.e., enhanced recall of the initially presented items) in the probed recall of preschoolers, in contrast to what was obtained with adults. Atkinson et al. offered no explanation for this finding, but later work by Hagen and his colleagues suggested that rehearsal factors influence the emergence of the primacy effect.

Hagen and Kingsley (1968) modified the Atkinson et al. task for some important initial work concerned with the role of labeling in children's memory. Hagen (e.g., Hagen & Kingsley, 1968; Hagen, Meacham, & Mesibov, 1970; Kingsley & Hagen, 1969) suggested that stimulus labeling enhances the recall of items at the end of a list sequence, whereas more active types of rehearsal facilitate the primacy section of the serial position curve. In addition, Hagen's findings suggested developmental changes in children's rehearsal, and these data were consistent with Belmont and Butterfield's (1969, 1971) observations in the context of a self-paced serial recall task. In this situation, children could control the amount of time they had to rehearse each item, and the distribution of "pause times" of older children suggested that they were making more active attempts at rehearsal and remembering than were younger children. The research of Flavell (e.g., 1970) and his colleagues concerned with production deficiencies, as well as

that inspired by the multistore models of memory, also stressed the critical nature of rehearsal and related acquisition strategies.

Sensory Memory

Influenced by the pioneering work on sensory information storage (Averbach & Coriell, 1961; Sperling, 1960, 1963), Haith and his associates began a systematic series of experiments concerning early visual information processing and memory in children. Haith, Morrison, Sheingold, and Mindes (1970) reported age differences in the number of items that children and adults could report following tachistoscopic presentation. However, the use of partial report techniques (Haith, 1971; Morrison, Holmes, & Haith, 1974; Sheingold, 1973), in which subjects are required to report only a portion of the presented array, suggested that there may be no age differences in the amount of information actually initially available in visual storage. Rather, the data support the view that age differences in the number of items that can be recalled under whole-report conditions (i.e., when the entire array is tested) are due to differences in the facility with which visual information can be read out of sensory memory and encoded in a more permanent form. This initial work on children's visual sensory memory stimulated other research on visual information processing. In addition, these findings emphasized the distinction between "hard-wired" aspects of the memory system, which may not change substantially with age, and the age-related strategies and processes used to influence the movement of information through these memory structures.

Models of Memory

Experiments on short-term memory and sensory memory in adults contributed to the development of multistore models of the human memory system. Atkinson and Shiffrin (1968), for example, argued for the utility of viewing memory as if it were composed of at least three stores: (1) a sensory register (i.e., an early sensory memory); (2) a short-term store (i.e., a temporary working memory); and (3) a long-term store (i.e., a permanent storehouse of information). In this system, information was assumed to flow in a well-regulated fashion through the component stores, and memory processes such as rehearsal were thought to affect this movement of information. Within this multistore framework, performance on tasks such as probed recall and free recall was viewed as reflecting the operation of both the short- and long-term memory components. Glanzer and Cunitz (1966) for example, suggested that the primacy effect in free recall (i.e., the enhanced recall of the initial list items) reflected the recall of information

from long-term store, whereas the recency effect (i.e., the superior recall of final list items) was a short-term store phenomenon.

From a developmental perspective, the utility of the multistore models is that they can suggest whether age changes in recall appear to reflect differences in retrieval from short-term store, long-term store, or both. Developmental changes in the primacy effect had been observed in the probed recall data of Atkinson et al. (1964) and Hagen and Kingsley (1968). Within the multistore framework, these findings would suggest age-related differences in the recall of item information from long-term store, but the data were not initially interpreted in this fashion. The multistore models were first applied to children's free recall data collected by Thurm and Glanzer (1971) and Cole, Frankel, and Sharp (1971). As was the case with the probed recall findings, the major age changes in recall were in terms of the initial list items; in contrast, there were no age-related differences in the recall of terminal list items. These data imply that recall from short-term store is similar in children over a wide age range, but that there are developmental changes in the recall of information from long-term store. Results such as these focused attention on developmental differences in the information processing strategies (such as rehearsal), which can serve to influence the transfer of information from short-term store to long-term store and/or the retrieval of information from long-term store.

