THE INTERACTION BETWEEN PICTURES AND THEIR LABELS IN THE MEMORY OF FOUR-YEAR-OLD CHILDREN

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by

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The reported experiments were concerned with the role of pictures and words in the memory of four-year-old children. The experiments demonstrated that providing four-year-old children with verbal labels facilitated their visual recognition and free verbal recall of pictures. This was true not only of labels, but also of longer, less-rehearsible descriptive phrases which did not necessarily suggest corresponding names. Furthermore, this finding was obtained when the labels, by themselves, did not permit the subject to distinguish between the alternatives on the visual recognition test. These findings indicate the inadequacy of a strictly response-oriented explanation of the results; neither rehearsal of the specific words by themselves nor their production at the retention test are sufficient to explain the recognition results. Instead, the effect of words was apparently to influence the subjects to process or store the information in the pictures differently than they would have done in the absence of the words.

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CHAPTER ONE

Introduction

As a child reaches nursery school age, his verbal abilities are developing rapidly. He is able to label objects and events around him and is using language overtly in many new tasks. How these new verbal abilities affect the child's capacity to remember the objects that he has seen is the major concern of this thesis.

During the first few years of his life, the child must have had some means of remembering past events, but in view of his relatively primitive language abilities, it is extremely unlikely that words could have played as prominent a role as they do in the memory of adults. At some point, verbal codings must be co-ordinated with, or incorporated into, this earlier memory. The available evidence, reviewed by White (1965), suggests that a particularly important part of this co-ordination is accomplished while the child is of kindergarten and early school age. Between the ages of five and seven, there is a significant increase in the tendency of children to label and to describe objects and events verbally; furthermore, internal speech during memory and problem solving increases after age five.

The nursery school child, at about age four, being quite competent in verbal communication, but standing before this apparent age of transition in non-communicative verbal functioning, should be an extremely interesting subject in whom to investigate the role of words in memory.

If, in fact, he does not use words internally as does an adult or older child, then we might expect to find differences in the manner in which he remembers events he has seen. Familiar visual events are exactly the type of material that he must have been dealing with prior to his acquisition of effective language. Yet, because they can be labelled and stored verbally, memory for these events might show marked changes if the child is induced to use his new verbal abilities. This thesis will address this problem by investigating the effect of providing familiar labels, upon the four-year-old's memory for a series of pictures. To provide an introduction to the specific issues that arise with this problem, a brief description will be given to two general approaches that psychology has taken to the subject of memory.

Approaches to Memory

Behaviorist Approach: The heart of the behaviorist research strategy is to account for as many learning phenomena as possible in terms of the literal stimuli and responses in the experimental situation. When additional, internal events are postulated in the subject, the preference is for making them analogous to external responses. Language, for example, whether internal or external, is treated as consisting of strings of associated verbal responses. These S-R notions have always worked more naturally with words than with images as internal events, since words obviously could be considered more analogous to external responses than could images.

According to the behaviorists, the benefits that a learner gains by acquiring verbal behavior are the result of the following properties of words: (a) unique verbal responses can be easily associated with

external events and, therefore, can be used to "represent" those events in later behavior sequences, since the words can act as stimuli for the same responses as the event itself, (b) verbal responses are easily rehearsible and can, therefore, be used to maintain information during an interval between the presentation of a stimulus and the occurrence of an appropriate overt response, (c) verbal responses can be either distinct or similar to one another, and, therefore, can be a source of discrimination or generalization that is independent of the external stimuli with which they are associated.

In investigating learning and retention performance, the behaviorists have favored the paradigms of serial-list learning and paired-associate learning. In both cases, the subject is required to learn associations between words, and it follows that a test of retention would be directed toward evaluating his retention of those associations by means of response cueing. Free verbal recall was considered a less suitable method for measuring retention of associations because there is no specific cueing of responses, and, therefore, the data are more difficult to analyse. In evaluating retention performance, visual recognition provides at least some difficulty for the behaviorists because it raises the possibility of storage which is not analogous to the overt responses.

Kendler and Kendler (e.g. 1962) have exemplified the behavioristic approach in first attempting to account for memory by assuming a direct association between external stimulus and overt response without postulating any intervening (internal) processes. The Kendlers have suggested that prior to about age five this model is apparently sufficient

to account for memory processes; i.e. prior to age five, the behavior of the child is apparently directly correlated with characteristics of the environmental situation. After this age, however, the single-stage paradigm is evidently insufficient and an additional stage of "internal mediating events" is invoked to account for the apparent increase in the child's abilities. The basic assumption of this two-stage model is that the initiating stimulus complex produces (or activates) an "internal response" which in turn produces the terminating overt response. Symbolically, this mediation paradigm is designated as: S -(r) - (s) - R, where (r) - (s) represents the implicit mediating response and its resulting internal stimuli. This internal response apparently can be analogous to any external response, but the Kendlers' major emphasis is upon verbal responses. The claim that children prior to age five do not mediate seems to imply that their memory is much simpler in structure and less flexible in function than adult memory. The Kendlers' research is discussed further in Chapter Two.

Cognitive Approach: In contrast to the behaviorists, the cognitive theorists are not primarily concerned with words as separate responses. Words are of importance only in the context of a paragraph or story from which context they presumably derive their meaning. A prototype of the cognitive study is telling a story and evaluating retention on the basis of whether basic themes and ideas, rather than specific words, are retained (e.g. Bartlett, 1932). The process of remembering is conceived of in terms of logical transformations upon the information in a story, not in terms of the execution of a series of specific responses.

An excellent example of the cognitive view has been presented by Schachtel (1947)in a discussion of adult amnesia for early childhood events. Autobiographical reports suggested to Schachtel that most individuals have amnesia for their early childhood from birth to approximately the fifth or sixth year of life. The explanation he has proposed for this amnesia is that,

> "The categories (or schemata) of adult memory are not suitable receptacles for early childhood experiences and therefore not fit to preserve these experiences and enable their recall." (1947, p.4)

Neisser (1967), although not primarily concerned with the development of memory processes, sustains the view presented twenty years earlier by Schachtel:

> "The reason (for childhood amnesia) as Schachtel (1947) saw clearly, is that adults cannot think as children do; they no longer carry out attentive constructions in the way they once did." (1967, p.290).

Schachtel (1947), Neisser (1967), and other cognitive theorists apparently view adult memory as an active, constructive process. Story recall indicates that individuals modify and transform the basic material to be remembered, in keeping with their past experiences and interests.

Childhood memory is viewed as being much less rigidly structured than adult memory, presumably because the young child has not yet learned to deal with his world in the conventionalized ways of adults. In addition, Neisser (1967) suggests that, in infancy and early childhood, imagery may be of primary importance to purposeful thinking and remembering; he suggests, further, that imagery becomes merely tangential to purposeful thinking and remembering in adulthood.

In summary, the behaviorists appear to regard memory as primarily

a reproductive process, with individual words playing a major role. The infant is attributed with few abilities, and relatively simple memory processes. A significant increase in abilities is believed to take place between the ages of five and seven, correlated with a significant development in the child's ability to produce and use verbal responses at that time.

The cognitive theorists regard memory as an active, constructive process, where the total context of an event to be remembered is more important than the individual units e.g. words, constituting the event. The processes of memory are seen as becoming more conventionalized and constrained as the child develops and is educated, so that adult memory may become quite different from childhood memory. There is some suggestion that the period from age five to age seven may be of importance in the development of memory if, after that time, the bases of memory construction are different, as Schachtel's (1947) studies of childhood amnesia appear to suggest.

The Effects of Labelling Objects

As we will see in Chapter Two, there is a good deal of evidence that, during the pre-school and early school years, labelling objects for the child, or inducing the child to label objects himself, helps him to remember them. The fact that the child can profit from being told to provide labels indicates that he is not suffering from an inability to use words. Rather, it is more persuasive that he simply has not adopted the strategy of producing words either covertly or overtly. This provides us with an opportunity to investigate the role that words play in his memory. If the above indications are right,

then one can arbitrarily introduce overt verbalizing into a variety of situations and observe its effect on memory.

The most popular explanations for the effects that have been observed are closely linked to the behaviorist approach outlined above. The words are supposed to aid learning because they provide a response to rehearse, thereby keeping current a response which is associated with the presentation event, e.g. a visual stimulus (Flavell, Beach, and Chinsky, 1966). This explanation might be adequate to account for remembering of the label; however, it does not adequately account for the remembering of the corresponding presentation stimulus. Alternatively, words might aid learning because they, themselves, have distinctive stimulus properties, which might add or subtract from the distinctiveness of an entire stimulus compound (Cantor,1965). From the description given above of the behaviorist research approach, we would expect that explanations such as these would be put to the most severe test if the retention tests were visual recognition and free verbal recall, and if the rehearsibility of the verbal component of presentation were varied.

Motivated by the above discussion, the major experiments of this thesis were designed to test the sufficiency of the notion that labels improve retention by acting as rehearsible and distinctive responses. For both experiments, the retention measures used were visual recognition and free verbal recall. In the first experiment, the labels were either easily-rehearsible one-word labels or longer, less-familiar and less-easily-rehearsible descriptive phrases, in order to evaluate the importance of the rehearsibility of the provided

labels. In the second experiment, the provided labels did not, by themselves, permit the subjects to distinguish between the pairs of alternatives on the visual recognition test of retention. It was thus possible to evaluate further the sufficiency of verbal labels and rehearsal of labels to account for retention performance. Subsequent experiments of the thesis were carried out to confirm and expand the basic findings of the first two experiments.

CHAPTER TWO

Historical Review

Previous approaches to the study of the role of pictures and words in memory, and the findings of these other studies, are reviewed in this chapter. The first section of the chapter is a review of research relevant to the role of words; the second section considers the role of "imagery", i.e. visual memory.

I - THE ROLE OF WORDS IN CHILDREN'S MEMORY

This topic has previously been investigated primarily by the following methods:

(A) observation of developmental changes in occurrence of spontaneous lip movements as evidence for spontaneous labelling in a retention task;

(B) comparison of short-term retention of visual information after presentation with and without experimenter-provided labels;

(C) investigation of the effects of label pre-training on motor paired-associate and discrimination learning tasks;

(D) reversal-shift studies.

This section reviews the above approaches, all of which involved pairing labels with meaningful, readily-identifiable, visual stimuli. Research concerned with pairings of labels and ambiguous visual stimuli

(e.g. Carmichael, Hogan, and Walter, 1932) is beyond the scope of the thesis.

(A) Studies of Spontaneous Labelling

The research of Flavell and his associates (e.g. 1966) is of particular significance for demonstrating change in children's verbal behavior. They explored the ability of young children to label objects spontaneously, and to use this labelling ability in the performance of a visual recognition task. The impetus for this research was expressed in Reese's (1962) review of much of the verbal mediation literature. Reese presented two alternatives for explaining the frequently inferred deficiency in verbally-mediated behavior during early childhood: (i) the mediational-deficiency hypothesis, which suggests that the verbal response is made, but does not mediate performance in a particular task; (ii) the production-deficiency hypothesis, which suggests that the verbal response is not made i.e. that a particular task fails to elicit a verbal response.

Flavell, Beach, and Chinsky (1966) found support for the second hypothesis by observing subjects' spontaneous lip movements during task performance. These spontaneous lip movements were of particular interest during the delay period between stimulus presentation and response, since verbal behavior has often been cited as crucial for rehearsal. Stimulus presentation involved the experimenter's pointing to, for example, three pictures in succession from an array of seven. The subject was required to point to the same sequence of pictures after 0 or 15 seconds delay. Subjects' eyes were covered for the 15 second delay period, during which time one of the experimenters observed their lips, recording all

observable lip movements as evidence of spontaneous verbal rehearsal of stimulus names. A post-experimental picture-naming test demonstrated that all subjects, from kindergarten, and grades two and five, could name all stimuli on request. Developmental changes in spontaneous labelling were found. Second-grade subjects produced a significantly greater amount of detectable verbal coding and rehearsal of the depicted objects across the immediate and delayed recognition trials than the kindergarten subjects. Furthermore, the production curve continued to rise from second to fifth grade. Correspondingly, recognition performance increased with age; however, there were no differences between the immediate and delayed recognition conditions per se. Because the kindergarten subjects could accurately name all of the objects, the finding of increasing production with increasing age was taken as confirmation of the production-deficiency hypothesis. Two possible reasons were presented for the observed deficiency: that the younger subjects might not know when to apply their language skills appropriately; or that they might suffer from a much more general cognitive immaturity, which would result in a deficiency in both verbal and non-verbal production.

Further work by Keeney, Cannizzo, and Flavell (1967) demonstrated that non-rehearsers of age six or seven, as identified by the same task, could be trained to rehearse in the experimental situation with a subsequent improvement in performance, but that they abandoned the strategy if given the option of doing so.

Daehler, Horowitz, Wynns, and Flavell (1969) observed spontaneous verbal and non-verbal rehearsal on a non-verbal delayed serial recall

task for children in kindergarten, and grades one, two and four. On a given trial, subjects were instructed to recall, after 15 seconds delay, either color order, spatial position order, or both color order and spatial position order, for a sequence of colored lights. The investigators hypothesized that verbal rehearsal of color names might predominate when color recall was demanded, whereas gestural i.e. pointing rehearsal might predominate when spatial position recall was required. They found that verbal rehearsal occurred almost exclusively on trials where color order was to be remembered; it served to facilitate recall and its occurrence was found to increase with age, as had been observed in the earlier studies. The failure to observe verbal rehearsal on position order trials was interpreted as indicating that, even with very young children, verbal rehearsal is an intentional and planful cognitive strategy, which the child employs selectively, dependent on the task requirements. Gestural rehearsal was not confined to position order trials, did not appear to mediate recall, and showed inconsistent age trends, possibly indicating that a pointing rehearsal strategy was not relevant to performance of the position order recall task, and that it might even have interfered with efficient recall.

This excellent body of research is particularly noteworthy for its success in dealing with the difficult problem of detection of spontaneous implicit verbalization, and demonstration of its significance for retention, as evaluated by a serial recognition task. Other experimenters, including this writer, have chosen to investigate the role of words by providing labels to some subjects and observing the effect of this on performance. The resulting gain in control of labelling is at

the expense of information regarding spontaneous labelling.

An interesting extension of Flavell's research would be to observe whether the effects of labelling extend to and are equivalent for free verbal recall and for visual recognition when order is not specified. For example, the verbal rehearsal allowed by spontaneous labelling could easily be more important for verbal recall than for visual recognition.

(B) Short-term Retention Studies

Several studies have investigated the role of labels in short-term retention, and the possibility of developmental differences in that role.

Wong and Blevings (1966) presented a serial list of CVC trigrams to ten-year-olds visually, visually and aurally, or visually with the subject vocalizing. On a test of immediate written recall, they found that those groups with additional auditory stimulation, whether experimenter- or subject-produced, were superior to the visual-alone presentation group. This finding was interpreted as supporting Murray's (1965) "additivity of cues" and "preferred modality" hypotheses. Murray proposed these hypotheses to account for his finding, with adult subjects, that free recall performance for visually-presented lists of consonants increased as a monotonic function of simultaneous vocalization level at presentation, for five levels ranging from silent reading to loud voicing. The "additivity of cues" hypothesis suggested that the more cues available - visual, verbal and motor - the better the recall performance; the supplementary "preferred modality" hypothesis suggested that, for some reason, auditory cues are particularly effective for

recall, over the effectiveness of visual and motor cues.

Bernbach (1967) investigated short-term memory for a sequence of colour patches, in four- and five-year-olds. As four, six, or eight colour-patch items were presented one at a time, they were placed face down in a row on a table. Subjects in the label condition were required to name the colours at presentation; the other subjects did not name at presentation. One of the over-turned cards was then pointed out by the experimenter; the subjects were required to identify the matching colour on a colour disc. Thirty-six trials were given to each subject. Bernbach found that performance of children who labelled on the task was identical in nature to that of adults on similar tasks, i.e. best performance on the most recent item, an S-shaped recency curve of performance, and a marked primacy effect. These characteristics were absent when children did not label at presentation. The task was a difficult one for the children and the superiority of the labelling group was present only for the two most recent items. He interpreted his results as consistent with a rehearsal hypothesis, on the assumption that subjects rehearse only those items which they label.

Hagen and Kingsley (1968) tested short-term memory of subjects ranging in age from four to ten years. Eight animal pictures were presented one at a time, then placed face down on the table. Half of the subjects were required to label the cards overtly at presentation. The test of recall for each of the 16 trials was matching-to-sample, where a correction procedure was employed, with the cue cards being displayed until subjects responded correctly. In general, task performance improved with age. The experimenters found that performance of

subjects aged six to seven was facilitated by labelling, whereas this was not so for the youngest and oldest subjects. They suggested that overt labelling might have interfered with the relatively-automatic covert labelling and rehearsing of the older children, resulting in absence of a performance difference between label and no-label groups. The lack of facilitation in the younger children was said to be due to mediational deficiency. When one looks more closely at the data, however, it is apparent that the youngest label and non-label groups did differ significantly for the most recent serial position. All subjects were performing just above chance level over all serial positions whereas for the most recent position the label group made 100% correct responses; the no-label group, 82% correct responses. This finding is similar to Bernbach's, although the latter found differences for the last two serial positions. In analysis, the failure of Hagen and Kingsley to find an effect over all eight serial positions does not preclude the existence of a significant effect for the most recent item.

From these short-term retention studies it is reasonable to conclude that labelling facilitates short-term retention of visually-presented material. As with Flavell's research, however, interesting information might have been gained from comparison of different retention methods. In addition, a clearer picture of labelling effects for four- and five-year-olds, in both the Bernbach, and Hagen and Kingsley studies, might have resulted with fewer items per trial. In light of this problem, the present research was designed with task difficulty as a serious consideration at all stages of the research. The number of presentation items was increased only when it was apparent

that fewer items made the task too simple, i.e. when all subjects, regardless of treatment, were performing at maximum-possible correct responses. The aim was always to evaluate group performance in a situation where all subjects could perform with some degree of competence, so that any failure to obtain group differences could not be attributed to task difficulty.

(C) Verbal Pretraining Studies

A third approach to the role of labelling encompasses a large number of studies, with children and adults, designed to study the effects of various kinds of verbal pretraining on subsequent performance on motor paired-associate or discrimination learning tasks. Because an extensive review of this body of research has been published by Joan H. Cantor (1965), this chapter presents only important features of this literature.

The typical experimental design involves a paired-associate pretraining task in which verbal responses are associated with non-verbal stimuli; the non-verbal stimuli are then used in a transfer task involving different, non-verbal (usually motor) responses.

