DOCUMENT RESUME

ED 186 847 CS 005 415

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TITLE On Functions of Pictures in Prose.
INSTITUTION Wisconsin Univ., Madison. Research and Development Center for Individualized Schooling.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
REPORT NO WRDCIS-Theor Pap-80
PUB DATE Dec 79
GRANT OB-NIE-G-80-0117
NOTE 52p.

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Educational Research; Elementary Education; *Illustrations; *Memorization; *Pictorial Stimuli; Prose; Reading Comprehension; *Reading Research; *Recall (Psychology); *Visualization
IDENTIFIERS *Prose Learning

ABSTRACT

A review of the literature on the function of pictures in prose learning indicates that visual illustrations are helpful to children's learning, but that visual imagery has inconsistent effects on prose learning, although it seems to have potential for assisting those with adequate word recognition but low comprehension. A conceptual framework has been hypothesized in order to reevaluate existing research and to permit a formal distinction among the several functions that prose-learning pictures likely serve. The functions hypothesized are decoration, remuneration, motivation, reiteration, representation, organization, interpretation, and transformation. Two of these functions, the representation function and the transformation function, have proved useful in differentiating between the magnitude and consistency of picture effects that can be anticipated from one prose-learning study to the next. The framework can prove helpful in identifying the kinds of variables that need to be controlled for when looking for pictures in prose effects, as well as the kind of research that still needs to be conducted to isolate the contributions of specific picture components. (MAM)

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Theoretical Paper No. 80

ON FUNCTIONS OF PICTURES IN PROSE

by

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Report from the Project on
Studies in Language: Reading and Communication

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December 1979

CS504065

MAY 27 1980

Published by the Wisconsin Research and Development Center for Individualized Schooling. The project presented or reported herein was performed pursuant to a grant from the National Institute of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education, and no official endorsement by the National Institute of Education should be inferred.

Center Grant No. OB-NIE-G-80-0117

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The Wisconsin Research and Development Center is supported with funds from the National Institute of Education and the University of Wisconsin.

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ACKNOWLEDGMENTS

This paper, which will be a chapter in a forthcoming book by Pirozzolo and Wittrock (in press), benefited greatly from my continuing collaboration and discussion with Michael Pressley of the University of Western Ontario. I am also grateful to Jean Padrutt for her helpful editorial suggestions, and to Lynn Sowle for typing the manuscript.

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In this chapter I will provide evidence that pictures can facilitate children's prose learning. Included in my purview of "pictures" are both visual illustrations that physically accompany a prose passage and analogous visual images that take shape only inside a learner's head. The evidence will be presented in the context of a conceptual framework which, at this writing, seems to account well for the various findings in the relevant prose-learning literature. As will be seen, this framework assumes that pictures in prose can serve multiple functions, two of which will receive special attention here. A consideration of these functions, along with selected text and learner characteristics, makes it possible to specify the conditions under which picture effects would be expected to be nonexistent or minimal on the one hand, and maximum on the other. Findings thought to provide critical support for the framework's assertions are then indicated.

The first part of the chapter includes a summary of what has recently been concluded about picture effects in children's prose learning. Then, the second part of the chapter presents the conceptual framework and its components, with the available empirical evidence re-evaluated in light of these components.

Pictures and Children's Prose Learning

Are Visual Illustrations Helpful?

Levin and Lesgold (1978) have examined children's prose-learning studies in which experimenter-provided pictures accompany a text. Their conclusions will provide us with a convenient point of departure.

One of the most salient discoveries in the Levin and Lesgold review is surely the inadequacy of researchers' operationalizations of the question: Do pictures facilitate children's prose learning? In some studies, comprehension has been confounded with word recognition. In other studies, the pictures used seem to bear little or no relationship to the story content. In still others, the specific prose passages presented--and the associated comprehension assessment devices--appear less than optimal for answering basic questions about picture facilitation. For these reasons, Levin and Lesgold had to delineate a number of side conditions, or "ground rules," associated with the conclusions they reached. The ground rules functionally eliminated from consideration any study suffering from one or more inadequate operationalizations of the kind just described.

Levin and Lesgold (1978) were able to identify nearly 20 experiments that incorporated their methodological ground rules. Several recent ones can now be added to that list. The results of these experiments clearly permit the conclusion that picture effects in children's prose learning are positive, potent, and pervasive. In particular, visual illustrations constructed to be relevant to (indeed, overlapping with) a story's content have been found invariably to facilitate children's learning of that content. Although the magnitude of facilitation varies across experiments, a figure of 40% represents an apparent lower limit. That is, children exposed to story-relevant pictures may be expected to

recall at least 40% more of that information in comparison to no-picture controls.[1]

Extensions to Other Prose Types. Levin and Lesgold's (1978) conclusions derive almost exclusively from studies in which children were presented fictional narrative passages to learn. Such passages are the kind that would likely appear in children's story books. However, the picture facilitation effects discussed so far would take on added significance if they extended to other classes of prose material. The results of a number of studies suggest that they might. For example, visual illustrations have been found to facilitate elementary school children's learning of historical and scientific content (DeRose, 1976; Schallert, in press). And, in a study recently completed in our laboratory (to be discussed in detail later), we found that a special kind of picture dramatically improved junior high school students' learning about the accomplishments of famous people. Finally, a generalization of the visual illustration findings to an important "everyday" class of prose materials was accomplished in a study by Jill Berry and myself.

