

THE FORM CLASS EFFECT

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THE FORM CLASS EFFECT

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ABSTRACT

A series of nine studies investigated the 'form class effect', the superior recall shown by children when to-be-associated nouns are studied linked by verbs or prepositions rather than by conjunctions, or without any 'connective'. One main finding was that the form class effect is limited to measures of associative recall, and not found in the overall levels of free recall. It was suggested that linking verbs or prepositions result in more joint representation of items in memory, and such differences in organization should emerge only in associative recall measures. A second finding was that instructions to form interactive images eliminated the superiority of verb-linked nouns in children's recall, by raising recall with conjunctions to the level of verbs. Conversely, instructions to form a separate image for each item also eliminated the form class effect, but by reducing recall with verbs to the level of conjunction linked nouns. The effects of imagery instructions were interpreted as supporting the view that different types of connective, like different types of imagery instructions, produce different associative recall levels because they influence the processing of information, relating the items together in memory. Younger, grade 3, children did not perform as predicted with imagery instructions, such that a form class effect was still observed. The finding is consistent with numerous other studies which show that

imagery instructions are often ineffective with younger children, and extends the observation to separate imagery. A number of explanations of the ineffectiveness of imagery instructions for younger children are evaluated. Finally, linking prepositions were shown to produce different levels of associative recall as a function of the degree of close spatial relationship implied between item referents. An explanation in terms of a greater tendency on the part of children to encode items separately unless certain types of relationship are actually present between items or implied between item referents was suggested.

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I. GENERAL INTRODUCTION

The 'Form Class' Effect

If children are instructed to remember which nouns occur together in a given pair from a list of arbitrarily paired familiar nouns, presenting each pair with a linking verb considerably improves children's recall of which nouns 'go together'. For example, if a list of pairs of nouns includes the pair 'DOG' and 'BOX', children are more likely to recall that 'DOG' and 'BOX' go together if, at the time of studying the list, they hear the two nouns linked by a verb (for example, "The DOG bites the BOX") rather than hearing the two nouns presented alone ("...DOG.....BOX"). Although such verb 'connectives' considerably improve children's associative recall (that is, recall of which list items 'go together'), other types of connectives produce different results. Linking nouns with conjunctions (for example, "The DOG and the BOX") produces no better levels of associative recall than presenting the nouns alone. Prepositional connectives (for example, "The DOG in the BOX") produce levels of associative recall performance sometimes equal to those found with verb connectives and sometimes less. Rohwer (1964) called this group of phenomena the 'form class effect' because it seemed that the grammatical form class of the connective (that is, whether the connective is grammatically a verb, preposition

or conjunction) produced different levels of associative recall. The basic phenomena of interest in the present studies are those referred to by the term the 'form class effect', namely that verbs, prepositions and conjunctions used as connectives to link to-be-associated nouns produce different levels of recall in children.

The intention in the present studies is to investigate the form class effect and to develop and to test an explanation of these phenomena. There are a number of reasons for pursuing such an investigation. In the first place, the form class effect has already been demonstrated extensively, replicated and shown to be of wide generality with certain clear boundary conditions. One of these boundary conditions of considerable interest is that the form class effect is found in children but not in adults. Because of the limitation of the form class effect to children, the form class effect has been interpreted in various ways as shedding light upon the process of development, specifically the development of memory processes during childhood (for example, Levin, 1976; Reese, 1976; Rohwer & Ammon, 1971; Rohwer, Ammon, Suzuki & Levin, 1971; Rohwer, 1968; 1971; 1973; 1980). Accordingly, the immediate objective of the present studies is to investigate the form class effect, but the wider objective is to draw some limited deductions concerning ways in which children's memory processes may differ from those of adults. Thus, the specific question addressed here is why do verbs or preposition connectives improve children's associative recall unlike conjunction connectives. The wider question is what

does the limitation of the form class effect to childhood, and the explanation proposed here of these phenomena, imply about children's memory processes as opposed to those of adults.

The wider question of how and why children and adults differ in terms of performance on various memory tasks and in underlying memory processes has been investigated intensively during the last decade (for example, see reviews by Brown, 1975; 1978; 1979; Cavanaugh & Perlmutter, 1982; Pressley, 1982; Reese, 1976). A large part of the motivation for this research has been because the ability to remember is basic to learning and the educational process. The major emphasis in such studies has been not so much upon optimal conditions for learning as upon critical differences in memory abilities between children of different ages and, within a given age, critical differences in memory abilities between 'efficient' and 'inefficient' learners (for example, Levin, 1976; Rohwer, 1968; 1980). The general assumption made by Rohwer and others is that similar differences in memory abilities underlie both age related differences and also the individual differences within a given age group in learning ability (for example, Rohwer, 1980). The motivation for this work has thus been, at least in part, the hope that if specific deficiencies in memory were identified, then it might be possible to train children to improve their memory skills and hence improve their ability to learn within the educational system.

While the present studies are not concerned specifically

with improving memory skills, the common assumption of the present studies and educationally oriented studies is that the form class effect is of considerable interest because it is a robust phenomenon which characterizes children's memory, but not adults' memory performance, and so provides the potential for insight into some of the differences. The present studies are also not concerned with memory processes in educable mentally retarded individuals, but, like children, educable mentally retarded individuals do exhibit the form class effect (Jensen & Rohwer, 1963a, b), so that the investigation of these phenomena may shed some light on the memory processes of the mentally handicapped. Finally, a further possibility is that investigation of the form class effect as a group of phenomena peculiar to children might also reveal something not only about developmental differences, but also about the process of memory development. While the present studies do have some clear implications about developmental differences between children's and adult memory, they are not directly concerned with the process of development.

Turning now from the wider question of developmental differences to the more specific issue of the causes of the form class effect, the first objective of this introductory chapter is to describe the basic phenomena of interest, the form class effect, in some detail. A second objective is to describe the generality of the form class effect and to note some of the more important boundary conditions that have been identified. A third objective is to explore

some of the theoretical interpretations of the form class effect that have been suggested. A final objective is to indicate some of the theoretical importance which has been attached to the form class effect by various theories, particularly those concerned with memory development.

Description and Parameters of the Form Class Effect

Description of the form class effect

The basic phenomena of the form class effect are well established. Rohwer and others have shown repeatedly that presentation of to-be-associated nouns in the context of a sentence in which a verb or preposition links the nouns produced levels of associative recall superior to presentation of the nouns linked by a conjunction or without any 'connective' (for example, Rohwer, 1964; 1970; 1973). Presenting the to-be-associated nouns with a preposition linking the nouns produced recall levels varying from a level equivalent to that observed with verb connectives (for example, Rohwer, Lynch, Levin & Suzuki, 1967) to a level intermediate between the levels observed with verb and conjunction connectives (for example, Rohwer, 1964). In terms of generality, the form class effect has been obtained across a wide range of subject populations varying in grade level, age, socio-economic status, intelligence quotient levels, rural and urban environments, public and parochial schools, and with a wide variety of materials and presentation methods (for reviews see Pressley, 1982; Rohwer,

1970; 1973; 1980). Finally, instructing children to construct sentences describing the referents of items in some interaction also appears to produce parallel effects to supplying a sentence (for example, Kerst & Levin, 1973; Milgram, 1967; 1968. For a review, see Pressley, 1982)..

Control studies

In a series of control studies, Rohwer and his collaborators eliminated various confounding variables. One possibility was that verb connectives might exert greater semantic constraint than conjunction connectives over possible response nouns, because the conjunctions could be meaningfully combined with any nouns, but the range of meaningful combinations was more restricted for linking verbs. Rohwer and Lynch (1966) showed that if lists were constructed so all the nouns in a list were interchangeable and could be joined by any of the verbs, nouns linked by verbs were still better recalled. Earlier studies also confounded connective form class with the number of different words used as connectives (that is, a variety of different verbs were used within a list but usually only two different conjunctions), such that intralist similarity was greater in the conjunction conditions. Rohwer and Lynch (1967) therefore equated the number of different words used as verb and conjunction connectives but still found a form class effect.

Another possibility is that linking nouns with verbs produces complete sentences and children might better remember complete sentences than conjunctive phrases, perhaps because complete

sentences are more familiar. Suzuki and Rohwer (1968) therefore compared verb and conjunction connectives within complex sentences. The verb connectives produced more efficient learning of noun pairs even if the contrasting conjunction connectives were also lodged in complex sentences. A final possibility considered was that verbs, rather than sentences, might be better recalled than conjunctions, such that the retrieval context would be more similar to the encoding context for verbs than for conjunction connectives. Rohwer, Shuell and Levin (1967) therefore compared the cued recall of pairs of nouns in which the connectives were presented at study, or on the test trial as part of the cue, or at both study and test. The results of this study indicated that verbs may be somewhat better recalled than conjunctions, since presenting the connectives only at study produced a larger form class effect than presenting the connectives at study and test. The form class effect, however, was still obtained if the connectives were presented at study and test, and so the effect is independent of better recall for verbs in and of itself. Rohwer, Shuell and Levin's study also indicated one important parameter of the form class effect, namely that the connective must be presented at encoding. If connectives were presented only on the test trial, no difference was found between verb and conjunction conditions.

Other parameters of the form class effect

Several studies ~~indicate~~ some other major parameters of the form class effect. One parameter, already referred to, is

age and/or grade level. Although the effect of verb connectives emerges in the nursery school years (about three years of age, Reese, 1965), there is little increase in the efficacy of verb connectives across childhood (see Ervin, 1976; Pressley, 1977; Reese, 1977). Originally it was thought that instructions to make up sentences describing the referents of items interacting became effective later than supplying a sentence context (for example, Rohwer, 1970). However, it is now fairly clear that the effect of sentence instructions emerges at about the same time as that of sentence context and facilitates associative recall across a similar age range, showing little increase developmentally in efficacy (Pressley, 1982; see Chapter IV).

The more interesting developmental data concern what happens in late adolescence through young adulthood. It is clear that the difference between verb and conjunction connective conditions is not observed in college students (for example, Bobrow & Bower, 1969; Suzuki & Rohwer, 1969). Several studies also suggested that the magnitude of the form class effect diminished by late adolescence (Jensen & Rohwer, 1965; Rohwer & Bean, 1973). The expectation from these studies was then that at some point during adolescence, performance in the control condition would be equal to that in the sentence condition. However, it has been difficult to identify such a point and the results of such studies have been inconsistent (Rohwer, 1971; Rohwer & Bean, 1973; Rohwer, Raines, Eoff & Wagner, 1977). Rohwer et al. (1977, Experiment 3) classified subjects into

good, medium or low associative learners, and found evidence for equal levels of performance in sentence and control conditions only for high ability seventeen year olds. Hence, for most children, sentence context facilitates recall late into adolescence, although the form class effect is not found in college adults.

Various other task and materials parameters of the form class effect have also been delineated. Two parameters seem particularly important, namely that sentence context must be meaningful and must be aurally presented. With regard to meaningfulness, Rohwer (1966) demonstrated that presenting nouns in the context of a sentence will help children's subsequent recall only if the sentences are syntactically correct and meaningful. Neither approximations to English syntax nor sentences that are syntactically correct but meaningless provide any improvement in recall. Second, presenting pairs of nouns linked by a verb frequently does not lead to improved recall if the verb (or more usually, the sentence context) is printed rather than presented aurally (for example, Levin, 1970; Levin & Horvitz, 1971; Yuille & Pritchard, 1969), although one study did report a positive effect of printed sentence context (Suzuki & Rohwer, 1969). Levin, Horvitz and Kaplan (1971) specifically compared the effects of presenting sentence contexts visually and aurally as opposed to only aurally and concluded that improved recall performance was limited to the condition in which the sentence context was presented aurally without concurrent visual presentation.

One possible explanation of the limitation of the form class effect to aural presentation is that there is interference between reading the sentence context and encoding the items in memory. If failure to find the form class effect for children when the sentence context must be read does reflect some kind of interference effect, then similar interference might account for the similarly atypical finding of a positive effect of sentence instructions with adult subjects over sentence context only if the subjects were required to read the sentence context (Bobrow & Bower, 1969; Bower & Winenz, 1970).

Interpretation and Significance of the Form Class Effect

Beginning with his doctoral thesis demonstrating the 'form class effect' in children (Rohwer, 1964), and parallel findings with the mentally handicapped (Jensen & Rohwer, 1963a, b), Rohwer began an investigation of the form class effect which in part led to the large number of studies concerned with 'mental elaboration'. Rohwer's specific definition of elaboration will be discussed later. At this point it is sufficient to note that elaboration in children is operationally defined by procedures which enhance (associative) recall, and in adults by the failure of the same operations to enhance recall over performance in control conditions, which is attributed to 'spontaneous elaboration'. The superior recall observed for children, but not for adults, if nouns are linked by verbs or prepositions is a criterial demonstration of elaborative

effects. Parallels between the effects of pictorial translations of, for example, the interactions described by linking verbs with nouns, instructions to form interactive images and instructions to make up sentences describing the referents of items in some interaction, and the effects of linking nouns with verbs or prepositions were subsequently noted from prior studies or demonstrated by Rohwer and his co-workers. All of these procedures produced substantial improvements in children's recall, but had little or no effect on adult (associative) recall levels, suggesting, among other hypotheses, that adults spontaneously engage in the use of memorial strategies (which Rohwer called 'spontaneous elaboration') involving components of the procedures which produced enhanced recall for children.

Consequently, Rohwer and his co-workers have originated many hypotheses concerning both the superior levels of recall observed for nouns linked by verbs or prepositions (that is, the form class effect), and about the developmental aspects of these phenomena. The developmental hypotheses attempt to explain why certain procedures which enhance recall for children do not do so for adults, and why certain procedures (for example, linking nouns with verbs) enhance children's recall at an earlier age than other procedures produce enhancement in recall (for example, instructions to form mental images of the referents of to-be-associated nouns in some interaction). The developmental hypotheses have led to a large body of research relevant to the general question of why and how children's memory

improves with age.

The specific question addressed in the present studies is why linking nouns with verbs or prepositions produces better recall for children. The hypotheses advanced by Rohwer as directly relevant to the form class effect are (i) the imagery hypothesis, (ii) the deep structure hypothesis and (iii) what may be called, the later elaboration position. Rohwer's developmental hypotheses, which were put forward to explain why the form class effect is observed in children but not adults and also why the form class effect appears at an earlier age than the effects of imagery instructions, are (i) the memorial strategy hypothesis, (ii) the 'event knowledge' or 'event repertoire' hypothesis, and (iii) the 'elaborative propensity hypothesis'. Of the developmental hypotheses, Rohwer has proposed the 'event knowledge' hypothesis as an explanation of the form class effect in its own right, and hence is a fourth account of these phenomena. The four hypotheses directly relevant to the question of why verb linked nouns are better recalled by children will be considered in relation to the present account and present studies. The developmental hypotheses will only be considered insofar as they are relevant to developmental issues arising from the present studies, but for clarity are also stated below.

Hypotheses concerning the form class effect

The imagery hypothesis. Rohwer's initial interpretation of the superiority of nouns linked by verbs in recall was in terms of imagery processes. In this view, different types of connective evoke different types of images which vary both in the extent to which list items are represented jointly or singly in memory, and in terms of the 'dynamism' of images, more active, dynamic images being more memorable. Rohwer's view was arrived at by noting the parallels between the effects of depiction and those of connectives (for example, Kee & Rohwer, 1974; Rohwer, Lynch, Levin & Suzuki, 1967). By depiction is meant that line drawings or photographs of the referents of nouns are displayed as list items to children. When pairs of nouns are depicted in some interaction (for example, a dog chewing a box), associative recall exceeds the level obtained if the items are depicted in some spatial relationship (for example, a dog on a box) which in turn is superior to displaying separate pictures of each item (for example, a picture of a dog and a picture of a box), (Davidson, 1964; Kee & Rohwer, 1974; Reese, 1965; Rohwer, Lynch, Levin & Suzuki, 1967). Rohwer therefore suggested an imagery interpretation of both the form class effect and the effects of depiction: "A number of explanations of the form class effect can be given, but the one that comes most readily to most minds . . . is that the three kinds of connectives evoke three kinds of visual imagery. The notion is that conjunction connectives evoke a static image of two objects arrayed side by side, preposition connectives

evoke a static image of two objects in a particular locational arrangement, and verb connectives give rise to an action image of some episode involving the two objects " (Rohwer, 1970, pp. 397-398). In addition, Rohwer argued that "It is intuitively clear . . . that action imagery is more memorable than static imagery, and that locational imagery is more memorable than coincidental (conjunction) static imagery" (p. 398). A specific test of the imagery hypothesis, comparing "action" and "still" verbs (Rohwer & Lynch, 1967) was not, however, successful. Both types of verbs were found to improve recall compared with nouns linked by conjunctions, but did not differ between themselves.

The deep structure hypothesis. At one point in elaboration research, considerable effort was spent in attempting to decide between imagery accounts of encoding and accounts in terms of linguistic processes. A second alternative account of the form class effect considered by Rohwer was in terms of linguistic structure, rather than imagery processes. Suzuki and Rohwer (1968) proposed that the effect of sentence context is to cause the items linked by a verb or preposition to be stored as one string in semantic deep structure (after Chomsky, 1965). It should be noted that the deep structure explanation was in fact subsumed by Rohwer's subsequent suggestion (1970) that sentence context prompts elaboration, as was the imagery hypothesis. Rohwer's later elaboration position is stated in such a way to include the possibility of both imagery and verbal encoding processes. The deep structure account, however, is a

strictly linguistic account. Thus, Suzuki and Rohwer (1969) suggested that when subjects understand a sentence they comprehend the underlying relations, and that these relations determine the functional units of memory storage. Thus, "... two words occurring in the same underlying string can be acquired more easily than those occurring in two different strings. . . . It is a more direct process for the first noun to be used in retrieving the second noun when both appear in the same storage unit than when they appear in two separate storage units" (Suzuki & Rohwer, 1969, p. 912).

The results of the initial studies of the deep structure hypothesis support the hypothesis but are consistent with Rohwer's later elaboration position as well, that it is the occurrence of the verb between the to-be-associated nouns that elicits associative encoding. Suzuki and Rohwer (1968) compared the deep structure and a surface structure account which would predict errors in recall should be greatest at the boundaries of phrases. They used complex sentences in which the two target nouns were linked by a verb or a conjunction, so that the two nouns occurred in different phrases in the verb condition, but the same phrase in the conjunction condition, for example,

"The ROCK hit the BOTTLE and him" (verb connective)

"The ROCK and the BOTTLE hit him" (conjunction connective)

Analysis of deep structure according to Suzuki & Rohwer would generate the following,

"The ROCK hit the BOTTLE. The ROCK hit him." (verb connective)

"The ROCK hit him. The BOTTLE hit him." (conjunction connective)

As predicted, on the basis of a deep structure analysis, they found the verb connective condition led to better cued recall. Similar results were found in a second study (Suzuki & Rohwer, 1969) which controlled for whether the subject or object of the sentence was compound.

Three other studies attempted to find evidence supporting a deep structure account and to reject the imagery hypothesis (Davidson & Dollinger, 1969; Ehri & Richardson, 1972; Ehri & Rohwer, 1969). The common method was to vary the grammatical form of sentences, and hypothesised deep structure, and to look for differences in children's recall as a function of sentence type. However, other factors were not well controlled, and may account for recall differences. For example, Ehri and Rohwer (1969) compared sentences in which the verbs were more related to either the subject or object noun. If cues included the verb, 'object-related' verbs produced better recall than 'subject-related' verbs. Although the degree of semantic constraint exerted by verbs over possible response nouns does not explain the form class effect, it does have a demonstrable effect (Rohwer et al., 1967) and so may account for the superiority of 'object-related' verbs.

It is also important to note that in all studies where the grammatical form of (meaningful) sentences was varied, the general conclusion is that sentences of any type always produced better

recall than non-sentence controls. Finally, studies of the deep structure hypothesis did not eliminate the possibility of imagery as an encoding process, although they did raise some questions about the necessity for verb connectives to evoke 'action' images, as Rohwer originally proposed. For example, it is unclear that imagery as an encoding process was ruled out for sentences such as "The cigar is longer than the snake" (Ehri & Richardson, 1972). The present view conceives of imagery as one of a number of possible encoding processes and it does not seem that studies of the deep structure hypothesis provide any strong evidence against this possibility.

The elaboration position. For a number of reasons, Rohwer moved on from an account of the form class effect in terms of either strictly linguistic or strictly imagery processes. Evidence accumulated from a number of studies supporting both of the latter approaches, but eliminating neither of them. Moreover, it became clear that neither the deep structure nor imagery hypothesis could alone account for the developmental phenomena which became apparent. For example, neither hypothesis explained why the form class effect was found in children's recall but not found for college adults. Rohwer's later account may be called the elaboration position ('position' since it subsumes the earlier hypotheses and some later ones). By 'elaboration' Rohwer meant "... the formation of an episode, process or relation involving the to-be-associated items" (Rohwer, 1973, p. 5). Thus,

A learner using imaginal elaboration to learn the pairing 'cat and apple' would generate an interactive image involving a cat

and an apple, such as a cat eating an apple. Alternatively, the learner could generate a sentence involving the two items. A good verbal elaboration would be, 'The cat ate the apple'. Pressley, 1982, p. 296).

It would also seem clear that Rohwer used 'elaboration' to refer to associative memory.

The basic assumption which Rohwer made about the superior recall observed if nouns are linked by verbs, or their referents depicted interactively, was that verbs or preposition connectives or interactive pictures 'prompt elaboration' (also, 'impose', Rohwer, 1973, or 'provide' elaboration, Pressley & Levin, 1977). By using the term 'prompt' Rohwer meant that the elaboration which is hypothesised to occur spontaneously in adults, is, in some way, elicited in children by prompts. In general, Rohwer and others have not spelt out in much detail how prompts such as linking verbs or interactive pictures do elicit elaboration, so that the elaboration position is essentially compatible with the earlier hypotheses (linking verbs elicit dynamic, action images or lead to storage in one deep structure string) and some later suggestions (verbs may afford mediating information young children lack). The key idea is that, in some way, linking nouns with verbs or prepositions results in the elaboration of the items so linked and hence, improved (associative) recall of the items by children.

Developmental hypotheses

With regard to the complex of developmental phenomena which elaboration studies have uncovered, Rohwer has put forward a general

hypothesis which Pressley (1982) has termed the 'developmental elaboration position' Rohwer argued that ". . . the older the learner, the less explicit are the prompts required for elaboration" (Rohwer, 1973, p. 8). Pressley has defined the position more clearly in a review of the developmental elaboration position:

In other words, older children should be more likely to use elaborative techniques spontaneously, and when usage instructions are necessary, they need not be as detailed as for younger children. Moreover, older children should be able to use elaboration with a wider variety of materials and more settings. The research summarized here has largely substantiated the developmental elaboration position. (1982, p. 297).

Thus, Rohwer distinguished between 'explicit prompts' such as linking verbs which provide elaboration and 'minimally explicit prompts' such as imagery instructions in which the elaborative process is elicited, but the child must generate his or her own elaborations. In the context of the present studies, the developmental elaboration position is exemplified by (i) the effectiveness of explicit prompts (here, linking verbs or prepositions) for children at all grade levels studied, (ii) the effectiveness of minimally explicit prompts (imagery instructions) only for older children, and (iii) disappearance of prompt effects by adulthood (here, linking verbs produce no increment in recall for college students).

The developmental elaboration position points to some fairly well substantiated conclusions about the difference in age at which explicit prompt effects appear and the age at which the effects of some minimally explicit prompts appear, and the disappearance of

prompt effects by adulthood. Consequently, a number of hypotheses have been investigated which attempt to explain the pattern of age related phenomena. It should be noted, however, that Pressley concluded in his review of the developmental elaboration literature that the developmental elaboration position is in error in one respect, namely, that sentence instructions (which are minimally explicit prompts) appear to be effective almost as early or as early as linking verbs (explicit prompts). This discrepancy will be referred to later and is of significance. At this point, however, the major hypotheses suggested concerning developmental elaboration phenomena will be noted.

The development of elaborative propensity. Rohwer's basic approach to the issue of the various developmental elaboration phenomena has been the hypothesis that differences in the propensity to elaborate items spontaneously account for age-related (and individual) differences (Rohwer, 1973; 1980). For example, given regular pair learning instructions, twelfth grade students exhibit far better recall of a list of noun pairs than sixth graders. Rohwer (1973) suggested this apparent age effect could be attributed to the development across adolescence of "... a marked propensity to elaborate for each pair an event that jointly implicates the referents of the two members" (Rohwer, Raines, Eoff & Wagner, 1977, p. 472). The elaborative propensity hypothesis attempts to explain (i) why younger children require explicit prompts to impose or provide elaboration (they have little or no elaborative propensity), (ii)

why somewhat older children benefit from minimal prompts such as imagery instructions (they have acquired some elaborative propensity but not enough to elaborate items spontaneously) and (iii), why, by late adolescence, explicit and minimally explicit prompts begin to lose their efficacy (elaborative propensity is well developed and spontaneous elaboration is occurring).

Tests of the elaborative propensity hypothesis have been less successful. If the development of elaborative propensity is the only significant factor in the development of associative memory, then elaboration instruction (sentence or imagery) should eliminate developmental or individual differences, between, for example, pre-adolescents and adolescents, but the finding is that differences are only reduced (Rohwer et al. 1977; Waters, 1982). Second, attempts to identify individuals with high elaborative propensity have met with only limited success such that even older adolescents may or may not exhibit spontaneous elaboration across situations (Rohwer, 1980; Rohwer et al., 1977; Rohwer, Rabinowitz & Dronkers, 1982). Nevertheless, the elaborative propensity hypothesis is consistent with a considerable number of the developmental findings. At the same time, Rohwer and others have attempted to identify other factors which may be involved in the development of (associative) memory, as well as trying to break down some of the factors which may underlie changes in 'elaborative propensity'.

Strategy and metamemory acquisition. Rohwer's collaborators and others have identified the concept of the development of

elaborative propensity with (among other things) the acquisition of memorial strategies (for example, Pressley & Levin, 1977; Waters, 1982). The suggestion that children lack memorial strategies which, when acquired, allow older adolescents or adults to 'elaborate' items 'spontaneously' is consistent with a large number of other studies of children's memory. In general, improvement in memory performance with age has been largely attributed to the acquisition of memorial strategies (for example, Brown, 1975; Flavell, 1970; Flavell & Wellman, 1977; Hagen & Stanovich, 1977; Kobasigawa, 1977; Reese, 1976), as well as to the acquisition of knowledge about memory (metamemory) such as which strategies are appropriate to which task, task difficulty, memory ability and capacity, or in other words, knowledge directly relevant to memory processes (for example, Flavell, 1971; Cavanaugh & Perlmutter, 1982). Rohwer has not been much concerned with metamemory, although his work is not inconsistent with the concept, and clearly assumes some sort of control processes governing strategy use and selection. However, much of the evidence for memorial strategy acquisition does derive indirectly from Rohwer's work. Evidence for the strategy acquisition hypothesis in the context of the present findings is reviewed in Chapter IV. For the present purposes it is sufficient to note that a strategy acquisition hypothesis (after Flavell, 1970) may be applied to account for (i) the fact that interactive imagery instructions are not effective for younger children (the strategy elicited by instructions in older children has not been acquired), (ii) efficacy of

instructions later in childhood (instructions are required to elicit the still poorly acquired strategy), and (iii) disappearance of explicit prompt effects by adulthood (adults have acquired a variety of strategies which they use 'spontaneously', or in Rohwer's terms 'spontaneous elaboration'). However, it is important to recognize that such strategy acquisition, for which there is considerable evidence, does not in itself explain how explicit prompts such as linking nouns with verbs help very young children's recall since the ineffectiveness of instructions with very young children is attributed to the lack of any strategies.

The "event knowledge" hypothesis. Recently, Rohwer proposed another explanation of developmental elaboration phenomena. Since attempts to equate elaborative propensity by the use of elaboration instructions have not been successful in removing developmental differences, Rohwer suggested that success in elaboration at all ages might be (also) tied to how much learners know about how paired items could be related and, thus, elaborative skills develop with increasing age because of increasing world knowledge ("event knowledge" and "event repertoires", Rohwer, 1980). Thus, Rohwer has variously suggested that pre-adolescents and adolescents might (i) differ both in elaborative propensity and in event knowledge, or (ii) share moderate levels of elaborative propensity but differ in event knowledge. While experimental tests of the event knowledge hypothesis have not provided much confirmation (Rohwer, 1980; Rohwer et al. 1982), similar ideas have been advanced by other

theorists to account for improvement in age in associative memory performance (for example, Lindberg, 1980; Perlmutter, 1980).

There is little doubt that when the information required to associate items together is highly unfamiliar to one group of subjects, but highly familiar to another, the latter condition results in much better associative recall (for example, Lindberg, 1980). The question, however, is the extent to which a lack of relational information, together with other factors, accounts for all age related improvements in associative memory performance. Although Rohwer has been mostly concerned with applying the event knowledge hypothesis to the persistence of developmental differences in adolescence when elaborative propensity has been equated by instructions, the hypothesis also may be applied to the effects of explicit prompts. The implication of the event knowledge hypothesis is, clearly, that at least part of the reason that explicit prompts impose or provide elaboration is that they supply or afford relational information which younger children have not yet had the opportunity to acquire. The question to be considered here, therefore, is whether the child's more restricted knowledge of the world accounts for the superior recall observed if nouns are linked with verbs or prepositions.

Summary of elaboration hypotheses

In summary, elaboration research has generated a variety of hypotheses concerning both the specific question addressed by the

present studies, namely, why are nouns linked by verbs or prepositions better recalled than nouns linked by conjunctions by children, and the broader developmental questions arising from the pattern of findings referred to as the 'developmental elaboration position'. These developmental questions include for the present purposes, why the form class effect is limited to children, and why the effects of explicit prompts emerge at an earlier age than (some) instructional effects. With regard to the superior recall by children of verb or preposition linked nouns (that is, the form class effect), Rohwer has suggested at various times (i) that different connectives lead to different sorts of images which differ in memorability, (ii) that different connectives differ in their effects upon semantic deep structure, (iii) that different connectives differ in their ability "to prompt elaboration", and (iv) that different connectives differ in the extent to which they supply information for relating items together ("event knowledge"). With regard to developmental effects, Rohwer and others have suggested that (i) individuals differ in 'elaborative propensity' which develops with age, (ii) with age, children acquire memorial strategies which at first are elicited by instructions, later used spontaneously, (iii) with age, children acquire increasing knowledge of the world which can serve as a basis for relating items together ('event knowledge', 'event repertoires'), and (iv) children acquire increasing knowledge about memory ('metamemory') and increasing control over their own memory processes.

All four developmental hypotheses explain why children, but

not adults, show explicit prompt effects such as the form class effect, since adults do not require prompts because they spontaneously use memorial strategies, have an adequate knowledge base to relate items together in memory, and have greater elaborative propensity than children. That the effects of elaborative prompts emerge before (some) effects of instructions such as imagery instructions in Rohwer's view, reflects both that prompts supply relational information children lack and that prompts elicit elaboration in some way, which adults do not require because the latter have acquired strategies, event repertoires and good elaborative propensity. As Pressley has noted, however, none of the latter reasons are directly relevant to the issue of what it is about prompts that gives them the ability to prompt elaboration.

Target and contextual integration

Another approach that may be modified to apply to the form class effect has been suggested by Ackerman (1982a). Ackerman's suggestion was that ". . . children may fail to integrate target information with contextual information and form a cohesive episodic event from the input " (p. 430), because ". . . even if young children automatically encode the semantic meaning of individual items . . . they may fail to access the semantic system in units larger than single items . . . and so fail to take advantage of the semantic relationships between items" (p. 430). Ackerman (1982a) required second and fourth grade children and college adults to recall target nouns presented in sentences varying in 'semantic

coherence'; for example, 'congruent', or describing situations likely to occur in everyday life, 'incongruous', or unlikely to occur, and 'anomolous' describing situations which could not occur. The assumption was that the more sentences describe situations consistent with prior semantic knowledge, the more the target noun and its context should be integrated (after Baker & Santa, 1977). The sentences included: "The boy placed the book on the table" ('congruous'), "The boy placed the book on the dog" ('incongruous'), and "The boy placed the book on the bear" ('anomolous').