The most widely-used explanation of the role of verbal cues in stimulus pretraining effects is the hypothesis of "acquired distinctiveness of cues" or ADC hypothesis (Miller and Dollard, 1941). In the transfer task, it is assumed that each external stimulus elicits an implicit verbal response whose accompanying response-produced cue becomes part of the stimulus complex. Since the verbal cues are presumably more distinctive than the external stimuli in this design, generalization between the stimulus complexes should be reduced, resulting in facilitation

of transfer task performance. The hypothesis of "acquired equivalence of cues" or AEC hypothesis (Miller and Dollard, 1941) has also been used, usually to explain the role of verbal cues in negative transfer after pretraining. This hypothesis deals with the situation where learning the same verbal response to two or more pretraining stimuli provides for the addition of identical verbal cues to the stimulus complexes in the transfer task, resulting in increased generalization and, therefore, interference in the learning of differential motor responses, or facilitation in a concept formation task.

A third hypothesis regarding a possible additional role of verbal cues in producing transfer, was proposed by Spiker and Norcross (e.g. 1962). They suggested that if a subject has readily-available names for stimuli during the transfer task, he can spend the time available between trials rehearsing the correct associations.

A final proposed explanation for transfer effects, in Cantor's review, is the formation of observing or attentional responses (e.g. Kurtz, 1955). The hypothesized effect is not dependent on the transfer of verbal cues, but on the resulting increased or decreased discriminability of the external stimuli. Kurtz, for example, assumes that observing responses are learned during pretraining, and that the same observing responses are transferred to the second task, providing distinctive stimulation to which the motor responses are then associated.

The clearest finding of the verbal pretraining studies is of positive transfer from the learning of distinctive names in pretraining, to motor paired-associate and discrimination learning tasks. This finding is true for the entire range of subjects from pre-schoolers to adults.

The data are less clear for negative transfer but do suggest that pre-training with identical names for stimuli interferes with the acquisition of differential motor responses. As Joan Cantor points out, although there is apparently definite support for the ADC and AEC hypotheses, the role of observing responses and rehearsal has not been as thoroughly defined and investigated; she suggests that both factors are likely involved to some extent.

(D) Reversal-Shift Studies

Prior to Flavell's research, the most influential body of research directed to the issue of a verbal mediational deficiency in younger children was that of the Kendlers (e.g. 1959,1962,1963,1966) on reversal-non-reversal shift behavior. A typical experimental design (e.g. 1959) used stimuli which differed simultaneously on two dimensions. Subjects were trained first to discriminate between stimuli varying on a particular dimension, followed by training on either the same or a second dimension. A reversal shift required that the subject respond on the originally-trained dimension but with the overt choices reversed. A non-reversal shift required that the subject shift to a discrimination dimension different from the training dimension.

A single-unit S-R theory would predict that a non-reversal shift should be learned more rapidly than a reversal shift, because the single-unit theory assumes a direct connection between the literal stimulus and the overt response. Presumably, in training the initial discrimination, each time a reinforcement occurs each element of the bidimensional discrimination gains strength so that the positive stimulus on the relevant dimension is reinforced 100% of the time, the negative stimulus on

the relevant dimension is reinforced 0% of the time, and the stimuli on the irrelevant dimension are reinforced 50% of the time. Thus, a non-reversal shift should be learned more readily because there is less difference in strength between the new positive and negative stimuli than in the case of the reversal shift; i.e. the negative stimulus in the reversal shift requires more extinction than does the negative stimulus in the non-reversal shift. On the other hand, mediation theory assumes that the relevant dimension is responded to with a covert response (r), which produces internal cues (s) that elicit the overt response. In a reversal shift, the initial dimension maintains its relevance, and, therefore, so does the mediating response. Only the overt response needs to be changed, and since the experimental situation provides only one alternative overt response, the problem presents no difficulty. In a non-reversal shift, the previously acquired mediation is no longer relevant; consequently both the mediating and the overt responses must be replaced, making the task more difficult than a reversal shift. Therefore, for subjects who mediate, a reversal shift should be acquired more easily than a non-reversal shift. In brief, the Kendlers have interpreted their extensive experimental data as supporting the position that subjects beyond the age of five, who usually learn a reversal shift more rapidly than a non-reversal shift, are behaving in a mediational, and probably verbal mediational manner. Prior to about age five, subjects apparently learn a non-reversal shift more rapidly and are therefore assumed, by the Kendlers, to be behaving in a non-mediational manner.

The major criticism of their research concerns their inferring that reversal-shift performance necessarily involves symbolic mediating

behavior. House and Zeaman (1962), for example, demonstrated that reversal shift performance could be explained equally well as the result of transfer of observing responses; presumably the subject learns to observe the relevant cues during training, and is thus more likely to observe the same cues in the second task. MacKintosh's (1965) attention model can also account for the data in similar fashion.

Furthermore, the Kendlers' approach has been limited by the fact that, although they leave the question of the nature of the mediating event open-ended (1962), their research is confined to words as mediators. As will be discussed in the next section of this chapter, Paivio, Rogers, and Smythe (1968), among others, have argued in favour of visual mediating events of effectiveness at least equal to that of verbal mediating events. This thesis, while concerned with the role of words in memory for pictures, is also concerned with the contribution, to free verbal recall and visual recognition, of the visual component of memory, i.e. it is not restricted to verbal mediation as is the case with the reversal-shift and verbal pretraining studies.

In summary, it can be said that labels apparently facilitate performance in a variety of learning and retention tasks. At the same time, however, as outlined in Chapter One and the present chapter, a great deal remains to be learned about the role of words in memory. For example, most of the above studies, which are in the associationist or S-R framework, do not go beyond consideration of memory as a reproductive process. The labels are assumed to facilitate performance primarily by providing a response to rehearse in the interval between the presentation of a stimulus and the occurrence of an appropriate overt response.

Although some of the studies (e.g. Flavell et. al., 1966) do consider the production of spontaneous labelling responses, none of the studies is concerned with stimulus functions of words.

II - THE ROLE OF "IMAGERY" (PICTURES) IN CHILDREN'S MEMORY

Paivio, Rogers, and Smythe (1968) have argued in favour of visual mediating events of effectiveness at least equal to that of verbal mediating events. They found that free recall of pictures, following serial list learning trials, was significantly better than free recall of words, for adults. They reasoned that if there were only verbal memory for the names and pictures, there should not be a difference in recall after either form of presentation. They suggested that the superiority for pictures is due to the fact that pictures are readily coded and stored in verbal form and also because pictures arouse concrete memory images of the things they represent; thus, the appropriate verbal response for recall can be retrieved from either symbolic mode. Paivio et. al. also suggested that the probability of dual coding is lower for nouns than for pictures i.e. the memory for nouns is less likely to have a visual component. No explanation was offered for why this might be so. In a subsequent study, Paivio (1969) reported that this finding is true for recognition memory as well as for free recall.

Rohwer (1969), using the paired-associate paradigm, has investigated the role of images and pictures in children's learning. He has suggested, in reference to Paivio's research (e.g. 1968), that pictures are easier to remember than words, but <u>only</u> when verbal labels are stored with them. Furthermore, he has suggested that, at an early age, there is

an incapacity for storing visual and verbal information simultaneously, and that the capacity for simultaneous storage increases with age. Assuming that the advantage of pictures over words is contingent on the subject's ability and tendency to represent in storage both the image and its label, the superiority of pictures over words should increase with age.

The first study reported by Rohwer (1969) employed kindergarten and grades one and three children, in a paired-associate learning task. Subjects were required to learn word pairs, picture pairs, or picture-word pairs. Performance on the combined pairs was better than on the word pairs; furthermore, the superiority of picture pairs over word pairs increased with grade level. He suggested two possible alternative explanations: (i) that the capacity of pictures to evoke imagery increases with age: (ii) that pictures evoke images at all ages, but that the ability to profit from the stored images is contingent upon storing an appropriate verbal representation of an object along with its image. This second alternative leads to the prediction that supplying the verbal label should boost the child's performance less and less as age increases because he becomes more likely to supply his own labels. The data were found to support the prediction. Further research reported by Rohwer (1969) showed that older children (grades three and six) were able to make better use of action depictions and action imagery in paired-associate learning than younger children. Younger children (kindergarten and grade one) performed better on the tasks when provided with action sentences than when provided with action images again supporting Rohwer's hypothesis that younger children fail to store the appropriate

verbal tags, i.e. in this case, the sentence description of the action depicted by the picture. The basic result was essentially replicated with children as young as 3-6 years of age.

The very interesting developmental hypothesis derived from the data by Rohwer is that the verbal mode is more preferred and more effective earlier in life, i.e. from about age four to seven, with the visual mode becoming more preferred and effective as the child grows older. As to why this might be so, he suggests that, in younger children, the language system is a more coherent and well-organized system than the imagery system, and that it is easier to acquire the capacity to use well-organized systems. Rohwer's developmental hypothesis is somewhat of a surprise, given his finding that the visual mode is superior to the verbal mode at all ages in the first reported experiment, i.e. children always performed better when imagery was presumably the mode of learning, as opposed to when the verbal mode was used. Furthermore, there is good reason to question his statement that, in very young children, language is a more coherent and well-organized system, which the child can use more effectively at an earlier age than the imagery system. As Palermo (1969) comments, there is no experimental evidence on which to base this statement, nor are there adequate criteria by which to define a "well-organized" system, which would then permit one to hypothesize in this way.

In summary, these studies suggest that "imagery" plays a significant role in memory, about which a great deal more must be learned.

In this thesis, the term "visual memory" is used in place of the more ambiguous term "mental imagery", although the latter term appears in current research articles. "Visual memory" refers to the component of

memory contributed by presentation of a visual stimulus; no attempt is made to specify the exact nature of the "visual memory", i.e. whether it is an "image" or whether it takes some other form.

As a result of this review, the following characteristics were included in the present research.

(i) Assessment of Sufficiency of the Verbal Component: It is well known from the previous literature that the addition of verbal labels aids retention. The behaviorists have emphasized the importance of words and their rehearsal in memory, and, therefore, have studied extensively the facilitative effects of adding labels, to learning and retention primarily of visual material. At the same time, most of the earlier research has neglected the question of the sufficiency of the verbal component alone. The first experiment to be reported included three treatment groups - visual, visual-verbal, and verbal - permitting a comparison of the effects of visual and verbal information, alone and in combination. Including a group which received only verbal information i.e. labels, made possible an evaluation of performance dependent primarily on verbal information. Furthermore, the second experiment to be reported considered this issue in a situation where the verbal labels, which were provided for the subjects, did not, by themselves, permit the subjects to distinguish between the pairs of alternatives on the visual recognition test of retention. In this experiment then, the verbal component itself could not be sufficient to facilitate retention.

(ii) Extension of Verbal Facilitation Effect to Descriptive Phrases: Whereas S-R research has emphasized the role of labels in facilitation, this thesis extended the paradigm to longer descriptions, to investigate

whether the effect is specific to labels, or whether it is also a function of longer, less-familiar and less-easily-rehearsible descriptions.

(iii) Assessment of Importance of Visual Component: The current literature on imagery, or visual memory, emphasizes the need for further study of the role of visual stimuli. As stated above, this thesis included study of treatment groups receiving only visual information, making possible evaluation of performance dependent primarily on visual information. The behaviorists have emphasized the transition period from five to seven years of age, after which time words and their rehearsal presumably become very important to remembering. It is of relevance to ask whether visual information alone is of greater importance than verbal information alone prior to that time, as Neisser (1967) has suggested.

(iv) Comparison of Free Verbal Recall and Visual Recognition: In earlier research, typically a single retention measure has been used in a particular study. Because different measures have not been compared within studies, it is unknown whether the addition of a verbal label will facilitate visual recognition as much as verbal recall, or whether the facilitation is greater when a verbal response is required. This thesis used both visual recognition and free verbal recall measures of retention in order to assess any differential treatment effects. Furthermore, as indicated in the previous chapter, the two retention measures employed in this thesis are particularly relevant to investigating the behaviorist position regarding the importance of words and their rehearsal in remembering.

(v) Evaluation of Visual Recognition Performance for Unfamiliar Visual Stimuli: Typically, recognition tasks have employed the same stimuli as used in training. This research included a visual recognition task, called the transfer task, where the verbal component was identical to the original input, whereas the visual component was a different, distinct instance of the verbal description e.g. two distinct pictures labelled "dog". The purpose of the transfer task was to assess more completely subjects' ability to use the presentation information, whether pictures, words or both pictures and words, where the visual component of that information was not identical. It is conceivable that the availability of a common verbal label for the pairs of recognition pictures would facilitate transfer in accordance with the mediated generalization paradigm, which appears to suggest that the amount of transfer between stimuli will increase if the subject makes the same response to each e.g. a labelling response (Kimble, 1961).

CHAPTER THREE

Experiment I

The general procedure of this experiment was to present to preschool children (a) series of six pictures (the visual condition), or (b) series of six labels (the verbal condition), or (c) six pictures and their labels (the visual-verbal condition), and to test for retention after a single presentation. These three presentation conditions were used to determine whether providing the children with pictures alone or words alone enabled them to perform as adequately on the retention tasks as when they were given both pictures and labels.

Visual recognition and free verbal recall were used as measures of retention. Both measures were taken because they might differentially tap the two kinds of presentation information. An additional, forced-choice recognition test was given in an attempt to separate the visual and verbal, and the recall and recognition aspects of the retention tests.

To test the generality of the child's memory for the presentation events, two types of pictures were used in the recognition series. On some trials, the pictures originally used at presentation were presented for recognition. On other trials, recognition pictures were used that had the same label as those originally presented, but which were visually distinct. (On both kinds of trials, none of the distractor pictures could be labelled with the same names as were applicable to the original

presentation items.) The visual transfer condition was employed to determine if the presence of labels was particularly important for generalization of the presentation information. If the notion of mediated generalization were correct, and if, in fact, the children did display a deficiency in providing their own labels, then the visual-verbal group should be substantially better at this visual transfer than the visual group.

Finally, an attempt was made to discover if any effect of verbal presentation was limited to short, familiar labels. In the first part of the experiment, called Exp. N, verbal presentation consisted of familiar labels. In the second part, called Exp. D, the verbal presentation consisted of descriptive phrases which the subjects could easily match with the pictures. These descriptive phrases should be a good deal less rehearsible than the labels, and would be unlikely to have been associated in as many previous situations in that explicit form.

The first part of the experiment, Exp. N, which employed names (Ns) as the verbal component, will be described and discussed first. The second part, Exp. D, which employed short descriptive phrases (Ds) as the verbal component, will then be described and discussed. In each section of the method, Exp. N will describe the basic methodology and Exp. D will outline any modifications incorporated into Exp. D.

Exp. N

METHOD

Materials

Coloured pictures of objects familiar to young children were chosen from various children's books, and were mounted on construction paper cards of dimensions 4" x 4½". No object appeared more than once in the experimental series. Precautions were taken to avoid the occurrence of similar-sounding names among pictures of a single trial. The stimuli that were used are listed in Appendix A.

There were thirteen sets of pictures - four pretest sets, and nine experimental sets. Each pretest set consisted of two presentation pictures, and two arrays of four recognition pictures each. The first array of four pictures, the presentation picture or PP array, was comprised of the two presentation pictures and two additional pictures; the second array of four pictures, the transfer picture or TP array, was comprised of two transfer pictures and the same two additional or extraneous pictures as for the PP array. The transfer pictures were objects which could be labelled by the same names as the corresponding presentation pictures. Each experimental set consisted of six presentation pictures, and two arrays, the PP and TP arrays, of 12 recognition pictures each. The PP array consisted of the six presentation pictures and six extraneous or distractor pictures; the TP array was comprised of six tranfer pictures and the same six additional pictures as for the PP array. Each picture in each presentation picture array of 12 was pasted on a card of the same colour; the pictures in each transfer

picture array were pasted on cards of varied colours in an attempt to decrease further the resemblance of the transfer pictures to the presentation pictures.

A large sheet of construction paper of a neutral beige colour served as the background sheet upon which the presentation pictures were placed. On this background, the subject also placed his choices in the visual recognition test.

Subjects

The subjects were 24 nursery school children, eight per group, from Hamilton Hebrew Academy and Binkley United Church Nursery. They ranged in age from 4 - 1 to 5 - 1 years. Subjects were assigned randomly to the three experimental conditions, with the restriction that each group contain approximately the same number of same-aged children, in months of age. The mean ages for the visual, visual-verbal, and verbal groups were, respectively, 4 - 7, 4 - 9, and 4 - 8 years. No subjects were discarded.

Experimental Design and Procedure

The design for Exp. N is presented in Table I. Three groups of eight subjects each (visual, verbal, and visual-verbal groups) were employed in Exp. N, one subject being tested at a time. Each subject took part in three experimental sessions, on successive days in so far as this was possible within the five-day school week. Four pretest trials were administered on the first day to familiarize subjects with the basic task requirements. Two trials were PP recognition trials, and

TABLE I

Design for Exp. N

Retention Test Order for Visual, Visual-Verbal, and Verbal Groups

Day I	Day II and III	Day IV
Four Pretest Trials	(1) PP Recognition and Recall; (2) TP Recognition and Recall.	Recall-Only

two were TP recognition trials. For the pretest trials, if it was apparent that the subject did not understand the task during recognition, he was shown the correct cards, and the trial was repeated.

The second and third days were for data collection, and no correction procedure was used. The order of presentation picture (PP) and transfer picture (TP) sessions was counterbalanced within groups. Three trials were given in each session.

The procedure will be described for a typical trial. All stimuli were presented within the context of a story. The instructions and story context are presented in Appendix A.

a) Presentation: For the visual and visual-verbal groups, E placed the six presentation pictures on the background sheet, one at a time at a rate of approximately one every two seconds, until all of the pictures were in front of the subject. For the visual group, E put each picture down and said "this", pointing to the picture. For the visual-verbal group, E said the object's name while pointing to the picture. Then, for both groups, each picture was pointed out again by E, in the same order as before. Again the pictures were designated by E as "this" for the visual group; this group was not permitted any overt verbalizing. The visual-verbal group's pictures were again designated by name by E; these subjects were required to repeat each name after E. All stimuli were then removed from view. This procedure ensured that all subjects were directed to the visual stimuli both visually and verbally, and made possible an evaluation of the role of familiar labels beyond that of merely directing subjects to the stimuli.

E presented the stimulus names twice verbally to the verbal group. On the second presentation, the subject was required to say each name after E. The verbal group were not shown pictures at presentation.

b) Visual recognition followed immediately after presentation. The subject was told to close his eyes for about ten seconds (the retention interval) while E placed before him, randomly, the 12 presentation picture or transfer picture alternatives. The subject was then told to open his eyes, and "to pick out the pictures that show what (was in the circus tent)". A stop watch was activated when the subject opened his eyes. The subject placed his picture choices on the background sheet. For the TP recognition trials, subjects had little difficulty in understanding the requirement that they were to choose pictures which "show what ...", although the pictures to be chosen differed in appearance from the presentation pictures. When there was any uncertainty, on the part of visual or visual-verbal subjects, this was clarified by the pretest procedure outlined above. That is to say, the subject was shown the correct TP and told, "this one shows what (was in the circus tent)". Then the pretest trial was repeated again. No limit was imposed on his number of choices per trial, and timing was stopped when he indicated that he was finished. No knowledge of results was given after the first, i.e. pretraining, session.

c) Verbal recall followed immediately after visual recognition. The subject was asked to recall the names of the presentation pictures, and to indicate when he was finished. Recall was not timed. In addition, the visual and verbal groups were required to name each

picture after the completion of verbal recall. This served to verify the fact that, although the pictures had not been named by E, the subjects were able to name each correctly.