INFLUENCES FROM DEVELOPMENTAL PSYCHOLOGY

As indicated earlier, developmental psychologists were affected by the increasingly cognitive orientation in experimental psychology. Furthermore, for a number of reasons, the 1960s represented a time of intense research activity in cognitive development, and developmentalists were also influenced by these forces. At this time, for example, American researchers became very interested in the Piagetian approach to children's thought, due to Flavell's (1963) major presentation of the Genevan position and to the work of Bruner and his colleagues (e.g., Bruner, 1964; Bruner, Olver, & Greenfield, 1966). Other important research on children's discrimination learning and concept utilization (e.g., Kendler & Kendler, 1962; Tighe & Tighe, 1968; Zeaman & House, 1963), language (e.g., Braine, 1963; Brown & Berko, 1960; Brown & Bellugi, 1964), and perception (e.g., Bower, 1966; Fantz, 1963; Gibson, Gibson, Pick, & Osser, 1962) contributed to a cognitive *zeitgeist* within developmental psychology. Two major lines of developmental research — those concerned with modes of memorial

representation and with production deficiencies — stemmed from this cognitive context.

Modes of Representation

Central to Bruner's (1964, 1966) research program on children's thinking was the issue of the manner in which information is represented or coded. Bruner claimed that the young child initially represented information in a motoric or enactive fashion, and that gradually there was a transition to iconic (visual imagery) and then to symbolic modes of representation. The view that the preoperational child's thought (in Piaget's sense; see, e.g., Piaget, 1970) is dominated by imagery, when combined with the increased interest in imagery *per se* in the experimental psychology literature (e.g., Paivio, 1967, 1969, 1971), stimulated much research on questions of imagery in children (e.g., Reese, 1970). With paired associate techniques, there were many attempts to test the Brunerian view of changes in mode of representation. Despite the fact that the data were mixed and did not (perhaps could not) provide strong support for Bruner's position (e.g., Dilley & Paivio, 1968; Milgram, 1967; Rohwer, 1970), interest in visual aspects of children's memory was clearly established. Rather than focusing exclusively on the hypothesis of developmental changes in representation, developmentalists began to explore the broader question of visual encoding in children's memory with a variety of techniques.

Production Versus Mediational Deficiencies

Early evidence from discrimination learning experiments and other complex learning situations suggested that there were developmental changes in the degree to which verbal symbols could be utilized as mediators (e.g., Kendler & Kendler, 1962; Reese, 1962). It was claimed that the young child might have the "appropriate" words but that these potential mediators might not function effectively in the context of the experimental situation. Flavell's (e.g., 1970) influential research program on children's mnemonic strategies developed from a concern with this issue of the child's presumed mediational deficiency. Flavell and his colleagues (e.g., 1970; Flavell, Beach, & Chinsky, 1966; Keeney, Cannizzo, & Flavell, 1967) distinguished between mediational deficiencies (i.e., failures of a generated mediator to "work") and production deficiencies (i.e., failures to produce the mediator). Of course, if a mediator is not produced it cannot serve to mediate performance, but the question of major interest to Flavell was whether mediators might function appropriately if the subjects were prompted to generate them.

Flavell utilized a short-term memory task to explore the production

deficiency/mediational deficiency issue, with verbal rehearsal assumed to function as an appropriate "mediator" in this situation. Flavell et al. (1966) observed that the likelihood of a subject spontaneously rehearsing increased with age, as did recall performance. Further, Keeney et al. (1967) found that recall was higher for first graders who rehearsed (i.e., for subjects who produced the mediators) than it was for comparable subjects who did not rehearse (i.e., for the nonproducers). In addition, it was found that those first graders who did not spontaneously rehearse could be instructed to do so and that recall improved under these conditions. Given this recall facilitation, the data were interpreted as indicating that the first graders' deficiency in this memory task was that of producing the appropriate mediators (here, rehearsal strategies) and not in utilizing the mediators once they were produced. This, of course, does not imply that younger children may not exhibit mediational deficiencies under some conditions.