Ackerman hypothesised that integration (relational encoding) would be enhanced when subjects rated the probability of occurrence of the events described by sentences, and not when they simply read the sentences. As predicted, integration (as measured by elimination of developmental differences in cued recall across grades, and between one word and sentence less target word cues, and larger differences between sentence types as a function of congruity) was more complete for children who rated the probability of the events described occurring. The difficulty with the results, however, is that requiring children to read sentences often does not help associative recall, as noted above, and there is even some suggestion for adults that reading sentences depresses performance (relative to performance with instructions to generate sentences, normally an equivalent condition, Bobrow & Bower, 1969; Bower & Winenz, 1970). Therefore, the condition in which subjects simply read the sentences is likely to have been equivalent or worse than presenting the nouns

without any context. That the congruity effect and recall levels were low is therefore not surprising. Previous data would therefore suggest that Ackerman's prediction, " . . . the children would not fully integrate the nouns with the sentence context in the Read condition" (p. 431), was correct, but not necessarily for the reasons he assumed.

In spite of the methodological problems of Ackerman's study, it is clear that a rather different view of children's memory for relational information was proposed. Like the elaboration account(s), Ackerman suggested that children are deficient (compared with adults) in their ability to relate items together. Instead, however, of suggesting that children lack mediating information or memorial strategies, Ackerman suggested that children have a general tendency not to integrate items together in memory because children fail to access the semantic system in units larger than single items and so "fail to take advantage of the semantic relationships between items". Ackerman's view is significant in that it emphasised children's tendency to process items individually. In contrast, the elaboration approach stresses the other side of the coin, namely children's tendency not to process items elaboratively (that is, to fail to relate items together) except under special conditions (prompts), in contrast to adult 'spontaneous elaboration'.

What would Ackerman's view suggest about the form class effect? If, as will be suggested below, the form class effect is an effect in associative memory, the effect of verb connectives

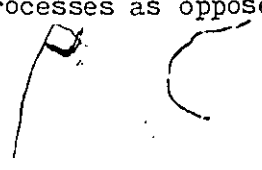
might be to increase the likelihood that children will form 'cohesive, episodic events'. Thus, linking verbs may overcome the tendency of children to process items individually by causing children to access the semantic system for several items together and so to process items jointly. Ackerman's (1982a) study does not, as noted, support this conclusion since the extent of interitem integration was much less when children read a sentence relating to-be-associated items together than when they also rated the likelihood of the event described by the sentence occurring. However, this study does not indicate what recall levels without a sentence would be like (that is, the study lacks the baseline conjunction or 'non-elaborated' condition which prevents conclusions about the effect of sentences). The sentences were also read by the children, a condition known to be less effective than reading the sentence to the children in terms of subsequent recall. Therefore, Ackerman's suggestion that children have a general deficit in associative memory, reflecting a failure to integrate items together due to accessing the semantic system in terms of individual items, would seem applicable to the phenomena of the form class effect because it is unclear that explicit integration instructions are necessary for such integration to occur. Modifying Ackerman's view, then, it may be hypothesised that the effect of verbs or prepositions upon the processing of the items they link is to overcome the tendency of children to process items individually and thus increase the likelihood of forming 'cohesive, episodic events' relating the to-be-associated items in

associative memory.

General Summary & Conclusions

The phenomena of central interest are those known as the 'form class effect'. The form class effect refers to the different levels of recall observed in associative memory tasks when to-be-associated nouns are linked by verbs, prepositions or conjunctions. The form class effect is a robust set of phenomena, observed from about age three to middle or late adolescence, but is not found in adult college students. The other major boundary conditions of the form class effect are that the sentences generated by linking the nouns must be read to children, rather than read by children, and the sentences or phrases must be meaningful. Numerous control studies have also been carried out, eliminating various confounding variables in the original demonstrations of the form class effect. Finally, a similar improvement in children's recall is observed if instructions are given to construct a sentence describing the referents of to-be-associated items in some interaction, across an age range similar to that for the form class effect.

The central significance of the form class effect is that these phenomena, like certain others, are characteristic of children's performance on memory tasks but not found in adults' performance. Therefore, investigation of the form class effect and related phenomena has been assumed to reveal something about the nature of children's memory processes as opposed to those of adults. Rohwer's original



(1964) demonstration of the form class effect led both to a group of hypotheses intended to explain the superiority of nouns linked by verbs or prepositions in recall over nouns linked by conjunctions, and a series of developmental hypotheses to account for occurrence of the form class effect for children's but not adults' recall, and the fact that linking nouns with verbs helped recall at an earlier age than instructions to form interactive images.

Rohwer proposed two earlier hypotheses about the superiority of verb linked nouns in recall, an account in terms of mental imagery, and an account stressing linguistic processes. Both of the earlier accounts were later subsumed by Rohwer in terms of a more general account in terms of elaboration. Four developmental hypotheses were also suggested by Rohwer and others to account for the effects of the various types of prompts in childhood. While neither the acquisition of strategies or metamemory, nor differences in elaborative propensity provide any direct explanation of why nouns linked by verbs are better recalled, it was noted that the hypothesis that verbs afford relational information children otherwise lack also constitutes an account of the form class effect. Finally, Ackerman's suggestion that children tend to process items individually, because of a tendency to access the semantic system for items individually (unless otherwise prompted, for example by linking verbs) was noted as a further possible account of the superiority of nouns linked by verbs or prepositions in recall, notwithstanding the results of his 1982(a) study.

II. AN OVERVIEW OF THE MAIN FINDINGS AND OF THE PRESENT THEORETICAL ACCOUNT OF THE FORM CLASS EFFECT

General

Chapter I outlined the phenomena of interest, the form class effect, its parameters, the various explanations suggested, and the significance attached to the phenomena as a starting point for research into 'mental elaboration' and as shedding light upon differences between the memory processes of children and adults. The overall aim of Chapter II is to provide an overview of the present investigation into the form class effect, both in terms of the main findings and the present theoretical account. Accordingly, the first objective of the chapter is to summarize the main findings of the thesis. The reason for such a summary of the main findings at this point is to give direction to the subsequent discussion of the theoretical account, indicating, for example, just what the present account must be able to explain. The second objective of the chapter is to present an overview of the present theoretical account of the form class effect. Finally, a third objective is to note in passing some of the more significant implications of the main findings and of the theoretical account. A more detailed analysis of the main findings and of the pertinent aspects of the theoretical account follows in the chapters reporting the studies (Chapters III - V).

On Overview of the Main Findings of the Thesis

The first major finding of the thesis is that the form class effect is limited to measures of associative recall. Most prior studies of the form class effect have used measures of associative recall (requiring children to indicate which items 'go together') and most accounts of the form class effect have assumed, more or less explicitly, that the locus of the effect is in children's associative memory (memory for which items 'go together'). The present account will be shown to lead to the expectation that if the form class effect is indeed an effect in children's associative memory, then the phenomena should only emerge in measures of associative recall. The first group of studies establishes that the form class effect is in fact limited to measures of children's associative recall by showing that the form class effect is found in cued recall but not in the overall levels of free recall. By cued recall is meant that one or more items which the subject has been instructed to associate together is presented as an aid to recall on the test trial and the subject is required to provide the missing associate. For example, if "DOG" and "BOX" were presented as a pair of to-be-associated items, one of the words, such as "DOG", is presented on the test trial to the subject whose task is then to recall the other word, "BOX". In the free recall test, no list items are presented on the test trial, and the subject is simply instructed to write down in any order all the list items that he or she can recall.

The present studies show quite clearly that the usual superiority of nouns linked by verbs emerges in the cued recall procedure, but is not found in free recall. Thus, when a list of pairs of nouns is presented, each pair linked by a verb, ("The BEAR sees the TREE"), more second nouns are recalled if cued by the first noun in each pair, compared with similar cued recall of nouns linked by conjunctions ("The BEAR and the TREE"). In contrast, when the first (or second) noun is not presented as a cue, and subjects are simply required to write down all the nouns they can recall from the list, children recall nouns linked by conjunctions just as well as nouns linked by verbs. Therefore, the form class effect is limited to cued recall and not found in free recall. The broader implication of the finding is that the form class effect is not found in all retrieval measures, and the theory must be able to account for this limitation of the phenomena.

The second major finding of the present studies is that interactive imagery instructions bring the associative recall of conjunction linked nouns up to the level of verbs. Interactive imagery instructions eliminate the differences between nouns linked by verbs and conjunction linked nouns by bringing the cued recall level of the conjunction condition up to the cued recall level of the verb condition. By "interactive imagery instructions" it is meant that children are told to "Make a picture in your head of the two things" (that is, the referents of the to-be-associated nouns) ". . . doing something together" (or words to that effect). If such

interactive imagery instructions are given on the study trial, associative recall performance is considerably improved for conjunction linked nouns, such that approximately equal cued recall levels are observed for both verb and conjunction conditions. Thus, the form class effect is eliminated in associative recall if interactive imagery instructions are given on the study trial. The implication of the finding is that both interactive imagery instructions and verb connectives have parallel effects, namely to promote children's associative recall, and the theory needs to be able to account for these parallels.

The third major finding of the thesis is that separate imagery instructions reduce the associative recall of verb linked nouns to the level of conjunction linked nouns. If separate imagery instructions are given, cued recall of verb linked nouns is reduced to the level of nouns linked by conjunctions. By "separate imagery instructions" is meant that children are instructed on the study trial to form a separate image for each list item. Such separate imagery instructions, like interactive imagery instructions, eliminate the form class effect, but by reducing associative recall of verb linked nouns, instead of improving recall of conjunction linked nouns. The implication of the finding is that separate imagery has an opposing effect to that of verb connectives, namely to reduce the associative recall benefit usually produced by linking verbs.

The fourth major finding of the thesis is that imagery instructions of both types eliminate the form class effect only for

older children. While the difference in cued recall of nouns linked by verbs and conjunction linked nouns is eliminated by interactive or separate imagery instructions for older children (grades 6 and 8), the form class effect was still obtained for younger (grade 3) children. However, a failure of imagery instructions with younger children is consistent with numerous other studies which indicate that imagery instructions are ineffective with younger children, particularly if the list items are words (as in the present studies) rather than pictures. The finding confirms the results of previous studies that imagery instructions are sometimes ineffective with younger children, extending this observation to separate imagery, and raises a developmental question, namely, what happens with age that makes children more sensitive to instructional effects.

The fifth major finding of the thesis is that different sorts of prepositions differ in the extent to which they benefit children's associative recall. Previous studies of linking prepositions suggest that prepositions are sometimes as effective in enhancing associative recall as verbs, sometimes somewhat less, but usually superior to nouns linked by conjunctions. The present studies identify differences within the grammatical form class of linking prepositions. While prepositions which imply a close spatial relationship between the referents of the items they link lead to significantly higher levels of cued recall by children than linking conjunctions, preposition connectives which do not imply as much spatial proximity between referents are recalled little better than

nouns linked by conjunctions. For example, "The DOG in the BOX" enhances recall on the average much more than "The DOG near the BOX", which in turn is recalled only slightly better, or no better, than "The DOG and the BOX." The main implication of the finding is that the differences observed in children's associative recall for different types of linking connectives are not, in fact, simply a function of the grammatical form class of the connective. In short, the form class effect is not a form class effect. The theoretical account must, therefore, clarify what factors produce the so-called form class effect.

An Overview of the Present Theoretical Account

The specific question addressed in the present series of studies is, as noted in Chapter I, why children recall to-be-associated nouns linked by verbs or prepositions better than nouns linked by conjunctions, or presented without any connective. The balance of Chapter II therefore presents an overview of the present theoretical account of the form class effect, together with some implications of the five main findings. In general terms, the theoretical account assumes that children do not, compared with adults, tend to remember items together (that is, encode them associatively), unless the way the items are presented suggests they 'go together', or unless steps are taken to construct subjective links. The basic assumption, therefore, is that the form class effect is an effect in children's associative memory, rather than any other kind of memory.

The present view is that the effect of verb or preposition connectives is to increase the probability that items will be remembered together; that is, linking nouns with verbs or prepositions improves children's memory for which nouns 'go together' (associative memory).

The assumption is that the form class effect is an effect in associative memory, but it is necessary to define what is meant by the latter term. Numerous recent studies have suggested that a useful way of distinguishing associative memory from other types of memory is to draw a distinction between memory for relational information and memory for item specific information, both for children and adults (see Chapter III). In brief, relational information refers to the information shared between events and is usually conceptualized as the basis for organizing events together in memory. Item specific information refers to the information which distinguishes events by emphasising the uniqueness of a particular event. The present view of the form class effect, stated in terms of the distinction between relational and item specific information, is that linking nouns with verbs or prepositions increases the encoding of information relating items together in memory, but leads to no better discriminative encoding of items than linking the same items with conjunctions.

The present account may be described as an 'organizational account' in that it assumes that different connectives produce different sorts of memory organization. The nature of the differences in organization are further specified below. At this point, it is more important to note that an underlying assumption is made which

provides the rationale for the present studies. The assumption is that differences in memory organization should become apparent at retrieval in that whether or not a particular organization affects memory performance depends on the nature of the retrieval tasks, since some types of organization benefit some tasks, but not others. Again, the expectations for retrieval will be further specified below, but it may be noted that, consistent with the above assumption, the suspicion from prior studies is that the form class effect does not reliably emerge in all retrieval measures. Most of the studies concerned with the form class effect, reviewed in Chapter I, used measures of associative recall (usually cued recall), but several studies using (simple) recognition showed no better recognition of items studied linked by verbs than for items linked by conjunctions. An adequate account of the form class effect needs to be able to specify not only the locus of the effect (in memory for relational information), but also how such differences in the encoding of associative information should emerge, or not emerge, in different retrieval measures.

Accordingly, certain other assumptions, detailed in Chapter III, are made to clarify both the consequences for memory organization of differences in the encoding of relational information and the expectations concerning the effects of different types of organization in various retrieval measures. The additional assumptions are derived from the organization-redintegration hypothesis proposed by Begg (for example, 1972, 1982). First, it is assumed that items are

either individually represented in memory by single traces or units,
or a number of items may be jointly represented as a single trace or
unit. The present view is therefore that children have a greater
tendency than adults to encode items separately, unless the way the
items are presented suggests (or 'prompts') that the items 'go
together'. The effect of verb connectives is then to increase the
likelihood that the nouns they link will be represented jointly in
memory by a single trace or unit.

Second, it is assumed that relational or associative
information is independent of information which enables item
discrimination. The implication is that the simple fact that a
number of list items are represented separately or jointly by single
memory units has no bearing upon the likelihood of contacting these
traces. Hence, while different types of connectives influence the
degree to which children encode relational information, the likelihood
of trace contact should be about the same. Finally, it is assumed
that memory traces or units are in some sense whole or integrated,
such that if any significant part of a unit is contacted, the rest
of the information in that unit becomes available. The implication
is that, given contact with a significant part of a unit,
redintegration of the information is equally good, irrespective of
whether a unit represents an individual list item or several items.

The general expectation then is that the hypothesised
differences in organization should become clear in retrieval, or
more precisely, that encoding conditions should interact with

retrieval task demands (cf. Tulving & Thomson, 1973). A detailed analysis of the role of memory for relational information and memory for item specific information in various retrieval tasks is given in Chapter III. It is sufficient to note at this point that the hypothesised effect of verb connectives (that they increase the joint representation of items in memory) should emerge only in those retrieval measures sensitive to the degree of relational encoding, namely, measures of associative recall such as cued recall and cued recognition, and not in the overall level of free recall or in simple recognition. As will be shown, limitation of the form class effect to measures of associative recall poses some difficulties for other accounts of the form class effect, because they do not, in general, specify how differences in the encoding of different types of memory information should emerge in different retrieval tasks. Without specifying the relationship of what is encoded to what will benefit performance in different retrieval tasks, it is impossible to explain the occurrence of the form class effect in some retrieval measures but not in others.

The present theoretical account of the form class effect is thus an organizational account, attributing differences in recall to differences in the organization of memory information, with the expectation that such differences in organization should become clear in retrieval. However, the present account is also a processing account in that it is hypothesised that the differences in organization are the result of differences in the processing of information.

relating the items together in memory. The assumption is that the form class effect primarily reflects the fact that verb, preposition and conjunction connectives differently influence the way relational information is processed at encoding. No specific role is attributed to verb or prepositional connectives other than to increase the encoding of information relating the items they link together in memory. (For example, it is not assumed that verb connectives necessarily afford mediators or 'event knowledge' which children otherwise lack.) Accordingly, other conditions which may be expected to promote the joint encoding of items should have parallel effects to those of verb connectives upon the processing of relational information and consequent organization.

Since there is considerable independent evidence suggesting that instructions to form interactive images of to-be-associated items also promotes the encoding of information relating the items together in memory (see Chapter IV), interactive imagery should have consequences parallel to verb connectives for the organization of memory and subsequent recall. Moreover, the implication of the present account of the form class effect is that conjunction connectives do not appreciably influence the processing of relational information by children, and so do not promote joint encoding any more than presenting the items without any connective. If conjunction connectives are poor relational organizers, and have little or no effect on children's tendency to encode items separately, and if interactive imagery biases processing towards items jointly,

interactive imagery instructions should sharply improve joint encoding of conjunction linked nouns, raising associative recall levels. Therefore, under interactive imagery instructions, the difference in children's associative recall of nouns linked by verbs and conjunctions linked by nouns should be attenuated if not eliminated.

Conversely procedures which reduce relational or joint encoding should have consequences for organization more like those of conjunction connectives. There is considerable evidence that instructions to form a separate image for each list item reduce relational or joint encoding (see Chapter IV). Therefore, if verbs are good relational organizers, and if separate imagery instructions bias processing towards items individually rather than in relation to other items, such instructions should reduce the likelihood that children will be influenced by verb connectives to process items jointly, and hence reduce associative recall levels for verb linked nouns. In short, the expectation for both types of imagery instructions is that the difference in associative recall levels for verb linked and conjunction linked nouns will be reduced or eliminated, although for differing reasons depending on the type of imagery. Moreover, the expectations concerning the effects of imagery instructions derive from the assumption that different types of connective (and imagery) influence the processing of relational information differently. Such an organization-processing account would not seem easily derived from linguistic accounts of the form

class effect.

However, the expectation to be derived from numerous prior studies of the effects of interactive imagery instructions is that such instructions may not be 'effective' (that is, influence associative recall levels and by inference encoding and memory organization) for younger children. The question which arises from such studies is what happens with age that makes older children's performance more sensitive to instructional effects? Although the developmental issues arising fall outside the present account of the form class effect, certain explanations, if supported, would tend to weaken it, while others are more consistent with it. For example, if all instructional effects appeared at a later age than that at which the form class effect appears, the case for viewing imagery instructions and connectives as having parallel effects would be weakened. If all instructional effects (sentence, imagery) appeared later than the effect of verb connectives then it would seem more plausible that verb connectives might afford specific mediating information which children otherwise lack, since instructions to generate sentences or interactive images do not afford specific mediating information.

However, more recent studies of sentence instructions have concluded that the effects of sentence instructions appear about as early as the form class effect. Moreover, sentence instructions are usually reported to be effective at an earlier age than interactive imagery instructions. Hence, an explanation of the ineffectiveness

of imagery instructions in the present and other studies would appear to need to be tied directly to the (slower) development of imagery processes (see Chapter IV). In short, the present view of the form class effect suggests that imagery instructions where effective should have parallel effects to those of connectives upon children's relational encoding, and is not necessarily contradicted by the ineffectiveness of such instructions with younger children.

The final theoretical issue addressed in the present studies concerns why verb or prepositional connectives help children's recall. The implication of the present account of the form class effect is that it is not in fact a form class effect; that is, the superiority of nouns linked by verbs or prepositions is not a direct function of the grammatical form class of the connective. Rather, it is claimed that the critical factor influencing the degree of joint encoding is the extent to which the connectives 'suggest items go together' (cf. Rohwer's 'prompt elaboration'). The theoretical issue arising is to clarify what is meant by saying that verb or prepositional connectives 'suggest items go together' or 'prompt elaboration'.

In Chapter V, it will be argued that a large number of studies in which the referents of to-be-associated nouns are depicted in various types of relationship (for example, in an interaction or in a spatial relationship) indicate the facilitating role for children's associative recall of suggesting (by depiction) interactivity or spatial relationships between item referents. Similarly, other studies in which actual spatial or interactive relationships between

items are manipulated suggest the considerable importance of the presence or absence of interactivity or close spatial relationships for children's subsequent associative recall. Therefore, it is suggested that connectives which promote relational encoding do so because they imply certain types of relationship (for example, close spatial relationships or interactivity) between the referents of the items they link.

The assumption is therefore that the form class effect reflects the extent to which the connectives imply certain types of relationship between item referents, rather than being a function of the grammatical form class of the connective. The expectation is, then, that by varying the extent to which a given type of connective implies a certain type of relationship, different levels of recall should be obtained. In the present studies, the degree of close spatial relationship implied by prepositions is shown to result in different levels of associative recall in children.

The implications of showing different levels of associative recall for nouns linked by connectives of the same grammatical form class as a function of the degree to which a particular relationship is implied by the connectives are several. First, the form class effect is clearly not a form class effect. Second, demonstration that it is not the grammatical form class of the connective in and of itself which produces different levels of associative recall is problematic for linguistic accounts of the form class effect. Third, if the types of relationship (implied by the connectives about item

referents) are also important in other situations in which children's associative memory is studied, some more general conclusions are suggested about the kinds of factors influencing children's associative memory. To the extent to which it is possible to conclude that children's greater tendency to encode items separately (relative to adults) is reduced by the presence of certain types of actual or implied relationships between to-be-associated items, the more general question of the thesis is also addressed. As defined in Chapter I, the specific question addressed in the thesis is why do verbs or prepositional connectives improve children's associative recall, unlike conjunction connectives. The wider question is what does the limitation of the form class effect to children, and the explanation proposed here of these phenomena, imply about children's memory processes as opposed to those of adults. The theoretical account attempts, therefore, to address both questions.

General Summary and Conclusions

Chapter II gave a preliminary overview of the main findings of the thesis and of the proposed theoretical account of the form class effect. The first major finding is that the form class effect is limited to measures of associative recall. The explanation proposed is that the form class effect reflects differences in the encoding of information relating items together in memory, and not differences in the encoding of information which enables item discrimination, and that measures of associative recall best index the encoding of

relational information. The finding presents difficulties for theories which do not specify how different types of memory information emerge in different retrieval tasks. The second finding is that interactive imagery instructions bring children's associative recall for conjunction linked nouns up to the level of verb linked nouns. The finding implies that conjunction connectives do not help children encode information relating items together in memory, and that the relational information afforded by interactive imagery instructions is sufficient to increase the degree of joint encoding of items despite the conjunction connectives. The finding also suggests the need for a processing account of the effects of both verb connectives and interactive imagery instructions.

The third finding is that separate imagery instructions reduce children's associative recall of nouns linked by verbs to the level of conjunction linked nouns. The finding implies that biasing processing towards items individually rather than in relation to others reduces the likelihood that children will be influenced by verb connectives to encode more items jointly in memory. Again, the finding for separate imagery instructions points to the need for a processing account of imagery instructions and connectives, in this case, concerning the parallel effects of conjunction connectives and separate imagery instructions. The fourth major finding is that both types of imagery instructions were ineffective for younger children. The finding raises the developmental question of what happens with age that makes older children's performance more


sensitive to instructional effects. Finally, the fifth major finding is that different types of prepositions differ in the extent to which they influence children to encode items jointly. The finding implies that the form class effect is not a form class effect and points to the need to clarify why some connectives promote relational encoding and others do not.

The theoretical account proposed distinguishes between memory for relational information and memory for item specific information. Certain other assumptions serve to clarify the expectations concerning how differences in memory organization should emerge in different retrieval tasks. One assumption is that items may be separately or jointly represented in memory. A second assumption is that if any significant part of a unit is contacted, all of the information in the unit becomes available for retrieval. A third assumption is that relational and item specific information are independent, such that whether a number of list items are represented in memory individually or jointly by single traces or units has no bearing upon the likelihood of contacting the traces at retrieval. In summary, the present view of the form class effect suggests that the effect of linking nouns with different types of connective is to produce differences in children's organization of memory, specifically in the processing of information relating the items together in memory. It is suggested that linking nouns with verbs or prepositions results in more items thus linked being jointly represented in memory than is the case for nouns linked by conjunctions, or presented without




any connective, and that such differences in the encoding of relational information should emerge in measures of associative recall.

The present view is both a processing and an organizational account, and the expectation is that other procedures which influence the degree of joint encoding should have effects in children's associative recall parallel to those of connectives. Accordingly, interactive imagery should, like verb connectives, promote the processing of relational information and joint encoding, while separate imagery should bias processing towards items individually and result in associative recall levels more like those observed for nouns linked by conjunctions. Prior studies suggest, however, that interactive imagery instructions are frequently ineffective for younger children. The present view is that such ineffectiveness of imagery instructions most probably reflects the slower development of imagery processes (after Pressley, 1982) in view of the earlier efficacy of sentence instructions, and, if so, should be true for both types of imagery instructions.

In conclusion, the present view of the form class effect is that children have considerably less tendency than adults to remember items together (that is, jointly encode them) unless the way the items are presented suggests they 'go together', or unless steps are taken to construct subjective links. The final theoretical issue arising concerns how connectives 'suggest items go together' or 'prompt elaboration'. On the basis of studies of the effects of certain types



of relationships either implied by the depiction of item referents, or actual relationships of interactivity and spatial proximity, it is suggested that the presence or absence of certain types of relationship (s) between items or their referents is important for children's relational encoding and underlies the form class effect.



III. THE FORM CLASS EFFECT IS LIMITED TO THE OVERALL LEVELS OF ASSOCIATIVE RECALL

General Introduction

Outline of Experiments 1, 2 and 3

The specific questions addressed in the first group of studies is whether the form class effect does indeed reflect differences in associative memory, as the present and other views of the effect have suggested or implied. The general research strategy used here is to examine interactions between encoding conditions and retrieval task demands (cf. Tulving & Thompson, 1973). In the present case, the effect of presenting to-be-associated nouns linked either by verbs or conjunctions is examined in two recall tasks, cued recall or free recall. In cued recall, subjects are given a list of one of the nouns in each pair and required to write down the missing associate. In free recall, subjects are not given any list cues, and are simply instructed to write down any of the nouns they can recall, in any order. The rationale for the present comparison is that, first, it is assumed that cued recall should be particularly sensitive to differences in associative memory, based upon a particular theoretical analysis of cued recall, and supporting evidence. Second, it is assumed that free recall should be less sensitive to differences in associative memory than cued recall, and in fact, based upon a particular theoretical analysis of free recall.

and prior studies, it is predicted that there should be no difference in the overall levels of free recall for nouns linked by verbs and nouns linked by conjunctions. Thus, the form class effect should not obtain in the overall levels of free recall.

Accordingly, subjects in Experiment 1(a) studied a list of to-be-associated nouns linked either by verbs or conjunctions, and they were then tested by either being required to write down the missing second noun given a list of first nouns (cued recall), or by being instructed to write down all the nouns they could recall from the list in any order on a blank sheet of paper (free recall). All comparisons were between groups. In Experiment 1(b), target nouns were also presented visually, at the same time as the nouns and linking verb or conjunction were read to the children. The change in procedure was made because of concern from Experiment 1(a), in which all material was simply presented aurally, that a large number of verbs were written down along with the nouns they linked in free recall. Since few linking conjunctions were written down, it was possible that recall levels for nouns linked by verbs might have been depressed in free recall by subjects writing out the verbs. The instructions in Experiment 1(b) stressed writing out only the visually presented target nouns, and with the revised procedure, very few verbs or conjunctions were written out in free recall. The revised procedure was also adopted in all subsequent studies (Experiments 2 - 9).

Experiment 2 was carried out to replicate the findings of

Experiment 1 using a different subject population, and a wider sample of grade levels. Also, in Experiment 2 the number of different verbs and conjunctions used to link the nouns was equated, as a control for any possible effect of the degree of semantic constraint exerted by verbs in cued and free recall. Finally, in Experiment 3, the reliability of the advantage of nouns linked by verbs over nouns linked by conjunctions in cued recall for children, and the reliability of the previously reported absence with adult subjects of any difference between verb and conjunction conditions was tested by varying the rate of presentation of list items from a few seconds to a quarter of a minute.

An organization-redintegration account of the effects of verb and conjunction connectives in cued and free recall

As outlined in Chapter II, the present account assumes, in general terms, that nouns linked by verbs are superior in cued recall to nouns linked by conjunctions because children do not remember items together (that is, encode them associatively) unless the way the items are presented suggests that they 'go together', or unless steps are taken to construct subjective links. The aspect of this account tested in Experiments 1 - 3 is that the advantage of nouns linked by verbs over nouns linked by conjunctions reflects differences in the encoding of information useful to the recalling of which items 'go together'. In other words, the present view is that the effect of verb connectives is to increase the probability that items will be remembered together; that is, linking nouns with verbs improves

memory for which nouns go together (associative memory), rather than other types of memory. Numerous recent studies have suggested that a useful way of distinguishing associative memory from other types of memory is to draw a distinction between memory for relational information and memory for item specific information, both for adults (for example, Begg, 1978a, b; 1983; Hunt & Einstein, 1981; Jacoby & Craik, 1979) and for children (for example, Ackerman & Rust-Kahl, 1982; Begg & Anderson, 1976). Relational information refers to the information shared between events and is usually conceptualized as the basis for organizing events together in memory. Item specific information refers to information which distinguished between events by emphasizing the uniqueness of a particular event. The present hypothesis stated in terms of the distinction between relational and item specific information in memory is that linking nouns with verbs increases the encoding of relational information, but has little or no effect on the encoding of item specific information. In fact, it is assumed that the two types of information are independent (see below).

Accordingly, the present view of memory for relational information is further specified by making assumptions derived from the organization-redintegration hypothesis and supporting studies proposed by Begg (for example, 1972, 1982). The organization-redintegration hypothesis has been mainly applied to account for the effects of mental imagery instructions, but it is potentially of wider generality. A central assumption about memory for relational

information is that list items are either individually represented in memory by single traces or units, or a number of items may be jointly represented in a single trace or unit. The rationale for this joint or separate view of encoding processes derives from the study of imagery processes which suggests that ". . . imagery is an effective process for organizing separate pieces of information into new meaningful ~~units~~ that mediate memory retrieval" (Begg, 1982, p. 273). For example, instructions to form an image of the referents of several items interacting in some way (such as, an image of a dog playing with a ball) is conceived of as resulting in the representation of the items ('dog', 'ball') in a single memory unit or trace. Likewise, separate imagery instructions are conceived of as resulting in the separate representation of each item by one unit or trace.

While a number of types of study provide support for the characterization of memory for relational information as joint or separate, probably the best evidence derives from the clear expectation that interactive imagery should exceed separate imagery in retrieval tasks which require the use of relational information for items that are encoded together under interactive imagery instructions, but encoded separately under separate imagery instructions. A wide variety of studies have demonstrated such an advantage for interactive imagery over separate imagery in recall tasks requiring the recall of the associate(s) of items (Bower, 1970; Begg, 1973; 1978a; 1979; Begg & Anderson, 1976; Dempster & Rohwer,

1974; Winograd & Lynn, 1979). Similarly, recall measures which depend on interitem association also should be influenced by interactive or separate imagery conditions. Thus, in free recall, interactive imagery should result in the recall of longer strings of contiguously studied items (for example, Begg, 1978a; Morris & Stevens, 1973). Interactive imagery thus benefits both memory tasks and measures that depend on interitem associations.