On the experimental trials (days II and III of testing) recall was always preceded by recognition. Because it was conceivable that the prior visual recognition trial might produce an inflated measure of subsequent verbal recall, a fourth session was added for each subject after the main experimental sessions had been completed, to obtain a measure of verbal recall in the absence of prior recognition. This Recall-Only condition used the same method of stimulus presentation as for Days II and III, with three new sets of stimuli. The subject was required to recall the names of the presentation pictures.

RESULTS

The data and analyses for Exp. N are presented in Figures I and II, Table III, and Appendices B and C, along with the data and results for Exp. D. The results for the two parts of the experiment are presented together to emphasize the similar findings which will be discussed further following the description of Exp. D. The primary measure of performance was mean number of correct responses per subject per trial, calculated over the three trials of a given condition. A correct response was a correct identification of a presentation or transfer picture, or correct recall of the name of a PP or TP, with a possible total of six correct responses per subject per trial. A correct omission of an extraneous or distractor picture was not scored. An error of intrusion (false alarm) was a choice of an extraneous picture on PP or TP recognition trials, or the

name of an object other than one of the presentation objects on verbal recall trials. Errors of intrusion were generally very few in number. Because the mean number of intrusions per subject per trial did not vary within-subjects i.e. over different recognition or recall conditions, the data were pooled within-subjects prior to further analysis.

The Wilcoxon Matched-Pairs Signed-Ranks Test (Siegel, 1956) was used for within-group comparisons; the Kruskal-Wallis Analysis of Variance (Siegel, 1956) and Mann-Whitney U Test (Siegel, 1956) were used for between-group comparisons.

I. Visual Recognition

The visual-verbal group maintained superiority over the other two groups on visual recognition, for both PP and TP ($p < .032$) for mean number of correct responses. For errors of intrusion, the visual-verbal group made significantly fewer wrong responses than the other two groups ($p < .05$). The performance of the visual-verbal group was thus better for both correct responses and intrusions.

A. Variation of the Visual Information from PPs to TPs: When the visual information was unfamiliar, i.e. TPs, the resultant performance was poorer than for PPs for both the visual and visual-verbal groups ($p < .02$) for mean number of correct responses. At the same time, however, the magnitude of the transfer deficit did not differ significantly between the visual and visual-verbal groups ($p > .05$).

It is difficult to determine the chance level for visual recognition because the subjects were not restricted in the number of choices which they could make per trial. Although most subjects in all

of the groups chose approximately six pictures per trial, the range of number of choices per subject per trial for all subjects in Experiment I was from 0 to 9, with a mean number of choices per subject per trial of 5.01. However, if we compare the number of correct choices to the number of incorrect choices (errors of intrusion) it is apparent that even the worst performance is above chance.

B. Replication: As expected, the performance of the verbal group was not different for the two recognition tests, i.e. PP and TP recognition ($p > .05$). Having seen no pictures at presentation, the verbal subjects would not be likely to perform differently for the two equivalent sets of stimuli.

II. Verbal Recall

Because there were no within-group effects due to the interpolated visual recognition test for mean number of correct responses per subject per trial, the three recall scores, i.e. after PP, after TP, and Recall-Only, were pooled for each subject, and further comparisons involved a single mean measure of correct recall per subject per trial.

The visual-verbal group was superior to the other groups for verbal recall in terms of the mean number of correct responses per subject per trial ($p < .025$), as was the case for visual recognition. The groups did not differ in terms of errors of intrusion, and for every group the number of errors of intrusion was very small (see Table III). In addition, whereas correct visual recognition performance for the visual-verbal group was almost at maximum possible score, in no instance did the mean number of correct recall responses per subject

per trial for any group exceed four items, a number which is reminiscent of the average memory span for digits at age four (Stanford-Binet, 1937).

III. Other Aspects of the Data

A. The Response Time Data: Response times were measured for visual recognition, but because of extreme variability they proved to be useless measures.

B. Practice Effects: There were no discernible practice effects over trials for any group in Exp. N.

C. Order of Events: The search pattern for recognition, i.e. the method of selecting the recognition choices, was without discernible pattern. The subjects approached the problem of finding the correct pictures in a variety of ways; some subjects would always start at the left or right of the display of alternatives, while others would start their search at any point. Subjects did not begin their search by looking for the first picture which had been presented, followed by the second and so on. In addition, for the verbal recall responses, the order of recall was random. These findings suggest that memory for order of events might be quite separate from that for the events themselves, and that children at age four do not rely on order of events as an aid to remembering. This is reminiscent of the data of Rossi and Rossi (1965), who found that, even at age two, children tended to recall stimuli in concept clusters rather than in presentation order.

DISCUSSION

The results of Exp. N indicated that providing four-year-olds

with short, familiar verbal labels for series of six pictures produced better visual recognition and free verbal recall of the picture information than when subjects were provided with only pictures or only labels. This was found despite the fact that subjects were able to name all of the pictures on request. The facilitating effect of the labels was also observed when the pictures to be chosen at recognition were different from the presentation pictures, i.e. the transfer pictures. The inadequacy of the verbal component by itself to account for all performance was evidenced by the fact that the verbal group, who were provided only with labels, performed more poorly than the visual-verbal group on all retention tests. The fact that the visual-verbal group performed better than the verbal group also indicated that the visual information was of some importance to visual recognition and verbal recall performance. The results for the first part of Experiment I will be discussed more fully after the description and discussion of the findings of Exp. D.

Exp. D

METHOD

Materials

The stimulus materials were 15 sets of picture cards, including the two pretest sets from Exp. N, the nine experimental sets from Exp. N, and three additional sets made up in the same way as the other experimental sets, i.e. with six presentation pictures and PP and TP arrays of 12

stimuli each. Descriptions of from three to seven words were chosen to emphasize a main feature of each visual stimulus, with the same description applying to both the presentation and the corresponding transfer picture, and to no other picture in the same set. In addition, an attempt was made to choose descriptions which would not readily suggest the relevant names. All of the descriptions are listed in Appendix A.

Subjects

The subjects were 27 nursery school children, nine per group, from Hamilton Hebrew Academy and Anshe Sholom Nursery. The age range was from 3 - 11 to 4 - 11 years. Subjects were assigned to the three experimental conditions with the restrictions that the mean age, digit span, and noun span be approximately equal between groups. These means were, for the visual, visual-verbal, and verbal groups, respectively, age: 4 - 5, 4 - 4, 4 - 5 years; digit span: 4, 4, 4 numbers; noun span: 3.4, 3.2, 3.4 words. On subject was discarded due to refusal to continue in the experiment.

Experimental Design and Procedure

The design for Exp. D is presented in Table II. In Exp. D, for the visual-verbal and verbal groups, longer descriptive phrases (Ds) were verbalized in place of names. Pilot research had shown that two repetitions of these longer verbalizations by E, followed by one repetition by the subject, made for a very tedious procedure placing excessive demands on the children's interest and willingness to

TABLE II

Design for Exp. D

Retention Test Order for Visual, Visual-Verbal, and Verbal Groups

Days I, II, III	Day IV
One Pretest Trial Daily. (1) PP Recognition and Recall; (2) TP Recognition and Recall; (3) Recall-Only.	Supplementary Forced-Choice Trials

co-operate. Therefore, in Exp. D, each descriptive phrase was presented only once by E, and repeated once by the subject.

The treatment of the visual group was essentially a replication of that in Exp. N. However, instead of E's designating each object twice by the word "this", longer verbalizations, e.g. "this is one", or "they (saw) this", were said once by E, and then repeated by the subject. It was necessary to lengthen the non-specific verbalizations to equate for the longer exposure to stimuli for the other groups during repetition of the descriptive phrases.

Each subject took part in three main experimental sessions - PP, TP, and Recall-Only. In session I, all subjects were first given the digit and noun span tests, which were also used in Experiment V, so that assignment to groups would ensure approximately equal numbers of children with the same digit and noun span. It was soon apparent that all children were performing at nearly the same level on digit and noun span tests and, therefore, assignment to groups with the age restriction resulted in mean digit and noun span being approximately equal for all groups.

E administered one pretest trial at the beginning of each three-trial session, under the same condition as for that session, i.e. PP, TP, or Recall-Only. During this trial, correction was used when required; this was frequently the case, especially for the verbal subjects who saw no pictures at presentation and were thus initially uncertain as to what was expected of them. In addition, for the verbal group, because they saw no pictures at presentation, an instructional

comment was added for all trials in order to maintain their interest. Subjects were told to "Listen to what (Jane and Bobby saw), and then we will look at some pictures." At the same time, however, no subjects were discarded for inability to perform the task.

No attempt was made to restrict the form of verbal recall to descriptions; subjects were told simply, "Now tell me what ....", and were permitted to recall names, descriptions, or both names and descriptions, as they were able. For all groups, pictures not named at recall were presented at the end of each trial to test the subjects' ability to name them. No subject had any difficulty in naming the pictures.

After the three main experimental sessions, a fourth session was added for each subject. This was a forced-choice recognition condition, including test items of visual recognition (PP and TP trials) and verbal recognition of stimulus names. The presentation procedure was the same as for the first three experimental days of Exp. D. The test phase was, however, quite different from the former test procedure. Pairs of items were presented to the subject, and he was required to choose the one originally seen or described. These pairs were of three forms: a PP, or TP paired with a picture of an extraneous object; or the name of a PP paired with an extraneous name. There were nine test pairings for the six stimuli of each trial, in blocks of three items of PP, TP, or verbal recognition. The last three items, chosen at random, were always similar to three of the first six in that the same labels were applicable. This repetition was done in order to increase the

amount of data obtained from each trial. Although no facilitation was apparent for the last three items, any possible effect should have been spread equally over the three kinds of trials, given the counter-balancing of block orders between subjects. The number of items given in this forced-choice procedure was curtailed far below the number normally necessary to obtain reliable data in order to stay within the limits of co-operation of subjects in this age group.

RESULTS

The data and analyses for Exp. D are presented in Figures I and II, Tables III and IV, and Appendices B and C. As for Exp. N, the primary measure of performance was mean number of correct responses per subject per trial, calculated over the three trials of a given condition. The same statistical methods were used as for the previous part of the experiment.

I. Visual Recognition

The visual-verbal group was significantly better than the visual and verbal groups for both PP and TP recognition, for mean number of correct choices ($p < .01$), and for mean number of errors of intrusion, i.e. false alarms ($p < .02$). The combination of both visual and verbal information served to enhance the absolute performance of this group, as was the case for the visual-verbal group in Exp. N, who were given names instead of descriptive phrases.

A. Variation of the Visual Information from PPs to TPs: When the visual information was unfamiliar, i.e. TPs, the resultant performance was poorer than for PPs for both the visual and visual-verbal

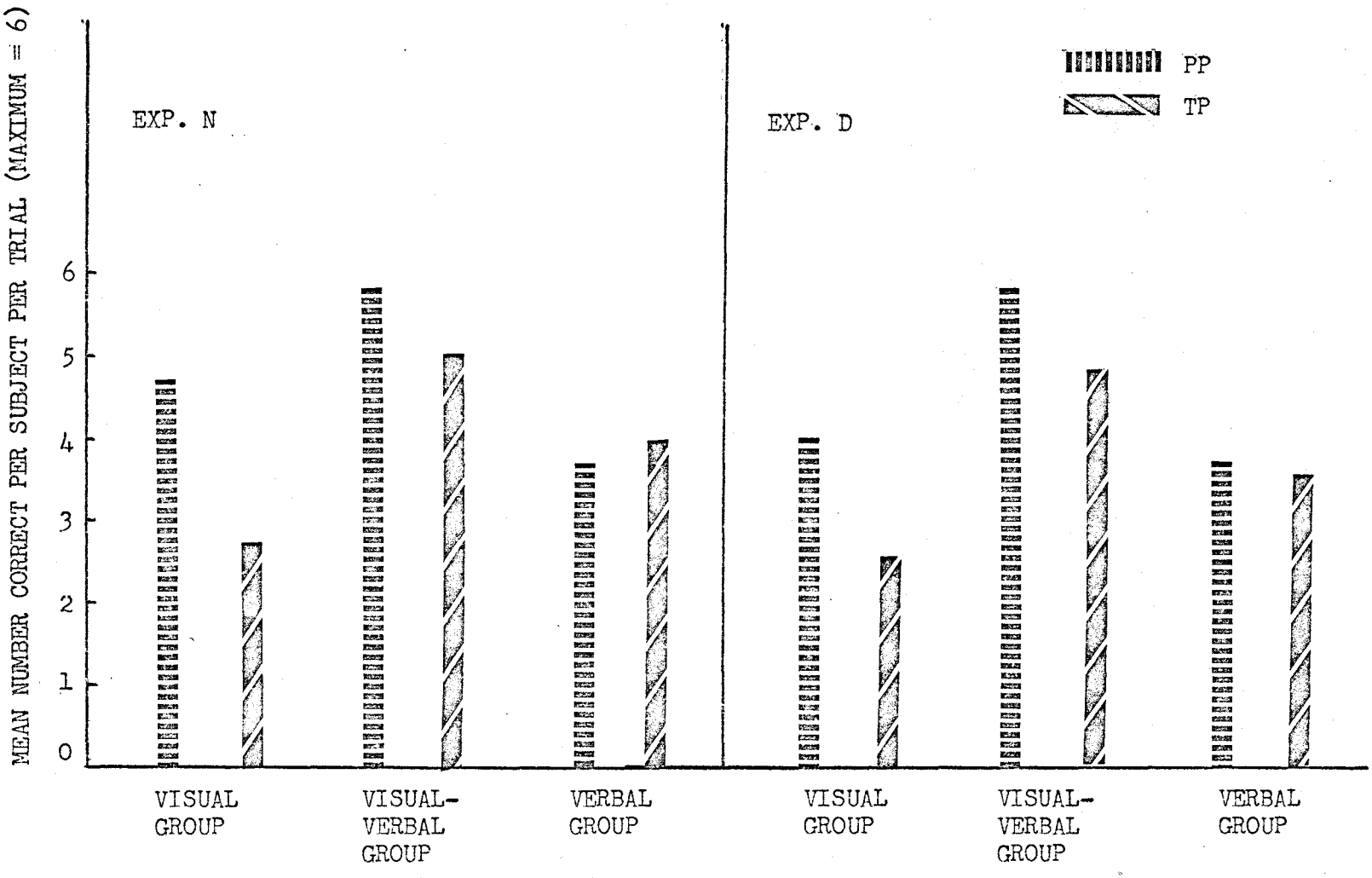

Figure I - The results for visual recognition, for presentation (PP), and transfer picture (TP) trials, presented in terms of mean number of correct choices per subject per trial out of a maximum of six. Exp. N employed names (Ns) as the verbal component; Exp. D employed descriptive phrases (Ds).

TABLE III

The Results for Exp. N and Exp. D, for Visual Recognition and Verbal Recall, Presented in Terms of Mean Number of Correct Choices ($\bar{X}$) Out of a Maximum of Six per Subject per Trial, Standard Deviation (S.D.), and Mean Number of Errors of Intrusion ($\bar{E}$) per Subject per Trial.

		Visual Recognition						Verbal Recall		
		Presentation Pictures			Transfer Pictures					
	n	$\bar{X}$	S.D.	$\bar{E}$	$\bar{X}$	S.D.	$\bar{E}$	$\bar{X}$	S.D.	$\bar{E}$
EXP. N										
Group										
Visual	8	4.7	.70	.71	2.7	1.45	1.04	1.8	.86	.51
Visual-verbal	8	5.8	.14	.04	5.0	.36	.21	3.6	.91	.11
Verbal	8	3.7	1.14	.75	4.0	.92	.42	2.6	1.20	.26
EXP. D										
Group										
Visual	9	4.0	1.17	.89	2.6	.60	1.56	1.6	.67	.33
Visual-verbal	9	5.8	.28	.08	4.8	.60	.63	2.4	.97	.54
Verbal	9	3.7	.98	1.78	3.6	.80	1.59	1.2	.76	.70

groups for mean number of correct choices ($p < .01$), as was found in the first part of the experiment. However, as in the previous part of the experiment, the magnitude of the transfer deficit did not differ significantly between the visual and visual-verbal groups ($p > .05$).

B. Variation of the Verbal Information from Ns to Ds: This manipulation at presentation between the two parts of this experiment (Exp. N and Exp. D) had no statistically significant effect on visual recognition performance, for either the visual-verbal or verbal groups in Exp. D, for either PP or TP recognition tests for mean number of correct choices ($p > .05$), although a deficit might have been expected after presentation of the longer, less-rehearsible descriptive phrases. Comparison of the errors of intrusion between the two parts of the experiment, for recognition, showed more errors of intrusion after presentation of Ds for both the visual-verbal and verbal groups; however, this difference was significant only for the verbal subjects who saw no pictures at presentation ($p < .02$).

C. Replications: As expected, the performance of the verbal group was not different for the two recognition tests, i.e. PP and TP recognition ($p > .05$). As for Exp. N, having seen no pictures at presentation, the verbal subjects would not be likely to perform differently for the two equivalent sets of stimuli.

The visual conditions for Exp. N and Exp. D were essentially replications and there were no between-experiment differences ($p > .05$) for either PP or TP recognition tests. This indicates that the modification in Exp. D, requiring visual subjects to repeat aloud the

non-specific verbalization, was of no apparent consequence to the performance of the visual group.

II. Verbal Recall

Because there were no within-groups effects due to the interpolated visual recognition for either experiment, as was the case for Exp. N, the three recall scores, i.e. after PP, after TP, and Recall-Only, were pooled for each subject, and further comparisons involved a single mean measure of verbal recall per subject per trial.

The visual-verbal group was superior to the other groups for verbal recall in terms of mean number of correct responses per subject per trial ($p < .01$), as for the visual recognition test. The groups did not differ in terms of errors of intrusion.

A. Variation of the Verbal Information from Ns to Ds: Ds were more difficult to recall than Ns for both the visual-verbal and verbal groups in Exp. D as compared to the corresponding groups in Exp. N for both mean number of correct responses per subject per trial ($p < .01$), and mean number of errors of intrusion per subject per trial ($p < .02$). A subsequent experiment of the thesis indicated that the decrement was not a function of subjects' uncertainty as to task requirements, i.e. as to whether they should recall Ns or Ds, but was likely a function of the Ds themselves.