Flavell (1970) went on to explore the operation of production deficiencies in a variety of different memory task environments and raised questions concerning variables which might be associated with the transition from nonproduction to production of mnemonic mediators. The research of Flavell and his colleagues had a most profound effect upon the study of the development of memory in children. A major proportion of the research concerned with the deployment of strategies in deliberate memory situations stems from this work.

THE CURRENT STATE OF THE ART

The Initial Influences

The various empirical and theoretical contributions indicated above represent some of the initial directions of American research on children's memory. It should be emphasized, however, that although these research programs were described as separate endeavors, they did not exist in isolation. Thus, as suggested previously, Flavell examined production deficiencies in many situations, including the free recall task in which young children do not often spontaneously use a clustering strategy to a great extent (Moely, Olson, Halwes, & Flavell, 1969). Further, Hagen (1971) began to interpret his findings on labeling and rehearsal in terms of the multistore models, and later (Hagen et al., 1975) in terms of production deficiencies. Also, Cole et al. (1971) began with an organizational approach to questions of age changes in free recall and adopted a multistore orientation when they thought it might be more profitable. Certainly by the early 1970s there was a merging of many of these different lines of investigation. In particular, the multistore model and the concept

of the production deficiency came to be informal frameworks through which many aspects of memory development could be viewed. Both approaches (as well as each of the other research programs described above) suggested the importance of subject-controlled strategies which could serve to influence levels of mnemonic performance.

From a multistore point of view, strategies such as coding, imagery, organization, and rehearsal are control processes (Atkinson & Shiffrin, 1968) which govern the movement of information through the component stores of the system. Developmental changes in the utilization of these strategies, which often can be viewed in terms of production deficiencies, have been found to be associated to a considerable extent with the age changes which are observed in the recall of information from long-term memory storage (see Hagen et al., 1975; Kail & Hagen, 1977; Ornstein, 1977). Indeed, evidence from a variety of experimental situations suggests that young children do not spontaneously employ task-appropriate strategies when they attempt to commit material to memory and that age-related improvement in these tasks (at least during the elementary school years) reflects the acquisition of sophisticated techniques for operating the memory system. In contrast, there are minimal if any developmental changes in terms of the structural features of the memory system; for example, the capacities of the sensory register (see, e.g., Morrison et al., 1974) and short-term store (see, e.g., Chi, 1976; Cole et al., 1971) do not appear to change with age. Further, in tasks that do not permit the operation of mnemonic strategies (e.g., A. L. Brown, 1973), no developmental trends in performance are found.

Recent Research Developments

Although the early influences described above are clearly visible in current research, the study of children's memory has been placed in a somewhat broader context in the past several years. Studies of recognition (e.g., A. L. Brown & Scott, 1971; Perlmutter & Myers, 1974), retrieval processes (e.g., Kobasigawa, 1974, 1977), encoding (e.g., Cermak, Sagotsky, & Moshier, 1972; Kail & Schroll, 1974; Kail & Siegel, 1977), processing speed (e.g., Chi, 1977), and cross cultural influences (e.g., Cole, Gay, Glick, & Sharp, 1971; Scribner, 1974; Cole & Scribner, 1977) have provided much useful information concerning the operation of children's memory and factors influencing its development. In addition, although there is still a major emphasis placed on the operation of children's memory strategies, current research has supplemented the initial concern for understanding age differences in deliberate memory tasks with an interest in nondeliberate (i.e., incidental) memory as well. This study of incidental memory stems from the observation that much information (particularly in children) is