The present view of the form class effect may then be restated as follows. Children have a greater tendency than adults to encode items separately (or, as it is more usually stated, adults have a greater tendency than children to associate items spontaneously, perhaps because adults have greater 'elaborative propensity', 'event knowledge', have acquired memorial strategies or learned more about memory, 'metamemorial knowledge'). However, if the way to-be-associated items are presented suggests (or 'prompts' in Rohwer's terms) relational encoding, children will encode more relational information and encode more items jointly. Thus, if nouns are presented linked by verbs or prepositions, children will encode more information relating the items together in memory and hence the probability of joint encoding is increased. In contrast, linking nouns with conjunctions leads to no greater encoding of relational information than presenting the to-be-associated nouns alone without any 'connective'. If a list of noun pairs is presented with either a verb or conjunction linking the nouns in each pair, as in Experiments 1 - 3, the list should be represented in the verb condition by fewer

memory units, but these units should, on the average, represent more items than in the conjunction condition.

A second assumption made here is that relational or associative information is independent of information that enables item discrimination. Put crudely, it is assumed that the information that enables remembering which items 'go together' is independent of the information which enables remembering which particular items were presented, or, more precisely, ". . . the simple fact that items are encoded interactively does not provide any information about the likelihood that those traces will be contacted" (Begg, 1982, p. 275). Support for the assumption that relational and item specific information are independent is provided by studies comparing the effects of interactive or separate imagery on measures of recall in which relational information can be assumed to be less important than item specific information. Thus, while differences in cued recall reliably emerge as a function of imagery instructions as noted above, the general finding is that the two types of imagery instructions do not differ in the overall levels of free recall (see above), or in the likelihood of item recognition (Dempster & Rohwer, 1974).

Where differences in free recall levels have been found as a function of imagery instructions (Morris & Stevens, 1973) there is good reason to believe that this difference reflected the formation of higher level units of organization in the interactive imagery condition (specifically, due to a failure to instruct subjects to keep images clearly distinct from one another, see Begg, 1978a).

Thus, comparisons of the effects of imagery instructions upon recall tasks assumed to rely mostly on relational information, versus those recall tasks assumed to rest upon greater use of item specific information have supported the claim that the two types of information are independent in that the two types of imagery instructions appear to differ only in the amount of relational information encoded. Similarly, the present view is that verb and conjunction conditions differ only in the amount of relational information encoded.

A third major assumption of the present view derived from the organization-redintegration hypothesis is that memory traces or units are in some sense whole or integrated such that, if any significant part of a unit is accessed during retrieval, the rest of the information in the unit becomes available (the principle of 'redintegration', for example see Begg, 1972, 1982). Implicit in the organization-redintegration account is the assumption that retrieval is a staged process (cf. Martin, 1967), in which units are (i) contacted, (ii) redintegrated and (iii) verbally decoded. The general assumption of the organization-redintegration account and other organizational theories of memory is that memory organization becomes clear in retrieval, so that different retrieval tasks reflect different types of organization in different ways. The assumption that memory organization becomes clear in retrieval is, as noted, the rationale for the studies in the present chapter.

Various predictions may be derived about how the hypothesised differences in organization for nouns linked by verbs and nouns

linked by conjunctions should emerge in different retrieval tasks.

In (simple) recognition tasks, subjects are required to decide whether or not items presented at test were in a previously studied list.

Performance on such simple recognition tasks should be related primarily to the extent to which item specific information has been encoded (and factors governing item discriminability) rather than associative memory, since trace contact alone could be sufficient for a positive response, and the need for the reintegration of the unit is minimal (see Begg, 1978a). In the present view, the form class effect is primarily an effect in associative memory and not in the encoding of item specific information. Accordingly, linking nouns with verbs should not lead to superior simple recognition of which items were presented, which is in fact the case (Lynch & Rohwer, 1971, Experiment II). However, if one noun in a pair is presented as a cue, and the subject's task is to recognize which item goes with it (from a list of items), it might be expected that memory for relational information should play a greater role. The form class effect should then, in the present view, be expected to emerge in such cued recognition tasks, and such has been observed (for example, Davidson, 1964; Davidson & Dollinger, 1969; Lynch & Rohwer, 1971, Experiment I; Rohwer & Lynch, 1966).

Similarly, cued recall should also reflect differences in organization (that is, in the encoding of relational information). After Begg (1978a), cued recall is conceptualized as involving three stages, (i) recognition of the presented item, (ii)

redintegration of the entire unit and (iii), verbal decoding of the response. In this view, contact will be reflected by cue recognition, and redintegration and decoding by measures of recall given cue recognition. Since it is assumed that cue recognition is equally good following sentence context or conjunctive phrase context, equal numbers of traces should be contacted in both conditions. Therefore, since "... no item can successfully cue another unless the two are encoded as a single unit" (Begg, 1978a, p. 176), cued recall of nouns linked by verbs should be superior to cued recall of nouns linked by conjunctions. Thus the cued recall procedure equates the number of units contacted and so given this "... the condition with the larger units produces superior recall" (Begg, 1978a).

This is not the case, however, in free recall. The most obvious expectation concerning free recall is perhaps that the total number of words recalled would be greater for pairs linked by verbs. However, as Begg (1978a) noted for interactive versus separate imagery comparisons, expecting joint encoding conditions to result in better free recall rests on the assumption that the same number of units are available for recall under joint and separate encoding conditions. If this were the case, recognition scores should be better under joint than separate encoding (because the units, on the average, represent more items). As noted before, equivalent levels of simple recognition are observed for verb linked nouns and conjunction linked nouns. The implication of the simple recognition finding in terms of the present theory is therefore that there are

more units available for recall in the conjunction than in the verb condition. Moreover, it is assumed that item contact will be independent of unit size (that is, organization). Hence, while more units should be contacted following presentation in conjunctive phrases, these units will be of smaller size (represent fewer items) than after sentence context. Therefore, in the overall levels of free recall, there should be a tradeoff between the number of units contacted and their size such that the overall levels of items retrieved in free recall should be roughly equivalent for both types of presentation context. Thus, in the present studies, the expectation is that nouns linked by conjunctions and nouns linked by verbs will lead to equivalent levels of free recall.

Studies derived from the organization-redintegration hypothesis have mostly compared the effects of instructions to form interactive or separate images of the to-be-associated items. The assumption is that interactive imagery instructions elicit joint encoding of items. As noted, the results obtained for adults are consistent with the predictions of the hypothesis. While the superiority of interactive images emerges in cued recall, in free recall both types of imagery instructions have been found to lead to roughly equivalent overall levels of recall in terms of the numbers of items recalled (Begg, 1978a). In addition, a different pattern of results is observed in free recall protocols under the two types of imagery instructions. Such protocols usually consist of a number of sequences with items from a given unit recalled

contiguously. If it is assumed that the number of sequences reflects contact, and the length of sequences reflects unit size, then fewer but longer sequences should be found after interactive imagery instructions than after separate imagery instructions, as is the case (Begg, 1978a, Expts. III and IV).

The predictions of the theory have not been as well confirmed with younger children, however. This may be because imagery instructions are ineffective with younger children, particularly for word items, as Pressley (1982) has suggested, and may, as he suggests, be due to slower development of imagery processes (see below). The probable reasons for these difficulties are reviewed in Chapter IV, in which explicit comparisons of the effects of linking nouns with verbs or conjunctions and imagery instructions are made. For the present, it is sufficient to note that reliable effects of connective form class (rather than imagery instructions) may be expected across the age range studied on the basis of previous studies of the form class effect.

Expectations based on other accounts of the form class effect

Elaboration accounts. Other accounts of the form class effect, such as the elaboration hypothesis, both in its earlier statements in terms of imagery or in terms of deep structure, and the later elaboration position, would make the same predictions as the present account for cued recall. However, none of the elaboration accounts provide clear predictions about what

should be expected in free recall for nouns linked by verbs and nouns linked by conjunctions. In terms of the deep structure account, Suzuki & Rohwer (1969) suggested that, if two words occur in the same underlying string, it is a more 'direct' process for one word to be used in retrieving the other than if the words occur in different underlying strings. Therefore, the deep structure account implies that the superiority of verb linked nouns should emerge in cued recall. Similarly, if verbs evoke "dynamic, action images" of the referents of the nouns they link, (Rohwer, 1970), given that imagery is an encoding process, nouns linked by verbs might be expected to be better remembered together than nouns linked by conjunctions, which give rise to "... a static image of two objects arrayed side by side". Finally, if verbs act as 'prompts for elaboration' (Rohwer, 1973), and elaboration consists in "... the formation of an episode, process or relation involving the to-be-associated items" (Rohwer, 1970, p. 5), then verb connectives should lead to superior associative recall than for nouns linked by conjunctions which do not prompt elaboration. In fact, the present account to this point is not much different from the later elaboration account in hypothesising that verbs 'suggest' relational encoding, while in Rohwer's terminology, verbs 'prompt elaboration'. In both cases, it should be noted that it is assumed that children have less tendency than adults to encode items relationally unless 'prompted'.

The problem for the various elaboration accounts is, however, that the expectations for free recall are not very clear. Least

clear are the expectations on the basis of the imagery hypothesis. Since Rohwer suggested that it is 'intuitively obvious' that the hypothesised, dynamic action images evoked by nouns linked by verbs are more 'memorable' than the static, side by side images of the referents of nouns linked by conjunctions, it is unclear whether this greater 'memorability' should be limited to cued recall, or also found in free recall. For the deep structure account and the later elaboration position, the expectations are clearer in that both are formulated in terms of the degree to which items are jointly represented. Thus, to the extent to which joint or separate representation of items in semantic deep structure may be identified with joint or separate representation of the items in memory, it would seem that the form class effect should emerge most clearly in measures of associative recall. Similarly, if items are more elaborated in memory if they are presented linked by verbs than by conjunctions, and elaboration refers to the degree of relational encoding, then the effects of verb connectives should emerge more clearly in the overall levels of cued recall, and less clearly in measures less sensitive to associative memory such as the overall level of free recall. The basic problem for the various elaboration accounts is essentially that they do not clearly distinguish between memory for relational information and memory for item specific information and how different sorts of information underlie different retention measures. If it is assumed, however, that they are basically organizational accounts (that is concerned with memory for

relational information), then the expectation is clearly that the superiority of nouns linked by verbs over nouns linked by conjunctions should emerge most clearly in associative recall.

However, it is still unclear on the basis of the elaboration accounts exactly what should be expected in a comparison of the overall levels of cued and free recall without making further assumptions. In the present account, it is assumed that the probability of trace contact does not depend on the size of the unit (the number of items represented by the unit), and that item discriminative information is independent of relational information. Second, it is assumed that more traces are likely to be contacted as the number of traces encoded increases (that is, more traces should be encoded for nouns linked by conjunctions). Third, the present account assumes redintegration of units (that is, if any significant part of the trace is contacted the entire unit is redintegrated and becomes available for verbal decoding). Consequently, the present account predicts equal levels of free recall for nouns linked by verbs and nouns linked by conjunctions, because of the above noted tradeoff between the number of units contacted and their size. In contrast, the various elaboration accounts do not clearly predict whether free recall levels in verb and conjunction conditions should be equivalent or worse for nouns linked by conjunctions than for verb linked nouns (see, for example, Rohwer & Roth, personal communication).


Ackerman's account. It has been argued above that Ackerman's (1982a) suggestion that children fail to jointly encode items as much as adults because they tend to access the semantic system in terms of individual items might be applied to account for the form class effect. Thus, linking verbs might increase relational encoding because they increase the probability of accessing the semantic system for more than one item at a time. The only difficulty with this extension of Ackerman's analysis is that it is contradictory to the assumption made by Ackerman that some procedure designed to increase the amount of semantic processing performed on items at input by children is required for any significant degree of joint encoding. Thus, Ackerman assumed that 'integration instructions' (rating the probability of occurrence of the event described by sentences) are required for interitem integration to occur. Contrary to Ackerman's view, the present account of the form class effect suggests that linking verbs are sufficient to promote joint encoding without integration instructions.

Thus, Ackerman's hypothesis about children's relational encoding is consistent with the present view in suggesting that children tend to encode items separately more than adults, but the present view suggests that if the material suggests a particular relationship between items, this is sufficient to promote relational encoding without the need for integration instructions. In fact, the rationale for Ackerman's assumption that integration instructions (or other procedures designed to induce semantic processing) are


necessary, seems to rest largely upon the numerous studies which showed that children's recall is much improved by procedures designed to increase semantic processing (for example, Geis & Hall, 1976). The difficulty with an interpretation of induced processing studies from the present view is that many such studies did not clearly distinguish between the effects of semantic processing on memory for relational and memory for item specific information. Although Ackerman did himself draw such a distinction (for example, Ackerman & Rust-Kahl, 1982), he did not assume that the two types of information are independent. From the present point of view, what is important for associative recall is whether a procedure results in increased processing of relational information, rather than any kind of information. Hence, if the material is presented in such a way as to elicit more processing of relational information, for example if nouns are linked by verbs or if instructions encourage processing resulting in the formation of subjective links, joint encoding by children should be increased. In short, Ackerman's (1982a) account is applied here as an explanation of the form class effect in a modified form, namely that it is assumed that linking verbs may promote relational encoding as much as 'integration instructions'. The present studies therefore also provide a test of Ackerman's assumption that integration instructions are essential and that linking verbs result in little joint encoding.

Previous studies

In two previous studies, the effects of linking nouns with



verbs or conjunctions were compared in cued or free recall. The results of these studies contradict the present predictions. Rohwer and Suzuki (1970) compared the cued and free recall of whole strings of nouns linked by verbs or conjunctions. They found that the verb condition exceeded the conjunction condition in free recall as well as in cued recall. Rohwer and Roth also examined cued and free recall of strings of five nouns, with sentences (linking all five of the nouns in a string), or pictures of the referents of all five nouns interacting versus conjunction and side by side depiction controls. Again differences in the overall levels of item recall were found in both cued and free recall, contradicting the present predictions. Both the sentence and interactive picture condition showed larger measures of chunking in free recall than the other two conditions, however, in line with the present expectations. The problem with both of these studies is, unfortunately, that subjects were informed as to the nature of the recall task before list learning, thus confounding possible learning strategies with the recall test. The difficulty is that prior knowledge of the recall conditions may have led to higher level relational encoding (cf. the differences obtained with imagery instructions in free recall levels in the Morris and Stevens (1973) study when subjects were not clearly instructed to keep images distinct from one another, see above). Since these studies also lack any controls for higher level unitization, it is unclear whether or not such unitization accounts for the findings.



Finally, Kee and Rohwer (1973) compared performance in cued and free recall for nouns linked by prepositions (rather than verbs). In free recall, prepositions were found to produce no better overall levels of item recall than conjunctions, which is consistent with the present hypothesis. Whether similar results would be obtained for nouns linked by verbs is still an open question, since the effect of linking prepositions has sometimes been significantly less than that of verbs even in cued recall (for example, Rohwer, Lynch, Levin & Suzuki, 1967).

Experiment 1

The assumption is thus that linking nouns with verbs has the effect of increasing the probability of joint encoding in a single integrated unit of the to-be-associated items. The first prediction tested is that the superiority of sentence context over conjunctive phrase context should be manifested in the overall level of cued recall, but not in the overall levels of free recall. This prediction was tested in Experiment 1, using two different methods of presentation and two different subject populations. In Experiment 1(a) all material, that is sentences or conjunctive phrases, was presented simply by the experimenter reading the list aloud. However, it was not found to be possible to instruct the children successfully to write down only the target nouns using this procedure in the free recall test. Particularly in the verb condition, children tended to write down the entire sentence including the verb, while the tendency to write out the conjunction was much less for conjunctive phrases. Since the cued recall condition simply required writing down the second noun, it was felt that lack of a difference between sentence and conjunctive phrase conditions in free recall might simply be due to wasting time writing out the sentences in free recall. Therefore, in Experiment 1(b), nouns were also presented visually while the context was read aloud by the experimenter, the same procedure used by Rohwer in most of his studies. Using this procedure, it was possible to instruct the children at test to write down only the nouns in free recall. Thus, in Experiment 1, children's recall

of pairs of nouns presented either in a sentence or conjunctive phrase context was compared either with or without cues.

Method

Design and materials. In a between-groups design, subjects learned a single list of 14 pairs of nouns presented either in the context of sentences or conjunctive phrases, followed by either cued or free recall. The sentences and the conjunctive phrases differed only in the connective linking the two nouns (table 9, page 225). All words were drawn from a grade 2 word list. Nouns were paired at random, and apart from the restriction that all sentences be meaningful, assignment of verbs and conjunctions to noun pairs was random.

Subjects. In the aural study, a total of 68 subjects was drawn from a single parochial school serving a predominantly middle socio-economic status suburban population. From the total within grade population, equal numbers of males and females were selected at random, to a total of 32 grade 3 and 36 grade 6 subjects.

In the visual study, a total of 120 subjects was drawn from a single parochial school, serving a mainly middle socio-economic status urban population. Forty children at each of grades 3, 6 and 8 were drawn at random from the total within grade populations, with equal numbers of males and females at each grade level.

Procedure

Within each grade, equal numbers of subjects were assigned to each treatment group. All subjects in a given group were tested simultaneously. The order of testing of each group was determined by alternating grade and counterbalancing the other two factors.

After rapport had been established, pair learning instructions were given. These instructions emphasized remembering (i) the nouns and (ii) which two nouns went together (Appendix II). No information was given to indicate the nature of the recall test. A practice list of 3 pairs was presented, with the appropriate sentence or conjunctive phrase, but recall was not required.

After ensuring that all subjects understood the instructions, the study list was presented. In Experiment 1(a), sentences or conjunctive phrases were read aloud to the subject. Each sentence or conjunctive phrase was read twice successively during a 10 sec. period. In Experiment 1(b), sentences or conjunctive phrases were read once during a 5 sec. period, while the two nouns were concurrently presented visually via a slide projector. The study trial was followed by instructions to recall the list in writing during a 5 min. time period. In the cued-recall condition, subjects were asked to fill in the missing second noun in a printed list of sentences/conjunctive phrases. In the free-recall condition, subjects were instructed to write down all pairs of nouns they could remember, and also any single nouns, in any order on a blank sheet.

Results and discussion

Recall of second nouns. The mean numbers of second nouns recalled for each treatment group are shown in table 1 for Experiments 1(a) and 1(b) respectively. The same pattern of results was obtained in both studies. The critical prediction is that verb connectives should facilitate recall relative to the conjunction control condition if cues are made available to the subject but not in free recall. In cued recall, every comparison in table 1 shows that the mean number of second nouns recalled with verb connectives is greater than in the comparable conjunction control condition. Such is not the case in free recall: in no comparison is the mean for the group learning with verb connectives greater than the mean for the comparable conjunction control condition. Comparison of the mean number of second nouns recalled when cues are made available to the subject versus the comparable experimental group when free recall was required indicates that, in almost all comparisons, the mean for cued recall was greater than the mean for free recall. Thus, cued recall of second nouns exceeded free recall. Performance also clearly improved with grade level, and sentence context was clearly superior to conjunctive phrase context in cued recall at all grade levels. There is no evidence for any attenuation of the form class effect across the age range studied.

TABLE 1

MEAN NUMBER OF SECOND NOUNS RECALLED AS A FUNCTION OF MODALITY OF PRESENTATION, GRADE, CUEING AND TYPE OF CONNECTIVE IN EXPERIMENT 1

	Cued Recall		Free Recall	
	Conjunction	Verb	Conjunction	Verb
Aural Presentation				
Grade 3	4.3	6.0	3.5	2.6
Grade 6	6.4	8.1	5.1	5.1
Visual Presentation				
Grade 3	7.1	8.4	4.8	2.5
Grade 6	5.3	9.9	6.2	5.5
Grade 8	9.3	12.3	7.2	6.2

NOTE: All means are the number of second nouns recalled out of a possible 14. Standard deviations range from 0.5 to 3.8.

The results suggested by inspection of table 2 are fully supported by a $2 \times 2 \times 2$ unweighted means analysis of variance of the data from Experiment 1(a) and a $2 \times 2 \times 3$ factorial analysis of variance for Experiment 1(b). These analyses compared the effect of connective (verb or conjunction), recall mode (cued or free) and grade level (3 and 6 for the first study, and grades 3, 6 and 8 for the second). With α set at .05, cued recall exceeded free recall of second nouns in both studies, $F(1,60) = 16.0$, and $F(1,108) = 59.6$, respectively. Performance improved with grade, $F(1,60) = 16.2$, and $F(2,108) = 17.4$, respectively. The critical

interaction of recall mode and type of connective also attained significance in both studies, $F(1,60) = 4.2$, and $F(1,108) = 12.5$. For the aural study, cued recall with verb connectives exceeded the other three conditions, which did not differ from themselves by a Newman-Keuls test. In the visual study, cued recall with verb connectives exceeded the other three conditions, which did not differ from themselves by a Newman-Keuls test. In the visual study, cued recall with verb connectives exceeded the other groups, while free recall with conjunction connectives exceeded free recall with verb connectives.

Free recall of pairs. Free recall performance was also analyzed in terms of the numbers of pairs correctly recalled in each treatment group. The mean number of pairs correctly recalled in the aural study, for conjunction and verb conditions, were 2.5 ($\sigma = .76$) versus 2.0 ($\sigma = 1.07$) at grade 3, and at grade 6, 3.5 ($\sigma = 2.46$) versus 4.9 ($\sigma = 2.20$). In the visual study, the group means were 4.7 ($\sigma = 2.6$) versus 2.3 ($\sigma = 1.3$), 5.2 ($\sigma = 2.7$) versus 5.0 ($\sigma = 0.8$), and 6.4 ($\sigma = 2.5$) versus 5.6 ($\sigma = 1.7$), for grades 3, 6 and 8. Thus in four out of five comparisons of free recall of pairs, means for the conjunction condition exceed those for the verb condition. As in the free recall of second nouns, free recall of pairs does not suggest any superiority in the verb condition. In fact in a 2×2 unweighted means analysis of variance of the number of pairs recalled in the first study and a 2×3 factorial analysis of variance of the second study data, the only

effect to attain significance was that of grade, $F(1,30) = 10.0$, and $F(2,54) = 7.5$.

Conditional probabilities. Conditional probabilities of recall of the other item in a pair given recall of one item were also calculated for (i) left noun given recall of the right, (ii) right noun given recall of the left, (iii) combining the two. No clear patterns are present in these data and the only effect to attain significance was in Experiment I (a), in which left nouns were better cues for right noun recall than the reverse, $F(1,30) = 4.4$.

The results of the visual study thus exactly replicate those of the aural study in spite of the differences in the method of presentation and the populations sampled. As predicted, verb connectives clearly led to superior levels of cued recall than found with conjunction connectives, but this effect is not found in free recall. In free recall, verb connectives do not lead to higher levels of recall than conjunction connectives.

Experiment 2

Experiment 2 was a parametric replication of Experiment 1 to control for the slight possibility that differences in the total numbers of different verbs (fourteen) and the total number of different conjunctions (two) used in the lists might favor the sentence condition in cued recall, especially because the cues were the context less the second noun (that is, included the verb or conjunction). Rohwer and Lynch (1967) tested exactly this possibility and found that even when the number of different verbs and conjunctions were equated within lists, verbs still led to superior cued recall compared with conjunctions. However, the Rohwer & Lynch study did not include a free recall condition, making it difficult to assess the extent to which the effect is associated with the cues. Thus, Experiment 2 was a replication of Experiment 1, except that the number of different verbs and conjunctions used as connectives was equated within the list.

Method

Design and materials. In a between groups design, subjects learned a single list of 12 pairs of nouns linked either by the same verb phrase (verb plus preposition, i.e. "plays with"), or the same conjunction ("and"). The 24 nouns were selected from a Grade 2 word list and randomly paired, except for the constraint that the first noun be animate and the second inanimate (table 10, page 226).

Subjects. A sample of 176 children was drawn from an urban

parochial school in a predominately middle socio-economic status area. Forty-four children were selected at random with equal numbers of males and females from the total within grade population at grades 2, 3, 6 and 8.

Procedure

Eleven subjects at each grade level were assigned at random to each of the four treatment groups. The procedure was the same as in the visual study of Experiment 1, except that the presentation rate was 8 sec. Thus, after rapport had been established, three practice pairs were presented and discussed with the children. Pairs of nouns appeared on the screen for 8 sec., during which time either sentences of the form "The duck plays with the ball" or conjunctive phrases of the form "The duck and the ball" were read aloud. Following presentation of the list, children were tested by either cued or free recall. In cued recall, the children were asked to fill in the missing second noun in a printed list of the sentences or conjunctive phrases. In free recall, the children were asked to write down all pairs of nouns they could remember in any order, and any single nouns, on a blank sheet. Again, 5 minutes were allowed for each recall task.

Results and discussion

The mean number of second nouns recalled are shown in table 2. It is clear from this table that the verb condition exceeded the conjunction condition at all grade levels in cued recall, but not

in free recall. The presence of cues enhanced recall in the verb condition by an average of 2.4 items, and hurt recall in the conjunction condition by an average of .6 items.

TABLE 2

MEAN NUMBER OF SECOND NOUNS RECALLED AS A FUNCTION OF GRADE, CUEING AND TYPE OF CONNECTIVE IN EXPERIMENT 2

	Cued Recall		Free Recall	
	Conjunction	Verb	Conjunction	Verb
Grade 2	1.5	2.7	2.4	1.5
Grade 3	3.7	7.0	3.9	3.2
Grade 6	4.8	7.1	5.1	4.1
Grade 8	4.5	6.3	5.3	4.7

NOTE: All means are the number of second nouns recalled out of a total of 12. Standard deviations range from 1.0 to 3.2.

The results suggested by an inspection of table 2 are supported by the results of a $2 \times 2 \times 4$ factorial analysis of variance. This analysis compared the effect of Connective (verb versus conjunction), Recall Mode (cued versus free) and grade Level (2, 3, 6 or 8). The main effects of Connective, $F(1,160)=5.31$, Recall Mode, $F(1,160)=10.5$, and Grade Level, $F(3,160)=27.2$, and the interaction of Recall Mode and Type of Connective, $F(1,60)=25.4$, were all reliable. By a Newman-Keuls test, cued recall with verb connectives exceeded the other three conditions, which did not differ.

Overall, Experiment 2 therefore replicates the results of

Experiment 1. A sentence context leads to superior cued recall performance, compared to a conjunctive phrase. This effect is not found in free recall, as predicted on the basis of the organization-redintegration hypothesis. Furthermore, this pattern is not attributable to more information being present because more verbs than conjunctions have been used as connectives within a list. The facilitation in cued recall irrespective of the number of connectives used, reported by Rohwer and Lynch (1967), is thus replicated. In addition, since all pairings were random, with all second nouns being inanimate object names, it is unlikely that the verb phrase exerted any different semantic constraint on possible response nouns than the conjunction. These results are consistent with the results of Rohwer and Lynch (1966) and Rohwer, Shuel and Levin (1967) who investigated and rejected the constraint hypothesis.

Experiment 3

In Experiment 3, the presentation rate of items was varied. The expectation was that, if the lack of a form class effect in adults is due to spontaneous elaboration or the use of voluntary, conscious memorial strategies, faster rates of presentation might produce a form class effect by preventing the use of such strategies. Adult subjects and children were therefore included, and only cued recall studied.

Method

Materials and design. Materials were identical to those used in Experiment 1. In a between-groups design, pairs of nouns were presented in sentence or conjunctive phrase context at three rates of presentation.

Subjects. The children were all grade 6. A sample of 54 children was drawn at random from the total within grade population of two parochial schools serving an urban lower socio-economic status population, and a second sample of 36 children from two parochial schools serving a suburban middle socio-economic status population. The adults were 42 introductory psychology students paid \$2.00 per hour. At each age level, there were equal numbers of males and females.

Procedure

Pairs of nouns were presented on a screen while either a sentence or a conjunctive phrase was read aloud. Three presentation rates were used: 1.5, 5 or 15 sec. (total slide to slide time).

Following the single study trial, 5 minutes was allowed for cued recall. Other aspects of the procedure are the same as in Experiment 1.

Results and discussion

The mean number of second nouns recalled is shown in table 3. Not surprisingly, performance grows worse at faster presentation rates. The verb connective condition was superior to the conjunction condition for the children, as usual, although there is a slight tendency with children for the difference between the verb and conjunction conditions to increase at slower presentation rates.

TABLE 3

MEAN NUMBER OF SECOND NOUNS RECALLED IN CUED RECALL FOR ADULTS AND CHILDREN AS A FUNCTION OF TYPE OF CONNECTIVE AND PRESENTATION RATE IN EXPERIMENT 3

	1.5 sec./pair		5 sec./pair		15 sec./pair	
	Conj.	Verb	Conj.	Verb	Conj.	Verb
Grade 6	4.5	5.8	8.3	10.6	7.8	11.3
Adult	5.7	6.7	12.1	11.3	12.1	10.6

NOTE: All means are the number of second nouns recalled out of a possible total of 14. Standard deviations range from 1.6 to 2.9.

There is also a suggestion that a difference might be developing for adults between the two conditions at the fastest presentation rate, but this again is slight. In a $2 \times 2 \times 3$ analysis of variance, the only effects to attain significance were those of Presentation Rate,

$F(2,84)=29.1$, and $F(2,36)=35.7$ and the effective of Connective for children, $F(1,84)=18.5$. Since the presentation rate could not be made any faster, this pilot study was not followed up.

General Discussion and Conclusions

Overall, it would seem that the central prediction of the first group of studies is clearly confirmed. If a list of pairs of nouns is studied with the nouns in each pair linked by verbs or conjunctions, the verb condition leads to higher levels of recall than the conjunction condition in cued recall, that is, when the first noun in each pair is presented as a cue and the task is to recall the second noun. However, if the recall task is simply to write down all the nouns from the list in any order which can be recalled without any cues, the overall levels of such free recall do not differ for nouns linked by verbs and nouns linked by conjunctions. Thus, the form class effect is found in cued recall, but not in the overall level of free recall. Experiments 1-3 confirm ~~this prediction~~ across a number of different subject populations and presentation methods, irrespective of whether the number of different verbs and conjunctions used to link nouns within a list is, or is not, equated. These results thus support Kee and Rohwer's (1974) finding that the effect of connective form class is limited to cued recall, and not found in free recall, and extend these conclusions to include nouns linked by verbs as well as nouns linked by prepositions compared with nouns linked by

conjunctions.

The present results are thus consistent with the view that the effect of linking nouns with verbs is upon memory for relational information; that is, verb connectives promote the encoding of information relating together the nouns they link in memory, such that verb linked nouns are more likely to be encoded as single units in memory than nouns linked by conjunctions, or nouns presented without any linking connective. The present data also contradict the finding of superiority in free recall of nouns linked by verbs over nouns linked by conjunctions in studies where the subjects had prior knowledge of the recall task at the time of studying the list (Rohwer & Roth, unpub.; Rohwer & Suzuki, 1968). In view of Begg's (1978a) demonstration of the memory role of the formation of higher order units (linking together several groups of items), and the lack of any controls for higher order unitization in the Rohwer and Roth and Rohwer and Suzuki studies, it would seem a good possibility that higher order unitization may account for the form class effect observed in free recall in the latter studies. Thus, given prior knowledge that free recall was to be required, children may have linked together enough of the strings of nouns joined by verbs to produce verb superiority in free recall.

Several problems do, however, arise with the present data. Begg and Anderson (1976) were able to show significant effects of imagery instructions upon organizational measures in free recall, while there were no significant differences as a function of verb

or conjunction connectives in pair recall or conditional probabilities in Experiments 1 or 2. One possibility is that linking nouns with verbs may be somewhat less powerful than imagery instructions in promoting joint encoding, so that imagery instructions are more likely to produce differences in organizational measures. Such an interpretation of the failure of verb connectives to produce differences in organizational measures in free recall is suggested by several lines of evidence. If the effects of verb connectives upon relational encoding are somewhat weaker than, for example, the effects of imagery instructions, then conditions under which the effects of verb connectives are maximised should produce organizational effects. One way to increase the possible range of organizational effects is to increase the number of items to be represented in one unit. Rohwer and Roth did find organizational effects, as a function of connective form class, in free recall for strings of nouns, although they also found differences in the overall levels of free recall as a function of the type of connective. From the logic of the present analysis, however, the occurrence of the form class effect in the overall levels of free recall reflects higher order unitization, while the organizational measures refer to measures of association within strings. Since, however, the Rohwer and Roth study lacks any controls for higher order unitization, that is measures of association between strings, it is not possible to be certain that organizational effects would appear in free

recall as a function of the type of connective, even when whole strings are linked by verbs when they do not appear in the overall levels of free recall.