B. Replication: As was the case for visual recognition, the recall performance of the visual groups did not differ between experiments ($p > .05$). This was to be expected because the visual conditions in the two experiments were essentially replications.

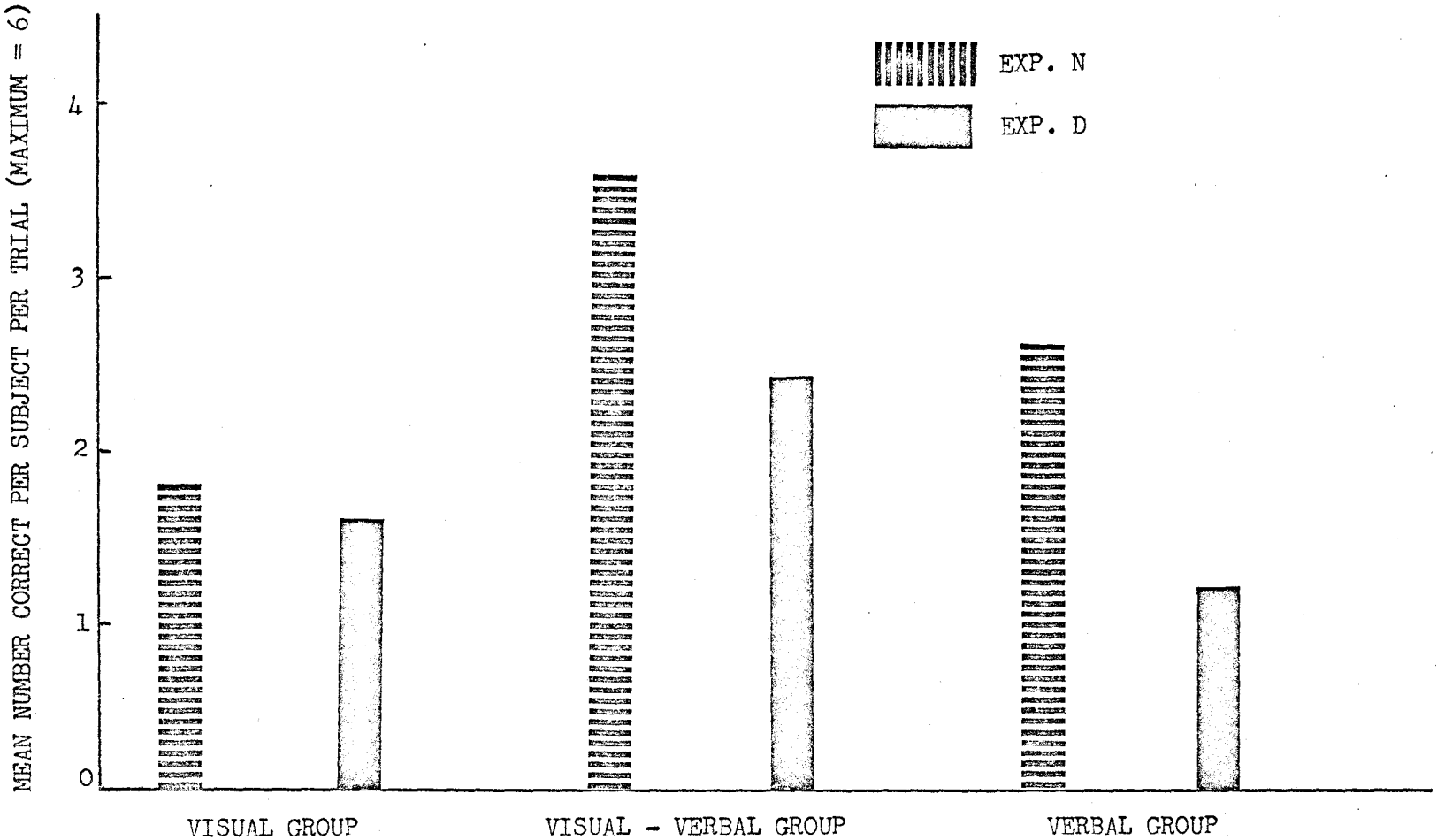

Figure II - The results for verbal recall, presented in terms of mean number of correct responses per subject per trial out of a maximum of six. Exp. N employed names (Ns) as the verbal component; Exp. D employed descriptive phrases (Ds).

Finally, as for Exp. N, in no instance did the mean for verbal recall for any group exceed four items, reminiscent of the average memory span for digits at age four (Stanford-Binet, 1937).

III. Other Aspects of the Data

A. The Forced-Choice Data: The forced-choice data are presented in Table IV, and in Appendices B and C. Within-group comparisons of mean number of correct choices and false alarms for the three conditions, i.e. PP recognition, TP recognition, and verbal recognition, yielded only one significant difference for one of the groups. This was the verbal group, for which PP recognition was significantly better than verbal recognition ($p < .05$). The three groups, i.e. visual, visual-verbal, and verbal, were shown to be significantly different on recognition performance, when the recognition data was pooled within-groups for the three variations of the recognition task (Kruskal-Wallis ANOVA, $p < .01$). Between-group comparisons yielded a significant difference between the visual-verbal and verbal groups for pooled recognition performance ($p < .002$), with the visual-verbal group performing significantly better than the verbal group. The visual-verbal group performed marginally better than the visual group ($p < .10$), and the visual group performed marginally better than the verbal group ($p < .10$). In general, these data are severely limited by a ceiling effect.

B. Practice Effects: Again, as in Exp. N, there were no discernible practice effects over trials for any group.

C. Order of Events: As in Exp. N, the search pattern for recognition was without discernible pattern. In addition, for the verbal

TABLE IV

The Results for Forced-choice Recognition Trials, Presented in Terms of Mean Number of Correct Choices ($\bar{X}$) Out of Three per Subject per Trial, and Standard Deviation (S.D.).

		PP Recognition		TP Recognition		Verbal Recognition	
	n	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Group							
Visual	9	2.6	.45	2.4	.53	2.4	.48
Visual-verbal	9	3.0	.00	2.9	.25	2.7	.40
Verbal	9	2.4	.32	2.1	.59	1.9	.32

recall responses, there was no evidence for subjects recalling the items in the presentation order.

DISCUSSION

In general, the results of Exp. D confirmed the findings of Exp. N, that providing four-year-olds with verbal labels produced better visual recognition and free verbal recall of the picture information than when subjects were provided with only pictures or only labels. Exp. D extended these findings to longer, less-familiar and less-easily-rehearsible descriptive phrases from the short, familiar labels used in the first part of Experiment I.

In the discussion to follow, Exps. N and D are considered to be comparable, although it is worth first briefly discussing the methodological differences. The first difference was that of presenting one pretest trial prior to each daily session in Exp. D, rather than presenting all of the pretest trials in a single pretest session as in Exp. N. The change was made in Exp. D, first, to eliminate the extra pretest session, and second, so that subjects had the procedure of the day, i.e. TP or PP recognition, or Recall-Only, demonstrated in the pretest trial just prior to the experimental trials for the session. Because the pretest trials served only to remind the subjects of the procedure, e.g. to remember names (recall) or to remember pictures (recognition), and because all subjects were able to perform after the first pretest trial, the change in pretest procedure was not considered to be of consequence to the results of the two experiments. This was confirmed for the visual groups in the two experiments, where the two groups performed at about

the same level for recall and recognition although the pretest procedures had been different. The second major change was necessitated by the fact that subjects found two repetitions of the Ds by E and one by the subject to be too long and uninteresting a procedure. Therefore, in Exp. D, E said each D only once, whereas in Exp. N each N had been said twice by E. The fact that recognition performance was almost identical for the corresponding groups in the two parts of the first experiment indicates that one repetition of the verbalization by E was probably sufficient to produce the verbal facilitation in the visual-verbal condition.

I. Visual Recognition

Adding words to pictures obviously improved visual recognition. We will first examine whether this facilitation can be explained in terms of the storage or production of the words themselves, or whether it is necessary to say that the words triggered some more effective processing of the visual material. There are three general ways in which the words as separate response units could produce the effect. These are discussed below.

A. Rehearsal: One possibility is that the words provided the subjects with responses that can be rehearsed more easily than can other codings of the visual stimulus. Several arguments can be raised against the sufficiency of this notion.

1. The four-year-old children in Experiment I and subsequent experiments were not observed to move their lips spontaneously, as Flavell had observed for older children. This does not automatically rule out the possibility of covert rehearsal, but it does rule out the overt rehearsal that Flavell (1966) demonstrated to be so beneficial

when done either spontaneously or in response to instructions at age seven. His findings suggest that any covert rehearsal that might be occurring in the absence of overt rehearsal at age seven is much less effective for retention than is overt rehearsal. The occurrence of effective spontaneous covert rehearsal seems even much less likely at age four than at age seven.

2. The recognition was facilitated almost equally by Ns and Ds despite the radically different verbal characteristics of the two types of material. One would expect that the Ds, being longer and less familiar than the Ns, would be far more cumbersome to rehearse. This anticipated difference in effectiveness was found in the poorer recall of Ds then Ns, but not on visual recognition performance. If the facilitation for recognition after presentation of Ds were due to the covert rehearsal of the Ds, then one would also expect that the Ds could be recalled as well as the Ns were, given that recognition performance was facilitated equally by Ns and Ds. Of course, it is possible that the Ds were converted to Ns at presentation, and that the poorer recall of the Ds reflects the difficulty of retrieving the Ds themselves. Even if this were so, it would be an interesting fact if the Ds were able to elicit covert naming when the pictures alone were not able to. However, there are some aspects of performance which suggest that the conversion of Ds to Ns would not be sufficient to explain the equal visual recognition in Exps. D and N. First, in Experiment IV, when the children were given one D at a time and asked to guess a corresponding name, there were 16 Ds that never evoked the correct response as

defined by the associated picture. This makes the equal recognition performance by the two verbal groups in the present experiment hard to explain by conversion of Ds to Ns. When those Ds (16) which had never been correctly associated with the corresponding names in Experiment IV, were compared with those which had always been named correctly (12), in terms of verbal recall and visual recognition for Exp. D, there was no difference in recall performance between the two categories of Ds. There was, however, some evidence that the 12 Ds which were always correctly named in Experiment IV were recognized more often, in Exp. D, than the 16 Ds which were never correctly named in Experiment IV. However, this trend of the more-easily-named Ds in Experiment IV to also have been associated with better recognition performance in Exp. D, was not consistent for those Ds which were named correctly 75% or 50% of the time in Experiment IV, i.e. for these latter Ds, recognition performance in Exp. D did not differ from those Ds never named correctly in Experiment IV. Therefore, there is only marginal evidence for the conversion of Ds to Ns as an explanation of the equal recognition performance by the two visual-verbal, and the two verbal groups in the present experiment. Second, when children in Experiment VI were given visual-verbal lists using Ds and were asked to give only Ns on recall they persisted in giving some Ds. This was not due to an initial failure to understand instructions, since they performed perfectly at least once on instructional pretest trials that differed only in having a smaller number of items. Further, this condition did not result in better recall than that of the visual-verbal group in the present Exp. D.

If the difficulty in recalling Ds in the present experiment is due to the difficulty of reconverting to Ds after using Ns to rehearse, then one would expect better performance on recall by relieving subjects of the necessity of converting to Ds, as in Experiment VI. In general, the lack of parallel between the effect of Ds on recognition and their effect on recall suggests that maintaining the words in active form was not the mechanism by which visual recognition was facilitated.

B. Verbal Recall: By this notion, at the time of recognition the child would free recall the words that had been presented, and then match them with the labels that he covertly provided for the recognition pictures. Both this recall explanation and the rehearsal notion require that the words be produced independently of the recognition array, and we know that free recall performance is much poorer than visual recognition performance, which argues against the adequacy of a verbal recall explanation for visual recognition performance. Argument 2 above is also relevant; that is, the lack of parallel between the effect of Ds on recognition and their effect on recall suggests that producing the words in an active form was not likely the mechanism by which visual recognition was facilitated.

C. Verbal Recognition: Another possible explanation for the facilitative effect of labels on visual recognition is that each recognition picture elicits a label which is recognized as having been given at presentation. Since labels were never presented during the recognition test, one has to hypothesize that the child is covertly producing them in response to the recognition pictures in order to make

a verbal recognition explanation work. This of course raises the question of why overt labels should be so effective if the child can produce them covertly anyway. To handle this problem one could supplement the verbal recognition explanation with the notion that overtly presented and produced labels, for the child anyway, might be stored more effectively and, therefore, lead to better verbal recognition during the retention test. This explanation, however, is not sufficient to explain the present results. Ds and Ns produce almost equal visual recognition in both the verbal and the visual-verbal groups in the present experiment. To explain this with a verbal recognition argument one would have to claim either (i) that the Ds were converted to Ns at presentation, and, later, led to recognition of the Ns elicited by the recognition pictures, or (ii) that the recognition pictures elicited the Ds which then could be recognized from the Ds given at presentation. The first argument (i) is no more persuasive now than it was with the verbal recall and rehearsal explanations. The second argument (ii) is also difficult to maintain; it is relatively easy to believe that the recognition pictures could independently elicit the labels used in this experiment, but much harder to believe that they would elicit the particular Ds used at presentation, given all the possible Ds which could have been used. It is hard to believe, that is, if one is trying to restrict one's explanation to the occurrence of specific response units such as the Ds and Ns.

Each of the above arguments will be given further consideration after the description and discussion of Experiment II, in Chapter IV,

because of the relevance of that data to this discussion.

At this point, the following statements can be made regarding performance of the visual recognition task.

(i) Verbal recognition, verbal recall or verbal rehearsal were not the only means by which the visual recognition task was performed.

(ii) Adding words to pictures, however, did help the subjects to perform visual recognition. This was so in spite of the fact that subjects could name the pictures when asked to do so, as was done after each trial for the visual and verbal groups.

(iii) Adding pictures to words helped visual recognition. This is not surprising for the presentation pictures, but becomes more interesting with the transfer pictures.

(iv) Adding words to pictures resulted in a type of storage which allowed easier generalization to new pictures. However, the excellent generalization performance of the visual-verbal group was not based solely on the verbal component of presentation, since the visual-verbal group performed better on the transfer pictures than did the verbal group. In addition, the verbal component cannot be taken as a pre-requisite for transfer to visually-dissimilar pictures. As will be shown in Experiment IV, children this age are quite capable of selecting the correct transfer picture to match with each presentation picture if they are asked to hold only one picture at a time in memory, even though they are not required to name each picture. Furthermore, the difference in performance between the visual and visual-verbal groups cannot be taken as indicating that the visual group in the present

experiment simply failed to understand the instructions. The visual-verbal group was given identical recognition instructions as for the visual group, and was treated identically during the recognition period. The poor transfer recognition of the visual group in the present experiment then, is probably contingent on the higher memory load placed on them in the absence of experimenter-provided labels.

From the evidence given above, it is possible to attribute to words a function beyond their existence as differential elements. The suggestion is made that the presence of words influenced the subjects to process or store the information in the picture stimuli differently than they would have done in the absence of the words. Supplying the visual-verbal subjects with words may have enabled these subjects to organize and give meaning to the visual stimuli; or to be more explicit about evaluating what they had seen; or the words may have forced the visual-verbal subjects to attend to distinctive features of the pictures, which features could then be retained in memory to facilitate visual recognition performance for both the PPs and the TPs. We cannot discriminate between these possibilities at this point, but postulating an active processing ability is consistent with the flexible approach manifested by the subjects throughout all of the present experiments. One way of stating the function of words might be to say that the words served, at presentation, to activate schemata (Bartlett, 1932) more effectively than would the pictures alone. We have used the term "schemata" with some hesitation because of its use historically (e.g. Bartlett, 1932). By the term we imply an active processing of meaningful stimuli, which

are stored as more than literal elements.

At the same time, however, it must be noted that there is a very close correspondence between the obtained mean number of correct choices per subject per trial for the visual-verbal conditions in this experiment, and the predicted values based on the assumption that the words and pictures do not interact, but summate only as independent probabilities (Exp. N: PP - predicted, 5.5; obtained, 5.8; TP - predicted, 4.9; obtained, 5.0: Exp. D: PP - predicted, 5.2; obtained, 5.8; TP - predicted, 4.6; obtained, 4.8). As will be discussed further in Chapter IV, the assumption of a summative effect of word and picture information is not sufficient to account for the recognition findings of Experiment II. The data of that experiment provide further evidence that the presence of, and rehearsal of the words as response units cannot explain fully the verbal facilitation effect.

II. The Forced-Choice Recognition Condition

The forced-choice recognition condition was carried out in an attempt to compare visual and verbal recognition. The first pilot attempt to do this had been a single stimulus, yes-no method. After stimulus presentation as for a typical trial in Experiment I, the recognition alternatives were displayed one at a time sequentially, and subjects were asked to identify the correct alternatives, whether names or pictures. Unfortunately, most subjects tended to say "yes" to most of the alternatives, possibly in their desire to please the experimenter. Therefore, the method was modified so that subjects were required to choose between two alternatives on each test trial. Although subjects

were able to perform on the forced-choice trials, no within-group differences were found among the two visual recognition tests (TP and PP) and the verbal recognition test with the exception of PP and verbal recognition for the verbal group ($p < .05$). This of course contrasts with the result from the main experiment that TP recognition was poorer than PP recognition when subjects chose from 12 recognition alternatives. Either this forced-choice measure of recognition was giving us different information about recognition, or it is sufficient to say that we do not have enough data to demonstrate within-group differences between the three measures of recognition. The first possibility is supported by the fact that, with adult subjects, the forced-choice recognition procedure yields very high hit rates, and very low false alarm rates; for example, Nickerson (1965) obtained a hit rate of .87, and a false alarm rate of only .02. Regardless of this limitation, however, the forced-choice data in Exp. D support the free recall and visual recognition measures in that the visual-verbal group's superiority over the visual and verbal groups was again apparent.

III. Verbal Recall

Because of the absence of cues - pictorial or verbal - it was not surprising to find that free verbal recall performance was much poorer than visual recognition performance for both Exp. N and Exp. D. In all cases, verbal recall did not exceed four items per trial, reminiscent of the immediate memory span at age four for numbers (Stanford-Binet, 1937), and for words (Experiment V).

We can state the following facts about verbal recall performance

as observed in the present research:

(i) Adding pictures to words at presentation helped recall of words, despite the fact that the pictures were not available at the moment of recall. This finding suggests that there was a degree of integration in memory between the two types of information.

(ii) Adding words to pictures also aided recall; however, the absolute recall was lower after adding Ds than Ns which was not the case for visual recognition. This finding indicates that we cannot eliminate completely the role of the specific characteristics of the verbal stimuli in determining recall performance. The lower effectiveness of Ds is likely due to processes both at presentation and recall.