A second way of making the effects of linking nouns with verbs more optimal for unitization so that they might appear in measures of association in free recall would be to combine the effects of linking nouns with verbs with other procedures which, from the present view, should promote joint encoding. Kee and Rohwer found that neither linking nouns with prepositions nor depicting their referents interacting produced organizational effects in free recall, although both produced better cued recall than conjunction or side by side depiction. However, when the effects of interactive depiction and prepositional connectives were combined, organizational effects were observed in free recall. Similar results will be shown for a combination of interactive imagery instructions and linking nouns with verbs below (Experiment 4).

Begg and Anderson found that overall cued recall was poorer than free recall for children, contradicting the usual pattern of cued recall superiority shown by adults. They therefore concluded that cueing hurts children's recall. These results are discussed at length below, but for the present it is sufficient to note that there is no evidence from Experiments 1 and 2 that cueing hurt children's recall. In the present studies, cued recall reliably exceeded free recall (of second nouns). Similarly, in the Kee and Rohwer study,

cued recall overall reliably exceeded free recall. These data, therefore, do not support Begg and Anderson's suggestion that children may have difficulty accessing traces from cues, and this suggestion does not explain why cued recall levels in the Begg and Anderson control condition were so poor in comparison to cued recall levels in the conjunction condition of Experiments 1 and 2 here and Kee and Rohwer's study, since cued recall of nouns linked by conjunctions has not been reported to differ from cued recall of nouns presented without any linking connective (for example, Rohwer, 1964). In the Begg and Anderson study, however, cues were left hand nouns only, while the cues in Experiments 1-3 were whole sentences less target nouns (or phrases less target) and difference in cue size might provide an explanation of the discrepancy between the two sets of findings. Whether or not whole sentences less target nouns lead to better recall than left noun cues is, however, far from established. (see below, discussion of Ackerman's 1982a study, also Experiment 7).

Nevertheless, the central prediction of the present studies is clearly and unequivocally supported by the data. While the superiority of nouns linked by verbs over conjunction linked nouns emerges clearly in cued recall, no such difference is found in the overall levels of free recall. Moreover, as predicted, the overall levels of free recall for nouns linked by verbs and nouns linked by conjunctions do not differ significantly in free recall. The results of Experiment 2 are also consistent with the findings of Experiment 1. However, tables 2 and 4 indicate that

the superiority of nouns linked by verbs over conjunction linked nouns is rather less in Experiment 2 than in Experiment 1 in cued recall. Relatively poorer cued recall in the verb condition in Experiment 2 might be interpreted as suggesting that intralist similarity may play some small role and/or accessing traces from the cues is relatively harder when all the connectives are identical. Since these data came from different subject populations, however, these observations are very tentative.

Thus consistent with the findings of Rohwer and Lynch (1967), even with the number of different verbs and conjunctions used in the list equated, verb superiority over conjunctions is still found in cued recall, and this effect is not found in free recall, as shown in Experiment 1. In addition, since all pairings were random, with all first nouns being animate and all second nouns inanimate, so that any first noun could be meaningfully combined with any second noun, it is unlikely that the linking verbs exerted any more semantic constraint on possible response nouns on the test trial than the linking conjunctions. These data are consistent with the results of Rohwer and Lynch (1966) and Rohwer, Shuell and Levin (1967) who investigated and rejected the constraint hypothesis.

Thus the results of Experiments 1-3 indicate that the advantage for verbs over conjunctions holds only for associative recall, not for free recall. These results extend the previously noted observation that the advantage for verbs over conjunctions holds only in cued recognition and is not found in simple recognition

tasks. The difficulty arising for the various elaboration accounts, including the deep structure hypothesis, the imagery hypothesis and the later elaboration position, is that the explanation of the finding requires a distinction between relational information (indexed by associative recall) and item information (indexed by free recall or simple recognition). The finding poses problems for the various elaboration accounts because they do not specify different sorts of memory information underlying different retention measures. Specifically, while the occurrence of the form class effect in cued recall or cued recognition is consistent with the various elaboration accounts, it is not clear what the expectations should be for free recall (or simple recognition tasks). Thus, even if the elaboration accounts are interpreted as concerning memory for relational information, it is still unclear as to exactly what pattern should be expected in free recall for nouns linked by verbs or conjunctions. The lack of clarity about the expectations for free recall is exemplified by the Rohwer and Roth study, in which both the lack of any difference between verb and conjunction conditions in free recall is predicted, a difference found contrary to the predictions, and the difference also accounted for on the basis of the elaboration position.

With regard to Ackerman's (1982a) suggestion that children are less able than adults to relate items together in tightly integrated memory units because the former tend to access the semantic system in terms of single list items, the present results

would seem consistent with the suggested view of children's associative memory, but inconsistent with the results of the study. Ackerman concluded that presentation of to-be-associated nouns in a sentence context was insufficient to integrate (jointly encode) items so linked. Integration, or joint encoding, as indexed by the congruity effect (differences in recall as a function of the incongruousness of the sentences) and by the difference between one word and whole sentence less missing associate as cues, was much greater when subjects rated the likelihood of the event described by the sentence, compared with reading the sentence and repeating it aloud. At face value, these data contradict the present claim that linking nouns with verbs promotes joint (that is, integrated) encoding of the nouns.

However, as already noted, the effects of linking nouns with verbs are not adequately estimated in Ackerman's study because it is known that when children must read the sentence context superior associative recall is often not observed (see above). Moreover, although no other studies of linking nouns with verbs have used a congruity effect as a measure of integration, Rohwer and Levin (1968) showed that anomolous sentences of the form "Roses drink hats" produce no improvement in recall, and meaningless sentences also do not help recall compared with controls (Rohwer, 1966). In addition, some of the differences obtained between various types of sentences in studies of the deep structure hypothesis may well reflect 'incongruity' in the sense used by Ackerman (for

example, Davidson & Dollinger found, perhaps not surprisingly, that 'manner/adverbial' sentences such as "Soft bread was delivered by ponies" did not help children's recall as much as somewhat more common sentence types). Regarding cueing, several studies compared the form class effect with first nouns or sentence less target nouns and report no significant differences (Ehri & Richardson, 1969; Rohwer & Levin, 1968; see also Expt. 7). There is, therefore, good reason to suppose that the 'sentence' condition in Ackerman's study seriously underestimates the amount of joint encoding which linking nouns with verbs produces, provided that children are not asked to read the sentences, and Ackerman's conclusion that integration instructions (event rating) are required for integration is not supported by the present data or other findings. Linking to-be-associated nouns with verbs is sufficient to cause children to jointly encode a significantly larger proportion of pairs, and explicit instructions designed to increase semantic processing of items together are not required for such interitem integration.

Finally, even if event rating did produce better associative recall than linking nouns with verbs, this would not necessarily contradict the present findings, since it is not implied by the present view that linking nouns with verbs is the only way of promoting associative encoding. Thus, adding together procedures which should enhance relational encoding may produce larger effects or clearer effects in associative recall than one procedure alone (for example, combining interactive depiction and linking nouns

with verbs produces effects in measures of association in free recall which neither procedure alone produces, Kee & Rohwer, 1974; see also Experiment 4). It seems likely, however, on the basis of previous studies that rating the likelihood of event occurrence would not lead to much enhancement in associative recall over simply reading the nouns linked by a verb to children (rather than having them read the sentences). Turnure, Buium and Thurlow (1976) examined the effects of asking 'What' or 'Why' questions after presenting nouns linked by verbs to children, compared with simply repeating the sentences, a procedure designed to increase 'depth of processing' but perhaps not unlike event rating. If recall was unexpected, the question condition was superior to the repetition condition, but later studies have shown that the positive effects were limited (for example, present at grade one but absent at grade six, Pressley & Bryant, 1982). However, the beneficial effects of answering questions in the above studies were not present under intentional learning conditions and the present, and Ackerman's, study involved intentional, not incidental, learning.

In conclusion, therefore, Ackerman's (1982a) suggestion that children tend to encode items separately, rather than jointly, because they tend to access the semantic system in terms of individual items more than adults is consistent with the present results, if it is assumed that linking nouns with verbs results in accessing of the semantic system for more than one item at a time. The implication of Experiments 1 and 2, however, is that Ackerman's assumption that

linking verbs are insufficient to lead to joint encoding without integration instructions is incorrect. Finding (1) indicates that linking verbs are sufficient to promote joint encoding, and other studies suggest that any additional effects due to procedures designed to force children to process items in the semantic system further may be fairly minimal in terms of the effects in memory for relational information, although they may well have additional effects on memory for item specific information.

Limitation of the form class effect to associative recall does not in itself contradict either the various elaboration accounts or Ackerman's suggestion that children have difficulty in relationally encoding items because they tend to access the semantic system in terms of individual items. Therefore, the present data simply (i) establish that the form class effect is limited to associative recall, (ii) indicate some of the shortcomings of the various elaboration accounts, and (iii) show that Ackerman's assumption that linking verbs are insufficient (without inducing semantic processing) to promote joint encoding is incorrect. Moreover, the present data also confirm the observation that the superiority of verbs is not observed, even in cued recall, for college students and even at very fast rates of presentation. However, although the results of Experiments 1-3 do confirm the central prediction that the superiority of verb connectives is limited to associative recall, they also leave certain questions unanswered.

Specifically, the results of Experiments 1-3 do not explain how verb connectives are effective in promoting relational encoding by children. Do children encode items jointly or separately mostly on the basis of whether or not the way the items are presented suggests a relationship? Are verb connectives effective simply because they supply mediators or relational information which children otherwise have not yet acquired (Rohwer's 'event knowledge')? Or do verb connectives enhance associative recall for the nouns they link because children lack appropriate, well acquired, memorial strategies? Are verb connectives effective in producing better associative encoding because the presence of a verb linking the to-be-associated nouns results in the representation of the nouns in one string in semantic deep structure? Finally, do verbs enhance associative encoding because they overcome a lack of 'elaborative propensity' in younger children? These are some questions which the remaining studies address.

: IV. IMAGERY INSTRUCTIONS PARALLEL

THE EFFECTS OF CONNECTIVES

General Introduction

Outline of Experiments 4-6

Experiments 1-3 established that the superiority of verb linked nouns in recall is limited to associative recall and not observed in the overall level of free recall. The finding was interpreted as supporting the view that verb and conjunction connective conditions differ in the amount of relational information encoded concerning the nouns which the connectives link, rather than any differences in the encoding of item specific information. Experiments 4-6 examine the question of whether imagery instructions and connectives have parallel effects in associative recall. The rationale behind such an investigation is twofold. First, there is considerable evidence that interactive and separate imagery instructions produce marked differences in the extent of the relational encoding of items. Thus, if imagery instructions and connectives can be shown to have parallel effects upon recall, the case for an interpretation of the effects of connectives in terms of memory for relational information suggested by Experiments 1 and 2 will be strengthened.

The second aspect of the rationale for comparing the effects of imagery instructions and connectives is that demonstration of

parallel effects will strengthen the argument for an understanding of the effects of connectives in terms of differences in the processing of information and consequent differences in memorial organization. If imagery and connectives have parallel effects, explanations which attribute the effect of connectives to characteristics peculiar to connectives without consideration of the consequences in processing and organization would seem less plausible. Demonstration of parallel effects would thus seem problematic for strictly linguistic accounts of the effect of connectives, or for the view that verb connectives supply relational information which children otherwise lack. Finally, since imagery instructions have frequently been found to be ineffective for younger children, unlike the effect of connectives, the present studies also provide the opportunity to contrast the absence and presence of parallel effects developmentally and to examine the implications for the present view.

The extent to which imagery instructions and verb and conjunction connectives produce parallel effects was therefore examined in Experiments 4-6. The effects of both interactive and separate imagery instructions upon the recall of nouns linked by verbs and nouns linked by conjunctions were studied. Interactive imagery instructions consist of instructing children, before studying the list, to "make a picture in your head of the two things doing something together" for each pair of nouns. By separate imagery instructions is meant that the children are instructed "to make a picture in your head for each word". In Experiment 4 all subjects

received interactive imagery instructions prior to studying a list of nouns linked by verbs or nouns linked by conjunctions, and being tested by either cued or free recall. Because imagery instructions were not found to be effective for younger children in Experiment 4, the cued recall condition of Experiment 4 was replicated in Experiment 5. To provide comparability with Experiments 1-3, half the subjects in Experiment 5 received regular pair learning instructions and half received imagery instructions prior to studying the same list of conjunction or verb linked nouns. In Experiment 6, the imagery instructions were separate imagery. Associative recall of verb or conjunction linked nouns was compared following separate imagery or regular pair learning instructions.

Expectations based on the present view of the form class effect

The present view of the form class effect assumes first, that the locus of the superiority of verb linked nouns over conjunction linked nouns lies in differences in memory for relational information and not in differences in the encoding of item specific information. This assumption was tested in Experiments 1-3 by showing that the effects of connectives are confined to the overall levels of associative recall and not found in free recall (or recognition), and is further tested in Experiments 4-6. Because there is strong evidence that the locus of the recall differences following interactive as opposed to separate imagery also lies in associative memory, then imagery instructions should have parallel effects in associative recall to those of connectives. The second assumption made by the

present view is that, for children, verb connectives increase the amount of relational information encoded about the nouns they link, while conjunctions have no greater effect on relational encoding than presenting the items without any connective. If the effect of verb connectives is simply to increase relational encoding, then other procedures which increase relational encoding, such as interactive imagery, should have parallel effects. On the other hand, procedures such as separate imagery which decrease the degree of relational encoding and promote separate encoding should have effects more like conjunction connectives.

The first assumption simply says that the locus of the form class effect is in memory for relational information. The second assumption goes further in hypothesising that verb and conjunction connectives influence the processing of relational information and have different consequences for memory organization. The second assumption is inconsistent with the idea that verb connectives lead to superior recall because they supply missing mediators which children lack. If verb linked nouns are better recalled only because verbs supply mediators, imagery instructions (which do not supply explicit mediators) should not necessarily have the same effects. Thus the present view is a processing-organization account. Two additional points about these assumptions need to be noted. First, imagery instructions have often been reported to be 'ineffective' (that is, do not lead to different levels of associative recall) for younger children, especially when the list items are words. Therefore,

the present expectation is that imagery instructions and connectives should only have parallel effects at grade levels where both are effective. Secondly, the previous point raises a central developmental issue: exactly why do verb connectives and imagery instructions promote relational encoding in children and how may differences in the age of effectiveness between them be explained? As will be seen, some additional assumptions are required to explain the developmental issues: namely, (i) why verb connectives promote relational encoding for children earlier than imagery instructions but (ii) have little or no effect on adult relational encoding. In summary, for

Experiments 4-6, the main expectation is that imagery instructions, where effective, should have parallel effects to those of connectives. The rationale for expecting parallel effects is based upon evidence locating the effect of connectives in memory for relational information, similar evidence concerning the effects of imagery instructions, and a processing-organization approach to both sets of phenomena.

The present studies are concerned with imagery instructions. Evidence supporting the present expectations about the effects of imagery instructions is found in studies concerned with the other major type of imagery manipulation, studies of depiction. The referents of to-be-associated items may be depicted separately ('coincidental depiction'), in some spatial arrangement ('locational depiction'), or in some interaction ('interactive depiction'). Differences in associative recall are found reliably as a function

of the type of depiction, and in a way which parallels the effects of connectives. Thus, nouns linked by verbs (generating a description of an interaction) exceed nouns linked by conjunctions (specifying no particular interaction or relationship) in associative recall, with nouns linked by prepositions (often describing some spatial relationship) generally intermediate. Similarly, items interactively depicted exceed separately depicted items in associative recall, with items depicted in some spatial arrangement intermediate (Davidson, 1964; Kee & Rohwer, 1974; Reese, 1965; Rohwer, Lynch, Levin & Suzuki, 1967, 1968; Rohwer, Lynch, Suzuki & Levin, 1967).

The one major discrepancy in parallels concerns the effects of linking nouns with prepositions compared with depicting the referents in some spatial arrangement. While such locational depiction is reliably intermediate between interactive and coincidental depiction in associative recall, associative recall levels for nouns linked by prepositions vary across studies from levels equivalent to nouns linked by verbs, to levels intermediate between verb and conjunction connective conditions to (rarely) no better than nouns linked by conjunctions. However, as will be shown in Chapter V, the variable results obtained with nouns linked by prepositions most probably reflects a mixture of different types of preposition, some of which suggest clear locational or spatial relationships (and lead to enhanced associative recall) and others which do not suggest a spatial relationship (and do not enhance recall). Finally, and most importantly for the case for parallel effects of imagery as defined

by depiction and the effects of connectives, Kee and Rohwer (1974) examined the locus of depiction effects. Just as differences as a function of the type of connective linking nouns emerge only in measures of associative recall, so also differences as a function of the type of depiction are confined to associative recall (cued recall, cued recognition) rather than measures reflecting a greater component of memory for item specific information (free recall, simple recognition).

A similar limitation of differences as a function of imagery type to measures of associative recall is obtained with the imagery manipulation studied here, namely imagery instructions. Evidence limiting differences in recall to certain retrieval tasks as a function of the type of imagery instructions is important for the present studies since, if covarying imagery and connectives does produce parallel effects, then the case for an interpretation of the effect of connectives as limited to associative memory will be further supported. When interactive imagery instructions are compared to separate imagery instructions, interactive imagery reliably exceeds separate imagery (Begg, 1973; Begg & Anderson, 1976; Bower, 1970; Dempster & Rohwer, 1974), even if recall is conditionalized on cue recognition (Bower, 1970). Moreover, recall cues are no better recognized after interactive imagery than separate imagery instructions, whether assessed by hit rate (Bower, 1970) or d' values (Dempster & Rohwer, 1974). In addition, in spite of the clear superiority of interactive over separate imagery in cued recall, the

differences disappear in free recall (Begg, 1973; 1978a; Begg & Anderson, 1976; Hasher, Riebmán & Wren, 1976; Jansen, 1976, Expt. 3). As Experiments 1 and 2 suggest for verb connectives, interactive imagery instructions are more effective in promoting the encoding of relational information. Therefore, the present expectation is that interactive imagery instructions should in general parallel the effects of verb connectives, while separate imagery should parallel the effects of conjunction connectives in measures of associative recall. Accordingly, interactive imagery instructions should eliminate the superiority of nouns linked by verbs by improving associative recall of nouns linked by conjunctions. Conversely, separate imagery instructions should eliminate the form class effect by lowering associative recall for nouns linked by verbs to the level of nouns linked by conjunctions.

Several reservations about the expectation that imagery instructions and connectives (of the appropriate type) should have parallel effects may be noted. The first is that the expectation for parallel effects applies to memory for relational information indexed primarily by measures of associative recall, and does not necessarily apply to recall measures more sensitive to memory for item specific information. For example, as noted before, imagery instructions of either type have been reported to improve recognition scores relative to rote controls for children, while no significant differences have been reported in simple recognition as a function of whether nouns are linked with connectives or presented alone

(Dempster & Rohwer, 1974). In the present view, simple recognition scores are more sensitive to memory for item specific information, about which no predictions are drawn here. Similarly, overall differences between picture and word items (see, for example, Rohwer, Lynch, Kevin & Suzuki, 1967) are not germane to the present predictions. In contrast, the relevant expectation from such studies is that pictorial 'translations' of linking nouns with verbs or conjunctions should have parallel effects in associative recall.

A second reservation concerning the expectation that imagery instructions and connectives should have parallel effects concerns developmental differences in the age at which imagery instructions and connectives produce differences in associative recall. For connectives, reliable differences between verb and conjunction linked nouns in associative recall have been reported from at least the beginning of grade school (see Chapter I). In contrast, imagery instructions appear to become effective (that is, produce differences in associative recall as a function of the type of instructions) considerably later, and the criterial age appears to vary as a function of item modality. At about age four, interactive images can apparently be formed but manipulation of to-be-associated items, such that the interaction is acted out, is required to improve cued recall over just observing the interaction, or just receiving interactive imagery instructions (Bender & Levin, 1976). Studies of somewhat older children (five through six) indicate that

instructions to form interactive images do facilitate cued recall relative to separate imagery controls or pair learning instructions, but the difference appears to be limited to picture or object items (Danner & Taylor, 1973; Levin & Pressley, 1978; Varley, et al., 1974; Yuille & Catchpole, 1973). If the list items are words, younger children do not seem to benefit from interactive imagery instructions in cued recall (Levin & Kaplan, 1972) and it is not apparently until age seven or eight that positive effects are reported with word pairs for imagery instructions (Begg & Anderson, 1976; Kemler & Juczyk, 1975; Pressley & Levin, 1977b, 1978).

Similarly, studies in which memorial strategies are taught as part of mnemonics to children indicate that sentence strategies are easier to teach to younger children than interactive imagery strategies, especially if the items are words (Pressley & Levin, 1978; Pressley, Levin & McCormack, 1980). However, it is important to note that these conclusions are drawn across studies (the exception is Pressley & Levin, 1978). Nevertheless, the general conclusion to be drawn is that imagery instructions become effective later developmentally than the point at which linking nouns with verbs or conjunctions produces differences in associative recall. Possible reasons for differences in the age at which imagery instructions and connectives become effective are discussed later in this chapter. However, the present expectation for parallel effects of connectives and imagery instructions can be stated firmly only for older children where imagery instructions are effective in producing reliable differences

in recall.

Expectations based on other views of the form class effect

Experiments 4-6 examine the effects of interactive and separate imagery instructions on the recall of nouns linked by verbs and nouns linked by conjunctions. The expectations to be derived from Rohwer's general elaboration position are clearly identical to the present view. Both connectives and imagery instructions are, in Rohwer's view, 'prompts' for elaboration, verb connectives being more 'explicit' prompts than imagery instructions, such that verb connectives should be effective at an earlier age than imagery instructions ("the younger the learner, the more explicit the prompts required for elaboration", Rohwer, 1973, p. 8). Nevertheless, both types of prompt are expected to influence relational encoding in the same way as the present view expects. Earlier, as noted before, Rohwer suggested that the effect of connectives was actually to evoke images of various types (corresponding to the various types of depiction) as an encoding process leading to differences in associative memory. Clearly, therefore, in terms of Rohwer's general elaboration position or the earlier imagery account of the form class effect, parallel effects of imagery instructions and connectives are to be expected.

The deep structure hypothesis, however, does not seem to lead to any very clear expectations about what the effects of covarying imagery instructions and connectives should be. It is not clear, for example, if imagery instructions should override the

effects of connectives, since it is not clear what effect imagery instructions should have upon the hypothesised representation of items in single or multiple strings in semantic deep structure. The present expectations are thus problematic for the deep structure account. In contrast, the present expectations, if confirmed, would seem to drift away from a linguistic account towards an organization-processing account, which direction Rohwer later followed in broadening his account of the form class effect from an account in terms of linguistic processes or in terms of imagery processes to a general account in terms of mental elaboration. A significant factor in the development of theory for Rohwer was the impossibility of eliminating imagery accounts when testing the deep structure hypothesis (see above, pp. 14-17) and the obvious parallels between the effects of connectives and those of depiction. In the present studies, a strictly linguistic account will thus be made more problematic by the demonstration of any further performance parallels between the effects of connectives and imagery manipulations as defined by imagery instructions.

Finally, Ackerman (1982a) suggested that children have a general tendency not to relate 'target' and 'contextual' information as much as adults so as to form a 'cohesive episodic event'.

Ackerman's suggestion is that relational encoding is more difficult for children than adults not because of any mediational deficits or lack of memorial strategies but because children fail to access the semantic system in units larger than a single item and so fail to take advantage of the semantic relationships between items. It

has been suggested above that this view may be applied to the effect of connectives, such that verb or prepositional connectives may be seen as promoting the accessing of the semantic system in larger units benefiting memory for relational information. Moreover, if imagery instructions might be viewed as promoting access to the semantic system in a similar way, then the expectations to be derived from Ackerman's view would be the same as the present account, namely that imagery instructions and connectives should have parallel effects, and imagery instructions should eliminate differences between nouns linked by verbs and nouns linked by conjunctions in predictable ways.

Previous studies

Two previous studies compared the effects of interactive and separate imagery instructions upon children's recall of lists of noun pairs. Dempster and Rohwer (1974) found that, for grade six children, associative recall with interactive imagery exceeded separate imagery which did not differ from a rote repetition condition. Although Dempster and Rohwer did not study free recall, they did include a simple recognition task, in which there were no differences as a function of imagery instructions although both separate and interactive imagery led to better recognition than a rote repetition condition. These data are consistent with adult findings and the assumption that the locus of differences in memory as a function of imagery instructions lies in memory for relational information.

Difficulties are raised, however, by the other major study

of the effects of imagery instructions on children's recall. Begg and Anderson (1976) compared the effects of interactive and separate imagery in cued and free recall for second and sixth graders. Consistent with adult findings, marked differences as a function of imagery instructions were found in cued recall and other measures reflecting pairwise organization. However, unlike adult findings, there were significant effects as a function of imagery instructions in free recall, although much less than in cued recall, and only for the first and not the second items in pairs.

A second difficulty raised by the Begg and Anderson study is that performance was generally poorer in cued recall than in free recall compared with the usual adult findings. For adults, cued recall usually exceeds free recall with interactive imagery, but not with separate imagery (for example, Begg, 1973). Begg and Anderson, however, found that cued recall did not exceed free recall with interactive imagery instructions and fell far short of free recall with separate imagery. This was interpreted by Begg and Anderson as reflecting difficulties in children's accessing of information from cues. The problem is clearly not in cue recognition in view of Dempster and Rohwer's finding that both types of imagery enhance children's recognition. In fact, cued recall was significantly inferior to free recall even in the control (standard pair learning instructions) condition in the Begg and Anderson study.

To the extent that nouns linked by conjunctions can be considered equivalent to presenting the nouns alone, the Begg and

Anderson finding that cueing hurts recall even under regular (non-imagery) instructions are contradicted by both the results of Experiments 1 and 2 reported above and by the findings of Kee and Rohwer (1974). Neither of the latter set of studies suggests that performance is worse in cued recall than in the free recall of nouns linked by conjunctions. As noted above, the cues used in the present and Kee and Rohwer studies were more elaborate (included the connectives) than in the Begg and Anderson study (first noun only), although it is unclear from prior studies that cue size reliably influences recall levels (see above, also Experiment 7). Moreover, no studies have reported any differences in the recall of nouns linked by conjunctions and nouns presented without connectives, suggesting that the conjunction condition in the present studies and Kee and Rohwer's should be equivalent to presenting nouns without connectives (for example, Rohwer, 1964). The possibility remains that cueing might hurt recall under imagery instructions. Accordingly, the present studies also included free recall (Experiment 4) as well as cued recall conditions.

Experiment 4

Experiments 1-3 established that the usual superiority of nouns linked by conjunctions is limited to associative recall. Experiment 4 compared cued and free recall of nouns linked by verbs or conjunctions, as in Experiments 1 and 2, but in Experiment 4 all subjects received instructions to form interactive images of the referents of the nouns in each pair prior to studying the list. The expectation was that interactive imagery instructions would eliminate the usual superiority of nouns linked by verbs in associative recall by raising associative recall of conjunction linked nouns to the level of nouns linked by verbs.

From previous studies it is clear that there is a developmental gradient in the effect of imagery instructions, so that effects have often not been found with younger children, and that effects emerge earlier for pictorial or object items than words. Therefore, since the present study used word items, it was not expected that imagery instructions would necessarily be effective for grade three children. In fact inclusion of this group provides a check on the generality of previous findings regarding the criterial age.

Experiment 4 also included both cued and free recall conditions. The expectations here are that the superiority of verb connectives over conjunction connectives should not be present in cued recall under interactive imagery instructions, in contrast to the pattern of results predicted and found for cued recall in Experiments 1-3. Since previous studies indicate that the effect of

conjunction connectives is no different in cued recall than a no-context control condition, comparison of the performance in the conjunction condition given imagery instructions should constitute a condition which allows comparison with Begg and Anderson's study. In that study, it will be recalled, interactive imagery instructions led to equivalent levels of performance in both cued and free recall, contra the usual adult finding in-favor of cued recall.

Method

Design and materials. In a between-groups design, subjects learned a single list of 14 pairs of nouns, linked either by a verb or a conjunction, and were tested by either cued or free recall. The sentences and conjunctive phrases so generated differed only in the connective linking the nouns (table 9, page 225). All words were drawn from a grade 2 word list. Nouns were paired at random and, apart from the restrictions that all sentences be meaningful, assignment of verbs to noun pairs was random. A single connective 'and' was used for the conjunction lists.

Subjects. A sample of 64 subjects was drawn from a single parochial school serving a predominantly middle socio-economic status suburban population. From the total within grade population, 32 grade 3 and 6 subjects were selected at random, except that sexes were equal in number.

Procedure

All subjects were given instructions to form interactive

images. These instructions stressed (i) remembering the nouns and (ii), remembering which "two words went together" by "making a picture in your head of the two words doing something together". Subjects were questioned to see if they were forming interactive images when the practice list was presented. As in the aural study of Experiment 1, all material was presented exclusively aurally. Other aspects of the procedure were identical to that study.

Results and discussion

Recall of second nouns. The mean number of second nouns recalled is shown for each treatment group in table 4.

TABLE 4
MEAN NUMBER OF SECOND NOUNS RECALLED AS A FUNCTION OF TYPE OF
CONNECTIVE, CUEING AND GRADE IN EXPERIMENT 4

	Cued Recall		Free Recall	
	Conjunction	Verb	Conjunction	Verb
Grade 3	4.3	7.9	3.1	3.0
Grade 6	9.9	9.6	4.9	6.1

NOTE: All means are numbers of second nouns recalled, out of a possible 14. Standard deviations range from 1.3 to 3.1.

The critical question is whether the advantage of verb connectives over conjunction connectives still holds for cued recall if, as in the present experiment, instructions to form interactive images are given. Table 4 indicates that no such superiority is present at the grade 6

level in cued recall, the mean number of second nouns recalled with verb connectives being, if anything, slightly less than that for conjunction connectives. No difference between verb and conjunction conditions contrasts with the clear effect of verb connectives observed in cued recall for grades 3, 6 and 8 in Experiment 1. However, at the grade 3 level in the present study, the mean number of second nouns recalled with verb connectives is clearly greater than that with conjunction connectives ($t_{14} = 2.8$). Thus, superior cued recall with verb connectives is present at the grade 3 level, but not at the grade 6 level.

By inspection, it is also clear that in all comparisons the mean number of second nouns recalled is greater in cued than in free recall, as was observed with regular pair learning instructions in Experiment 1. Thus, cueing does not hurt recall; in fact, the opposite is true. In all comparisons also, the means for grade 6 exceed the comparable treatment group means for grade 3. These conclusions are supported by a $2 \times 2 \times 2$ factorial analysis of variance of these data, which compared the effects of connective (conjunction versus verb), recall mode (cued versus free recall) and grade level (3 versus 6). Cued recall was superior to free recall, $F(1, 56) = 43.0$. The main effect of grade was also significant, $F(1, 56) = 30.7$. Performance with verb connectives overall exceeded that with conjunction connectives, $F(1, 56) = 20.3$.

The only other effect to attain significance was the triple interaction of connective, recall mode and grade, $F(1, 56) = 4.9$,

which partly reflects the presence versus absence of verb superiority over conjunctions in cued recall at grade levels 3 and 6 respectively. Although there is some suggestion from Table 4 that the converse pattern of results might hold in free recall, the suggestion that the verb condition exceeded the conjunction condition in free recall at the grade 6 level does not attain significance in a post hoc t test.

Recall of pairs. Performance in the free recall condition was further analyzed in terms of the number of pairs correctly recalled. Group means for conjunction and verb connective conditions were 2.9 versus 2.6 for grade 3, and 4.0 versus 5.6 for grade 6. Although, again, there is the suggestion of a trend in the direction of verb superiority at the grade 6 level, this difference did not attain statistical significance. In a factorial 2×2 analysis of variance, which compared the effects of connective and grade, the only effect to attain significance was that of grade, $F(1, 28) = 9.1$. Thus, as in Experiment 1, there is no evidence for verb facilitation in free recall for either the number of second nouns recalled or the number of pairs correctly recalled.

Conditional Probabilities Again there is a suggestion of a trend in favor of verb connectives in free recall and this difference does attain significance. With an error mean square of .04, the means for the overall conditional probability (the proportion of the total number of words that were recalled as pairs) for each group were at the grade 3 level, .78 for the conjunction condition, and

.74 for the verb condition, and at the grade 6 level, .65 and .91, respectively. In a 2 x 2 analysis of variance, the only effect to attain significance was the interaction of grade and connective, $F(1, 28) = 4.20$, which was due to the superiority of the verb condition at grade 6 over the other conditions, which did not differ.

Discussion

The hypothesis tested in Experiment 4 was that interactive imagery instructions would eliminate the usual superiority of nouns linked by verbs in cued recall. The advantage for nouns linked by verbs in associative recall observed in Experiments 1-3 was indeed eliminated when instructions were given to form interactive images of the referents of items, but only at the grade six level. It has already been noted, however, that imagery instructions have frequently been found to be ineffective for younger children. In addition, consistent with the present view, the manner in which imagery instructions eliminated the usual superiority of verb linked nouns over nouns linked by conjunctions would seem to be due to an improvement in cued recall in the conjunction condition. Since Experiment 4 lacks a regular instructions control in which performance with verb and conjunction linked nouns could be compared with performance under imagery instructions, it is not possible to state definitively that elimination of the usual verb advantage under imagery instructions is due to an improvement in recall of conjunction linked nouns. Lack of a difference in recall of conjunction and verb linked nouns, might, for example, reflect poor cue to trace accessing

under imagery instructions. The hypothesis tested is thus supported at the grade six level by elimination of the usual form class effect in cued recall. The only difficulty these data raise is the failure of imagery instructions to be effective at the grade three level. Since these conclusions are further tested in Experiments 5 and 6, the significance of the failure of imagery instructions to eliminate the advantage in cued recall of nouns linked by verbs over nouns linked by conjunctions is discussed following those studies.

Experiment 4, however, is the only study of the present series to include a free recall condition, and these findings are therefore discussed here. One difficulty from the results of Experiments 1 and 2 was that there was no evidence for the hypothesized differences in organization in free recall, such that neither the number of complete pairs recalled nor the conditional probabilities of recalling the other item in a pair given recall of the first favored the verb condition. In contrast, Begg and Anderson reported that both pair recall and conditional probabilities indicated greater whole unit recall under interactive imagery instructions than under separate imagery. In the discussion of Experiments 1 and 2 above it was therefore suggested that verb connectives may be somewhat less powerful organizers than imagery instructions in promoting joint encoding, so that the latter are more likely to produce organizational effects in free recall. On this basis it was suggested that organizational effects in free recall might be produced by verb connectives either when the number of items to be unitized was

increased (as in Rohwer and Roth's study), or when several parameters hypothesised to produce joint encoding were combined (for example, Kee and Rohwer, 1974).

Partial support is provided by the results of Experiment 4 in that, under interactive imagery, the conditional probabilities for nouns linked by verbs do exceed those for nouns linked by conjunctions, although the difference for the recall of pairs does not attain significance. However, it is important to note that in the Kee and Rohwer study, differences in pair recall emerged only when the condition maximizing relational encoding (prepositional connective plus interactive depiction) was compared with the condition minimising it (conjunction connective plus separate depiction), and not for intermediate conditions (preposition plus separate depiction or conjunction plus interactive depiction). In the present study, the comparison is between conditions maximizing relational encoding (imagery instructions plus verb) and a mixed, or intermediate, condition (imagery instructions plus conjunction). Consistent with the Kee and Rohwer findings, therefore, significant differences in pair recall might be expected only in the present study if a condition minimising relational encoding was included (regular pair learning instructions plus conjunction). Unfortunately, this latter condition was not included. Nevertheless, the results at least for the conditional probability of recalling one item given recall of the other do support the present expectations, and in a contrast which does not maximize hypothesised differences in relational encoding.

A second finding specific to Experiment 4 concerns the issue of whether cueing hurts children's recall, as suggested by Begg and Anderson. The results of Experiments 1 and 2 indicate that under regular pair learning instructions, cueing considerably helps recall, and contradict the Begg and Anderson regular pair learning instructions condition results. The possibility still remained that cueing might hurt children's recall under imagery instructions. The present results do not support the view that cueing hurts recall even under imagery instructions. Exactly the same results were found under regular instructions in Experiments 1 and 2. Hence, the present data contradict Begg and Anderson's suggestion that cueing hurts children's recall, whether under regular or imagery instructions.

A

Experiment 5

The results of Experiment 4 indicate that at least for grade six children, interactive imagery instructions eliminate the superiority of nouns linked by verbs over nouns linked by conjunctions in associative recall. Elimination by imagery instructions of the usual form class effect is consistent with the hypothesis that verb connectives and interactive imagery instructions have parallel effects in promoting the relational encoding of items at least at the grade six level. However, Experiment 4 does not show clearly that interactive imagery instructions eliminate the superiority of verb over conjunction connectives because of an increase in associative recall in the conjunction condition. The present expectation is that interactive imagery should eliminate the form class effect because recall for conjunction linked nouns should improve, and not because recall for verb linked nouns suffers. To reach such a conclusion it is necessary to include a regular instructions condition to establish a baseline for associative recall of nouns linked by verbs and nouns linked by conjunctions. The results of Experiment 4 thus do not eliminate the possibility that performance with verb connectives becomes worse under imagery instructions. Instructions to form interactive images might, in some way, interfere with the effects of verb connectives so that items are not represented as a single string in semantic deep structure, as the deep structure hypothesis might suggest. Alternatively, it might be that children's encodings are more variable under both imagery instructions and with verb connectives

so that encodings might vary from study to test approximating the conditions of Ackerman's (1981) study, which showed a more severe effect for children of cross modal switching from study to test. (see pp. 219-220).

In addition, the results of Experiment 4 suggest that imagery instructions are not effective at the grade three level. Since this age is somewhat older than the criterial age at which other studies suggest imagery instructions become effective (Pressley, 1982), it was felt to be necessary to replicate the results of Experiment 4 concerning the age at which imagery instructions became effective and to extend them by including a grade 8 sample. Experiment 5 also included, for the above mentioned reasons, a regular instructions control conditions, in addition to an interactive imagery instructions condition, to establish base line performance for associative recall of verb and conjunction linked nouns. It was therefore predicted that imagery instructions would, at least for the two older groups of children, eliminate the usual superiority of verb linked nouns over nouns linked by conjunctions in associative recall, due to an increase in performance for conjunction linked nouns under imagery instructions. Free recall was not studied in Experiment 5.

Method

Design and materials. In a between-groups design, subjects from grades 3, 6 and 8 learned a single list of 14 pairs of nouns, with either conjunction or verb connectives under regular pair learning or imagery instructions. Materials were identical to

Experiment 1.

Subjects. A sample of 168 subjects was drawn from a single parochial school serving a predominantly middle socio-economic status urban population. From the total within grade population, 56 grade 3, 6 and 8 subjects were drawn at random, except that sexes were equal in number.

Procedure

The procedure was identical to the second study of Experiment 1 (the nouns were presented concurrently visually), except that all recall was cued and half the subjects were given imagery instructions. Regular instructions were identical to those given in Experiment 1 and imagery instructions were identical to those given in Experiment 4.

Results

The mean number of second nouns recalled is shown for each treatment group in table 5. It is readily apparent from table 5 that, under regular pair learning instructions, the usual superiority of verb connectives is present at all grade levels in cued recall. In contrast, under imagery instructions, there is clearly no facilitating effect of verb connectives for grades 6 and 8, since the verb condition is, if anything, slightly worse than the conjunction condition. At the grade 3 level under imagery instructions, as in Experiment 4, a residual verb connective facilitation effect is still apparent ($t_{26} = 1.8$).

TABLE 5

MEAN NUMBER OF SECOND NOUNS RECALLED AS A FUNCTION OF INSTRUCTIONS,
TYPE OF CONNECTIVE AND GRADE-IN EXPERIMENT 5

	Regular Instructions		Interactive Imagery	
	Conjunction	Verb	Conjunction	Verb
Grade 3	6.8	9.9	10.7	12.4
Grade 6	6.0	11.1	12.0	9.9
Grade 8	7.5	9.9	12.1	11.4

NOTE: Means are out of a possible total of 14. Standard deviations range from 1.8 to 4.2.

Also, elimination of the superiority of verb connectives under imagery instructions is due, as predicted, to an improvement in performance with conjunction connectives rather than to any decrement with verb connectives. If performance with verb connectives under regular and imagery instructions is compared, in only one case is performance with verbs under imagery instructions worse than with regular instructions, and this difference is in any case slight compared with the considerable superiority of the conjunction condition under imagery instructions over that under regular instructions.

These conclusions are supported by a $2 \times 2 \times 3$ analysis of variance, which compared the effects of connective (conjunctions versus verbs), instructions (regular versus imagery) and grade level (3, 6 and 8). Performance with imagery instructions exceeded that with regular instructions, $F(1, 156) = 39.1$, and performance with

verb connectives overall exceeded that with conjunctions, $F(1, 156) = 14.2$. The critical interaction of connective and instructions also attained significance, $F(1, 156) = 22.6$, and Scheffé tests indicate that, under regular instructions, the verb condition exceeded the conjunction condition, $F(1, 156) = 36.3$, $F'(5, 156) = 15.7$, while there was no difference under imagery instructions. Moreover, associative recall of nouns linked by conjunctions under imagery instructions was significantly greater than under regular instructions, $F(1, 156) = 60.6$, while there was no difference as a function of instructions in the associative recall of nouns linked by verbs. The only other effect to attain significance was the triple interaction of connective, grade and instructions, $F(2, 156) = 3.3$.

Discussion

The results of Experiment 4 indicated that the usual advantage for verb connectives over conjunctions connectives in cued recall is eliminated if instructions to form interactive images are given. The present account of the advantage in associative recall produced by linking nouns with verbs or by interactive imagery instructions is that both should have parallel effects in promoting relational encoding. Accordingly, elimination of the usual advantage of nouns linked by verbs over nouns linked by conjunctions in associative recall by imagery instructions should be because of an improvement in the recall of nouns linked by conjunctions. The results of Experiment 5 clearly indicate that cued recall of conjunction linked

nouns is significantly greater under imagery instructions than under regular instructions and this difference accounts for the elimination of the usual form class effect under imagery instructions.

In addition, the results of Experiment 5 replicate the finding from Experiment 4 that imagery instructions do not eliminate the usual form class effect for younger children. As noted before, numerous studies indicate that interactive imagery instructions, particularly for word items, are ineffective. (By 'ineffective' is meant that interactive imagery instructions have not been found to lead to any better associative recall levels than regular pair learning instructions.) According to the present analysis, imagery instructions can only be expected to eliminate the usual superiority of nouns linked by verbs over nouns linked by conjunctions in associative recall when the children are old enough for imagery instructions to be effective, since only then can imagery instructions and verb connectives be expected to have parallel effects.

There are, however, two difficulties in explaining the failure of the present hypothesis at the grade three level in terms of the 'ineffectiveness' of imagery instructions for younger children. Since, as will be shown in Experiment 6, the conclusion that imagery instructions are ineffective at the grade three level also holds for separate imagery instructions, which is itself a new finding, the question arises as to why imagery instructions should be ineffective for younger children. The developmental issue is considered below in the general discussion following Experiment 6. A second problem,

however, is that most studies indicate imagery instructions are effective by grade three. Since again the findings hold for separate imagery in the present studies, the discrepancy in the age of effectiveness of imagery instructions is also considered below.

In general, however, the results of Experiments 4 and 5 indicate that interactive imagery instructions bring the associative recall of conjunction linked nouns up to the level of nouns linked by verbs. The finding implies that the instructions are sufficient to promote relational encoding despite the conjunctions, suggesting that conjunctions do not lead to much joint encoding of items, unless steps are taken to construct subjective links. Furthermore, since the effects of linking nouns with verbs or instructing subjects to form interactive images of the referents of the nouns do appear to be parallel (at least above the grade three level), an explanation of the form class effect in terms of differences in the processing of relational information at encoding and consequent differences in memorial organization would seem more likely than a strictly linguistic account. What effect imagery instructions should have upon hypothesised differences in semantic deep structure would not seem clear on the basis of the linguistic account proposed by Suzuki and Rohwer.

Furthermore, it would seem that if imagery instructions are sufficient to link the nouns despite the conjunction connectives so associative recall is as good as that observed with verb linked nouns, it would not seem likely that the only effect of verb

connectives is to supply 'event knowledge'. If verb connectives help associative encoding only because they supply mediating or relational information that children otherwise lack, it is difficult to see how instructions to construct interactive images (or sentences) can have the same effects, since no specific mediator or event knowledge is afforded by the instructions. One possibility is that event knowledge might be necessary at the grade three level, and hence the ineffectiveness of imagery instructions at that grade level, and the efficacy of verb connectives. While a lack of event knowledge might explain the pattern of results for grade three, it will not explain either the superiority of nouns linked by verbs at grade six or eight when imagery instructions are effective, or more seriously, studies which indicate sentence instructions are effective in improving associative recall at grade three or younger (see Pressley, 1982). In summary, consideration of the present finding of the elimination of the usual superiority of verb linked nouns in associative recall by imagery instructions therefore tends to support a processing-organizational account of the form class effect, rather than a linguistic or mediational deficiency account.

Experiment 6

The other prediction made about imagery instructions is that separate imagery instructions should eliminate the usual superiority of nouns linked by verbs over conjunction linked nouns in associative recall by lowering recall with verbs to the level of recall with conjunctions. Separate imagery instructions should bias processing towards items individually, rather than in relation to other items, and so should reduce the likelihood that children will avail themselves of the linking information provided by verbs. Experiment 6 also allows a further examination of the failure of imagery instructions to be effective at the grade three level in Experiments 4 and 5. Previous studies have reported that interactive imagery instructions are often ineffective for younger children. Will the same be true for separate imagery?

Method

Design and Materials. In a between-groups design, subjects learned a single list of 14 pairs of nouns presented either in the context of sentences or conjunctive phrases with either regular pair learning instructions or instructions to form separate images of each word in each pair. The list was the same as that used in Experiment 1.

Subjects. Forty-four children, were selected at random from the total within grade population at grades 3 and 6, except that there were equal numbers of males and females at each grade level. The samples came from a single parochial school serving a middle

socio-economic status urban population.

Procedure

The procedure was identical to the visual study of Experiment 1 (nouns were presented concurrently visually) except that all recall was cued and half the subjects were given separate imagery instructions, and the presentation rate was 8 sec. Regular instructions were identical to those given in Experiment 1 (visual). The separate imagery instructions (Appendix II) stressed (i) remembering the nouns and which two nouns went together and (ii) making "a picture of each of the two words separately". Again, ample practice was given, and recall was cued, with 5 min. allowed for the test.

Results

The mean number of second nouns recalled is shown for each treatment group in table 6. For the older children, the size of the usual superiority in cued recall of verbs over conjunctions is much reduced with separation instructions, with a 2.8 item reduction for verbs compared with a 1.5 increase for conjunctions with respect to the regular instruction controls. In a $2 \times 2 \times 2$ factorial analysis of variance the following effects attained significance, Grade, $F(1, 80) = 38.0$, Connective, $F(1, 80) = 66.3$, Instructions, $F(1, 80) = 7.5$, the interaction of Grade and Connective, $F(1, 80) = 5.93$, and the interaction of Connective and Instructions, $F(1, 80) = 5.56$.

TABLE 6

MEAN NUMBER OF SECOND NOUNS IN CUED RECALL AS A FUNCTION OF GRADE,
TYPE OF CONNECTIVE AND INSTRUCTIONS IN EXPERIMENT 6

	Regular Instructions		Separate Imagery Instructions	
	Conjunction	Verb	Conjunction	Verb
Grade 3	4.2	11.2	2.3	7.9
Grade 6	7.6	13.2	9.1	10.4

NOTE: All means are the number of second nouns recalled out of a possible total of 14. Standard deviations range from 1.1 to 3.4.

Thus performance improved with grade, and verb connectives led to better cued recall than conjunctions, but separate imagery instructions led to poorer recall than regular instructions. The interaction between connective and instructions indicated that the facilitation due to verbs was greater with regular than separation instructions. More precisely, nouns linked by conjunctions were about equally well recalled after regular and separation instructions, with means of 5.9 and 5.7, while nouns linked by verbs were better recalled after regular than separation instructions, with means of 12.2 and 9.2. Because of the interaction between instructions and grade, each grade was analyzed separately. The effect of instructions was reliable at grades 3 and 6, with $F's(1, 40) = 8.68$ and 5.11 , respectively, as was the effect of the type of Connective, $F's(1, 40) = 51.6$ and 17.8 , respectively. However, the interaction

between the two was only reliable for the older children, $F(1, 40) = 7.00$. Analysis of the interaction by a Newman-Keuls test revealed that regular instructions with verb connectives produced higher recall than any other condition, and that recall of verb linked nouns under separation instructions was better than recall of conjunction linked nouns under regular instructions.

Discussion

The results of Experiment 6 thus indicate that separate imagery instructions also eliminate the usual superiority of nouns linked by verbs in associative recall, but only for older children. As hypothesised, for older children the reduction of verb superiority over conjunctions primarily reflects poorer associative recall under separate imagery instructions for nouns linked by verbs. Thus, separate imagery reduces cued recall of verb linked nouns to approximately the level of nouns linked by conjunctions. By biasing processing towards items individually, rather than in relation to other items, it is possible to reduce the likelihood that children will be influenced by verb connectives to encode items jointly. Again, the general finding is that imagery instructions, where effective, and connectives have more or less parallel effects and this finding tends to support an account of the effect of connectives in terms of processing and organization, rather than a purely linguistic account such as the deep structure hypothesis, for which these results are problematic. In terms of the deep structure account, there is no particular reason to expect imagery instructions

to have parallel effects to those of connectives. Likewise, these results are also problematic for Rohwer's suggestion that verbs supply event knowledge. It is unclear why separate imagery should reduce the associative recall of nouns linked by verbs if verbs supply relational information otherwise lacking, or if verbs cause nouns to be stored in a single string in deep structure.

Certain other points about the results of Experiment 6 may be noted. First, separate imagery instructions did not eliminate the usual superiority of verb linked nouns at grade three. The failure of imagery instructions to be effective for younger children is thus general for both interactive imagery (Experiments 4 & 5), and separate imagery (Experiment 6). The developmental issue is discussed below. Second, in Experiment 6, separate imagery led to poorer cued recall than regular instructions. Begg and Anderson found, however, that while interactive imagery exceeded separate imagery and regular instructions, the latter two conditions did not differ in cued recall. In the Begg and Anderson study (i) the regular instructions condition did not include a condition in which nouns were linked by verbs raising cued recall levels, (ii) cued recall levels are extremely low for separate and regular instructions conditions which may obscure possible differences, and (iii) the overall level of cued recall is very low, relative to free recall, as compared with cued and free recall levels in the present studies (Experiments 1, 2 & 4).

A third issue arising from the results of Experiment 6 is that while separate imagery eliminated the difference in recall

between verb and conjunction conditions at the grade six level, verb linked nouns learned under separation instructions still exceeded conjunction linked nouns studied under regular instructions. The results of Experiment 5 indicate, in contrast, that the appropriate comparison in that study does not show any difference; nouns linked by conjunctions studied under interactive imagery are as well recalled as nouns linked by verbs studied under regular instructions. One possible explanation is that separate imagery instructions may be somewhat more difficult for children to follow, such that interactive imagery instructions more successfully wipe out any differences between verb and conjunction linked nouns.

Discussion

The first group of studies (Experiments 1-3) showed that the advantage for verbs over conjunctions in recall holds only for associative recall, not free recall. The results support the view that the effect of verb connectives is to promote the encoding of information relating the items linked by the verbs, rather than any effect in memory for item specific information. The second group of studies (Experiments 4-6) indicated that interactive imagery brings the associative recall of conjunction linked nouns up to the level of verbs, that separate imagery reduces the associative recall of verb linked nouns to the level of conjunctions, and that both of the latter conclusions only hold for older children.

That imagery instructions eliminate the usual superiority of verb linked nouns in associative recall provides further support for

the view that the effect of verb connectives is to promote relational encoding. Because studies indicate that differences between interactive and separate imagery are found only in measures of associative recall and not, for example, in free recall, the effects of imagery instructions and connectives should be parallel if, as Experiments 1 and 2 suggest, the locus of recall differences as a function of connectives is also in associative memory. The results of Experiments 4-6 also imply that verb connectives parallel interactive imagery in promoting relational encoding, and conjunctions parallel separate imagery, resulting in more separate encoding of items. That interactive imagery raises performance with conjunction connectives to the level of verbs implies that such instructions are sufficient to cause children to encode jointly equally for conjunction and verb linked nouns. The finding also supports the view that conjunction connectives do not provide much help to children to encode items jointly, in the absence of instructions to construct subjective links. On the other hand, verb connectives are more like interactive imagery instructions, helping children to encode items jointly. That separate imagery brings recall with verbs down to the level of conjunction connectives implies that, if processing is biased towards items individually, it is possible to reduce the likelihood that children will be influenced by verb connectives to encode more items jointly. Further confirmation for these conclusions is provided by studies of the other major class of imagery manipulations, depiction. When depiction and connectives are covaried using pictorial translations of the sentences and phrases generated

by linking nouns with connectives, parallel effects are in general observed in associative recall.

With regard to other accounts of the form class effect, the present findings do not contradict Rohwer's elaboration account, either in terms of imagery or the later more general elaboration position. Both explicit prompts (verb connectives or interactive depiction) and less explicit prompts (interactive imagery) should elicit elaboration. That separate imagery should eliminate the superiority of verb linked nouns is also not necessarily contradictory to Rohwer's account, since he also assumed that prompts may be 'antagonistic' to elaboration (Rohwer, 1973, p. 10). As noted in Experiments 1-3, the present view proposes that items tend to be jointly or separately encoded, leading to clearer predictions, concerning expectations in free recall, so that imagery instructions of the two types may be thought of as promoting joint or separate encoding. Nevertheless, it would seem clear that the results for Experiments 4-6 do not contradict the elaboration account.

The finding that imagery instructions of either type eliminate the form class effect (for older children) would, however, seem problematic for a linguistic account of the form class effect, such as Rohwer's earlier deep structure hypothesis. On the basis of the deep structure account alone, it is unclear what effect imagery instructions should have upon the associative recall of verb and conjunction linked nouns. Given that the effects of connectives and imagery as defined by instructions or by depiction are parallel,

it seems more plausible to propose an account which deals more generally with the processing of relational information and consequent organization. Finally, the present findings would also seem consistent with Ackerman's suggestion that children are less able to encode items relationally because they tend to access the semantic system for each item individually. For example, interactive imagery instructions might be plausibly conceived of as biasing access to the semantic system towards more than one unit at a time.

Developmental issues

The results of Experiments 4-6 indicate that interactive and separate imagery instructions eliminate, respectively, the inferiority of conjunction linked nouns and the superiority of verb linked nouns in associative recall only for older children, and not at the grade three level. This finding is consistent with numerous other studies which show that interactive imagery instructions produce no better associative recall than regular pair learning instructions for younger children, although interactive imagery instructions clearly benefit older children. It should be noted, however, that Experiment 6 extends the conclusion that imagery instructions are ineffective for younger children to separate imagery. A number of theoretical viewpoints may be identified in the literature which may be applied to account for the ineffectiveness of imagery instructions with younger children.

Differences in elaborative propensity. Rohwer's main

suggestion about the ineffectiveness of instructions for younger children is that younger children have so little propensity to elaborate items that explicit prompts, which impose or provide elaboration, are required. Likewise, the improved recall observed for older children given imagery instructions reflects the fact that, although they still require prompting, their propensity for elaboration is sufficient for minimally explicit prompts (such as imagery instructions), which do not provide an elaboration, to be effective. Disappearance or reduction in prompt effects by late adolescence or adulthood (Experiment 3), reflects the fact that adults have high propensity to elaborate items and do so spontaneously, without the need of prompts.

While the elaborative propensity hypothesis describes the pattern of findings for older children and adults, it is clearly inadequate as an account of prompt effects in younger children. The main difficulty is that sentence instructions are effective before imagery instructions and, in several studies, as early as explicit prompts, and produce as much enhancement of recall as explicit prompts. Originally it was thought that instructions to make up sentences describing the referents of items interacting became effective later than supplying a sentence context (for example, Rohwer, 1970). However, it is now fairly clear that the effect of sentence instructions emerges at about the same time as that of sentence context, and facilitates associative recall across a similar age range, showing little increase developmentally in

efficacy (Kerst & Levin, 1973; Levin, Davidson, Wolff & Citron, 1973; Levin, McCabe & Bender, 1975; Milgram, 1967, 1968; Pressley, Levin & McCormick, 1980; Rohwer & Bean, 1973). Pressley (1982) has argued that the absence of facilitation due to sentence instructions has occurred in some studies because of ceiling or floor effects (for example, at the kindergarten level in Buium & Turnure, 1977, and in Turnure, Buium & Thurlow, 1976; at the older age levels in Jensen & Rohwer, 1965). A second reason given by Pressley (1982) for the failure of sentences instructions to be superior to control conditions in some studies is that older subjects engaged in spontaneous use of memorial strategies in the control condition (for example, Rohwer, Raines, Eoff & Wagner, 1977; Kemler & Jusczyk, 1975). The issue of the spontaneous use of memorial strategies by older subjects will be discussed below.

Therefore, while the differences in elaborative propensity may provide an explanation of the disappearance of the form class effect by adulthood (Experiment 3), the evidence concerning sentence instructions indicates that the concept of elaborative propensity does not well explain the effects of prompts in younger children's recall. Although the finding that imagery instructions appear to be effective later than connectives (Experiments 4-6) is consistent with the elaborative propensity hypothesis (the effects of minimally explicit prompts emerge later than the effects of explicit prompts), the elaborative propensity hypothesis would seem inadequate in view of the findings of other studies concerning the early efficacy of

sentence instructions.

— Differences in event knowledge. A supplementary explanation implied by Rohwer for the earlier efficacy of explicit prompts such as verb connectives is that such prompts afford relational information which younger children lack (the 'event knowledge' hypothesis). There is, of course, no doubt that some relational information by definition is required to encode items relationally, and under certain circumstances children have less information to serve as a basis for relating items together in memory. For example, Lindberg (1980) demonstrated that children can exhibit superior associative recall to that of adults (that is, a reverse developmental gradient) if the relational knowledge base favoured the children and was relatively unknown to the adults (for example, a list of names from a T.V. show popular with children but little watched by adults).

For several reasons, however, it seems unlikely that the possibility that linking nouns with verbs affords relational information children otherwise lack is the main reason for verb superiority in associative recall. First, in the present (and other studies of the form class effect), the nouns used were selected from material very familiar to very young children, and it seems unlikely that information or experience about how these items might be related would be lacking to the degree required by the event knowledge hypothesis. Second, the superiority of verb linked nouns over conjunction linked nouns or 'non-elaborated' controls remains more or less constant across the grade school years to at least

mid-adolescence, during which time considerable information about how items might be related is acquired. Third, and most damaging, instructions to form sentences describing to-be-associated items in some interaction produce superior associative recall in many studies as early and as large as those produced by supplying the child with a verb linking the nouns, as noted before. Clearly, sentence instructions do not afford specific relational information children otherwise have not acquired. In that sentence instructions have occasionally not been reported to produce effects as early or as large as those produced by linking nouns with verbs, it is possible that verb or prepositional connectives may to some slight extent afford relational information that children otherwise lack, but it does not seem very likely that this explanation can completely account for the effects of verb connectives in processing and organization. The studies reported in Chapter 5, therefore, focus on just why explicit prompts are effective.

Strategy acquisition. An alternative approach taken by some of Rohwer's collaborators was to try to identify differences in elaborative propensity with (in part) the acquisition of memorial strategies. In this view, instructions are ineffective with younger children because they have not acquired, or sufficiently practiced, the memorial strategies which are elicited by instructions in older children (Pressley & Levin, 1977; Waters, 1982). This view, in common with many others, assumes that the process of memory development consists in a large part of the acquisition of memorial

strategies (for example, Brown, 1975; Flavell, 1970; Flavell & Wellman, 1977; Hagen & Stanovich, 1977; Reese, 1976). Flavell (1970) suggested that strategy acquisition falls into four stages: 'mediational deficiency' (the strategy has not yet been acquired), 'production deficiency' (the strategy has been learned but the child does not yet use it spontaneously), 'production inefficiency' (some facilitation is produced by appropriate instructions but the strategy is used inefficiently and abandoned when the instructions are withdrawn) and, finally, the stage at which the strategy is used spontaneously and instructions have no effect (in Rohwer's terminology, this is called 'spontaneous elaboration'; that is, the spontaneous use of memorial strategies). From this point of view, the failure of imagery instructions to be effective at the grade 3 level and their effectiveness in older children reflects the lack of acquisition and/or practice with the appropriate strategy, or mediational deficiency, and the acquisition, but not spontaneous use of, the strategy at the grade 6 and 8 levels, or production inefficiency. Rohwer's account in terms of mental elaboration goes somewhat further than a purely strategic account. Rohwer assumed, as noted before, that explicit prompts (verb connectives, interactive depiction) may 'impose' elaboration' (force the child to encode associatively) prior to strategy acquisition, and continue to be effective through the stage where instructions are required to elicit strategy use. Thus, other factors such as event knowledge or event repertoires are invoked to explain various prompt effects, and as such constitute

another aspect of memory development (that is, the child also acquires relational or mediational information). Nevertheless, in the strategy view, the developmental gradients observed in the present studies for imagery instructions reflect strategy acquisition.

The best evidence that interactive imagery instructions, when effective, do elicit strategy use, is provided by studies which suggest the spontaneous use of strategies involving interactive imagery in late adolescence to early adulthood. The general paradigm used by Rohwer and others is one in which a 'non-elaborated' control condition (one in which list items are present as single pictures or words without connectives or other elaboration) is compared to one in which items are depicted interactively, or nouns are linked by verbs, or interactive imagery, or sentence instructions are given. If performance in the control condition is equal to that in the experimental condition, it is assumed that elaborative (that is, associative) memorial strategies have been used in the control condition. This procedure is often supplemented by self report data concerning strategy use. While the results of such studies have uncovered large individual differences, such that seventeen year olds may or may not report strategy use (Rohwer, Raines, Eoff & Wagner, 1977), there is fairly good evidence for (i) increasing reports of strategy use with age including the use of interactive imagery as a strategy, and (ii) significant correlations of reported strategy use, including interactive imagery, and performance in associative recall (Pressley & Levin, 1977;

Waters, 1982).

A second group of studies also provides some, though perhaps less convincing, evidence that the failure of imagery instructions for younger children and efficacy for older children reflects strategy acquisition. Studies in which younger children are taught memorial strategy use indicate that, in general, younger children can be taught memorial strategies and can sometimes transfer or generalize such strategies, including using interactive imagery as a strategy. For example, studies of mnemonics which involve teaching interactive imagery strategies, such as the 'keyword method', indicate the considerable benefit for children's associative learning (Levin, McCormick, Miller, Berry & Pressley, 1982; Pressley, Levin, Kuiper, Bryant & Michener, 1983; Pressley, Levin & Miller, 1982; for a review see Pressley, Levin & Delaney, 1982). However, studies in which strategies are taught to children also commonly have found that children often do not transfer or generalize (for example, Brown, 1975; Flavell & Wellman, 1977; Pressley & Dennis-Rounds, 1980; Rohwer & Litrownik, 1983). Moreover, as tasks or items become more different, even very extensive training often does not result in successful strategy generalization for younger children up to at least grade school (for example, Berger, 1980; Campione & Brown, 1977; Kramer & Engle, 1981). Failure to transfer or generalize has usually been attributed to inadequate acquisition of the strategy (that is, production inefficiency), or to inadequate metamemorial knowledge.