As was the case for visual recognition, the obtained mean number of correct responses per subject per trial for each of the visual-verbal conditions is very close to values predicted by assuming that word and picture summate as independent probabilites to produce the visual-verbal recall performance (Exp. N: predicted, 3.6; obtained, 3.6: Exp. D: predicted, 2.5; obtained, 2.4). While this interpretation of the data is insufficient to account for all of the visual recognition findings of this thesis, it cannot be eliminated for the verbal recall findings.

CHAPTER FOUR

EXPERIMENT II

The purpose of this experiment was to investigate the effect, on visual recognition, of providing subjects with meaningful and relevant labels for pictures, which labels would not, independently of the presentation pictures, enable the subjects to differentiate between pairs of alternatives on the visual recognition task. The labels alone were non-differential because each pair of recognition picture alternatives was identifiable by the same label. If the labels as response and rehearsal units were necessary for the superior performance on visual recognition after visual-verbal presentation in the first experiment, then one would expect that providing non-differential labels would result in no verbal facilitation, as compared to recognition performance when no labels were provided. Furthermore, if label rehearsal were the sole basis of verbal facilitation, then subjects provided with non-differential labels should choose either recognition picture of each pair with about equal probability. If, however, the labels serve the function of enabling the subjects to process the visual stimuli differently than they would in the absence of labels (e.g. forcing the subjects to attend to distinctive features of the pictures or to be more explicit about what they had seen, or enabling the subjects to organize and give meaning to the visual stimuli), then the visual-verbal superiority should be found even though the labels alone do not differentiate between

the recognition picture alternatives. Verbal recall performance should still be better after visual-verbal presentation, even though the labels were non-differential to visual recognition, since the visual stimuli are not present at recall.

In this experiment, the number of presentation stimuli was increased from six to eight pictures, in an attempt to eliminate the ceiling effect in the first experiment, where the visual-verbal subjects were all performing almost at a maximum in recognizing the six presentation pictures.

Finally, to demonstrate that the non-specific verbalizations, e.g. "this", had not interfered with efficient production of implicit labelling responses for visual subjects in the first experiment, neither the experimenter nor the subjects verbalized overtly during presentation on visual trials in this experiment.

METHOD

Materials

Part A:

The materials were six arrays of stimuli - two pretest arrays of two presentation (P) pictures, and four experimental arrays of eight P pictures each. The stimuli for visual recognition consisted of the P pictures and their corresponding T pictures, i.e. two P and two T pictures for the pretest arrays; and eight P and eight T pictures for each experimental array.

Part B:

The same materials were used for this part of the experiment with, however, a modification of the visual recognition items to include the eight P pictures (as in Part A), four of the corresponding T pictures, and four extraneous pictures.

All stimuli had been used in earlier experiments. The stimuli are all listed in Appendix D.

Subjects

The subjects were 10 children from Anshe Sholom Nursery, ranging in age from 4 - 3 to 5 - 3 years ($\overline{X}$ = 4 - 10 years). All subjects were given both visual and visual-verbal trials.

Experimental Design and Procedure

The procedure was identical for Parts A and B of the experiment. On visual-verbal trials, as for the earlier experiment, subjects were presented with names and pictures at the rate of one picture every two seconds. After E said each name once, subjects were required to repeat the name while pointing to each picture. On visual trials, subjects were shown the eight P pictures without being given verbal labels. E did not verbalize, but simply placed each picture before the subject at a rate equivalent to that for the visual-verbal trials. Subjects were required to point to each picture after E did, but to say nothing at all. The order of the two visual and two visual-verbal trials was counterbalanced between subjects. A pretest trial, with correction, was administered prior to both types of trials, using the same procedure as used in Experiment I.

The instructions for visual recognition were identical to those

used for Experiment I, i.e. subjects were asked to "pick out the pictures that show what .... and put them here (on the background sheet). Tell me when you are finished." Recall followed recognition for all trials.

RESULTS

The data for Experiment II are shown in Table V. As for the first experiment, the primary measure of performance was mean number of correct responses per subject per trial, calculated over the two trials of a given condition. The same statistical methods were used as for the previous experiment.

Five subjects performed under the conditions for Part A of the experiment, with recognition choices being made from eight P and eight T pictures. Every subject performed better on visual-verbal trials. On visual trials, three of five subjects chose 1,7, and 3 T pictures for a total of only 11 Ts out of 58 responses made by the five subjects on the two visual trials. On the visual-verbal trials, two subjects chose 4 and 1 T pictures for a total of 5 TPs out of 79 responses made by the five subjects on the two visual-verbal trials.

Five subjects were tested under Part B conditions, with recognition alternatives consisting of eight P, four T, and four extraneous pictures. Every subject performed better on visual-verbal trials. On the two visual-verbal trials, three subjects chose 1,1, and 2 TPs, i.e. four TPs out of a total of 76 responses made by the five subjects; on the two visual trials, four subjects chose 1,2,2, and 2 extraneous pictures for a total of seven errors by all five subjects on visual trials.

TABLE V

The Results for Experiment II for Visual Recognition and Free Verbal Recall. The Recall Results are Presented in Terms of Mean Number of Correct Responses per Subject per Trial ($\bar{X}$). The Recognition Results are Presented in Terms of Mean Number of Presentation Picture (PP), Transfer Picture (TP), and Extraneous Picture (EP) Choices per Subject per Trial.

	Visual Recognition			Verbal Recall
Part A (n=5)	PP (8)	TP (8)		$\bar{X}$
Visual	4.7	1.1		2.5
Visual-verbal	7.4	.5		3.9
Part B (n=5)	PP (8)	TP (4)	EP (4)	
Visual	5.3	.9	.7	2.5
Visual-verbal	7.2	.4	.0	3.3

The data for Parts A and B were pooled in order to determine the existence of the visual-verbal superiority which had been found, in the first experiment, for recognition and recall. The visual-verbal mean was 7.3P pictures per subject per trial (S.D.=.76); the visual mean was 5.0 P pictures per subject per trial (S.D.= 1.78). Performance was significantly better on visual-verbal trials ($T=0$; $p < .01$).

For recall, the visual-verbal mean for the pooled data was 3.5 words per subject per trial (S.D.= 1.03); the visual mean was 2.5 words per subject per trial (S.D.= .78). Thus, there was a significant difference in favour of the visual-verbal condition over the visual condition ($T= 3.5$; $p < .05$). Recall never exceeded four items per subject per trial, again reminiscent of the digit-span norm for the Stanford-Binet (1937).

DISCUSSION

Performance on visual-verbal trials was significantly better than on visual trials for both verbal recall and visual recognition. The results for visual recognition will be considered first.

The fact that visual recognition performance was better on visual-verbal trials indicates that although the labels, by themselves, did not permit the subjects to differentiate between the pairs of alternatives, their presence resulted in superior performance. After visual-verbal presentation, subjects not only chose more P pictures than after visual presentation, but also chose fewer T pictures and fewer extraneous pictures.

As was the case in Experiment I, adding words to pictures improved

visual recognition. In the discussion of Experiment I, the possibility that the facilitation could be explained in terms of the storage or production of the words themselves was explored. Three general ways in which the words as separate response units could produce the effect were considered.

A. Rehearsal. This possibility was that words provided the subjects with responses that could be rehearsed more easily than other codings of the visual stimulus. In addition to the arguments stated in Experiment I, the data for Experiment II provide strong evidence against the adequacy of the rehearsal possibility. Since the words by themselves were non-differential for the recognition task, no facilitation from words or their rehearsal should have been observed. The only type of rehearsal that would be plausible in the face of this evidence would be a type in which the verbal label rehearsal acted mainly as a backbone which supported concurrent rehearsal of other aspects of the visual stimulus. However, even this possibility seems unlikely in light of the two arguments presented in the discussion of the first experiment, namely, that there was no evidence for spontaneous lip movements, and, that, although the Ds were far more cumbersome to rehearse than the Ns, recognition was facilitated almost equally by Ns and Ds.

B. Verbal Recall. This possible explanation requires the child to recall the presented words at the time of recognition, and then to match them with the labels that he has covertly provided for the recognition pictures. In Experiment II, the words that would be recalled would not permit the child to choose between the pairs of identically-labelled recognition pictures. Therefore, this is further argument

against the sufficiency of a verbal recall explanation for the verbal facilitation of visual recognition.

C. Verbal Recognition. As discussed in Experiment I, another possibility for the facilitating effect of labels on visual recognition is that the recognition pictures elicit a label which is recognized as having been given at presentation. Once again, Experiment II provides a strong argument against this possibility. When the names that are presented would apply to more than one of the recognition choices, recognition of that word during the retention test could not help the child choose between the pictures. Even supplementing a verbal recognition explanation with the idea of the verbal material arousing connotations that are common to Ns, Ds, and pictures, would not be sufficient to explain the results of Experiment II. The problem raised by this experiment is to understand how a general label can aid the child in recognizing the differential features of the two recognition pictures that have the same label. This problem is not solved by appealing to a different class of general elements such as connotations or common associations.

All of the above arguments, and those in Experiment I, suggest that the present of, or the rehearsal of the words as response units was not sufficient to explain the results. It appears that the function of the provided labels was to enable the subjects to process the visual stimuli differently than in their absence. The findings of this experiment demonstrate that the visual-verbal subjects were more attentive to, or found it easier to retrieve, the distinctive features of the presentation pictures, in that fewer T pictures were chosen after visual-

verbal presentation than after visual presentation.

This experiment also extended the finding of significantly better visual recognition and verbal recall after visual-verbal presentation than after visual presentation, to a within-subjects design. The fact that, for all subjects, retention was better after visual-verbal trials indicates that presenting labels on some trials did not result in the adoption of a more effective strategy by subjects on trials when no labels were provided by the experimenter.

In spite of the fact that the number of P pictures was increased to eight, in this experiment four-year-old subjects were still performing almost perfectly on visual-verbal trials of recognition.

One final point is noteworthy. In this experiment, neither the experimenter nor the subjects verbalized during presentation, for the visual condition. In the first experiment, a non-specific verbalization had accompanied each presentation picture. The fact that recognition performance on visual trials, in this experiment, was still significantly poorer than for visual-verbal trials indicates that the occurrence of non-specific verbalizations e.g. "this", is <u>not</u> an adequate explanation for the lack of adequate implicit labelling on the part of the visual groups in the first experiment. That is, it seems unlikely that the non-specific verbalizations in the first experiment interfered with efficient production of implicit labelling responses for visual subjects.

CHAPTER FIVE

Experiment III

Part of the interest in the preceding experiments was due to the implicit assumption that words were having an effect on remembering, at age four, that they would not have for adults. The purpose of this experiment was to determine whether eight-year-olds and adults would, in fact, perform no better for visual recognition and verbal recall after visual-verbal presentation than after solely visual presentation. Two levels of task difficulty, i.e. eight and 16 presentation pictures, were investigated with the eight-year-olds, to determine whether task difficulty was of importance to the obtained results.

METHOD

Materials

Eight-Year-Olds

Part A: The materials were: two pretest arrays of two presentation pictures, and four recognition pictures (two PPs and two extraneous pictures); and four experimental arrays of eight presentation pictures, and 14 recognition pictures (eight PPs and six extraneous pictures).

Part B: The materials were two experimental arrays of 16 presentation pictures and 24 recognition pictures (16 PPs and eight extraneous pictures).

Adults

One pretest array which had been used in Part A was used. In addition, there were two experimental arrays of 25 presentation pictures and 50 recognition pictures (25 PPs and 25 extraneous pictures).

All stimuli had been used in previous experiments. The stimuli are listed in Appendix D.

Subjects

The eight-year-old subjects were eight children from the Grade II class at Hamilton Hebrew Academy, ranging in age from 7 - 11 to 8 - 7 years ($\bar{X}$ = 8 - 1 years). Each subject took part in two experimental sessions: Part A was administered in the first session; Part B involved a second session with each subject after all subjects had completed Part A.

The adult subjects were 17 adults from McMaster University summer school classes. Their mean age was 29.9 years.

Experimental Design and Procedure

The procedure for eight-year-olds was identical in all respects to that for Experiment II. For adults, the story context was omitted, on the assumption that a fairy tale context could only detract from the seriousness of the experiment. Also, the recognition procedure was modified for adults. A sequential recognition task was set up to eliminate the difficulties of trying to display, simultaneously, an array of 50 pictures. Subjects simply went through the randomly-ordered deck of 50 items sequentially, and said "yes" for pictures which they recognized; "no", for pictures not recognized. The recall procedure was the same as

for the earlier experiments.

RESULTS

The results for this experiment are presented in Table VI. As for previous experiments, the primary measure of performance was mean number of correct responses per subject per trial. The same statistical procedures were used as in the previous experiments.

For Part A recognition, five subjects performed better on recognition following visual-verbal presentation; three subjects performed equally well on both recognition tasks. On visual-verbal trials, all subjects gave perfect performance; on visual trials, a total of only four incorrect choices were made by all subjects. For verbal recall, five subjects performed better after visual-verbal presentation and one subject, better after visual presentation. On recall, for visual-verbal trials, a total of two errors of intrusion were made by all subjects, whereas for visual trials, a total of only five errors were made by all subjects. The trend was thus in favour of superiority of the visual-verbal condition for both visual recognition and verbal recall.

In Part B, for seven subjects, recognition was superior after visual-verbal presentation to that following visual presentation ($T=0$; $p < .01$); for one subject, performance was not different for either type of presentation. Six of the eight subjects still performed at maximum (16 PPs) for the visual-verbal trial; one, for the visual trial. No incorrect choices were made on any trial for Part B recognition. For recall, six subjects were superior on the visual-verbal trial; two, on the visual trial. Only a total of three incorrect responses were made

TABLE VI

The Results for Experiment III, Presented in Terms of Mean Performance ($\bar{X}$) per Subject per Trial, and Standard Deviation (S.D.). Maximum Possible Score per Subject per Trial was: Part A - 8; Part B - 16; Adults - 25.

		Recognition		Recall	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.
Condition					
Eight-year-olds					
Part A (n=8)	Visual	7.5	.46	4.8	1.34
	Visual-Verbal	8.0	.00	5.7	1.19
Part B (n=8)	Visual	13.4	2.32	5.1	2.53
	Visual-Verbal	15.5	1.07	6.5	1.69
Adults					
(n=17)	Visual	23.6	1.62	12.7	4.18
	Visual-Verbal	23.5	1.51	13.2	3.26

by all subjects on the visual-verbal trial; none were made on the visual trial. Thus, again, there was a suggestion of a visual-verbal facilitation effect.

For the adult subjects, for both recognition and recall, there was no difference between the two conditions. For recognition, on the visual-verbal trial only a total of four errors of intrusion, i.e. false alarms, were made by all subjects; a total of three incorrect choices were made by all subjects on the visual trial. For recall, there were no errors of intrusion on the visual-verbal trial, and a total of only one on the visual trial.

DISCUSSION

Although the sample size was limited, the data for Parts A and B definitely suggest that, at age eight, recognition and recall of visually presented stimuli are still superior, as at age four, when subjects are provided with labels for the pictures. It is conceivable that with fewer than eight stimuli at presentation no difference would be found between visual and visual-verbal trials for eight-year-olds. In pilot research, and in Experiment IV, with four-year-olds, subjects were found to be able to perform the experimental tasks perfectly with and without labels when small enough amounts of material were presented to them. In addition, it would appear that eight-year-olds might be able to recognize several more than 16 pictures on a single trial, particularly if also given the corresponding labels. Even with 16 presentation pictures, six of eight subjects achieved perfect performance on the visual-verbal trial; one subject, on the visual trial.

It is of interest to compare these data with Flavell's findings (e.g. 1966). By assessment in terms of the occurrence of lip movements correlated with an increase in performance, he demonstrated that, by approximately age seven, children begin verbalizing, i.e. rehearsing, spontaneously when shown pictures for subsequent recognition. Prior to age seven, i.e. at approximately age five, he had evidence, in the absence of lip movements, for production deficiency. In this experiment, however, in the few cases where lip movements were observed - three subjects in Part A and one in Part B - performance was not noticeably different from that of the other subjects. In addition, there was still a facilitating effect from providing labels, as was the case at age four.

Adult performance did not differ under the two conditions. Spontaneous comments from subjects suggested that, if anything, providing labels served only to confuse the subjects and to detract from their "usual" methods for memorizing items.

CHAPTER SIX

Experiments IV and V

These experiments were both attempts to obtain data on the ability of four-year-olds to perform similar types of manipulations to those which were required in the first experiment, but under a low memory load, i.e. when the number of stimuli and the required transformations were reduced to a minimum on a single trial.

Experiment IV

This experiment was designed to investigate:

I. Whether four-year-olds can, when given one stimulus at a time, match the names used in Exp. N with the correct pictures,

II. whether they can match the individual Ds with the correct pictures,

III. whether they can attach labels to individual Ds,

IV. whether they can match individual pairs of P and T pictures.

These tasks demonstrate the ease or difficulty that the child has in making transformations under minimal memory load, among the basic types of material used in the previous experiments.

METHOD

Materials

The materials were the 12 sets of stimuli used in Exp. D.

Subjects

The subjects were 16 nursery school children from Hamilton Hebrew Academy and Anshe Sholom Nursery. The age range was from 3 - 11 to 5 - 0 years, with a mean of 4 - 5 years.

Experimental Design and Procedure

All subjects were individually tested under all four conditions of the experiment, over four testing sessions, using the 12 sets of stimuli from Exp. D (with 6 PPs per set) in story groups of three, so that for each story group of three stimulus sets, four different subjects were tested under each of the four conditions of the experiment. Therefore, for each stimulus set the maximum number of correct associations was 24 for each condition.

The four conditions were as follows:

I. Name-Picture: Subjects were required to associate names with pictures. In story context, E said, "I'll tell you what .... and you point to the right pictures". E then placed the 12 card array (6 PPs and 6 extraneous pictures) from the PP recognition test before each subject, and said the PP labels one at a time. After each name was given, the subject pointed to the corresponding picture in the array. No correction was given, and only infrequently was it necessary for E to repeat a name.

II. Description-Picture: The procedure was identical to that for labels, except that each D was said by E, and the subject was required to point to the associated picture.

III. PP-TP Matching: Subjects were shown the P pictures one at a time. Each picture was removed after brief presentation, and each

subject was required to choose the relevant T picture from the TP recognition array of 12 pictures, i.e. 6 TPs and 6 extraneous pictures.

IV. Description-Name: E presented each D and each subject was required to give the name of the object e.g. "... something that says quack, quack. What is it?"

For all conditions, subjects did not verbalize the stimulus cue prior to or during the search for the correct response.

RESULTS

The data are presented in Appendix E. This section will present an overview of the results. For the name-picture matching, only four errors occurred for all stimuli for all subjects out of a total of 288 responses; for description-picture matching, five errors in 288 responses; and for PP-TP matching, two errors in 288 responses. For description-name production, six of 18 Ds were named correctly by three or four subjects for Story I; and 7, 6, and 6, of 18 Ds respectively, for Stories II to IV, for a total of 25 Ds out of 72. All of the other 47 Ds were identified by two or fewer of the four subjects, with 16 Ds from the four stories never being identified correctly.

DISCUSSION

Experiment I demonstrated that subjects could name all of the objects when asked to do so post-experimentally. The present experiment demonstrated, further, that subjects could make the correct picture association to a name, description or PP, and, furthermore, that they could do so under a small memory load, i.e. none of the comparisons

were concurrent - while the subject was making the correct response the initiating stimulus was not overtly present. This makes the results of the previous experiment even more noteworthy, demonstrating that, in spite of the fact that four-year-olds were able to perform all of the required operations on single items, within the experimental context, with larger numbers of stimuli, significant group differences in performance were obtained.

With regard to the description-name data, further comment is warranted. Although the criterion for choice of Ds was that they should emphasize a main feature of the visual stimulus independently of the name, we cannot rule out, completely, the possibility that some Ds might have produced (implicit) naming responses in some subjects at presentation in Exp. D, which names might then have been stored in memory.

Experiment V

The purpose of this experiment was to determine whether the verbal recall findings of the earlier experiments, where verbal recall performance never exceeded four words per subject, could be replicated under different, i.e. memory span, conditions. Because the score of four is reminiscent of the digit span norm of four digits at age four in the Stanford-Binet Intelligence Test (1937), immediate memory span was obtained for digits, pictures and words (nouns), using tests of memory span similar in construction to the digit span subtest of the Stanford-Binet Test. The basic difference in procedure from previous experiments was that, in this experiment, recall performance was scored for order of recall of items, and there was no overloading of memory, i.e. rather

than presenting to subjects, six or eight items, subjects were presented with a maximum of only as many items as they could recall correctly on a single trial. Finally, presentation rate was increased to one stimulus per second.

METHOD

Materials

i) Digit Span: The digit span subtest from the 1937 Stanford-Binet Intelligence Test (Form L) was administered.

ii) Noun Span: Lists of words, three each of length 1, 2, 3, 4, 5, and 6 words, were made up in the following way. Using as source a number of children's picture books, a lengthy list of labels of common objects was drawn up. These nouns were randomly placed in lists of the required length, with two restrictions: (a) that no two in the same list could begin with the same sound, and (b) that none of the words from the first experiment could be used, because the same subjects were used in this experiment as in Exp. N.

iii) Pictorial Noun Span: The lists of words were made up as for noun span and a picture depicting each noun was made up according to the procedure for Exp. N stimuli. All word lists are presented in Appendix D.

Subjects

For digit and noun span, the 24 subjects used in Exp. N were again used, with group identity maintained as for Exp. N. For pictorial noun span, only nine of the same subjects, from Hamilton Hebrew Academy, were available. Group identity was not, therefore,

maintained as for the first two tests.

Experimental Design and Procedure

Digit and noun span were administered to each subject in a single session. The procedure and scoring method was that for the Stanford-Binet (1937), i.e. items were presented at a rate of one per second, and the subjects were required to repeat the items in the same order. Each subject's score was the length of the longest correctly-repeated list.

The pictorial noun span test procedure varied from that on noun and digit span as follows:

a) Visual (pictures only): each subject was shown series of pictures of increasing length. These pictures were placed before him one at a time and designated by the word "this", until all were before him. No names were given. The pictures were then covered; the subject was required to name them in the specified order. The instructions were as follows:

> "I am going to show you some pictures, and when I am finished I want you to tell me their names. Give me this name first, then this (an example being given so that the subject would understand the requirement of correct order.)"

b) Visual-verbal simultaneous (pictures and labels, all items simultaneously): these were presented as for a) with the name instead of the indicator "this". Instructions were as for a).

c) Visual-verbal successive (pictures and labels, each item individually): here, pictures were presented one at a time and

immediately removed from view, so that the subject saw each one only for one second, and did not have a simultaneous view of all stimuli of a single list length. In other respects, the procedure was as for a) and b).

For all tests, the score was the length of the last correctly-repeated list.

RESULTS

The data are presented in Table VII, in terms of mean memory span per subject and standard deviation, for each of the span tests. For digit and noun span, there were no statistically significant differences between groups, and both measures were in accord with the 1937 Stanford-Binet norm of 4 digits at age four. For pictorial noun span, the visual-verbal-simultaneous and visual-verbal-successive conditions were not significantly different; the visual condition produced significantly poorer performance ($T=0$; $p < .01$). This difference was in the same direction for all subjects; all subjects obtained a score of at least 1 on the visual subtest. In no case, for any of the span tests, was the score for a subject a result of a failure to repeat the correct number of stimuli in the correct order. In all cases, the scores were the result of a failure to repeat a longer list of stimuli in its entirety. That is, all subjects were able to recall lists of nouns with the additional requirement of correct order, and a failure to attain a higher score was never a result of confusion of order of recall.

DISCUSSION

As expected, the verbal memory spans for both digits and nouns

TABLE VII

The Results for Experiment V, Presented in Terms of Mean Memory Span ($\bar{X}$) and Standard Deviation. Part A Presents the Results for Digit and Noun Span for Visual, Visual-verbal, and Verbal Groups of Subjects. Part B Presents the Results for Pictorial Noun Span, for Three Within-subject Conditions.

TEST PROCEDURE

Part A

		Digit Span		Noun Span	
Group	n	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Visual	8	4.1	.84	3.5	.75
Visual-verbal	8	4.1	.84	4.0	.54
Verbal	8	4.1	.64	3.5	.54

Part B

Condition (n=9)	Noun Span	
	$\bar{X}$	S.D.
Visual	1.4	.53
Visual-verbal-simultaneous	3.7	.71
Visual-verbal-successive	3.3	.50

was approximately four, in keeping with the Stanford-Binet norms for age four. Even when subjects were given both pictures and words at presentation, the recall span did not exceed the number four. A similar observation was previously made for verbal recall in Experiments I and II, i.e. verbal recall performance for the visual-verbal and verbal subjects never exceeded four.

The similarity between these results and the results of the earlier experiments is interesting because the circumstances of recall were very different. In the earlier experiments, recall was not immediate, usually being preceded by visual recognition. Furthermore, order of events was not specified in the earlier experiments, whereas order of recall was specified in this experiment. It is noteworthy that the visual, and visual-verbal conditions for the first experiment and this experiment yielded almost identical mean performance per subject per trial (Exp. N: visual $\bar{X} = 1.8$; visual-verbal $\bar{X} = 3.6$; Experiment V: visual $\bar{X} = 1.4$; visual-verbal $\bar{X}$ 3.7). There was a discrepancy between the means of the verbal group in Exp. N ($\bar{X} = 2.6$) and for noun span for the same subjects in the present experiment ($\bar{X} = 3.5$); however, this difference was not statistically significant. The similarities in results show that verbal recall performance is not sensitive to these variations in procedure.

For pictures alone in this experiment, recall span was significantly poorer than for the other conditions. Subjects were able to recall the names of pictures from memory, but their ability to do so was very limited. This was also evident in Exps. N and D, and Experiment II, where mean

recall scores for the visual conditions were, respectively: 1.8, 1.6, and 2.5 words.

CHAPTER SEVEN

Experiment VI

This brief experiment was conducted to determine whether the poorer recall performance for the visual-verbal group in Exp. D than for the corresponding group in Exp. N, was due to the characteristics of the Ds themselves, or whether it was due to subjects' confusion as to what was required on recall, i.e. as to whether they were allowed to give Ns, Ds or both. If all subjects gave Ns, they might do better than if they were restricted to Ds or were allowed to give either Ns or Ds as in Exp.D. Only the visual-verbal condition was included because to have included a verbal group would have been to impose upon subjects the difficult task (as indicated in Experiment IV) of converting Ds to Ns without the aid of supporting pictures. In addition, the verbal subjects in Exp. D had indicated impatience with the recall-only procedure; this had been dealt with by promising to show them pictures after each recall-only trial. To avoid these difficulties, no verbal group was run.

METHOD

Materials

The materials were two pretest arrays of two presentation pictures each and four experimental arrays of six presentation pictures each. The stimuli were randomly selected from those which had been used in Exp. D. They are listed in Appendix D.

Subjects

Ten nursery school children from Hamilton Hebrew Academy and Anshe Sholom Nursery served as subjects. Their age range was from 4 - 3 to 5 - 0 years ($\bar{X}$ = 4 - 9 years).

Experimental Design and Procedure

The procedure was a modification of that for the recall-only condition for Exp. D. After visual-verbal presentation as for Exp. D, i.e. presentation of pictures and descriptions (Ds), for each recall trial the type of recall (Ns or Ds) was specified. On N trials, the subject was asked to "give the names of ...."; on D trials, he was asked to "tell me what we just said that ....". For each of the two types of trials, a pretest trial was administered, using a correction procedure for errors, to ensure that subjects understood that they must give Ns or Ds as required on different experimental trials. Each subject was given two N and two D trials in a single session, with trial order counterbalanced between subjects. Any D response which included elements of the presentation description was scored correct, e.g. the response "quack, quack" given for the description "something that says quack, quack".

RESULTS

The mean performance for Ns was 2.55 Ns per subject per trial (S.D. = 1.12); for Ds, 1.8 Ds per subject per trial (S.D. = 1.14). Seven of 10 subjects recalled more Ns ($T = 0$, $p < .01$); three recalled equal numbers of Ns and Ds. Although type of output for recall was specified on each trial, and although all subjects were able to

perform as required on the pretest trials, a number of responses on both types of experimental trials were a combination of both Ns and Ds. for N trials, out of 68 responses made by all subjects on the two trials, 17 responses were Ds; for D trials, out of a total of 41 responses given by all subjects, 7 responses were Ns.

DISCUSSION

When type of recall was specified, subjects were able to give more N responses than D responses. However, when the performance in this experiment is compared to that for the recall-only condition of the visual-verbal group in Exp. D ($\overline{X} = 2.4$), it is apparent that specifying type of recall did not produce better recall.

Unfortunately, the results were somewhat less clear than desired. All subjects were able to perform on the two-item pretests; however, on experimental trials most subjects had some difficulty in giving only the specified type of response, as indicated by their giving both N and D responses on both types of trials, although the numbers of non-specified responses, e.g. Ns on D trials, were much fewer than the numbers of specified responses.

These data suggest that the low recall scores for Exp. D were not likely a result of subjects' confusion as to requirements of the free recall task, but were more likely a function of the nature of the verbal presentation, i.e. Ds. In addition, the content of recall (Ns and Ds) suggests that four-year-old subjects apparently have some ability to transform the presentation Ds on demand, and can produce in free recall

either Ns or, with more difficulty, Ds.

CHAPTER EIGHT

Summary and Conclusions

The purpose of this thesis was to investigate the role of labels in the memory of four-year-old children for familiar pictures. This chapter summarizes the findings and relates them to the research and theoretical interpretations reviewed in Chapters One and Two.

Supplying nursery school children with meaningful verbal labels facilitated their visual recognition and free verbal recall of pictures. This finding was true for names (Ns), and for longer, less-familiar, and less-easily-rehearsible descriptive phrases (Ds). The results for the descriptive phrases may not be completely independent of names, however, because some of them suggested the corresponding names. Because of this, we could not rule out completely the possibility that some subjects might have produced at least some of the corresponding names when they were given the descriptive phrases. A result which tends to argue against complete conversion from Ds to Ns is the fact that the facilitative effect for free verbal recall was less following presentation of descriptive phrases than following presentation of names; there was no such difference for visual recognition following presentation of the two different types of labels. This almost identical visual recognition performance after presentation of Ns and Ds was found even for the verbal condition, which was shown to be insufficient to allow ready conversion of Ds to Ns on command.

The facilitation observed following presentation of labels was shown not to be due solely to recognition or recall of the literal words, nor was the effect due to rehearsal of the literal words. This finding was shown most clearly in the second experiment where there was facilitation from adding labels even though the presented labels alone did not permit the subjects to differentiate between the pairs of visual recognition alternatives. In agreement with Flavell's (1966) research, the thesis supports the contention that the deficiency observed in young children's performance, when not provided with labels, was one of failure to produce labels efficiently, rather than of failure to use available labels as mediators. Contrary to Flavell's suggestion, however, rehearsal of the literal labels was not found to be of primary importance to remembering. Although the effect of rehearsal has been well documented in Flavell's research, the data of this thesis indicate that rehearsal of verbal labels is not necessarily sufficient to explain the labelling effect as evaluated by visual recognition and free verbal recall. The data of Experiments I and II, in particular, served to rule out almost completely any explanation of facilitation of retention performance by labelling which does not have as a crucial component the retrieval of individuating details, i.e. of specific features characteristic of the events which have been labelled. It appears that the function of the provided labels was to enable the subjects to process the visual stimuli differently than in their absence, possibly making the subjects attend more closely to the distinctive features of the pictures, or making the subjects more explicit in their evaluation of the visual stimuli, or

enabling subjects to organize and give meaning to the visual stimuli. This processing difference resulted in both greater specificity and more ability to transfer when the labels were added. In the first experiment, visual-verbal subjects were able to perform better on the transfer task i.e. they were able to apply the specific visual information from presentation in the selection of different visual stimuli, whereas subjects performed close to chance level on the transfer task when presented only with pictures. In the second experiment, when given labels, subjects chose more of the specific presentation pictures and fewer of the similarly-labelled but visually-distinct pictures, and made fewer errors of intrusion, than in the absence of labels. Thus, it appears that the presence of experimenter-provided labels resulted in greater ability to use the specific visual information in a transfer task, and in more explicit memory for the specific visual information at presentation.

This research contributes to the growing body of information on visual memory, an aspect of memory long overlooked in the literature, with its emphasis on verbal mechanisms. The specific visual information at presentation was found to be useful in performing both visual recognition and verbal recall tasks when paired with meaningful, relevant labels. In addition, there was found to be some ability to perform on the retention tasks, at age four, in the absence of experimenter-provided labels.

As stated in Chapter Two, Rohwer (1969) investigated the role of images and labels in children's learning, within the paired-associates paradigm. On the basis of his findings, he hypothesized that the verbal mode is more preferred and more effective earlier in

life, i.e. from about age four to age seven, with the visual mode becoming more preferred and effective as the child grows older. He suggested that this might be so because the language system is better organized in younger children than is the imagery system, and because it is easier to acquire the capacity to use well-organized systems. While, as indicated earlier, there is good reason to question this hypothesis, the Rohwer results are interesting because they replicate, in a different situation, one basic finding of this thesis, that pictures plus words produce better performance than either mode alone. He also found that the visual mode was superior to the verbal mode at all ages in the first reported experiment, i.e. children always performed better when imagery was presumably the mode of learning, as opposed to when the verbal mode was used. In the thesis, however, the visual mode was not found to be superior to the verbal mode at age four, i.e. for visual recognition, mean performance for the visual group was only slightly better than for the verbal group, and the verbal group was superior on verbal recall. His suggestion that experimenter-provided labels become less effective as children begin to provide their own labels, is consistent with the findings of the thesis, and with Flavell's (1966) findings.

In contrast to Flavell's situation, in which he found little spontaneous verbalization among kindergarten children, several of the nursery-school children in the present studies initially named the stimuli of their own accord. Since our primary interest was in assessing the effect of naming, not in its spontaneous occurrence, we instructed the children not to say anything about the pictures until we asked them

to do so. Despite this initial instruction, a few of the subjects had to be cautioned during the experiments not to say anything. Unfortunately, we do not have a record of what proportion of the subjects required this extra instruction, but our impression is that it was not more than 15%. In addition to this 15%, of course, there may also have been some subjects who did not name the stimuli solely because of the initial instruction. As a consequence, we cannot say definitely whether the deficiency that we are finding in the visual groups is one that would normally be observed in children at age four. At the very least, it is likely that spontaneous performance on this task would not be as poor as that shown by our visual groups. It is also worth noting that regardless of spontaneous frequency of naming, this difference between the visual and the visual-verbal groups is not obtained with adults. The most conservative interpretation of the present results is that telling children this age not to name suppresses an activity that is not suppressed in adults.

Whereas certain deficits were apparent in the performance of the four-year-old children, e.g. they apparently did not label as spontaneously as adults do, at no time was there found to be a complete deficit in ability to label or to perform on the experimental tasks. All of the component abilities to perform the experimental tasks were present at age four; only with fairly large numbers of presentation stimuli, e.g. six or eight, did we find differences between the treatment conditions. These differences were still apparent at age eight with large enough amounts of presentation information.

Thus, there did not appear to be evidence for any dramatic change in performance between the ages of five and seven, whereas White (1965),

and others, have suggested that, after the age of about five, children perform memory tasks in quite different ways than those prior to the age of five.

It must be kept in mind that all of the experimental stimuli were familiar to all subjects and that, therefore, we have been dealing with fairly well-established memory processes. It would be necessary to study much younger children to learn how these processes develop initially. It would be reasonable to suggest that, even at a very early age, both words and pictures are of importance, since the child, from infancy, is usually provided with meaningful labels for objects by eager adults who want to teach him to talk. Finally, no statement can be made, at this point, regarding the effects of adding non-meaningful or irrelevant labels, because the data are not available. However, it seems reasonable to suggest that the particular functions here attributed to labels, e.g. permitting broader transfer of the presentation information, could only be accomplished on the basis of meaningful, relevant labels.

At the end of this series of experiments, we know that we cannot accept the sufficiency of a strictly response-oriented explanation for the results. But, we cannot fill this gap with an alternative which is as specific or as easy to test. The word is probably having its main effect on the way in which the visual material is being coded - an effect that is more than simply the addition of, or replacement by, a specific verbal response. To give this recoding any more specific properties is beyond the reach of the present data.

However, there are two techniques in this work which might profitably be extended. The relation between the visual and the verbal

material at presentation can be made quite different from that between the pictures and either the Ds or Ns in the present research. The relevance of the verbal material for differentiating between the recognition choices can also be more varied than in Experiments I and II in this thesis. Future studies which exploit these possibilities might provide more specific information about the type of recoding that the verbal material induces in the child.

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APPENDIX A

Exp. N: Instructions, Stimuli, and Stories

The first set of stimuli for Story I is incorporated into the instructions to demonstrate the procedure used on each trial. (The numbers before stimuli are only for listing purposes.)

Each day, when the subject was brought into the experimental room, E said,

> "I am going to tell you a story and show you some pictures. This is a story about (a circus and a jungle hunt). Listen carefully to everything I say, and do not say anything at all until I tell you to."

Trial I stimuli were presented at this point, within a story context.