A strategy acquisition account would then imply that the failure of imagery instructions to be effective at the grade 3 level

in Experiments 4-6 reflects the fact that the strategy elicited by the instructions in older children has not yet been acquired at grade 3, and there is a considerable body of evidence suggesting that strategies are indeed acquired. A number of reservations about a simple memorial strategy explanation of the ineffectiveness of imagery instructions at grade 3 may be noted. First, the present studies indicate that both separate and interactive imagery instructions are ineffective at grade three. Since the processes elicited by the two types of imagery instructions have different consequences in associative recall, it would seem clear that the strategies elicited must be different as well. While there is evidence for the spontaneous use of interactive imagery strategies in adolescents, there seems to be very little evidence that separate imagery strategies are used (for example, Waters, 1982). However, since most strategy studies have been concerned with associative memory tasks, for which use of separate imagery strategies would be counter-productive, lack of reports of separate imagery as a strategy in such tasks is hardly surprising. In fact, since separate imagery, like interactive imagery, enhances recognition, it would seem more likely that separate imagery as a strategy would emerge in recognition tasks. Some slight support for a strategy interpretation of the present data is that there is some suggestion that separate imagery was slightly less powerful than interactive imagery in eliminating the form class effect. Since such a separate imagery strategy might be expected to be less well acquired than an interactive imagery

strategy (the former enables only item specific encoding, the latter both item specific and relational encoding), separate imagery should be less powerful. However, to the extent that both types of imagery strategies overlap in terms of the imagery operations they involve (see below), some ability with separate imagery as a strategy might be expected.

A more serious difficulty for a strategy account of the failure of imagery instructions in the present studies is that such a strategy account must deal properly with the fact that the failure of instructions at grade three is peculiar to imagery (not sentence) instructions. Moreover, other evidence suggests that a complex of imagery processes may be involved in the failure of instructions rather than the simple lack of a strategy. Pressley (1982) has argued that the failure of imagery instructions with younger children reflects the slower development of imagery processes because that age at which imagery instructions become effective varies as a function of the precise instructions and item modality. For example, much earlier effects of imagery instructions were obtained if the instructions require enactment of the interaction to be imaged (Pressley & Levin, 1976), or if instructions to use the images formed at study were given at retrieval (Pressley & Levin, 1980). Moreover, between-studies comparisons suggest that the ability to benefit from imagery instructions emerged later if the list items were words (for example, Begg & Anderson, 1976; Kemler & Juczyk, 1975; Pressley & Levin, 1977b) rather than picture or object items

(Danner & Taylor, 1973; Levin & Pressley, 1978; Varley, Levin, Severson & Wolff, 1974; Yuille & Catchpole, 1973) and within one study (Pressley & Levin, 1977b). Studies of the keyword mnemonic technique have also indicated that it is much easier to teach a sentence generation version of the keyword to younger children if the list items were words rather than an interactive imagery version (Pressley & Levin, 1978; Pressley, Levin & McCormack, 1982).

Pressley and Levin's study (1980) also indicated the complexity of the effects of imagery instructions, since imagery instructions were effective for younger children only if instructions to use the images formed at study were given at retrieval. Pressley (1982) went further in suggesting some of the complexity of the processes that may be involved in whether or not imagery instructions are effective for younger children. Pressley's suggestion was that the difference between the point at which sentence and imagery instructions become effective, and the differences for word and picture items learned under imagery instructions, may reflect factors in the development of imagery processes. Such processes might be the relative difficulty of translating words into images and combining them, and the number of operations involved in these processes.

Thus, more recent analyses of the effects of imagery instructions suggest, in short, that the failure of imagery instructions may reflect the relatively slower acquisition by the child of imagery processes. In that the present studies show for the first time that both interactive and separate imagery instructions

are ineffective for younger children, the case for interpreting such ineffectiveness in terms of imagery related processes is further strengthened. However, to say that imagery processes are still being acquired at the point where instructions are ineffective is not to say that the acquisition of these processes does not constitute part of strategy acquisition, but rather emphasizes that the processes being acquired in the case of imagery strategies may be quite complex. Thus, while a strategy account of the failure of imagery instructions at grade three is well supported by evidence from studies of memorial strategies, to be plausible, such an account must recognize the complexity of the processes involved and that at least two patterns of strategic operations are involved for interactive and separate imagery.

Recently, however, Rohwer and Litrownik (1983) questioned the adequacy of a strategy acquisition account of memory development, suggesting that differences in spontaneous strategy use may be related to changes in the capability to use such strategies rather than simply acquisition of the strategy. They demonstrated that younger, but not older, children failed to maintain the use of an experimentally taught elaborative strategy on more difficult transfer tasks. The results were interpreted as supporting the view that general changes in children's capability to use strategies (related to general developmental changes in cognitive abilities) underlie developmental differences in spontaneous strategy use. In terms of the present results, however, Rohwer and Litrownik's study does not,

in itself, explain why imagery related strategies are harder to teach younger children. Again, the need to distinguish between the types of strategy and the operations involved in them seems important.

One final difficulty with such an interpretation of the ineffectiveness of imagery instructions at the grade three level in Experiments 4-6 is that all other studies report imagery instructions are effective at an earlier age and certainly by grade three (for example, Begg & Anderson, 1976). Pressley's conclusion was that seven or eight is the critical age by which imagery instructions are reported to be effective, and grade three students' mean age in the present studies was 8 years 7 months. (Mean ages at grade three were: in Experiment 4, 8 years 7 months, with a range of 7 years 3 months to 12 years 10 months; in Experiment 5, 8 years 8 months, with a range of 8 years to 9 years 9 months; and in Experiment 6, 8 years 6 months with a range of 7 years 2 months to 10 years.) The one major difference between Experiments 4-6 and all other studies is that other studies did not include connectives linking the to-be-associated nouns. An alternative explanation of the failure of imagery instructions specifically at grade three in the present studies is that it may be harder to overlay imagery if the material already suggests a particular organization. Thus, the ineffectiveness of imagery instructions at grade three may reflect in part both inadequate acquisition of imagery processes and related strategies, and difficulty in overriding the memorial processing and consequent organization suggested by the material. The two might also be

expected to interact. Thus, the fact that separate imagery instructions (Experiment 6) seem less effective overall than interactive imagery instructions (Experiments 4 and 5) in overriding the effects of linking nouns with verbs or conjunctions, might be viewed as the result of the powerful effects in associative encoding of verbs versus conjunctions connectives, and lesser practice with separate imagery related strategies (because of their lesser usefulness) than with the processes involved in interactive imagery strategies.

The growth of metamemory. The concept of metamemory provides an alternative type of possible explanation for the ineffectiveness of imagery instructions for younger children. By 'metamemory' is meant knowledge about which strategies are appropriate to which task, knowledge about memory capacity and ability, knowledge about task characteristics, and sometimes, memory control processes (for example, Brown, 1975; Flavell, 1971; Flavell & Wellman, 1977). For example, the intention to remember has been identified as much less in younger children (Flavell, 1971; Kreutzer, Leonard & Flavell, 1975). Usually, however, the concept of metamemory has been applied to account for the stage at which, for example, imagery instructions are effective but the imagery strategies are not used spontaneously, rather than the stage at which instructions are ineffective and the strategy not yet acquired. As such, metamemory is probably to be identified to some extent with Rohwer's concept of elaborative propensity as governing individual differences in spontaneous strategy use, or

cross situational differences in spontaneous strategy use at a given age level.

A simple metamemorial explanation of the failure of imagery instructions to be effective with younger children might be that younger children do not understand the importance of following the instructions, while explicit prompts such as verb connectives or interactive depiction do part of the work required for relational encoding for the child and, in a sense, force relational encoding. The difficulty, however, that arises is that it would again seem clear that any such metamemorial explanation of the ineffectiveness of imagery instructions for younger children must again be tied to imagery related processes because sentence instructions are effective in many studies as early as explicit prompts. Hence, no simple metamemorial explanation in terms of failure to follow instructions would seem adequate. Thus, Pressley and Levin (1980) showed that imagery instructions were ineffective for younger children unless the importance of using the images previously formed was explained at retrieval, and recent evidence indicates that such inadequacies at retrieval may emerge even with interactive depiction (Pressley & MacFadyen, 1983). Pressley (1982) has, therefore, suggested that metamemory related to imagery processes may be deficient in younger children, and may account for the failure of imagery instructions to be effective for younger children, as in the present studies.

Initial studies attempting to correlate metamemorial knowledge to performance have produced low to insignificant

correlations (Cavanaugh & Perlmutter, 1982). Nevertheless, more recent evidence does indicate significant correlations of metamemory, strategy use and performance, although the relationship is clearly complex (Borkowski, Peck, Reid, & Kurtz, 1983; Kurtz & Borkowski, 1984; Waters, 1982), but again at age levels where instructions are effective and the major issue is spontaneous strategy use. For younger children, the best evidence for metamemorial factors in the effectiveness of instructions would seem to be that if metamemorial instruction is combined with teaching memorial strategies, much better transfer of training has been obtained than is usually the case (Black & Rollins, 1982; Kendall, Borkowski & Cavanaugh, 1983). Recently, Borkowski (1983) has suggested that elaborative transfer is related strongly to metamemorial factors. In summary, therefore, recent studies suggest that metamemorial factors may account, in part, for the ineffectiveness of imagery instructions with younger children, together with acquisition of memorial strategies involving imagery processes.

General Conclusions

Experiments 4-6 indicate that interactive imagery instructions bring the associative recall of nouns linked by conjunctions up to the level of nouns linked by verbs, that separate imagery reduces the associative recall of verb linked nouns to the level of nouns linked by conjunctions and that both of the former conclusions hold true only for older children. These findings support both the view that the form class effect reflects differences in the encoding

of relational information and suggest an interpretation in terms of the processing of relational information and consequent differences in memorial organization. Because of the demonstration of parallels between the effects of verb connectives and interactive imagery instructions, these results are somewhat problematic for purely linguistic accounts of the superiority of nouns linked by verbs in associative recall.

The developmental finding is more difficult to interpret because of the variety of possible explanations suggested in the literature. In general, the literature would appear to provide the most support for the view that the ineffectiveness of both types of imagery instructions with younger children, and their efficacy in older children, reflects the acquisition of memorial strategies, and also, to some extent, the acquisition of metamemorial knowledge. In either case, however, it would seem that the kind of strategies being acquired and any metamemorial knowledge must involve specifically imagery related processes. The results of Experiments 4-6, however, may also be seen as problematic for a strategy acquisition account of the phenomena observed in certain respects.

If the effectiveness of instructions at grade three reflects the fact that imagery related strategies have not been acquired, while their efficacy for older children reflects acquisition of such strategies, such an account still does not explain why explicit elaborative prompts such as linking nouns with verbs or depicting their referents interactively produce enhanced associative recall for both younger and older children. Additional assumptions are

required to explain why verb connectives or interactive depiction prompt relational encoding if the memorial strategy which interactive imagery instructions elicit has not been acquired at grade three level. The possibility that such explicit prompts afford mediators ('event knowledge') which children otherwise lack would also seem not to be an adequate account of the effects of linking nouns with verbs or prepositions. Finally, since the criterial age at which imagery instructions are reported by other studies to be effective appears to be less than the mean age at the grade three level in the present studies, it was noted that it may be harder to override the usual processing and organization with imagery instructions if the material already suggests a particular type of organization.

V. DIFFERENT TYPES OF PREPOSITIONS DIFFER
IN THEIR LINKING ABILITY

General Introduction

Outline of Experiments 7, 8 and 9

The specific question addressed in the present studies is, as stated in Chapter I, why children's associative recall of nouns linked by verbs or prepositions is superior to their recall of nouns linked by conjunctions or nouns presented without any connective. The more general question concerns what an investigation of verb or preposition superiority in children's (but not adults') recall implies about children's memory as opposed to adult memory processes. To this point, Experiments 1-6 have established four major findings about the superiority of nouns linked by verbs in children's associative recall. First, the superiority of verb linked nouns is limited to measures of associative recall, which was interpreted as consistent with the view that verbs lead to the encoding of more information relating the items they link than conjunction connectives. Second, interactive imagery instructions bring the recall of conjunction linked nouns up to the levels of nouns linked by verbs and separate imagery lowers recall with verb linked nouns to the level of nouns linked by conjunctions. The parallel effects of imagery instructions and verb and conjunction connectives are interpreted as suggesting a need

for an account of the form class effect in terms of the processing of relational information and consequent differences in organization, rather than in terms of characteristics peculiar to verb connectives. Fourth, imagery instructions of either type failed to eliminate differences between verb and conjunction linked nouns at the grade three level. Various possible explanations of the ineffectiveness of imagery instructions at the grade three level were considered in the preceding chapter.

However, the specific question addressed by the present studies remains, in part, unanswered. Given that linking nouns with verbs does lead to the encoding of more information relating the to-be-associated items, and that, for older children, imagery instructions do have parallel effects suggesting a processing-organizational account, the specific question remains: what is it about verb or prepositional connectives which causes children to encode more relational information? The literature suggests a number of possibilities.

(1) Linking verbs elicit a strategy. It might be suggested, on the basis of the growing body of evidence for strategy acquisition and use, that verb connectives elicit the use of a strategy. Rohwer's developmental elaboration position ('the older the learner, the less explicit the prompts need to be for elaboration') implies that younger children require 'explicit prompts' (such as linking verbs) because younger children have not yet developed the strategies elicited by instructions in older children, the evidence

for this view being the ineffectiveness of (imagery) instructions for younger children together with the considerable efficacy of explicit prompts at the same age. However, it is now clear that sentence instructions are often effective as early as linking nouns with verbs in promoting associative recall, and some earlier studies which failed to show early effects of sentence instructions may be misleading (see above). Therefore, it might be the case that verb connectives, like sentence instructions, elicit the same strategy (although, in the latter case, the child has to perform some additional operations like generating a linking verb). Moreover, the implications of the present view of the form class effect are that the processing and organizational consequences of verb connectives and (interactive) imagery instructions are identical, at least for older children. To the extent that processing at encoding and its organizational consequences may be considered part of a memorial strategy, the present studies likewise suggest that the effects of verb connectives and sentence instructions (hypothesized to elicit strategy use) involve some of the same strategic operations, or at least some components of strategies.

The problem with such a strategy explanation of the form class effect is that it does not go far enough. Such a strategy account does not indicate what it is about verb connectives which elicits joint or relational encoding, and what it is about linking prepositions which produces a variety of results from equivalence in associative recall to verb connectives to no better associative

recall than for conjunctions, and why conjunction connectives produce no better relational encoding than presenting the to-be-associated items without any connectives. In fact, consideration of the present specific question as to why different types of connectives differ in their linking ability points to a weakness in the strategy account; namely, why does generating a sentence help recall? Therefore, while 'explicit prompts' (verb connectives, prepositional connectives, interactive or locational depiction) may well elicit operations in processing or organization which are identical to some operations, or components, involved in the strategies elicited by instructions, the question remains as to why different prompts produce different levels of associative recall.

(2) Verbs 'prompt' or 'impose' elaboration. Rohwer's explanation of the effects of explicit prompts is that they 'prompt' or 'impose' elaboration. Again, however, this suggestion is not really an explanation of what it is about, for example, verbs or prepositions, that 'prompts' elaboration. Similarly, in the present studies, phrases such as 'suggesting items go together' have been used to describe verb connectives, while conjunctions have been described as 'poor relational organizers'. The implications of the use of all of these terms is that there are some aspects or characteristics of certain prompts which elicit certain types of processing and organization. Moreover, during the course of elaboration research, the parallels between the effects of the

various types of depiction and verb, preposition and conjunction connectives have been repeatedly noted. Just as the parallels between the effects of covarying imagery instructions and connectives in the present studies suggest the need for a processing-organizational account which will encompass both sets of phenomena, so the parallels between the effects of depiction and connectives suggest the need for an explanation which will encompass both of these groups of phenomena as well.

(3) Verbs elicit action images. Earlier Rohwer suggested that both connectives and pictorial translations of sentences, prepositional and conjunctive phrases elicited different types of imagery which differed in its memorability (Rohwer, 1970). In terms of the imagery hypothesis, interactive images were more memorable than locational images, which, in turn, were hypothesized to be easier to remember than separate, side by side, images. The present studies and others suggest that imagery instructions produce superior item specific encoding, but vary considerably in terms of the encoding of relational information as a function of the type of imagery. To the extent that imagery instructions can be assumed to elicit imagery, Rohwer's imagery hypothesis is inadequate because it does not distinguish between memory for relational and item specific information. Hence, the imagery hypothesis does not specify limitation of the form class effect to associative recall, and also does not specify the differing effects of types of imagery on memory for relational and item specific information (see Chapter

III). Nevertheless, the hypothesis did lead Rohwer to attempt to identify what aspects of linking verbs were important in producing better (associative) recall. Rohwer and Levin (1968) compared, on the basis of the imagery hypothesis, verbs implying 'action' and verbs implying less action ('still' verbs) between the referents of the items they linked, but found no differences in recall.

In the same way, the objective of the third set of studies (Experiments 7-9) is to clarify what is meant by saying that verb or preposition connectives 'prompt elaboration' or 'suggest the items go together' by comparing the effect of the extent to which verbs and prepositions suggest spatial proximity between the referents of the items they link. The rationale for hypothesizing that the degree of spatial relationship is critical for relational encoding in children is as follows. First, studies of depiction indicate that depicting the referents of items in a spatial ('locational') relationship reliably exceeds separate, side-by-side, depiction of the referents ('coincidental depiction'). Second, linking nouns with prepositions produces variable results from recall levels as good as those observed with nouns linked by verbs to, in a few studies, no better than those observed for conjunction linked nouns. But, quite obviously, some prepositions imply spatial proximity (for example, 'in' and 'on') and others imply less proximity (for example, 'near' and 'by'), and some prepositions do not imply a spatial relationship at all. In fact, studies of nouns linked by prepositions have mixed together the various sorts of prepositions, with the above noted inconsistent results in recall levels. Third,

a number of other studies of young children's memory suggest spatial proximity or a spatial relationship as a factor governing children's relational encoding. Thus, the present hypothesis is that one of the dimensions critical to 'prompting elaboration', that is, eliciting relational encoding by children, is spatial proximity.

Accordingly, three studies compared the degree of spatial proximity implied by verbs or prepositions linking nouns about the referents of the items they linked. Experiment 7 examined children's associative recall of a list of nouns linked by verbs implying spatial proximity ('have' and 'hold') and verbs implying less spatial proximity ('like' and 'want'). Experiment 8 studied children's associative recall of nouns linked by prepositions implying a high degree of spatial proximity between referents of nouns ('in' and 'on'), and recall of nouns linked by prepositions implying little spatial proximity ('near' and 'by'). Experiment 9 was a replication of Experiment 8, using a different subject population and a wider sample of grade levels.

Expectations Based on the Present View of the Form Class Effect

The present view of the form class effect can be stated more fully at this point to clarify a number of issues including some of the developmental issues raised in Chapter IV.

(1) Younger children tend to encode less relational information than adults and so encode more items separately rather than jointly,
when arbitrarily-paired familiar items are to be associated (cf.

Ackerman, 1982a). Numerous studies indicate clear developmental gradients are present in associative recall across grade school through at least middle adolescence in control conditions in which the task is simply to associate arbitrarily-paired or grouped words or pictures, particularly when prompts such as linking verbs or interactive depiction or imagery or sentence instructions are not available (for example, Rohwer & Bean, 1973). Reduction in the efficacy of prompts relative to non-elaborated controls reflects improvements with age in relational encoding; that is, adults tend to encode to-be-associated items relationally more effectively than children, and with age, prompts are increasingly unnecessary. Whether the improvements with age in associative recall are due to metamemory, strategy acquisition, changes in elaborative propensity, or the acquisition of event knowledge, the bottom line is that as children grow older, they tend to encode items jointly or relationally to a greater extent. The corollary is that children tend to encode items separately more than adults, particularly in the absence of explicit or minimally explicit prompts.

(2) Experiments 1 and 2, together with other studies, suggest that linking verbs or prepositions 'prompt' or 'impose' elaboration in the sense that they elicit more joint encodings of the items they link. The results of Experiments 4 and 5 also suggest that interactive imagery instructions elicit more joint encodings. The general conclusion from these findings and many other studies is that children's tendency to encode items separately is reduced by 'explicit

'prompts' (verb or preposition connectives, interactive or locational depiction) or by 'minimally explicit prompts' (imagery or sentence instructions).

In contrast, the effect of separate imagery upon the form-class effect implies that conjunction connectives or separate imagery instructions do not improve children's associative recall because they do not reduce children's greater tendency to encode items separately. Similarly, coincidental depiction does not enhance children's associative recall. The difference between the connectives which do enhance recall and those which do not, and between pictures of item referents which enhance or do not enhance recall, is that 'prompts' provide a relationship between the referents of items, while conjunction connectives or coincidental depiction do not provide a relationship. Similarly, interactive imagery instructions and sentence instructions encourage children to form subjective links between the referents of items, that is, generate a relationship between item referents, while separate imagery instructions discourage the formation of any relationship between item referents.

(3) Verb or preposition connectives provide a relationship between items, and this provision of a relationship is what elicits joint encoding. The idea that prompts provide a relationship is not to be confused with Rohwer's suggestion that explicit prompts afford mediating information which children otherwise lack. While children do acquire increasing knowledge of the world which can serve as a basis for relating items together in memory, the

acquisition of 'event knowledge' cannot fully explain the effects of linking verbs if sentence instructions often produce effects as early and as large as verb connectives. What is meant by saying that linking verbs or prepositions provide a relationship is that the verb or preposition implies a relationship between the items so linked. The presence of an implied relationship between the referents of items is what elicits joint, rather than separate, encoding. In summary, children tend to encode items relationally less than adults, and this tendency is reduced by presenting the items in a relationship or by giving instructions to construct a relationship (construct subjective links) between the referents of the items.

(4) The type of relationship implied by explicit prompts including connectives is important in determining the amount of relational or joint encoding elicited. It is clear that not all types of relationships produce the same levels of relational encoding. For example, nouns linked by verbs usually exceed nouns linked by prepositions in associative recall, and interactive depiction of the referents of items exceeds depiction of the items in a spatial relationship. The implication of the observation that not all relationships between items (or more correctly, the relationships implied between the referents of items) produce the same recall levels is that it is insufficient to say that the presence of a relationship between items produces more relational encoding by children. Not only are some relationships more effective than others in producing joint encoding, but the suspicion then is that some relationships may

not enhance relational encoding. Therefore, if linking verbs or prepositions elicit differing levels of relational encoding because they imply relationships between the referents of the items they link, the question remains as to what exactly is important about the relationship, or what kinds of relationships enhance children's relational encoding.

(5) Certain dimensions in relationships seem to be important in influencing the degree of relational encoding.

(a) Implied relationships. The terms 'suggesting relational encoding', 'suggesting items go together' and Rohwer's 'prompting elaboration' have all been used to describe the enhancement in associative recall observed for children when nouns are linked by verbs or prepositions, item referents are interactively or locationally depicted, or instructions are given to generate sentences, or interactive images, of item referents 'doing something together'. Moreover, numerous parallels between the effects of connectives, depiction, sentence, and imagery instructions have been noted here and in many other studies. Across the range of 'prompts', however, certain dimensions seem to be critical for children's relational encoding. The first is the degree to which interaction is suggested between the referents of to-be-associated nouns or pictures. Thus, interactive depiction, interactive imagery, sentences describing interactions, verb connectives (which imply interaction), and interactive manipulation of object items all produce superior levels of associative recall relative to various 'non-elaborated' controls.

The second common dimension is a spatial relationship or spatial proximity. Locational depiction and prepositional connectives all produce superior associative recall in children, but in general, are inferior to interactive depiction or linking verbs. Moreover, Begg and Sikich (1984) have shown that for adults, interactive imagery exceeds spatial-relational imagery instructions which exceed separate imagery instructions for associative recall levels. Although there is not yet any study of spatial-relational imagery instructions in children, since (i) interactive imagery produces enhanced recall for children compared with separate imagery, and (ii) children's control condition performance is more like that observed with separate imagery instructions (Begg & Anderson, 1968; Experiment 6 above), it seems likely that for children both interactive and spatial-relational imagery instructions would enhance recall compared with non-elaborated controls, with spatial-relational imagery inferior to interactive imagery.

Therefore, in short, it would seem that children are more likely to encode items jointly if interaction or a spatial relationship is implied by the material, or generated as a response to elaboration instructions. Thus, 'prompting', 'providing', or 'imposing' elaboration would appear to refer to the degree of interactivity or spatial relationship which elaborative prompts imply between item referents. It would seem that children's relational encodings are relatively more influenced than those of adults by whether or not interaction or a spatial relationship is implied

between the referents of to-be-associated items, or generated as a response to instructions.

(b) Actual relationships. Moreover, evidence from quite different studies of children's associative memory also implicates interaction in the real world and actual spatial relationships as primary determinants of whether or not items are relationally encoded by children. Bender and Levin (1976) showed that instructions to enact interactions between object items produced superior associative recall for younger children, for whom instructions to form interactive images were ineffective. Horowitz and Lampel (1969), using a spatial display of pictures or objects, and presenting all the items but one as a cue, found that nursery school children's associative recall was based on interactivity (depiction of objects in an interaction), spatial proximity and temporal contiguity. Interactive conditions exceeded simultaneous serialization (side-by-side and simultaneous), which exceeded temporally serialized presentation of items. In cued recall, Perlmutter and Ricks (1979) showed the effects of interactivity, spatial and temporal contiguity. For younger pre-school children, simultaneous, side-by-side presentation of items did not help recall, but by age four simultaneous, side-by-side presentation helped recall cued by colour or attribute considerably. These studies also suggest that temporal contiguity (which is usually confounded with interactivity or spatial proximity) may also be an important factor governing children's relational encoding. However, these studies and others also indicate that the effects of interactivity and spatial

proximity cannot be explained simply in terms of contiguity.

Free recall studies in which measures of association are examined (for example, clustering measures) also indicate the role of spatial proximity as a factor governing relational encoding. Baumeister and Smith (1979) showed that in the free recall of pictorial items, although explicit semantic themes were used as a basis for organization at grade five, spatial proximity was also an important factor at the grade five level, and the only basis for organization for preschool children. Similarly, Perlmutter, Sophian, Mitchell and Cavanaugh (1982) found that category cues helped preschool children's free recall of words, as previous studies have shown, but that categorically unrelated cues only helped recall if they had been presented simultaneously in a side-by-side position to the to-be-remembered items. Spatial factors in organization are also implicated in a study by Garrison (1980), who studied free recall of pictures presented spatially blocked by categories or blocked by noncategories. Although no purely spatially based organization was found in four or six-year-olds' recall, Garrison concluded that even six-year-olds' use of organization is closely linked to spatial arrangement. Also, Frankel and Rollins (1982) found evidence for associative clustering in free recall based on spatial proximity rather than categories.

Finally, object sorting studies may be interpreted as indicating the dimensions for organization which are most salient or most used by children in the world, and may, thus, be also the basis

for organization in memory. Object sorting studies indicate a powerful role of spatial factors upon organization, particularly if spatial factors are salient (for example, Markman, 1981). In addition, much evidence indicates that children are familiar with taxonomic categories (for example, Saltz, 1972) and are able to use them in cognitive tasks (Smiley & Brown, 1979), but prefer to organize items on the basis of complementarity rather than taxonomic criteria. By 'complementarity' (Denney, 1974) is meant that organization proceeds on the basis that objects share some relationship in the child's past experience or in the experimental situation. The present view of children's memory for relational information suggests, essentially, that memorial organization (joint encoding) is strongly influenced by whether or not to-be-associated items share some relationship implied by the material as presented. Thus, the parameters used as a basis for organization by children in object sorting appear to be very similar to the parameters used by children as a basis for relational encoding in memory. Both sets of observations suggest the importance, or perhaps salience, of certain parameters for children as the basis for organization, whether in the world or in determining joint or separate encodings.

In conclusion, the expectation in Experiments 7-9 is that to the extent that the degree of spatial relationship implied by connectives about the referents of the items they link is important, spatially joining verbs should produce better associative recall than verbs less suggestive of a spatial relationship, and spatially joining

prepositions should exceed spatially separating prepositions.

Expectations based on other views of the form class effect

The present expectations are quite consistent with the elaboration position, although going further than Rohwer in suggesting at least one specific dimension which is hypothesized as important in determining whether or not children jointly encode items. The rationale for identifying the important dimensions for relational encoding is based, in part, upon the earlier imagery hypothesis of Rohwer, although it is specified here that the effect is in associative encoding. Expectations based on the imagery hypothesis would be that differences should be found in recall as a function of the degree of spatial relationship (based on parallels with locational depiction) but not for verb connectives since action was hypothesized to be the critical factor. With regard to the suggestion that prompts afford event knowledge, there would seem to be no particular reason to expect differences as a function of the degree of spatial relationship implied by the connectives about the referents of the nouns they link. The present expectations are clearly contradictory to any linguistic account based on the grammatical form class of the connective, such as Rohwer's earlier deep structure hypothesis. The deep structure hypothesis predicts that associative recall should be a function of the grammatical form class of the connective and predicts no differences as a function of the degree of spatial relationship implied within a form class.

The present expectations also seem problematic for Ackerman's view that children's greater tendency to encode items separately reflects accessing the semantic system in terms of individual items. It would not seem clear what effect the degree of spatial relationship implied by connectives about the referents of the nouns they link should have upon access to the semantic system. The lack of clarity for the Ackerman suggestion derives from the assumption that integration instructions are essential to produce joint encoding by children. In contrast, the present view assumes that if the material suggests a (certain) type of relationship, this is sufficient to promote joint encoding by children.

Other studies

While nouns linked by verbs reliably exceed nouns linked by conjunctions in children's associative recall, nouns linked by prepositions sometimes are as well recalled as verb linked nouns (Rohwer & Lynch, 1967), sometimes intermediate (Rohwer, Lynch, Suzuki & Levin, 1967) and, rarely, as poorly recalled as nouns linked by conjunctions (Rohwer & Lynch, 1967). From the present view, the varying results obtained with prepositions reflect the use of a mixture of prepositions which imply a close spatial relationship and prepositions which imply less spatial proximity.

Other studies suggest, however, that while spatial proximity or the degree of spatial relationship is an important dimension for depiction and probably for prepositions, the dimension important for verbs in producing enhanced recall may be more complex than simply

spatial proximity or the degree of spatial relationship. Based on the parallels with depiction, the difficulty is that interactivity may also be important, in that, interactive depiction reliably exceeds locational depiction (see above). To the extent that the hypothesis that spatial proximity is the critical dimension for prepositions is based on the parallels with locational depiction and what is implied by such depiction about the referents of items depicted (that is, a spatial relationship), the superiority of interactive over locational depiction suggest that, for verbs, other dimensions may also be important. Therefore, the present hypothesis that an implied (close) spatial relationship is an important dimension in prompting relational encoding by children is most directly tested by comparing different types of prepositions. Previous studies suggest that the present hypothesis may not be supported for verb linked nouns because other dimensions such as the degree of interactivity implied may be also, or more, important.

The effect of the degree of action implied by verb connectives was tested by Rohwer and Levin (1968). Identification of 'action' as the critical dimension underlying the superiority of verb linked nouns in recall was based upon the imagery hypothesis proposed by Rohwer, that

... conjunction connectives evoke a static image, preposition connectives a static image of two objects in a particular locational arrangement, and verb connectives give rise to a dynamic or action image of some episode involving the two objects (Rohwer, 1970)

Thus, the important dimensions in that view for verbs would be action,

and for prepositions spatial location.