> "One day a big circus came to town. The children watched the parade. Bozo Clown was in the parade. After the parade was over, everyone went into the big tent to see the circus acts. In the circus tent there was:"

Here the six presentation stimuli were placed before the subjects in the visual and visual-verbal groups. For the visual group, E said as she placed each stimulus in front of the subject:

> "this, and this, and this ....." (pointing at the same time to the picture). E then pointed to each picture again, saying "Now let's look at the pictures again", and repeating "this, and ....."

For the visual-verbal and verbal groups, E said (pointing to each stimulus for the visual-verbal subjects),

"(1) a crowd, (2) a bicycle, (3) a doggie clown, (4) a monkey, (5) a boot, and (6) a tiger." E said, "Now you say after me" (again E pointed to each picture for the visual-verbal group), "a crowd, ..." The subject repeated each word after E.

All stimuli were removed from sight, and all subjects were told:

"Now close your eyes and don't open them until I tell you to do so."

At this time the 12 cards, from which the subject was to select the presentation pictures, were placed on the table in random order. E activated the stopwatch, saying,

"Open your eyes. Now pick out the pictures that show (what was in the circus tent) and put them here" (pointing to the backgound sheet). "Tell me when you are finished." E recorded the choices, and when the subject indicated that he was finished, E recorded the amount of time taken. E removed the recognition stimuli and said,

"Now tell me what was (in the circus tent)".

All the subject's responses were recorded. The subject indicated when he was finished. The instructions were the same for all trials.

Story I

Set 1 (Presented with instructions.)

Set 2 When the circus was over, Bozo clown went hunting in the jungle. In the jungle, he saw: (1) a net, (2) a gorilla, (3) a lion, (4) an ostrich, (5) a bullfrog, and (6) a jungle man.

Set 3 At the end of the hunt, the animals had a big picnic. At the picnic, there was: (1) an elephant, (2) a cake, (3) a basket, (4) a dish, (5) a hand, and (6) a banana.

Story II

Set 4 Jack climbed the beanstock to visit Snow White. When he got to the top, he saw: (1) a cottage, (2) a tower, (3) a goose, (4) an elf, (5) a dress, and (6) roses.

Set 5 Cinderella met Little Red Riding Hood in the forest. Cinderella showed her: (1) trees, (2) a prince, (3) a wheel, (4) a coachman, (5) slippers, and (6) a cape.

Set 6 The three pigs invited the three bears for dinner. They had: (1) a cabin, (2) a hat, (3) a door, (4) a tie, (5) a bowl, and (6) a coat.

Story III

Set 7 It was time to go to the cottage to open it for the summer. This is what the family took with them: (1) a candle, (2) bacon and eggs, (3) a shirt, (4) a bat, (5) glasses, and (6) an airplane.

Set 8 There was a lot of work to do at the cottage. The whole family helped - Daddy, Mommy, Neil, and Kathy. This is what there was: (1) a window, (2) a hammer, (3) a bench, (4) paint (5) a washtub, and (6) leaves.

Set 9 When all the work was finished, everyone went for a long walk. They saw: (1) an Indian, (2) a butterfly, (3) an ant, (4) a fox, (5) a haystack, and (6) a rock.

Exp. D: Stimuli and Stories

The changes in instructions were listed in the body of the thesis. The stories were basically the same as for Exp. N, therefore, only the additional story will be listed here.

Story I

Set 1 (1) they came to watch (crowd), (2) he has stripes (tiger), (3) something to put on a foot (boot), (4) he does tricks (monkey), (5) something to ride on (bicycle), (6) he eats bones (dog).

Set 2 (1) something to catch animals with (net), (2) he swings from a tree (gorilla), (3) he roars in the jungle (lion), (4) he has a long neck (ostrich), (5) he goes croak, croak (frog), (6) he lives in the jungle (jungle man).

Set 3 (1) he has a long trunk (elephant), (2) something covered with icing (cake), (3) something to carry lunch in (basket), (4) something to put food on (plate), (5) something with five fingers (hand), (6) something yellow to eat (banana).

Story II

Set 4: (1) a small place to live (cottage), (2) something with high towers (castle), (3) something that goes quack, quack (duck), (4) he wears a pointy cap (elf), (5) something nice for girls to wear (dress), (6) something with a pretty smell (roses).

Set 5: (1) things that grow in the forest (trees), (2) he loves Cinderella (prince), (3) this turns round and round (wheel), (4) he drives the coach (coachman), (5) something to wear on on Cinderella's feet (slippers), (6) something to put over Cinderella's shoulders (cape).

Set 6: (1) this goes on your head (hat), (2) this has windows in it (cabin), (3) this opens to go inside (door), (4) something to wear with a shirt (tie), (5) something to put porridge in (bowl), (6) something to wear outside (coat).

Story III

Set 7: (1) something for breakfast (bacon and eggs), (2) something for Jane to play with (doll), (3) something to ride in (cart), (4) something to light up the cottage (candle), (5) something to pound nails (hammer), (6) something to paint with (brush).

Set 8: (1) something to look through (window), (2) something to carry water (pail), (3) something to drink tea from (cup), (4) something that grows on trees (leaves), (5) someone with long hair (girl), (6) something that goes squeek, squeek (mouse).

Set 9: (1) someone who wears a feather (Indian), (2) a place to splash around in (pond), (3) something that shines in the sky (sun), (4) something birds lay eggs in (nest), (5) something with long ears (rabbit), (6) something hard that squirrels eat (nuts).

Story IV

(This story was added for Exp. D, and is, therefore, presented in full here.)

Set 10: Sally and Billy live on a farm. One sunny day, they decided to walk into town. On the way they walked past the barn. This is what they saw: (1) he says meow (pussy), (2) he says peep, peep (chick), (3) he crows every morning (rooster), (4) he goes moo, moo (cow), (5) kids can ride on him (horse), (6) he is very dirty (pig).

Set 11: They walked into town and stopped by the window of the toy store. This is what they saw: (1) he plays a drum (toy soldier), (2) a toy animal (toy horse), (3) something to fly in the sky (kite), (4) something to build towers with (blocks), (5) something to float on water (boat), (6) something to blow up with air (balloon).

Set 12: They finally came to the park. It was a long, long way. They went to the zoo, and this is what they saw: (1) he chases rabbits (fox), (2) he crawls on the ground (snake), (3) he sleeps all winter (bear), (4) he swims in the pond (fish), (5) he flies and chases after small birds (buzzard), (6) he goes hoot, hoot (owl).

APPENDIX B

Raw Data for Experiment I (Exp. N and Exp. D)

The order for presentation is as follows:

(I) Visual recognition data for each trial (T) of Exp. N and Exp. D. The maximum number of correct responses (Max.) equals six.

(II) Verbal recall data for each trial of Exp. N and Exp. D (Max. = 6).

(III) Forced-choice data for each trial of Exp. D (Max. = 3).

I VISUAL RECOGNITION

	PP RECOGNITION						TP RECOGNITION					
	Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion		
VISUAL GROUP	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Exp. N												
Subject 1	3	5	6	1	0	0	2	1	3	0	1	1
2	5	6	6	1	2	0	2	0	0	0	0	1
3	5	2	4	0	1	0	4	2	2	0	0	0
4	5	5	6	1	2	0	5	3	5	1	0	3
5	6	6	5	0	1	0	5	5	3	0	1	0
6	5	3	3	0	0	2	4	5	4	1	3	1
7	5	4	5	1	0	0	2	1	1	0	0	0
8	5	5	3	1	1	3	2	2	2	4	4	4
Exp. D												
Subject 1	3	4	4	3	2	2	3	2	3	2	2	5
2	3	0	3	3	4	1	0	2	3	0	2	1
3	5	6	6	0	0	0	4	1	2	2	0	4
4	5	4	5	0	0	1	4	3	3	0	2	3
5	4	3	4	0	0	0	3	4	3	3	0	1
6	3	5	4	3	0	0	2	3	4	2	3	2
7	5	6	5	0	0	0	1	4	3	3	2	0
8	3	2	3	0	2	3	3	2	3	1	1	1
9	4	4	5	0	0	0	2	1	2	0	0	0

I VISUAL RECOGNITION cont.

	PP RECOGNITION						TP RECOGNITION					
	Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion		
VISUAL-VERBAL GROUP	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Exp. N												
Subject 1	6	5	6	0	0	0	6	4	5	0	0	0
2	6	6	5	0	0	0	6	5	6	0	1	0
3	6	6	5	0	0	1	4	6	6	2	0	0
4	5	6	6	0	0	0	5	5	4	0	0	0
5	6	6	6	0	0	0	6	4	5	0	0	0
6	6	6	5	0	0	0	6	5	5	0	0	0
7	6	6	6	0	0	0	5	4	5	0	0	0
8	6	6	6	0	0	0	4	5	5	1	0	1
Exp. D												
Subject 1	6	6	6	0	0	0	3	3	6	1	1	0
2	6	5	6	0	0	0	4	5	6	1	1	0
3	5	6	5	0	0	0	5	5	4	0	0	0
4	6	6	6	0	0	0	5	4	5	1	1	1
5	6	6	6	0	0	0	4	6	5	0	0	0
6	6	6	6	0	0	0	4	6	5	1	1	1
7	5	5	6	0	0	0	2	5	4	1	2	2
8	6	6	6	0	1	0	6	6	5	1	0	1
9	6	6	6	0	1	0	5	5	5	0	0	0

I VISUAL RECOGNITION cont.

VERBAL GROUP	PP RECOGNITION						TP RECOGNITION					
	Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Exp. N												
Subject 1	3	4	3	1	0	1	3	4	4	0	0	0
2	5	3	5	3	3	3	4	6	5	2	1	2
3	4	2	0	0	0	1	3	4	4	0	0	0
4	2	3	1	1	1	1	5	2	3	1	0	0
5	6	5	4	0	0	0	5	6	5	0	1	0
6	5	4	4	1	0	1	3	3	4	0	0	1
7	4	5	4	0	0	0	4	5	6	0	0	0
8	4	5	4	0	1	0	3	2	3	0	1	1
Exp. D												
Subject 1	3	2	3	1	3	2	4	3	5	1	1	0
2	4	4	4	0	1	2	4	3	4	1	2	0
3	1	2	5	5	2	1	3	3	3	3	3	2
4	6	3	5	2	1	3	4	6	3	1	2	1
5	5	3	5	2	2	1	4	5	5	3	4	2
6	5	4	4	1	2	2	3	3	4	3	3	2
7	5	5	4	3	0	2	3	4	5	1	1	1
8	4	3	4	1	3	0	3	3	4	0	0	3
9	3	1	2	1	3	2	2	3	1	0	0	3

II VERBAL RECALL

	RECALL (AFTER PP RECOGNITION)						RECALL (AFTER TP RECOGNITION)						RECALL (NO PRIOR RECOGNITION)					
	Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion		
VISUAL GROUP	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Exp. N																		
Subject 1	2	3	3	1	0	0	2	0	3	0	0	0	0	1	2	0	0	0
2	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
3	4	1	3	0	1	0	4	1	2	0	1	0	2	2	2	0	1	0
4	2	1	4	1	2	0	1	3	2	0	0	1	2	1	4	0	0	0
5	6	4	4	0	1	0	3	4	1	1	0	0	4	0	3	0	0	0
6	2	0	2	0	1	0	1	3	1	0	0	1	1	2	3	0	0	0
7	3	2	2	1	0	0	2	1	1	0	0	0	3	1	1	0	0	0
8	1	1	0	3	2	4	2	1	0	2	4	4	3	0	0	0	2	3
Exp. D																		
Subject 1	3	0	2	0	0	1	1	1	2	1	2	2	3	3	2	0	0	0
2	0	0	1	1	3	0	2	0	0	0	1	0	1	2	2	0	0	0
3	3	0	3	0	0	0	1	0	1	0	0	1	4	0	1	0	0	0
4	2	2	2	1	0	0	2	1	2	0	2	2	2	3	2	0	0	0
5	3	2	3	0	0	0	2	2	1	2	0	0	2	2	0	0	0	0
6	0	0	1	2	1	0	0	3	2	0	1	0	3	2	2	0	0	0
7	4	1	0	0	0	0	0	0	3	1	0	0	1	4	4	0	0	0
8	2	1	1	0	0	1	1	2	3	1	1	0	1	0	1	0	0	0
9	1	0	3	0	0	0	2	1	0	0	0	0	0	2	2	0	0	0

II VERBAL RECALL cont.

VISUAL-VERBAL GROUP	RECALL (AFTER PP RECOGNITION)						RECALL (AFTER TP RECOGNITION)						RECALL (NO PRIOR RECOGNITION)					
	Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Exp. N																		
Subject 1	5	4	5	0	1	0	4	4	3	0	0	0	3	4	4	0	0	0
2	3	4	3	0	0	0	5	4	5	0	0	0	3	4	3	0	0	0
3	4	4	4	0	0	1	4	2	2	1	0	1	4	2	3	0	0	0
4	3	2	2	0	1	0	3	2	1	0	0	0	4	2	3	0	1	0
5	6	6	5	0	0	1	5	5	4	0	0	1	4	4	3	0	0	0
6	3	0	2	0	0	0	4	5	3	0	0	0	3	4	3	0	0	0
7	5	2	3	0	0	0	3	4	3	0	0	0	4	3	2	0	0	0
8	4	5	4	0	0	0	5	5	5	0	0	0	6	3	3	0	0	0
Exp. D																		
Subject 1	5	2	0	0	1	0	1	2	2	0	1	0	4	1	3	0	0	0
2	5	1	2	0	0	0	2	3	2	0	1	0	1	2	0	0	0	0
3	4	3	3	0	0	0	4	4	3	0	0	0	5	5	4	0	0	0
4	2	2	1	1	0	0	3	2	3	0	0	0	4	2	1	0	1	1
5	4	3	1	2	1	2	3	3	3	0	0	0	3	2	3	0	0	0
6	3	4	1	0	0	1	4	2	3	0	0	2	1	2	1	0	0	0
7	2	2	2	0	2	0	1	1	0	1	2	0	0	3	3	4	2	0
8	3	3	3	0	2	0	0	3	5	3	1	1	4	3	4	0	0	0
9	0	2	0	2	2	1	1	2	0	1	1	2	2	2	2	0	2	0

II VERBAL RECALL cont.

VERBAL GROUP	RECALL (AFTER PP RECOGNITION)						RECALL (AFTER TP RECOGNITION)						RECALL (NO PRIOR RECOGNITION)					
	Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion			Number Correct			Errors of Inclusion		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Exp. N																		
Subject 1	3	4	4	0	0	0	2	2	3	0	0	0	2	5	3	0	0	0
2	3	1	1	1	2	1	2	3	2	0	1	2	2	2	2	2	1	1
3	2	1	0	0	0	0	1	3	3	0	0	0	1	0	0	0	0	0
4	2	4	2	1	1	0	4	1	2	0	0	0	0	2	1	1	0	0
5	6	3	3	0	0	0	4	4	4	0	0	1	0	0	1	0	1	1
6	4	4	3	0	0	1	2	3	3	0	0	1	3	3	5	0	0	0
7	3	4	4	0	0	0	4	6	4	0	0	0	5	6	3	0	0	0
8	3	2	1	0	0	0	3	2	2	0	0	0	1	2	2	0	0	0
Exp. D																		
Subject 1	1	2	0	1	0	1	1	0	1	0	1	0	2	0	0	0	0	0
2	1	2	1	0	1	3	2	3	1	1	0	0	2	1	1	0	0	0
3	0	0	0	1	0	0	0	1	2	0	1	0	0	2	0	0	0	0
4	1	1	0	0	0	2	2	1	0	2	6	2	1	2	1	0	0	2
5	2	5	2	0	0	1	1	0	2	0	0	1	3	2	0	0	0	0
6	1	2	1	0	1	0	0	0	0	1	0	4	0	0	0	2	2	0
7	1	1	0	0	0	0	2	1	1	0	3	1	2	0	3	0	1	0
8	2	1	2	0	0	0	1	2	2	1	0	2	3	2	3	0	0	0
9	0	0	0	2	1	3	2	1	1	0	1	2	1	0	1	3	0	1

III FORCED-CHOICE RECOGNITION DATA

	PP RECOGNITION Number Correct			TP RECOGNITION Number Correct			VERBAL RECOGNITION Number Correct		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
VISUAL GROUP									
Subject 1	2	2	3	3	2	3	3	0	3
2	3	2	2	1	2	1	1	3	3
3	3	3	3	3	3	3	3	3	3
4	2	3	3	3	2	2	1	3	2
5	3	2	3	1	3	2	2	3	1
6	3	3	3	3	2	2	3	3	3
7	3	3	3	3	3	3	3	3	2
8	2	2	1	2	3	2	1	3	2
9	3	3	3	3	3	2	3	3	3
VISUAL-VERBAL GROUP									
Subject 1	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	2	3	2
3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3
5	3	3	3	3	2	3	3	3	3
6	3	3	3	3	3	3	3	3	2
7	3	3	3	3	3	1	3	2	1
8	3	3	3	3	3	3	3	3	3
9	3	3	3	3	2	3	2	3	2
VERBAL GROUP									
Subject 1	3	3	1	2	3	1	1	3	1
2	2	2	3	1	2	2	2	2	2
3	2	3	2	1	3	1	2	2	2
4	2	3	1	1	3	2	3	2	1
5	3	3	1	3	3	3	2	3	1
6	2	3	2	3	3	3	2	2	1
7	3	3	3	2	3	2	2	3	2
8	3	3	2	2	2	1	1	2	1
9	1	2	3	3	0	2	3	3	1

APPENDIX C

Statistical Analysis for Exp. N and Exp. D

I VISUAL RECOGNITION (CORRECT RESPONSES)

WITHIN-GROUPS COMPARISONS (WILCOXONS)

Exp. N

PP-TP

Group	N	T	p
Visual	8	1.0	< .02
Visual-Verbal	7	0.0	< .02
Verbal	8	12.0	n.s.

Exp. D

PP-TP

Group			
Visual	8	0.0	< .01
Visual-Verbal	9	0.0	< .01
Verbal	8	12.5	n.s.

KRUSKAL-WALLIS ANALYSIS OF VARIANCE

		df	H	p
Exp. N	PP	2	14.96	< .001
	TP	2	12.10	< .01
Exp. D	PP	2	16.07	< .001
	TP	2	17.80	< .001

BETWEEN-GROUP COMPARISONS (MANN-WHITNEY U TESTS)

Exp. N	n_1	n_2	U	p
PP Recognition				
Groups				
Visual + Visual-Verbal	8	8	5.0	< .001
Visual + Verbal	8	8	15.0	< .08
Visual-Verbal + Verbal	8	8	0.0	< .001
TP Recognition				
Groups				
Visual + Visual-Verbal	8	8	0.0	< .001
Visual + Visual-Verbal PP-TP Interaction	8	8	14.0	< .064
Visual + Verbal	8	8	15.5	< .104
Visual-Verbal + Verbal	8	8	14.0	< .032
Exp. D				
PP Recognition				
Groups				
Visual + Visual-Verbal	9	9	3.5	< .001
Visual + Verbal	9	9	35.0	n.s.
Visual-Verbal + Verbal	9	9	0.0	< .001
TP Recognition				
Groups				
Visual + Visual-Verbal	9	9	0.0	< .001
Visual + Visual-Verbal PP-TP Interaction	9	9	38.0	n.s.
Visual + Verbal	9	9	12.0	< .02
Visual-Verbal + Verbal	9	9	8.5	< .01

BETWEEN-EXPERIMENT COMPARISONS (MANN-WHITNEY U TESTS)

		n_1	n_2	U	p
Groups					
Visual	PP	8	9	23.0	n.s.
	TP	8	9	35.5	n.s.
Visual-Verbal	PP	8	9	30.5	n.s.
	TP	8	9	26.5	n.s.
Verbal	PP	8	9	35.0	n.s.
	TP	8	9	29.0	n.s.

II VISUAL RECOGNITION (ERRORS OF INTRUSION)

There were no within-group differences in the error data. Therefore, all analyses were done using pooled data for each group.

KRUSKAL-WALLIS ANALYSIS OF VARIANCE

	df	H	p
Exp. N	2	7.98	< .02
Exp. D	2	20.40	< .001

BETWEEN-GROUP COMPARISONS (MANN-WHITNEY U TESTS)

	n_1	n_2	U	p
Exp. N				
Groups				
Visual + Visual-Verbal	8	8	8.0	< .01
Visual + Verbal	8	8	23.0	n.s.
Visual-Verbal + Verbal	8	8	13.0	< .05
Exp. D				
Groups				
Visual + Visual-Verbal	9	9	9.5	< .02
Visual + Verbal	9	9	24.0	n.s.
Visual-Verbal + Verbal	9	9	0.0	< .002

BETWEEN-EXPERIMENT COMPARISONS (MANN-WHITNEY U TESTS)

	n_1	n_2	U	p
Groups				
Visual	8	9	25.5	n.s.
Visual-Verbal	8	9	18.0	n.s.
Verbal	8	9	7.5	< .02

III VERBAL RECALL (CORRECT RESPONSES)

There were no within-group differences in the verbal recall data. Therefore, all analyses were done using pooled data for each group.

KRUSKAL-WALLIS ANALYSIS OF VARIANCE

	df	H	p
Exp. N	2	11.8	< .01
Exp. D	2	12.1	< .01

BETWEEN-GROUP COMPARISONS (MANN-WHITNEY U TESTS)

	n_1	n_2	U	p
Exp. N				
Groups				
Visual + Visual-Verbal	8	8	1.0	< .001
Visual + Verbal	8	8	16.0	< .104
Visual-Verbal + Verbal	8	8	13.0	< .025
Exp. D				
Groups				
Visual + Visual-Verbal	9	9	12.0	< .01
Visual + Verbal	9	9	22.0	n.s.
Visual-Verbal + Verbal	9	9	6.0	< .001

BETWEEN-EXPERIMENT COMPARISONS (MANN-WHITNEY U TESTS)

	n_1	n_2	U	p
Groups				
Visual	8	9	29.5	n.s.
Visual-Verbal	8	9	8.0	< .01
Verbal	8	9	5.0	< .001

IV VERBAL RECALL (ERRORS OF INTRUSION)

KRUSKAL-WALLIS ANALYSIS OF VARIANCE

	df	H	p
Exp. N	2	1.96	n.s.
Exp. D	2	2.20	n.s.

BETWEEN-EXPERIMENT COMPARISONS (MANN-WHITNEY U TESTS)

	n_1	n_2	U	p
Groups				
Visual	8	9	30.5	n.s.
Visual-Verbal	8	9	12.5	< .02
Verbal	8	9	14.0	< .02

V FORCED-CHOICE RECOGNITION - EXP. D

WITHIN-GROUP COMPARISONS (WILCOXONS)

	N	T	p
PP-TP			
Group			
Visual	7	6.5	n.s.
Visual-Verbal	3	-	n.s.
Verbal	8	12.0	n.s.
PP-VERBAL			
Group			
Visual	5	2.0	n.s.
Visual-Verbal	4	-	n.s.
Verbal	8	2.5	$< .05$
TP-VERBAL			
Group			
Visual	7	15.0	n.s.
Visual-verbal	5	2.0	n.s.
Verbal	7	9.0	n.s.

The data were pooled within-groups prior to the following analyses.

KRUSKAL-WALLIS ANALYSIS OF VARIANACE

	df	H	p
Visual, Visual-Verbal and Verbal Groups	2	13.2	< .01

BETWEEN-GROUP COMPARISONS (MANN-WHITNEY U TESTS)

Groups	n_1	n_2	U	p
Visual + Visual-Verbal	9	9	17.5	< .10
Visual + Verbal	9	9	19.0	< .10
Visual-Verbal + Verbal	9	9	1.5	< .002

APPENDIX D

Presentation Stimuli used in Experiments II to VI

I. Experiment II : Presentation Stimuli

Set 1:	(1)	crowd	(5)	elf
	(2)	ostrich	(6)	food
	(3)	tiger	(7)	mice
	(4)	bike	(8)	rabbits
Set 2:	(1)	cottage	(5)	horse
	(2)	window	(6)	pig
	(3)	candle	(7)	flower
	(4)	dish	(8)	hammer
Set 3:	(1)	girl	(5)	kite
	(2)	dolly	(6)	blocks
	(3)	soldier	(7)	net
	(4)	wheel	(8)	tower
Set 4:	(1)	basket	(5)	leaf
	(2)	frog	(6)	nest
	(3)	monkey	(7)	fish
	(4)	jungle man	(8)	snake

II. Experiment III : Presentation Stimuli

Eight-Year-Olds

Part A: the same presentation stimuli were used as for Experiment II.

Part B:

Set 1:	(1)	dog	(5)	goose	(9)	cow	(13)	fox
	(2)	gorilla	(6)	prince	(10)	rooster	(14)	owl
	(3)	lion	(7)	cart	(11)	chick	(15)	bear
	(4)	elephant	(8)	pail	(12)	kitten	(16)	sun
Set 2:	(1)	hat	(5)	bowtie	(9)	cake	(13)	trees
	(2)	boot	(6)	glove	(10)	cups	(14)	nut
	(3)	coat	(7)	paint brush	(11)	banana	(15)	door
	(4)	dress	(8)	feather	(12)	bowl	(16)	boat

Adults

Set 1:	(1)	crowd	(8)	doll	(15)	gorilla	(22)	cups
	(2)	tiger	(9)	wheel	(16)	elephant	(23)	nut
	(3)	elf	(10)	blocks	(17)	dog	(24)	bow
	(4)	bacon and eggs	(11)	tower	(18)	boot	(25)	cake
	(5)	window	(12)	frog	(19)	children		
	(6)	candle	(13)	African	(20)	paint		
	(7)	iris	(14)	nest	(21)	boat		

Adults (cont.)

Set 2:	(1)	ostrich	(8)	girl	(15)	lion	(22)	banana
	(2)	unicycle	(9)	kite	(16)	prince	(23)	dress
	(3)	mice	(10)	net	(17)	hat	(24)	bowl
	(4)	cottage	(11)	basket	(18)	pail	(25)	glove
	(5)	rabbits	(12)	monkey	(19)	coat		
	(6)	bones	(13)	leaves	(20)	feather		
	(7)	hammer	(14)	goose	(21)	trees		

III. Experiment IV : The presentation stimuli were those used in Exp. D. They are listed in Appendix A.

IV. Experiment V : Word lists for noun span and pictorial noun span.

Noun Span

2 Nouns: (a) button - goat

(b) key - handle

(c) igloo - nail

3 Nouns: (a) lantern - fur - cork

(b) whisker - rifle - point

(c) trunk - ring - violet

4 Nouns: (a) pumpkin - iron - cone - eye

(b) book - goldfish - machine - neck

(c) cowboy - whale - top - plant

5 Nouns: (a) tongue - wool - gun - needle - organ

(b) lily - ice cream - crown - thimble - spout

(c) petal - wing - shovel - curl - lemon

6 Nouns: (a) lamp - knife - finger - pocket - daffodil - rope

(b) tail - saddle - panda - arm - buckle - dust

(c) pin - ear - lady - fence - cactus - accordian

Pictorial Noun Span

List 1

1 Noun: (a) queen

(b) rings

(c) ants

Pictorial Noun Span (cont.)

2 Nouns: (a) wool - tiger

(b) rooster - watering cans

(c) airplane - moth

3 Nouns: (a) lamp - ships - apple

(b) chairs - umbrella - squirrel

(c) bicycle - Eskimo - bus

4 Nouns: (a) Indians - wagon - dolly - hen

(b) washtub - boys - table cloth - prince

(c) jack o'lantern - trees - deer - heart

5 Nouns: (a) daffodil - baby - cap - hands - teddybear

(b) bird - door - hat - books - lions

(c) pageboy - band - car - flag - pears

6 Nouns: (a) butterflies - cow - octopus - feet - bed - chick

(b) frogs - sheep - broom - corn - horse - fish

(c) blocks - cup - irons - pig - balloons - crown

List 2

1 Noun: (a) cowboy

(b) cactus

(c) needle

Pictorial Noun Span (cont.)

2 Nouns: (a) peaches - violets

(b) window - alligator

(c) rabbit - zebras

3 Nouns: (a) bell - cake - lantern

(b) skipping rope - alarm clock - truck

(c) leaves - pencils - elephant

4 Nouns: (a) bat - train - dog - flowers

(b) store - baseball - tulips - palm tree

(c) kittens - bottle - irons - angel

5 Nouns: (a) turtles - crayons - hammers - grass - bear

(b) pants - chairs - house - bicycle - goose

(c) puppy - wolf - girl - toy soldier - lady

6 Nouns: (a) duck - rope - bicycle - pumpkin - bee - tiger

(b) angel - dish - boots - pitcher - sweater - cow

(c) shorts - duck - basket - puppy - flowers - doll

List 3

1 Noun: (a) pail

(b) wolf

(c) mouth organ

Pictorial Noun Span (cont.)

2 Nouns: (a) lion - scissors

(b) bear - cottages

(c) waterlily - hand

3 Nouns: (a) banana - wagon - parachutes

(b) lemons - drum - boat

(c) shoes - cloud - barrel

4 Nouns: (a) cradle - seal - bluebirds - gopher

(b) sunflower - windmills - lassie - kittens

(c) beets - guitar - candy - egg

5 Nouns: (a) bottle - girl - anchor - igloos - houses

(b) shoes - tree - bottles - dolls - ball

(c) watering cans - cat - scissors - windmills - bus

V. Experiment VI : Presentation Stimuli

Set 1: (1) they come to watch (crowd), (2) he has a long neck (ostrich), (3) he has stripes (tiger), (4) something to ride on (bicycle), (5) he has a pointy hat (elf), (6) they long ears (rabbits).

Set 2: (1) something with high towers (castle), (2) something for Jerry to play with (doll), (3) he plays a drum (soldier), (4) something to catch animals with (net), (5) something to fly in the sky (kite), (6) something to build buildings with (blocks).

Set 3: (1) a small place to live (cottage), (2) something to look through (window), (3) something to light up the room with (candle), (4) something with a pretty smell (flower), (5) something to pound nails with (hammer), (6) something to eat (bacon and eggs).

Set 4: (1) someone with long hair (girl), (2) something to put food in (dish), (3) he's very dirty (pig), (4) something kids can ride on (horse), (5) they say squeak, squeak (mice), (6) this goes round and round (wheel).

APPENDIX E

Raw Data for Experiments II to VI

I RAW DATA FOR EXPERIMENT II

	VISUAL RECOGNITION								VERBAL RECALL	
	PP		TP		Total (PP+TP)		Intrusions (Part B only)			
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
PART A										
Visual Trials										
Subject 1	4	7	0	0	4	7	-	-	2	4
2	7	6	1	0	8	6	-	-	2	2
3	4	4	0	0	4	4	-	-	2	2
4	4	1	4	3	8	4	-	-	1	3
5	6	4	1	2	7	6	-	-	4	3
Visual-Verbal Trials										
Subject 1	8	7	0	0	8	7	-	-	3	4
2	8	8	0	0	8	8	-	-	2	5
3	8	7	0	0	8	7	-	-	2	4
4	7	5	1	3	8	8	-	-	6	4
5	8	8	1	0	9	8	-	-	4	5
PART B										
Visual Trials										
Subject 6	8	5	0	1	8	6	0	1	1	3
7	6	6	0	0	6	6	0	0	4	3
8	7	6	2	0	9	6	2	0	3	0
9	7	5	1	1	8	6	0	2	4	3
10	2	1	2	2	4	3	1	1	3	1
Visual-Verbal Trials										
Subject 6	8	7	0	1	8	8	0	0	4	2
7	7	8	0	0	7	8	0	0	2	3
8	6	8	1	0	7	8	0	0	2	4
9	8	8	0	0	8	8	0	0	5	5
10	6	6	0	2	6	8	0	0	4	0

II RAW DATA FOR EXPERIMENT III

	VISUAL RECOGNITION				VERBAL RECALL			
	VISUAL		VISUAL-VERBAL		VISUAL		VISUAL-VERBAL	
	T1	T2	T1	T2	T1	T2	T1	T2
EIGHT-YEAR-OLDS								
PART A (Maximum Score = 8)								
Subject 1	7	8	8	8	5	4	5	4
2	8	8	8	8	3	1	3	5
3	8	8	8	8	7	5	6	6
4	7	7	8	8	5	6	8	7
5	8	7	8	8	6	6	6	4
6	8	8	8	8	6	5	7	5
7	7	7	8	8	4	5	6	5
8	7	7	8	8	5	3	7	7
PART B (Maximum Score = 16)								
Subject 1	14		16		3		4	
2	15		16		4		7	
3	16		16		7		9	
4	15		16		9		7	
5	15		16		8		5	
6	11		15		2		7	
7	10		16		4		8	
8	11		13		4		5	
ADULTS (Maximum Score = 25)								
Subject 1	25		22		19		18	
2	22		24		8		11	
3	22		22		4		9	
4	23		22		11		13	
5	24		24		17		10	
6	25		25		14		17	
7	25		25		16		9	
8	23		23		11		12	
9	24		20		11		11	
10	23		24		9		15	
11	25		25		10		10	
12	19		22		15		12	
13	25		25		16		16	
14	25		25		16		17	
15	23		23		7		11	
16	23		25		16		19	
17	25		24		16		14	

III RAW DATA FOR EXPERIMENT IV

	NAME-PICTURE TOTAL CORRECT (Max. = 24)	DESCRIPTION-PICTURE TOTAL CORRECT (Max. = 24)	P PICTURE-T PICTURE TOTAL CORRECT (Max. = 24)
Story I			
Set 1	24	24	24
2	24	23	24
3	24	24	24
Story II			
4	24	24	24
5	24	24	24
6	22	24	24
Story III			
7	24	24	22
8	24	24	24
9	24	23	24
Story IV			
10	24	23	24
11	24	24	24
12	22	22	24

DATA FOR EXPERIMENT IV (CONT.)

NAME-DESCRIPTION

LISTING OF ERRORS FOR EACH STIMULUS (OUT OF FOUR RESPONSES)

STIMULI ARE NUMBERED ACCORDING TO THEIR LISTING IN APPENDIX A

Stimulus Number	1	2	3	4	5	6
STORY I						
Set 1	clown	zebra, kangaroo		clown, dolphin, cat	horse (3)	
2	stick	vine		giraffe (3), zebra	chicken, monkey	crocodile, lion (2)
3		ice cream	bag (2), horse	stove, towel, tray	person	orange, cupcake, grapefruit
STORY II						
Set 4	castle (2)	chimney, water fountain		witch, Snow White, monkey	skirt	perfume
5	beanstock (2)	dwarf, Red Riding Hood, everyone	merry-go-round (2), ferris-wheel	wolf, no one		clothes, brush

DATA FOR EXPERIMENT IV (CONT)

Stimulus Number	1	2	3	4	5	6
STORY II (cont.)						
Set 6	crown			skirt, underskirt, pants (2)	cup, cookies	
STORY III						
Set 7	toast, cereal (2), porridge	ball, toy (2)	wagon, fire engine, horse	match, fire	nail file, wood	paper
8	telescope, glasses, micro-scope (2)			apples (2)	skunk, barbie doll	monkey, squeeker, chicken
9				egg pot	monkey, elephant, giraffe	polar bear, trees
STORY IV						
Set 10		mouse, monkey			camel, bike	mud, clothes, tree, dirt

DATA FOR EXPERIMENT IV (CONT.)

Stimulus Number	1	2	3	4	5	6
STORY IV (cont.)						
Set 11	musician, man	zebra, elephant, truck	airplane (2) bird, butterfly	bricks (2)		breath
12	dog	turtle, dog, bee, caterpillar	worm	duck (2)		bird, crow

IV RAW DATA FOR EXPERIMENT V

PART A Digit Span (DS), and Noun Span (NS). The data was obtained from the subjects in Exp. N, after completion of the experiment.

	VISUAL GROUP		VISUAL-VERBAL GROUP		VERBAL GROUP	
	DS	NS	DS	NS	DS	NS
Subject 1	4	4	6	5	4	4
2	5	4	4	4	3	3
3	4	4	4	3	5	4
4	5	4	4	4	4	3
5	4	4	4	4	4	4
6	5	4	4	4	5	4
7	3	2	4	4	4	3
8	3	3	3	4	4	3

PART B Pictorial Noun Span. All subjects were given all conditions.

	PICTURES ALONE	PICTURES PLUS LABELS-SIMULTANEOUS	PICTURES PLUS LABELS-SUCCESSIVE
Subject 1	2	3	3
2	1	3	3
3	1	4	3
4	1	4	3
5	2	4	4
6	1	3	3
7	1	3	3
8	2	5	4
9	2	4	4

V RAW DATA FOR EXPERIMENT VI

VERBAL RECALL

	Names (Ns)		Descriptions (Ds)	
	T1	T2	T1	T2
	(Maximum Score Per Trial = 6)			
Subject 1	3	2	0	3
2	4 (+ 1D)	1	1	1 (+ 1N)
3	1	0	1	0
4	4 (+ 1D)	4 (+ 3D)	3 (+ 1N)	4
5	3	2 (+ 1D)	2	3
6	2 (+ 1D)	3 (+ 1D)	2	3
7	1 (+ 1D)	1 (+ 1D)	1	0
8	4 (+ 2D)	4 (+ 3D)	3 (+ 1N)	3 (+ 2N)
9	2	4	4	1 (+ 1N)
10	4 (+ 1D)	2 (+ 1D)	0	1 (+ 1N)