Rohwer and Levin compared cued recall after sentence context in which verbs were 'action' or 'still' (as classified by adult experimenters without any pilot study). Cued recall after sentences such as "Roses drink rain" and "Roses like rain" was compared, but the two conditions did not differ. The possibility, therefore, remains that the degree of spatial relationship implied by verb connectives may be important (tested in Experiment 7), or perhaps the degree of interactivity implied.

Experiment 7

The first experiment in this series attempted to find, like Rohwer and Levin, differences within verb connectives. If the degree of close spatial relationship implied by verbs about the referents of the items they link is the critical factor in producing differences in relational encoding, verbs which imply a close spatial relationship should lead to superior recall to that produced by verbs which imply less spatial proximity. In fact the attempt was unsuccessful.

Method

Design and materials. In a $2 \times 3 \times 3$ factorial design, the effects of verbs judged by the experimenter to imply more or less spatial contiguity were compared as connectives in sentence contexts at grade levels 3, 6 and 8. All recall was cued, and cues were either the first noun or first noun plus verb. A single list of 12 pairs of nouns selected from a grade 2 word list was employed (table 11, page 227). The verbs used to link the nouns were 'push' and 'hold' (judged spatially joining), and 'like' and 'want' (judged not to imply as much spatial proximity), and the conjunctions used were 'and' and 'or'. All subjects were presented with the list with two different connectives, but which connective was used for which pair was reversed for half the subjects.

Subjects. Forty-eight grade 3, 6 and 8 (total 144) children served as subjects. Equal numbers of grade 3 and 6 children were drawn at random from the total within grade populations of two public

elementary schools serving middle socio-economic status areas. Grade 8 students were drawn from the junior high fed by the two elementary schools in the City of Brantford, Ontario.

Procedure

Each treatment group consisted of 8 subjects assigned at random from the sample for each grade. Noun pairs were presented using a slide projector at a 5 second rate and elaboration plus nouns was concurrently read aloud by the experimenter. Regular pair learning instructions were given to all subjects. On the test trial, half the subjects were given a list of first nouns as cues, and half received a list of first nouns plus linking verb as cues.

Results

The mean number of second nouns recalled is shown in table 7. By inspection it is clear that there is no difference between the two types of verb connectives in associative recall, but both conditions were superior to the conjunction condition. In a $2 \times 3 \times 3$ factorial analysis of variance, these impressions are confirmed. The main effects of connective, $F(2, 126) = 22.50$, and grade, $F(2, 126) = 13.80$, were reliable, and no other effects attained significance. Scheffé tests indicated that both verb conditions were superior to the conjunction condition, $F(1, 126) = 45.88$ and $F(1, 126) = 36.55$, and did not differ themselves.

TABLE 7

MEAN NUMBER OF NOUNS IN CUED RECALL AS A FUNCTION OF GRADE, TYPE OF CONNECTIVE AND CUE IN EXPERIMENT 7.

	Conjunction		Separating Verbs		Joining Verbs	
	Noun only cues	Noun plus verb cues	Noun only cues	Noun plus verb cues	Noun only cues	Noun plus verb cues
Grade 3	4.3	5.4	7.4	8.3	8.0	8.8
Grade 6	7.1	7.4	9.9	9.0	9.4	9.5
Grade 8	6.4	9.1	9.9	11.6	9.5	8.9

NOTE: All means are out of a possible total of 12. Standard deviations range from 0.9 to 3.1.

The results, therefore, do not support the view that the degree of close spatial relationship implied by linking verbs is an important determinant of the superior cued recall produced by sentence context. Both verbs judged spatially joining and those judged spatially separating produced equivalent levels of associative recall, and were superior to the recall levels for nouns linked by conjunctions. It may also be noted that, consistent with the view that verb or preposition connectives are sufficient for children to jointly encode items, and contrary to Ackerman's (1982a) findings, both first nouns and whole sentences less target nouns functioned equally well as cues. Clearly, however, the degree of spatial relationship implied by linking verbs about the referents of the

items they link is not the critical factor in verb superiority in associative recall.

Experiment 8

While the degree to which verbs imply a close spatial relationship between the referents of the items they link does not appear to be the important factor for verbs, it may still be the critical factor for prepositions. In fact, that the degree of spatial relationship is important for prepositions might seem more probable because prepositions can clearly and explicitly describe such spatial relationships. As noted in the introduction, other evidence does suggest that verbs may well involve other factors such as interactivity, for which there is independent evidence that it promotes relational encoding. Therefore, the effects of linking nouns with prepositions implying a close spatial relationship and prepositions which implied less spatial proximity were compared in two studies.

Method

Design and materials. In an incomplete 3×3 factorial design, the effects of connective (conjunction, separating preposition and joining prepositions) were compared at three grade levels (3, 6, and 8). Due to an inadequate number of grade 8 subjects, the grade 8 conjunction control condition had to be omitted. A single list of 14 pairs of concrete nouns was given to all subjects. The words were randomly selected from a grade 2 word list. Apart from the need for meaningful prepositional phrases, pairing was random (table 12, page 228).

Subjects. A total of 80 subjects was drawn in three separate samples, from three different parochial schools, randomly from the total

within grade population except that sexes were equal in number. The grade 3 sample (30 subjects) was drawn from a school serving a high socio-economic status suburban population. The grade 6 sample (30 subjects) was drawn from a school serving a lower middle socio-economic status urban population and the grade 8 sample (20 subjects) from a school serving a low socio-economic status urban population. This method of sampling was adopted by necessity rather than choice and confounded grade with socio-economic status/school, as well as omitting the grade 8 control group.

Procedure

Each treatment group consisted of 10 subjects assigned at random from the sample for each grade. At the grade 8 level, only 2 treatment groups were formed (the conjunction condition was omitted). Noun pairs were presented using a slide projector at a 5 second rate and elaboration plus nouns was concurrently read aloud by the experimenter. Regular pair learning instructions were given to all subjects. All other aspects of the procedure are identical to that followed in Experiments 1-4.

All recall was cued using response sheets consisting of a list of cues (phrases less the second noun in each pair). Cues were listed vertically down the sheet in a different random order from the presentation order.

Results and Discussion

In view of the incomplete factorial design, the data (number :

of second nouns correctly recalled) were analyzed in two separate ways to answer the two questions of interest. Means for each treatment group are shown in table 8. In the first analysis, only the preposition groups were considered. The purpose of this analysis was to test the prediction of central interest that performance with joining prepositions would exceed that with separating prepositions.

TABLE 8
MEAN NUMBER OF SECOND NOUNS RECALLED AS A FUNCTION OF GRADE, AND TYPE OF CONNECTIVE IN EXPERIMENTS 8 & 9

	Conjunction	Separating Prepositions	Joining Prepositions
Experiment 8			
Grade 3	2.7	5.7	6.9
Grade 6	3.3	4.7	7.4
Grade 8		7.1	10.4
Experiment 9			
Grade 3	6.1	8.4	11.9
Grade 6	3.7	3.8	9.0
Grade 8	7.3	7.6	12.3

NOTE: Means are out of a possible total of 14. Standard deviations range from 1.8 to 4.2.

A 2 x 3 factorial analysis of variance, therefore, compared the effects of the two types of prepositional phrase across the three grade levels. Performance with joining prepositions exceeded that with separating prepositions, $F(1, 54) = 12.37$. The main effect of

grade was also significant, $F(2, 54) = 6.34$. The interaction of grade with connective was, however, nowhere near significant, $F(2, 54) = 0.84$.

The second question examined in the analysis was whether separating prepositions facilitate relative to the conjunction control condition. A 2×3 factorial analysis of variance was therefore used to examine the effects of the three types of connective at grades 3 and 6. The only effect to attain significance was that of connective, $F(2, 54) = 13.39$. Orthogonal comparisons of treatment means indicated that the separating preposition condition was superior to the conjunction control condition. Before discussing these results, however, the results of Experiment 9 will also be reported, since it was essentially a replication with a complete factorial design of Experiment 8.

Experiment 9

In a second study, the effects of spatially joining and spatially separating prepositional connectives relative to a conjunction control were again compared at grades 3, 6, and 8. This time it was possible to obtain enough subjects to complete the factorial design. One difficulty in the first study concerns the possibility that the joining prepositions, 'in' or 'on', when presented with the first noun as a cue might exert more semantic constraint on the number of appropriate response nouns. Although this hypothesis was tested in Experiment 3 and by Rohwer and Lynch (1967) both studies concern nouns linked by verbs, not prepositions. In addition, it was the case in Experiment 7 that 'in' and 'on' could not be combined with all response nouns meaningfully, and this was not the case for the separating prepositions 'near' and 'by', which could be combined with any of the response nouns. Therefore, a new list was constructed for Experiment 9 in which any of the prepositions could be used to link any of the pair of nouns to produce a meaningful phrase (table 13).

Method

Design and materials. The design was identical to that of Experiment 8, except that a conjunction connective condition was included at the grade 8 level. Each experimental group was split such that a given connective was used for half the subjects, while the remaining subjects received the alternate connective within their condition. Prepositional phrases used are shown in table 13, p. 229.

Subjects. Thirty children were selected at random from the total within grade population at each of grades 3 and 6 from two public schools serving an urban middle socio-economic status population. Thirty grade 8 students were similarly drawn from a single senior public school, which was the school fed by the elementary schools sampled. Ten subjects were randomly assigned to each connective treatment group, except that each group had equal numbers of males and females. Other aspects of the procedure were identical to Experiment 8.

Results and discussion

The mean number of second nouns recalled are shown for each treatment group in table 8. As predicted, performance was better with joining prepositions than separating prepositions, as in Experiment 8. Unlike Experiment 8, however, separating prepositions did not produce any superior performance to the conjunction control condition. In a 3×3 factorial analysis of variance, the effects of connective, $F(2, 81) = 33.2$, and grade, $F(2, 81) = 15.9$, were reliable. Performance with joining prepositions exceeded that with separating prepositions and conjunctions, which did not differ.

Thus, for both Experiments 8 and 9, prepositional connectives implying spatial proximity between the referents of nouns in a pair produced superior recall relative to prepositional connectives implying little or no spatial proximity between item referents. These results hold across several different school populations, and whether or not any response noun can be meaningfully combined with any first

noun plus prepositional cues.

The only alternative explanation of the present data would seem to be in terms of age of acquisition. If prepositions such as 'near' and 'by' are acquired later than prepositions like 'in' and 'on', this would account for the differences. Inspection of table 8 does not support such a view, because it would predict that the difference between spatially joining and spatially separating prepositions should decrease with age, and there is no evidence to support this.

The results of these studies (Experiments 8 and 9) would seem on the whole consistent with the predictions made on the basis of an organizational account of the facilitating effect of prepositional connectives. The only result that is inconsistent is the finding that separating prepositions exceeded the conjunction control in Experiment 8. This was not the case, however, in Experiment 9 in which a grade 8 conjunction control was also included. In view of the more complete factorial design of Experiment 9, it would seem reasonable to give these results somewhat more weight, and to conclude, on the whole, that the results of these studies generally support the hypothesis tested. A possible explanation of the results in Experiment 8 is that cohort effects may not have been well controlled, in that all subjects at a particular grade were tested within one small school. In the second study, subjects at grades 3 and 6 were drawn from two separate schools, and all experimental conditions run in each, which is preferable in terms of possible cohort effects.

General Discussion and Conclusions

The results of Experiments 8 and 9 confirm the hypothesis that the degree of spatial proximity or spatial relationship implied by prepositions about the referents of the nouns they link is the critical dimension leading to superior recall. Different sorts of prepositions differ in their linking ability, and the form class effect is not an effect of the grammatical form class of the connective, but rather of certain types of relationship implied by connectives about the referents of the items they link. That the level of associative recall observed for nouns linked by prepositions depends on the degree of spatial proximity implied by prepositions about the referents of the items they link supports the conclusion that preposition connectives 'prompt elaboration', or 'elicit relational encoding', because they provide a certain type of relationship.

The degree to which verbs imply spatial proximity between the referents of the nouns they link is clearly not the important factor in determining relational encoding for verb connectives. However, considerable evidence from the studies of depiction, imagery instructions and other studies of children's associative memory suggests that interactivity may also be an important relationship influencing relational encoding. In that (i) verb connectives usually produce better recall than preposition connectives, (ii) interactive depiction exceeds locational depiction and (iii), interactive imagery instructions exceed spatial relational instructions (at least for adults), it would seem to be a strong possibility that verbs may lead

to superior associative recall because they imply a relationship of interactivity between the referents of the items they link.

Interaction, as operationally defined by pictures of the referents of items interacting, or instructions to generate images of interactions, or actual interaction between items, would seem to entail attributes of action, spatial proximity and temporal contiguity. Separating out particular attributes, such as spatial proximity, might not then be sufficient to reduce the overall degree of interaction implied by verb connectives. The failure of Experiment 7 to show any differences between verbs in terms of their linking ability as a function of the degree of implied spatial proximity may well be, therefore, a failure to control for other attributes of interactivity. Likewise, Rohwer and Levin's failure to show differences in the linking ability of verbs as a function of the degree verbs imply action may also reflect the fact that the important relationship implied by verbs, as well as by interactive depiction and interactive imagery instructions, is interactivity.

In fact, some of the same verbs were selected in Experiment 7, and also in the Rohwer and Levin study, as being respectively, 'still' and 'separating' verbs (for example, 'like' and 'see'). One way of interpreting this cross classification is that the distinction between 'action' and 'spatial proximity' was not clear even to the experimenters. Thus, it is not clear that 'like' does not imply interactivity. A further possibility, related to the first, is that no pilot studies were carried out to determine whether or not children

understood the verbs in the same way as the experimenters who categorized them on the activity and spatial dimensions. There might be a real possibility that younger children may understand 'like' as more like 'hug', that is highly and concretely interactive, or active, and implying spatial contiguity.

Nevertheless, the clear finding from Experiments 8 and 9 is that nouns linked by prepositions are better recalled because of the type of relationship prepositions imply about the referents of the items they link. Thus, if prepositions imply a close spatial relationship between the referents they elicit more encoding of information relating the items together in memory. Studies of locational depiction suggest the generality of implied spatial relationships in eliciting joint encoding. Furthermore, the importance of a relationship of implied interactivity is suggested by studies of interactive depiction, and possibly also by the superiority of verb connectives over prepositions. Thus, if relationships of interactivity or spatial relationships are implied by the material about to-be-associated items, children's tendency to encode items separately is reduced. The superiority of interactive imagery over spatial relational imagery which is in turn superior to separate imagery instructions for adults; and the superiority of interactive over separate imagery for children, also suggests the importance of subjective linkages based on interactivity and spatial relationships in prompting children's joint encodings. However, a study of spatial-relational imagery instructions in children is required to verify this conclusion.

The significance of the present findings are underscored by evidence that actual interactivity and actual spatial relationships between items strongly influence children's relational encodings. The general implication is then, that children's relational encodings depend heavily upon whether or not certain relationships are (i) actually present between items, (ii) implied by the material about the referents of items, or, (iii) at least for interactivity, generated by instructions. In other words, whether or not children jointly encode items appears to depend upon whether or not relationships of interactivity or spatial proximity exist, are implied, or are generated between items or their referents.

The findings for prepositions do not contradict Rohwer's elaboration account of the effects of connectives, although they do show that the form class effect is not an effect of the grammatical form class of the connective, as Rohwer (1964) originally proposed. Rather, the present data point to the need to go further than the elaboration account in analyzing just what is meant by saying that verb or preposition connectives 'prompt' or 'impose' elaboration. The present results also emphasize the need to consider the effects of elaborative prompts upon younger children's associative recall in more detail, rather than simply focussing on changes in associative memory performance in adolescence (loss of effectiveness of prompts in late adolescence, spontaneous elaboration, and memorial strategy acquisition), since prompt effects are peculiar to children's memory performance and have implications in their own right for differences between adult and child memory.

With regard to linguistic accounts of the form class effect, the present results clearly contradict the deep structure hypothesis proposed by Suzuki and Rohwer. Since storage in one string in semantic deep structure or in two strings is hypothesized to be a function of the grammatical form class of the connective, thus leading to differing levels of (associative) recall, recall differences should not occur within one grammatical form class of connectives.

The present results also seem problematic for Rohwer's recent suggestion that explicit prompts are effective (in part) because they afford 'event knowledge', information which can serve to relate items together in memory, which children have not yet acquired. If anything, the present results would suggest that certain kinds of 'event knowledge' are more useful than other kinds (presence or absence of spatial relationships). Given, however, the evidence that prompts remain effective across the grade school years, even when instructions which provide no event knowledge become effective, the evidence suggests that the effects of prompts lies in the fact that they imply a relationship of a certain kind between item referents which elicits relational encoding, rather than in the possibility that they afford relational information the child otherwise has not yet acquired.

Finally, the present results would seem problematic for Ackerman's suggestion that children have a general tendency to access the semantic system for items individually. It is not clear, on the basis of Ackerman's view, why differences in accessing the semantic system should depend on the presence or absence of an implied spatial

relationship between item referents. Moreover, the results of Experiment 7 that cue size had no effect on associative recall levels for nouns linked by verbs also contradicts Ackerman's (1982a) conclusion (and data) that sentence context was insufficient to promote interitem integration (joint encoding) by children, and that explicit instructions designed to produce greater semantic processing of items are required.

Certain reservations about these conclusions should be noted. First, the present data do not rule against linguistic or verbal encoding processes in favour of imaginal encoding. Rather, they suggest that whatever the encoding process(es) may be, whether or not a close spatial relationship is implied about the referents of to-be-associated items is important in determining the degree of relational encoding by children, and the grammatical form class of the connective is not the critical factor. In addition, these results raise questions about the interpretation of the earlier deep structure studies. Again, in these studies, the degree of interactivity or spatial relationship implied about the referents of the target nouns may be the critical factor governing relational encoding. Ehri and Richardson (1972) would seem to have not gone far enough in claiming that it was not clear that imagery processes could explain the results of the deep structure studies.

Thus, the degree of interactivity implied between item referents may better explain the superiority of all the various verb conditions in Ehri and Richardson's study, which exceeded 'polar noun

phrases' implying spatial comparison. The superiority of such noun phrases ("The long snake; The short cigar") over controls might also be accounted for in terms of the degree of spatial relationship (here, spatial comparison) implied by the context about the referents of to-be-associated nouns, although it is not clear from the Ehri and Richardson study whether the effects are limited to associative recall, and thus, to memory for relational information. Similarly, the general superiority of all conditions in which verbs linked nouns over controls in the various deep structure studies may also indicate that the degree of implied interactivity is the critical factor (Davidson & Dollinger, 1969; Ehri & Richardson, 1969; Suzuki & Rohwer, 1968, 1969). In summary, therefore, the results of the last group of studies indicate that different sorts of prepositions differ in their linking ability, and the form class effect is not an effect of the grammatical form class of the connective, but rather of certain types of relationships implied by connectives about the referents of the items they link.

VI. GENERAL DISCUSSION AND CONCLUSIONS

Summary of Studies

The specific question addressed in the present studies is why children's recall of nouns linked by verbs or prepositions exceeds recall of nouns linked by conjunctions or presented without any linking connective. In a series of nine studies, five major and a number of subsidiary findings emerged.

Experiments 1-3

The superiority of nouns linked by verbs over conjunction linked nouns is found only in associative recall, not in free recall. The results of Experiment 1(a) indicate that the superiority of verbs over conjunctions emerges only in cued recall, and not in the overall level of free recall, across grades 3 and 6. Using a different subject population, a wider sample of grade levels (3, 6, and 8) and concurrent visual presentation of target nouns to minimize the writing out of connectives in free recall, the results of Experiment 1(a) were replicated in Experiment 1(b). Limitation of the superiority of verbs over conjunctions to cued recall was again demonstrated in Experiment 2, using a different subject population, equating the number of different words used as connectives in the verb and conjunction conditions, and with a wider sample of grade levels (2, 3, 6, and 8).

The results of Experiments 1 and 2 contradict the finding of verb superiority in free recall in studies where prior knowledge of

the recall test was given, but are supported by the findings of Kee and Rohwer (1974) for linking prepositions. Limitation of verb superiority to associative recall is further supported by prior studies which indicate that nouns linked by verbs are better recognized in cued recognition than nouns linked by conjunctions, but no difference is found in simple recognition between nouns linked by verbs and conjunction linked nouns. Several subsidiary findings may be noted from the results of Experiments 1 and 2. First, no differences were found in measures of association in free recall for nouns linked by verbs and conjunction linked nouns. Second, no evidence was found for the view that cueing hurts children's recall. On the contrary, cueing, if anything, helped recall. Finally, Experiment 3 showed that the superiority of verbs over conjunctions holds true for children across a wide range of item presentation rates. Experiment 3 also replicated the previously reported finding that no difference between verb and conjunction linked nouns emerges in adult's associative recall, irrespective of whether the item presentation rate is fast or slow.

Experiments 4 and 5

Interactive imagery brings the associative recall of conjunction linked nouns up to the level of verbs. The results of Experiment 4 indicate that if interactive imagery instructions were given to children, the usual difference between verb and conjunction linked nouns is no longer found in cued recall for older grade 6 children. Experiment 5 replicated the results of Experiment 4 using

a wider sample of grade levels (3, 6, and 8) and a different subject population. Experiment 5 also extended the results of Experiment 4 by including a regular instructions condition, which made it possible to conclude that interactive imagery instructions eliminate the superiority of linking verbs not because of any effect upon the recall of verb linked nouns, but because associative recall of conjunction nouns linked is improved to the point that it reaches the level of nouns linked by verbs. Two main subsidiary findings may also be noted from Experiments 4 and 5. First, the combination of interactive imagery and verb connectives compared with conjunction conditions did produce a difference in one measure of association in free recall (higher conditional probabilities for recalling the second noun given recall of the first noun). Second, there is no evidence in Experiment 4 that cueing hurts children's recall. On the contrary, cueing, if anything, helped recall.

Experiment 6

Separate imagery instructions reduce the associative recall of verb linked nouns to the level of nouns linked by conjunctions. Under separate imagery instructions, for older children only, the form class effect was also eliminated. Since a regular instructions control was included, it was possible to conclude that elimination of the difference between verb and conjunction conditions reflected a reduction in associative recall for nouns linked by verbs.

Two main subsidiary findings emerge from Experiment 6. Although the difference between verb and conjunction conditions was eliminated

by separate imagery, a difference was still obtained between the recall of nouns linked by verbs with separate imagery instructions and nouns linked by conjunctions given regular instructions. Thus, there is some suggestion that separate imagery instructions may be slightly less effective than interactive imagery instructions in eliminating differences between verb and conjunction conditions; particularly since Experiment 5 does not show any such differences. In the corresponding contrast, nouns linked by conjunctions given interactive imagery are as well recalled as nouns linked by verbs under regular instructions. A second subsidiary finding is that separate imagery overall led to poorer cued recall than regular instructions, contradicting Begg and Anderson's finding of equivalent levels of associative recall. It was noted above, however, that the inclusion of the linking verb condition in the present studies probably accounts for this discrepancy, since conjunction conditions did not differ under separate and regular imagery instructions. Equivalent associative recall of nouns linked by conjunctions given separate imagery or regular instructions supports the view that children's usual associative recall performance is more like that observed for separate imagery.

Imagery instructions of either type influence associative recall levels only for older children. Consistent with prior studies indicating that imagery instructions are often ineffective for younger children, the form class effect is eliminated by interactive imagery only at the grade 6 level (Experiment 4) and at grades 6 and 8

(Experiment 5), and not at the grade 3 level in either experiment. Experiment 6 shows for the first time that the failure of imagery instructions to be effective for younger children extends also to separate imagery, in that separate imagery instructions eliminate the form class effect at grade 6 but not at grade 3. The subsidiary finding is that the age level at which imagery instructions were observed to fail to eliminate the form class effect in Experiments 4-6 is somewhat older than the age at which imagery instructions have previously been reported to be effective.

Experiments 7-9

Different sorts of prepositions differ in their linking ability. No differences were found in Experiment 7 in associative recall for verbs implying different degrees of spatial relationship between the referents of the items they link. However, prepositions implying differing degrees of spatial relationship produce different levels of associative recall at all grade levels sampled (3, 6 and 8). In Experiment 8, nouns linked by prepositions implying a close spatial relationship between the referents of items were better recalled than nouns linked by prepositions not implying such a relationship, which in turn exceeded conjunction linked nouns. In Experiment 9, the two types of linking prepositions produced different levels of associative recall, and prepositions not implying a close spatial relationship led to no better recall than that observed for conjunction linked nouns.

Theoretical Interpretation

Taken as a whole, the findings are interpreted as supporting an account of the superiority of nouns linked by verbs or prepositions over conjunction linked nouns in children's associative recall in terms of differences in the processing of relational information and consequent differences in memorial organization. The fact that the advantage of verbs over conjunctions in recall holds only for associative recall, not free recall, points to the need to distinguish between relational information in memory (indexed by associative recall) and item information (indexed by free recall). The interpretation suggested is that verb (or preposition) connectives promote the encoding of relational information to a considerably greater extent than children normally encode when presented with to-be-associated, familiar, and arbitrarily paired items with a linking conjunction or without any connective. The present view also implies that the different levels of recall observed for linking verbs, prepositions and conjunctions reflect little or no difference in the encoding of item specific information. Accordingly, retention measures which are sensitive to the degree of associative encoding should exhibit the form class effect (cued recall or cued recognition), while retention measures more sensitive to the extent to which item specific information has been encoded should not show any form class effect in the overall levels of recall (free recall or simple recognition).

Limitation of the form class effect to measures of associative recall presents problems for theoretical accounts which do not specify what kind of memory information is required in different retrieval tasks. To varying extents, the several elaboration accounts of the form class effect (the imagery hypothesis, the deep structure hypothesis, and the later elaboration position) fail to emphasise the distinction between memory for relational and item specific information, such that the expectations in the various retention measures are unclear. The later elaboration account (Rohwer, 1970, 1973) is clearest in specifying that the account and the concept of elaboration refers to associative memory. However, while this account leads to clear predictions about associative recall, it is still not quite clear what effects linking verbs, prepositions or conjunctions should have in retention measures more sensitive to item specific information. Additional assumptions, made in the present account, are required to specify what should be expected in free recall for nouns linked by the various types of connective. Most basic to these additional assumptions is the assumption of the independence of relational and item specific information in memory, such that linking nouns with verbs should enhance the encoding of relational information, but lead to no better encoding of item specific information than linking nouns with conjunctions. The pattern of results observed in free recall provides further support for the validity of the assumption that item specific and relational information are, in general, independent.

That interactive imagery instructions eliminate the form class effect implies that such instructions are sufficient to increase the degree to which children jointly encode the nouns in spite of the conjunction connectives. The implication is also that conjunctions do not, in the absence of instructions to construct subjective links, promote much joint encoding of items. The effects of interactive imagery instructions on the form class effect emphasise the need for an account of the usual advantage in associative recall of nouns linked by verbs in terms of the processing of relational information. In other words, the fact that interactive imagery instructions and linking verbs have parallel effects upon relational encoding, and in associative recall suggests that an adequate account of the form class effect needs to refer to the effects of imagery instructions and verb connectives upon the processing of relational information, rather than attributing differences in recall for verb linked and conjunction linked nouns solely to characteristics peculiar to verbs. That interactive imagery and interactive depiction parallel the effects of linking verbs is thus problematic for linguistic accounts of the form class effect. Moreover, that both interactive imagery and sentence instructions parallel the effects of verb connectives is problematic for accounts of the form class effect which attribute the facilitating effect of verbs to the supplying of mediating information children otherwise lack.


That separate imagery instructions reduce the associative recall of verb linked nouns to the level of conjunctions implies that

separate imagery biases processing towards items individually, rather than in relation to other items, thus reducing the likelihood that children will avail themselves of the linking information provided by verbs. Again, that separate imagery instructions eliminate the form class effect is problematic for linguistic accounts of the form class effect, since it is unclear why separate imagery instructions should affect linguistic processing. Likewise, it is unclear why separate imagery should reduce associative encoding for nouns linked by verbs if the critical factor in verb superiority is that verbs supply relational information which children otherwise lack. Thus, an organization-processing account seems again to be more adequate. Elimination of the form class effect by separate imagery is not, however, contradictory to Rohwer's imagery hypothesis or later elaboration position that verbs 'prompt' elaboration. The latter view suggests that separate imagery instructions would be an 'antagonistic prompt' for elaboration. However, in that children's associative recall for nouns linked by conjunctions was about the same after regular or separate imagery instructions, the present data support the view that children's usual relational processing is about the same as that following separate imagery (cf. also Begg & Anderson). That children's associative recall is about the same whether separate imagery or regular pair learning instructions are given supports the view that children's tendency is to process items individually and encode little relational information (cf. Ackerman, 1982a), at least in the absence of prompts such as linking verbs.

The fourth major finding of the present studies is that imagery instructions of either type fail to eliminate the superiority of nouns linked by verbs over nouns linked by conjunctions in associative recall at the grade three level. The finding raises the only major developmental issue of the present studies (along with the lack of any difference between verb and conjunction conditions for college students). The question arising is what happens with age which makes older children's performance more sensitive to instructional effects? Of the various developmental hypotheses advanced by Rohwer and others, the one which appears to be most relevant to the failure of imagery instructions to eliminate differences between verb and conjunction conditions for younger children is that the memorial strategies elicited by imagery instructions of either type in older children have not been acquired by younger children. Other recent studies suggest that metamemory is deficient in younger children and is critical to successful generalization or transfer of memorial strategies (for example, Black & Rollins, 1982; Borkowski, 1983; Kendall et al., 1983). Thus the failure of imagery instructions to be effective in eliminating the form class effect in Experiments 4-6 is consistent an explanation in terms of children's deficiencies either in memorial strategies and/or metamemory. It is clear, however, that any deficiencies in either strategies or metamemory must be related at least in part to imagery processes, in view of the earlier efficacy of instructions to generate sentences describing the referents of

to-be-associated items in some interaction. In view of the evidence for strategy acquisition, including the spontaneous use of imagery strategies by older adolescents (for example, Waters, 1982), it would seem preferable to interpret evidence supporting the view that imagery processes develop fairly slowly as indicating the slower development of imagery related processes involved in memorial strategies rather than as evidence against strategy acquisition.

The present data contain some hints consistent with a strategy acquisition account (or rather, lack of acquisition) of the failure of imagery instructions to be effective in the present studies with younger children. The suggestion from the present data that separate imagery instructions may be slightly less effective than interactive imagery in influencing relational encoding is consistent with a strategy acquisition account. It would seem likely that separate imagery related strategies would be less practiced than strategies involving interactive imagery, because separate imagery is of lesser utility in associative memory tasks. Second, the grade level and age at which imagery instructions are found to be ineffective in the present studies is somewhat older than the point at which other studies report imagery instructions becoming effective. The ineffectiveness of imagery instructions at the grade three level in the present studies suggests the possibility that it may be more difficult to overlay different processing and organization by instructions if the material already suggests a particular type of organization. Thus, failure of imagery instructions at a later age



than is usually reported may also suggest that the strategies elicited by instructions are not yet well acquired, such that they are not applied when the material suggests a different type of organization.

The alternative developmental hypotheses suggested by Rohwer would not seem to provide as adequate explanations of the failure of imagery instructions at the grade three level. The 'event knowledge' of 'event repertoires' hypothesis suggests that success in elaboration is tied to how much an individual knows about how items might be related. In this view, imagery instructions would be ineffective at grade three while linking verbs promote relational encoding because verbs, at this age level, provide relational information which children otherwise lack. The difficulty with the event knowledge account is that sentence instructions are effective in many studies as early as verb connectives in promoting associative recall and instructions to generate a sentence afford no more specific relational information than imagery instructions. Moreover, across grade school and into adolescence, linking nouns with verbs continues to produce considerable enhancement in associative recall, during which time considerable information about how items might be related together is acquired. It should be noted, however, that other evidence does indicate that for unfamiliar items, event knowledge even for adults can be very important in determining relational encoding (for example, Lindberg, 1980; Perlmutter, 1980). Similarly, while 'elaborative propensity' may be an important factor in determining individual and developmental differences in children and adolescents, it would not seem to provide

any clear explanation of why imagery instructions are ineffective at the grade three level in Experiments 4-6. The difficulty is that recent studies indicate that sentence instructions (which are hypothesised to require a greater level of elaborative propensity than explicit prompts and the same level as imagery instructions to be effective) are often effective as early as linking verbs, and well before imagery instructions. In that other studies indicate that imagery instructions usually are effective by grade three, and the suggestion is that the failure of imagery at grade three in the present studies may reflect difficulty in overlaying a particular relationship suggested by the material itself, an explanation in terms of a lack of the propensity to elaborate items would seem also not very helpful.

Thus, the failure of imagery instructions at the grade three level in the present studies would appear to be most adequately explained in terms of a lack of adequate acquisition of the imagery related strategies elicited by imagery instructions (or imagery processes involved therein) and perhaps also deficits in metamemory related to the use of imagery related strategies, such as, for example, not realizing at retrieval the utility of interactive images formed at encoding. However, such a metamemory-strategy account does not explain in and of itself why linking verbs enhance recall at the grade three level. Clearly, if imagery related strategies have not yet been well acquired at grade three, lack of strategy acquisition does not in itself explain the superiority of verb linked nouns in

associative recall at the same grade level.

One possibility considered is that, since sentence instructions are often reported effective as early as verb connectives, it might be that both verb connectives and sentence instructions elicit the same memorial strategy. In such a case, with sentence instructions the child has to perform additional operations like generating a linking verb. Since the implication of the results of Experiments 4 and 5 is that the processing and organizational consequences of verb connectives and interactive imagery instructions are identical (at least for older children) and given that imagery instructions, where effective, do elicit strategy use, the present studies themselves do suggest that linking verbs probably do elicit some of the same operations or components of processes as are elicited in memorial strategies by instructions. The problem, however, with such a strategy explanation of the form class effect is that it does not go far enough and does not indicate what it is about verb or preposition connectives (rather than conjunction connectives) which elicits joint encoding. In fact, consideration of the question of why different types of connectives lead to different types of processing and organization points to a weakness in the strategy account. Given that sentence instructions elicit a strategy which involves generating a sentence, why does such a sentence help recall? Thus, a strategic account of the effect of linking verbs (or prepositions) does not seem to provide an adequate explanation of the form class effect.

The fifth major finding of the present studies is that

different sorts of prepositions differ in their linking ability. Prepositions which imply a close spatial relationship between the referents of the nouns they link lead to superior recall across all grades studied compared with prepositions suggesting less spatial proximity, which in turn either produce better associative recall than nouns linked by conjunctions (Experiment 8), or are no better than nouns linked by conjunctions (Experiment 9). The first implication of this finding is that the form class effect is not a form class effect, that is, the differing levels of associative recall observed for nouns linked by verbs, prepositions or conjunctions is not a function of the grammatical form class of the connective, as Rohwer (1964) originally proposed. The second implication is that the superior associative recall observed for nouns linked by prepositions is at least in part a function of whether or not a close spatial relationship is implied by the preposition about the referents of the nouns it links. Therefore, parameters other than the grammatical form class of the connective govern children's relational encodings.

The present interpretation of the findings for prepositions is that the superior recall observed for preposition linked nouns does not, then, reflect any effect directly due to the grammatical form class of the connective, but rather reflects the degree to which the preposition implies a close spatial relationship between the referents of the items it links. In view of the similarly enhanced associative recall produced by locational depiction of the referents

of to-be-associated items, such that item referents depicted in a spatial relationship are better recalled than referents depicted in separate, side-by-side pictures, it would seem that (i) the degree of close spatial relationship is a more accurate term than 'spatial proximity', and (ii) the degree of close spatial relationship implied between the referents of to-be-associated items is an important factor governing the degree to which children encode information relating the items together in memory. Because the degree of enhanced recall produced by verb or preposition connectives, or by locational depiction, remains more or less constant from about age three to about middle adolescence, it would seem that the effect of the degree of close spatial relationship implied between the referents of items by the way items are presented (that is, by locational depiction or linking prepositions) governs, in part, the degree to which children jointly encode items across childhood. Moreover, since the actual degree of spatial proximity or spatial relationship which exists between picture or object to-be-associated items has been found, in numerous studies of children's memory performance, to influence the degree of associative recall, it would seem that the degree of spatial relationship actually existing between, or implied about the referents of, to-be-associated items is an important factor governing children's relational encoding.

That different sorts of prepositions differ in their linking ability is clearly contradictory to the expectations of the deep structure account of the form class effect, since the degree of

associative recall should be a function of the grammatical form class of the connective. The finding is not contradictory to the imagery hypothesis proposed by Rohwer, but the shortcomings of this account have been noted above in relation to its failure to specify any distinction between relational or item specific information in memory. The finding for prepositions is consistent with the elaboration position proposed by Rohwer, that linking verbs or prepositions 'impose', 'prompt' or 'provide' elaboration, but goes farther than the elaboration position in indicating such 'prompting' consists at least in part in whether or not a close spatial relationship is implied between item referents. In other words, it would seem that not just any kind of 'episode, process or event' constitutes elaboration (that is, enhances relational encoding). With regard to the suggestion that linking verbs or prepositions afford relational information which children otherwise lack, it would seem that the finding is also somewhat problematic for this 'event knowledge' hypothesis. While both types of prepositions studied in Experiments 8 and 9 would seem to afford relational information, at the least, some relational information is more useful than other information. Other difficulties with the event knowledge hypothesis have been noted above, but it is perhaps worth noting that if spatial-relational imagery instructions are shown to enhance children's associative recall (which seems likely in view of the adult findings, see Begg & Sikich), this would provide serious difficulties for the suggestion that 'joining' prepositions supply missing relational

information.

Finally, the finding for prepositions would appear to be consistent with Ackerman's (1982a) suggestion that children tend to process items individually, unless steps are taken to encourage processing of more than one item at a time at the semantic level. The present studies also indicate, however, that rating the probability of event occurrence (Ackerman, 1982a) is only one of a number of ways of ensuring that joint encoding occurs. Experiments 8 and 9 indicate, like Experiments 1 and 2, that if the material already suggests a certain type of relationship, children's relational encoding is improved without specific instructions to encourage relational encoding. The finding for prepositions, however, goes further in indicating that the presence of certain kinds of relationship implied by the material about item referents is an important factor in determining the degree of children's joint encodings.

The failure of the present studies to show that the degree of close spatial relationship implied by verbs about item referents is an important factor in relational encoding, and the failure of Rohwer and Levin (1968) to show any importance for the degree of implied activity, may, in the present view, suggest that the degree of interactivity implied by verbs about the referents of the nouns they link is important. That the degree to which interactivity is implied about the referents of to-be-associated items is important for children's relational encoding is suggested by the fact that

interactive depiction of item referents leads to enhanced associative recall compared with either locational or co-incidental depiction. Moreover, actual interaction between items (pictures or objects) on the study trial enhances children's associative recall over spatial proximity or non-interactive, separate presentation conditions. In the various studies of the deep structure hypothesis (Chapter 1), verb conditions reliably exceed conditions which imply spatial relationships, but not interactivity, between item referents. Likewise, nouns linked by verbs are generally better recalled than preposition linked nouns, which in turn exceed nouns linked by conjunctions. Thus, the above parallels may be interpreted as suggesting that the critical factor for verbs is that they imply a relationship of interactivity, like interactive depiction, and this elicits relational encoding by children of the items so linked.

With regard to the developmental issues, the preposition results in no way contradicts an account of the failure of imagery instructions at grade three or absence of the superiority of verbs in college students' recall in terms of either the acquisition of memorial strategies and the growth of metamemory. The finding for prepositions speaks to the issue of what it is about 'explicit prompts' which gives them the power to prompt or impose elaboration (enhance children's relational encoding). The finding for prepositions is that the degree of spatial relationship implied between the referents of items is an important factor in accounting for the efficacy of some explicit prompts (prepositions and locational

depiction) in promoting relational encoding by children. The possibility is also strongly suggested by other studies, but not tested here, that the degree of interactivity implied by other explicit prompts about the referents of to-be-associated items is a second type of relationship which also elicits relational encoding of items so linked by children. The performance parallels between (i) interactive imagery, verb connectives, interactive depiction and sentence instructions, (ii) spatial or joining prepositions, locational depiction and probably also spatial-relational imagery instructions and (iii), coincidental depiction, conjunction connectives and separate imagery instructions are all suggestive of the conclusion that both the effects of explicit prompts and the strategies hypothesised to be elicited by instructions may all involve to some extent similar operations, governed by similar parameters (that is, relational encoding based on a relationship of interactivity or spatial relationships implied between item referents, or generated as a response to elaboration instructions, and separate processing and encoding in the absence of such relationships, or induced by separation instructions). The possibility, however, was noted that other factors such as the degree of temporal contiguity between items may also be important types of relationship governing children's relational encoding of familiar, arbitrarily paired or grouped material.

Finally, one possible difficulty for strategic or metamemorial explanations of memory development concerns the way in which there is

a loss of the influence of parameters such as the degree of spatial relationship upon relational encoding by late adolescence and adulthood (such that, for example, the form class effect is not observed in college students, Experiment 3). The question which arises is whether the disappearance of explicit prompt effects by adulthood is simply to be explained in terms of the acquisition of strategies and the growth of metamemory. One alternative explanation is that repeated experience with the consequences of encoding and organization based on the presence or absence of certain types of relationships between items or their referents in subsequent retrieval might lead to a diminishing of the influence of relationships of interactivity and spatial relationships. The difficulty found in teaching children memorial strategies, for example, may reflect both a lack of strategy acquisition and metamemory, but since much practice is also required (for example, Black & Rollins, 1982), the difficulty may also reflect children's inexperience with the consequences for retrieval of simply basing relational encoding on the presence or absence of certain types of relationship between items or referents. Similarly, younger children's failure to maintain a newly learned memorial strategy on a more difficult transfer task might reflect less central processing capacity or generally lesser cognitive abilities as Rohwer and Litrownik (1983) have suggested, but might also reflect the strength of prior habits of encoding against the relative weakness of newly acquired patterns.

Similarly, the inconsistent results obtained in studies of developmental and individual differences in elaborative propensity

(Rohwer et al., 1977; Rohwer et al., 1982) may reflect differences in the acquisition of different types of strategy, or differences in the growth of metamemory, but it might also reflect a tendency to persist in certain situations in a childhood pattern of basing relational encoding upon the presence of certain types of relationship between items or referents. If persistence in childhood patterns of relational encoding should be shown to be an important factor in its own right in accounting for differences in elaborative propensity, this would have important implications for the educational issues which research on elaborative propensity (for example, Rohwer, 1980) and on teaching children memorial strategies (for example, Levin, 1976) has attempted to address.

Memory Development - Some Speculations

The present studies do not specifically contradict any of the various possibilities suggested in the literature as contributing to the general improvement in memory performance observed across childhood and adolescence. On the basis of the present studies it would seem, as noted in Chapter IV, that explanations of the failure of imagery instructions with younger children in terms of deficits in imagery processes involved in imagery related strategies and perhaps also in metamemory seem the most obvious possibilities. For unfamiliar items, 'event knowledge' or 'event repertoires' might be a more important factor influencing developmental gradients (cf. Lindberg, 1980; Perlmutter, 1982). Likewise, for older children than those

studied here, the degree of spontaneous elaboration, that is, spontaneous use of memorial strategies perhaps related to individual differences in 'elaborative propensity', would be expected to be more important on the basis of recent studies (for example, Waters, 1982). Finally, it should also be noted that children's memory for connected narrative exhibits rather different characteristics, and other factors such as the growth of 'story schema' are implicated (for example, Mandler, 1978; 1979; Mandler & Johnson, 1977; Mandler, Scribner, Cole & DeForest, 1980).

The present studies do, however, point to certain other possibilities concerning memory development. The first is that, for the types of task which the present studies and studies of 'mental elaboration' have been concerned, it is important to distinguish between the development of memory for relational information and the development of memory for item specific information. In that linking nouns with verbs helps only children's recall, and does so by improving recall measures primarily reflecting the encoding of information relating items together in memory, the so-called 'form class effect' points to deficits, or at least differences, in children's relational encoding, compared with that of adults. In common with Ackerman (1982a), the present studies suggest that younger children do tend to encode items separately much more than adults, unless steps are taken to construct subjective links by generating certain types of relationship between the referents of to-be-associated items (by instructional set), or unless the material already suggests a

particular type of relationship between the referents of items, or unless a particular type of relationship actually exists between items as presented. In that developmental differences are not completely eliminated in most studies by elaboration instructions or by elaborative prompts, it would also seem clear that other factors, such as perhaps the growth of metamemory, elaborative strategies, elaborative propensity and event knowledge, as well as the development of memory for item specific information, and perhaps also changes in overall cognitive abilities (cf. Rohwer & Litrownik, 1983), underlie developmental changes in memory performance. Nevertheless, the present and other studies imply that elaborative prompts facilitate relational encoding and associative recall in large part because they imply certain types of relationships between items (close spatial relationships, interactivity and perhaps also temporal contiguity), which when present, either by implication between referents, generated as a response to instructions, or actually present between items as presented, elicit relational encoding by children (and considerably reduce the younger child's tendency to encode items separately). While Rohwer's studies of locational depiction identified interactivity and spatial relationships as important for relational encoding, the present studies extend these conclusions, at least for spatial relationships, to the other major class of 'explicit prompts', namely the form class effect.

Finally, a further issue arising from the present and other studies, is that given that certain types of relationships between

items or their referents are important for whether or not children relationally encode, or separately encode items, and the presence or absence of these relationships are no longer important for determining relational encoding by adulthood, it is necessary to account for the loss of importance of these relationships during development. Why do explicit prompts lose their power to enhance relational encoding by adulthood? It may be as Rohwer and others have implied or suggested that explicit prompts lose their efficacy simply because children acquire memorial strategies, metamemory and memory control processes and knowledge of the world which can serve to relate items together in memory which provide, by middle to late adolescence, increasing freedom from basing relational encoding largely on whether or not certain relationships are present or absent between items or their referents.

However, a basic assumption of the present and other studies is that the type of memory organization becomes apparent in different retrieval tasks (cf. Tulving & Thomson, 1973). It might also be suggested that the consequences of organization based upon particular parameters should also become apparent in retrieval (that is, successful or unsuccessful recall depending upon the task). Since it would seem obvious that there are many situations in which relational encoding of items is required in the absence of spatial relationships or relationships of interactivity between items or their referents, the tendency of younger children to base relational encoding of items on whether such relationships are present or absent might be expected

to lead to fairly frequent recall failure. Thus, while developmental gradients in associative recall may reflect in large part the acquisition of strategies, metamemory, event knowledge and thus increasing ability by the child to control his or her own memory processes, they may also reflect in part the effect of failure in recall of relational encoding based largely on the presence or absence of certain types of relationships between items or their referents. In addition, therefore, to the variety of factors implicated in the development of memory for relational information, modification of the younger child's tendency to encode jointly or separately on the basis of the presence or absence of certain types of relationships may also be a factor governing associative memory development. Difficulties in teaching memorial strategies or metamemory and the need for much practice in addition by younger children for successful acquisition and transfer of training (for example, Black & Rollins, 1982) might reflect not only the lack of strategies and metamemory or, perhaps, changes in general cognitive abilities but also a relatively greater tendency for younger children to encode items jointly or separately on the basis of whether or not the material already suggests a particular type of relationship.

Item Specific Memory - Some

Further Speculations

The present series of studies is not concerned with children's memory for item specific information, except in so far as it indicates

that the superior recall observed for nouns linked by verbs or prepositions compared with conjunction linked nouns does not derive from differences in the encoding of item specific information by children. The present studies and others suggest that differences in associative recall as a function of various elaborative prompts are to be attributed to the effects of prompts upon the processing of information relating items together in memory, and consequent differences in the organization of memory. Moreover, the present studies support the view that differences in organization do not necessarily involve differences in the encoding of item specific information (cf. Begg, 1978a, b; 1982). The general conclusion drawn about children's memory in the present studies, that the presence or absence of certain types of relationship between items or their referents governs at least in part whether children jointly or separately encode items, concerns children's memory for relational information, and not item specific memory. Similarly, the developmental issues raised by the present data (the disappearance of the form class effect by adulthood and the failure of imagery instructions to eliminate the form class effect in younger children) and the theoretical interpretations of these phenomena considered (the acquisition of strategies, metamemory, event knowledge, elaborative propensity, and the growth of imagery processes) are basically theoretical accounts of the development of children's memory for relational information. However, certain of the developmental hypotheses considered are capable of being applied to

children's memory for item specific information. For example, since both separate imagery and interactive imagery instructions benefit children's (simple) recognition of items (see above), it might be proposed that the acquisition of imagery related strategies may have some role in the development of children's memory for item specific information.

One aspect of the present results, however, raises the question of children's item specific encodings. While Begg and Anderson found that, under imagery instructions, cueing hurt children's recall (at least in comparison to the usual pattern of findings for adults), the present results do not provide much support for this conclusion. Begg and Anderson suggested, since the problem in cueing could not reflect any problem in cue recognition given the beneficial effects of imagery instructions upon recognition, that children might have difficulty in accessing traces formed under imagery instructions from cues. That children sometimes form images under instructions but have some difficulty using them at retrieval is also suggested by Pressley and Levin (1980).

In a series of studies, Ackerman has suggested that children's memory for item specific information is deficient, compared with adult memory processes, in two particular ways. Ackerman suggested that children tend to encode items or events less distinctively (Ackerman, 1983; Ackerman & Hess, 1982; Ackerman & Rust-Kahl, 1982; Emmerich & Ackerman, 1979). Encoding distinctiveness is conceptualised to vary from general or idiosyncratic encodings to unique encodings of

episodic events, more distinct encodings sampling item-specific information which distinguishes the event from other events (cf. Begg, 1982; Craik, 1981; Craik & Jacoby, 1979). Among other possibilities, Ackerman has suggested that the tendency of younger children to encode more of the sensory and formal features of items at the expense of semantic features reflects not only developmental changes in the semantic system but also a general tendency to encode items less distinctively. Thus, considerable evidence suggests that younger children tend to encode more sensory and formal features of items at the expense of semantic attributes (for example, Bach & Underwood, 1970; Cramer, 1972; Hasher & Clifton, 1970; Naron, 1978). Younger children's tendency to encode fewer of the semantic features of items and that these features better enable discriminative encoding is further supported by studies which showed that inducing children to further process items in terms of semantic features helped children's recall, while inducing adults to process items in terms of sensory or formal features hurt their recall (for example, Geis & Hall, 1976; McFarland & Rhodes, 1978; Owings & Baumeister, 1979). In support of the hypothesis that younger children tend to encode less distinctively and that this may in part account for their lesser encoding of more distinctive (semantic) features, Emmerich and Ackerman (1979) showed that even inducing further acoustic processing of items aided children's recognition performance.

Ackerman has also suggested that children are more variable in their encodings, for example in the encoding of cues from study to

test (Ackerman, 1981; 1982b; 1983; Ackerman & Hess, 1982; Ackerman & Rust-Kahl, 1982). According to the encoding shift principle (cf. Tulving, 1979; Tulving & Thomson, 1973), successful retrieval of episodic information requires that the encoding of cue attribute information be similar at the time of acquisition and retrieval. In support of the view that children are more variable in their encodings, Ackerman (1981; 1982b; 1983) showed that children had a larger encoding shift penalty than adults. The encoding shift penalty was the recall decrement that resulted from inducing subjects to encode different semantic attributes of cue information at retrieval than had been encoded at acquisition. The implication of Ackerman's view that children are more variable in their encodings of item specific information and demonstration of a larger encoding shift penalty is that children are more influenced by the immediate context than adults in terms of the item specific information they encode.

Ackerman's two hypotheses may be applied to issues concerning the encoding of item specific information in the present and other studies of the effects of elaborative prompts. That imagery instructions of either type improve recognition performance in children might be interpreted as suggesting that imagery instructions of either type cause children to further process items such that items are encoded more distinctively (cf. Ackerman's suggestion that picture items lead to more distinctive encodings than words, Emmerich & Ackerman, 1979). Secondly, it might be suggested that, if children tend to encode more variably than adults from study to test, children

might sample rather different item specific information for items studied under interactive imagery instructions at acquisition than when the items are presented at test as cues, resulting in poorer cue to trace accessing. Thus, under imagery instructions, children might encode items more distinctively so recognition is improved at test, but sample somewhat different attributes at retrieval resulting in poorer cue to trace access. However, the present studies and others do not support Begg and Anderson's finding that, in comparison to adults, cueing hurts children's recall. The discrepancy concerning the effects of cueing may reflect some peculiarity of the Begg & Anderson study. However, since the present and other studies which indicate that cueing does not hurt children's recall even under imagery instructions involved presentation of items with linking connectives (conjunctions, prepositions or verbs), it is possible that connectives of any sort may have some beneficial effect on children's item specific encodings such as reducing variability in encoding under imagery instructions from study to test. Since studies of the effects of connectives (that is, the form class effect) have primarily been concerned with comparing the effects of different types of connective and in associative recall (in the main), it is not known whether connectives of any sort (including conjunctions) benefit simple recognition as do either type of imagery instructions. Should connectives have some general effect in reducing variability in study to test encodings, the discrepancies between the findings of Begg and Anderson and the present and other studies with regard to the effects

of cueing might be explained.

Finally, Ackerman's studies of children's memory for item specific information suggest that the course of development is from less distinctive, more idiosyncratic or general encodings, which are more influenced by the immediate presentation context (so, for example, children show a greater encoding shift penalty) to a more flexible sampling of item specific information enabling more discriminations. Similarly, the present view of children's memory for relational information suggests that it is, compared to adult relational encoding, more determined by the presence or absence of certain types of relationships between items or their referents. In contrast, adults' memory for relational information appears to be more flexible, more sensitive to the actual requirements of memory tasks, shows more conscious control and knowledge and the use of a variety of memorial strategies. Thus, it would seem that one way of describing the development of children's memory is as proceeding from a baseline of relative inflexibility (cf. Myers & Perlmutter, 1976; Smirnov, 1973; Smirnov & Zinchenko, 1969; Yendovitskya, 1971) and overdetermination by the immediate characteristics of the material and context, towards increasing flexibility and appropriateness to the actual requirements of tasks. Thus, one way of describing children's memory, compared with the memory processes of adults, is that the former is overly determined by certain characteristics of the way items are presented (for relational encoding by the presence or absence of certain relationships, for item specific encoding, by the

immediate context such that changes in context result in larger encoding shift penalties than for adults).

The question arising, therefore, if the above is a reasonably accurate description of children's memory and of memory development, is whether the increasing flexibility and appropriateness of encodings to study opportunities and retrieval task demands reflects simply the acquisition of strategies, metamemory, event knowledge, and growth of the semantic system and general cognitive abilities, or whether development may also reflect the shaping of encoding processes by the consequences of encoding in retrieval. To the extent that the present and other studies suggest that children's relational encodings appear to be strongly influenced by the presence or absence of certain types of relationships between items or their referents, and that these relationships are no longer important in determining joint or separate encoding by adulthood, the question arises as to whether the growth of strategies, metamemory, event knowledge, elaborative propensity and general cognitive abilities completely account for the development of memory for relational information, or whether repeated experience with encodings based on certain types of relationship at retrieval does not itself modify encodings. Similarly, movement from less distinctive, more context determined, encodings of item specific information might reflect the growth of metamemory, strategies and growth of the semantic system, but might also reflect shaping of item specific encoding towards more distinctive and less variable encodings by the consequences of encoding in retrieval. In conclusion,

therefore, the present and other studies suggest the need to distinguish between the development of memory for relational information and memory for item specific information and also to establish clearly the baseline characteristics of younger children's memory processes for any adequate treatment of the issues of memory development.

APPENDICES

I. STUDY LISTS USED

TABLE 9

NOUN PAIRS, CONJUNCTIONS AND VERBS USED IN
EXPERIMENTS 1, 3, 4, 5 and 6

	Conjunction	Verb	
The GIRL	and	wants	the FLOWER
The FATHER	and	cleans	the ROOM
The NURSE	and	makes	the BED
The BABY	and	hugs	the LEG
The FROG	and	brings	the BALL
The DUCK	and	rides	the TOY
The CAT	and	loves	the HAM
The BOY	and	climbs	the CHURCH
The MOTHER	and	gets	the EGG
The BIRD	and	races	the JET
The LAMB	and	sees	the SHOE
The DOG	and	fight	the BEAR
The GIANT	and	hears	the BOAT
The DOCTOR	and	shovels	the SNOW

TABLE 10

NOUN PAIRS, CONJUNCTIONS AND VERBAL PHRASE USED IN EXPERIMENT 2

	Conjunction	Verbal Phrase	
The FROG	and	plays with	the SHOE
The HORSE	and	plays with	the COAT
The CLOWN	and	plays with	the CAR
The GIANT	and	plays with	the BOAT
The GIRL	and	plays with	the BALL
The DOCTOR	and	plays with	the TOY
The FISH	and	plays with	the FLOWER
The KING	and	plays with	the CAKE
The LADY	and	plays with	the APPLE
The SNAKE	and	plays with	the BOX
The CAT	and	plays with	the BOOK
The BIRD	and	plays with	the PAPER

TABLE 11

NOUN PAIRS, CONJUNCTIONS, SEPARATING AND JOINING
VERBS USED IN EXPERIMENT 7

	Conjunctions	Separating Verbs	Joining Verbs	
The CLOWN	or	wants	holds	the PIG
The MONKEY	and	likes	pushes	the TEACHER
The HORSE	or	wants	holds	the DOG
The GIANT	and	likes	pushes	the BUS
The FISH	and	likes	pushes	the FLOWER
The KING	or	wants	holds	the BABY
The LION	and	likes	pushes	the MOUSE
The LADY	and	likes	pushes	the COW
The DOCTOR	and	likes	pushes	the POLICEMAN
The SNAKE	or	wants	holds	the FATHER
The GIRL	or	wants	holds	the BALL
The FROG	or	wants	holds	the SHOE

NOTE: For half of the subjects, the connectives used with each pair were reversed (for example, "The CLOWN pushes the PIG".)

TABLE 12

NOUN PAIRS, CONJUNCTIONS, SEPARATING AND JOINING
PREPOSITIONS USED IN EXPERIMENT 8

	Conjunction	Separating	Joining	
The BIRD	and	near	on	the CHURCH
The DOG	and	near	on	the BED
The PIG	or	by	in	the SCHOOL
The FROG	or	by	in	the BOX
The CLOWN	and	near	on	the HOUSE
The BOY	and	near	on	the LAKE
The BEAR	or	by	in	the HOSPITAL
The DUCK	or	by	in	the CAR
The CAT	or	by	in	the BATH
The MOTHER	and	near	on	the SLED
The GIANT	and	near	on	the BOAT
The DOCTOR	or	by	in	the CAGE
The LION	or	by	in	the STORE
The LAMB	and	near	on	the TABLE

TABLE 13

NOUNS, CONJUNCTIONS, SEPARATING AND JOINING
PREPOSITIONS USED IN EXPERIMENT 9

	Conjunction	Separating	Joining	
The DOG	or	by	in	the BATH
The LION	or	by	in	the SCHOOL
The BIRD	and	near	on	the CAR
The BEAR	or	by	in	the STORE
The DOCTOR	and	near	on	the BOAT
The CAT	or	by	in	the BED
The FROG	and	near	on	the DESK
The MOUSE	or	by	in	the BOX
The CLOWN	and	near	on	the BUS
The DUCK	or	by	in	the CHURCH
The BOY	and	near	on	the TRUCK
The GIANT	and	near	on	the HOUSE
The PIG	or	by	in	the HOSPITAL
The FATHER	and	near	on	the JET

II. STUDY AND TEST INSTRUCTIONS GIVEN TO CHILDREN FOR ALL STUDIES

Regular pair-learning instructions (Experiments 1, 2, 3, 5, 6, 7, 8 & 9)

"We are interested in how people remember words. So I will be reading you some words I'd like you to remember. When I read the words I'll read them like this" (First example presented). "Now all you have to do is remember the words, especially which words go together. What were the words I just read you?" (The remaining two examples were presented and subjects asked to recall the phrase/sentence). "Now I am going to read you a whole lot of words and I want you to remember as much as you can. Afterwards I'll ask you to print them. O.K.?"

Interactive imagery instructions (Experiments 4 & 5)

"We are interested in how people remember words. So I will be reading you some words I'd like you to remember. When I read the words I'll read them like this." (First example presented). "Now I would like you to remember them in a special way. You all know how to make a picture in your head from words. If I asked you to make a picture in your head of a policeman you could do it easily couldn't you? Look at the board and make a picture of the policeman. Now look at the board and make a picture of a car. Now look at the board and make a picture of the two words doing something together." (At this point, subjects were questioned about the nature of their images). "So, what I want you to do is to look at the board when you hear the first word and make a picture of the two words doing something together". The other two examples were presented and the subjects questioned about the images formed.

Separate Imagery Instructions (Experiment 6)

"We are interested in how people remember words. So I will be reading you some words I'd like you to remember. When I read the words I'll read them like this." (First example presented). "Now I would like you to remember them in a special way. You all know how to make a picture in your head from words. If I asked you to make a picture in your head of a policeman you could do it easily couldn't you? Now what I want you to do is to make a picture in your head for each word separately. Look at the "(an object such as a window on the left front of the room) and make a picture of the policeman. Now look at the "(an object at the right front of the room) "and make a picture of a car." (At this point subjects were questioned about the nature of their images). "So, what I want you to do is to look at the _____ when you hear the first word and make a picture in your head, and then look at the _____ when you hear the second word and make another picture in your head." The other two example pairs were then presented and subjects questioned about the nature of the images formed. "Now I'm going to read you a whole lot of words and I want you to remember each pair using the pictures the way we practiced. Afterwards I will ask you to print them, O.K.?"

Free Recall Instructions (Test Trial)

"On the blank sheet of paper I just gave you, write down as many of the words I just read to you as you can. First of all write all the words that go together that you can remember. Then, write down any other words that you remember I read you. If you are not sure which words go together, guess. If you can't write, print the words. Spelling isn't important, so don't worry about that. You have 5 minutes altogether. Any questions?"

Cued Recall Instructions (Test Trial)

"On the sheet I just gave you, there are all the phrases/sentences I just read you. In each case, there is one word missing. Write the word that is missing in the blank space. If you are not sure which words go together, guess. If you can't write, print the words. Spelling isn't important, so don't worry about that. You have 5 minutes altogether. Any questions?"

Finally, following both free or cued recall, subjects were asked not to tell their friends about the experiment.

III. DISCARD PROCEDURE, AGE RANGES AND SCHOOL POPULATIONS

Discard Procedure

The data from 962 subjects was included in the nine studies reported here. Approximately twice that number of subjects were actually tested. The following discard procedure was used. Papers were collected and the number of required sheets taken from the top of the pile. The rest were discarded. The need for discarding subjects arose mainly because of the request from school authorities that all children in any class sampled be tested. The data from four experimental groups was discarded due to procedural errors. The experimental errors were three cases of repeating an already run experimental group (the repeated duplicate group's data was discarded) and one group for which there was an uproar outside the classroom during testing (the group was rerun and the original discarded). By inspection of means, it appears that no major discrepancies in means result from the discard procedure.

Age Ranges

The ages of children tested were comparable across all populations (schools) sampled for each grade level. The mean ages of grade 8 children were from 13 years 7 months to 13 years 10 months, with a range of 12 years 1 month to 17 years 3 months. At grade 6, mean ages were from 11 years 7 months to 11 years 9 months and ranged from 10 years to 14 years 3 months. At grade 3, mean ages ranged from 8 years 7 months to 8 years 9 months and ranged from 7 years 3 months to 12 years 10 months. At grade 2, the mean age was 7 years 7 months, with a range from 6 years 4 months to 11 years.

Age trends must be viewed with some caution since the younger children in rural schools (which have more recently come to serve new suburban developments) were more urbanized than the older children in rural schools.

School Populations

Samples were drawn from schools in three cities (Hamilton, Brantford and Burlington), and counties (Wentworth, Halton and Brant) and from both the public and parochial school systems.

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