In that study (Berry & Levin, Note 1), fourth-grade students were read a series of passages. The passages consisted of

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[1] Of course, in specifying such a figure, one must assume that the results are based on passages for which there is plenty of "room" for pictures to show their worth. That is, with extremely simple or memorable passages that produce near-ceiling level performance in a control condition, obviously pictures cannot produce 40% improvement. Picture-Control differences could alternatively be expressed in within-group standard deviation units (e.g., Levin, 1975)--which would help alleviate this problem somewhat--but percentage facilitation is reported here because most readers likely are more used to thinking in those terms.

human interest and novelty stories that had been gleaned from local newspapers. Consider, for example, the following passage:

> The honey bee, Wisconsin's official state insect, is dying. It is dying from a poisonous spray that farmers use to destroy bugs on their crops. The farmers don't mean to kill the bees, but some spray they use gets carried through the air to the hives of neighboring beekeepers. These beekeepers want the farmers to stop spraying their crops so the bees won't die. If the farmers won't stop spraying, the beekeepers want the farmers to tell them when and where they will be spraying so the beekeepers can move their bees away from sprayed crops.

As each passage was read, half of the children were shown a colored line drawing that captured the main idea of the passage. For the present example, the picture in Figure 1 was displayed. The other half of the children simply listened to the passages without pictures. In one experiment, the children's recall of passage content was tested for immediately; in a second experiment, it was tested for after a 3-day delay. In both experiments, children who were shown the pictures remembered more of that information in comparison to children who were not shown the pictures. Thus, it appears that the consistently positive effects of pictures on children's recall of fictional narratives do indeed generalize to their recall of illustrable real-life incidents.

In summary then, to answer the question posed at the beginning of this section--Are visual illustrations helpful?--one can respond with confidence: Yes, very!

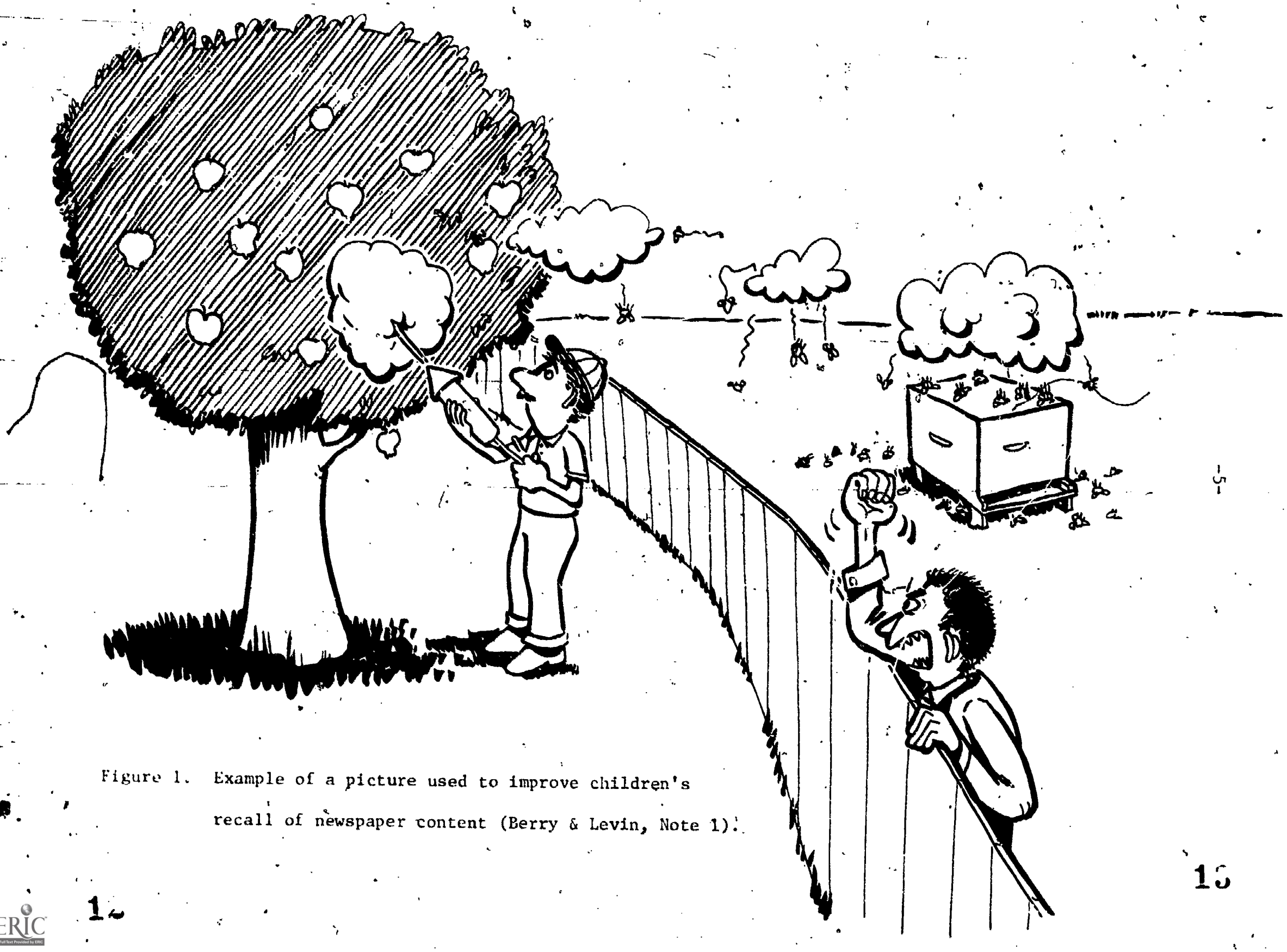

Figure 1. Example of a picture used to improve children's recall of newspaper content (Berry & Levin, Note 1).

Are Visual Imagery Instructions Helpful?

Illustrations versus images. A review of the imagery and learning literature reveals that many researchers do not attend much to the distinction between externally presented illustrations on the one hand, and internally generated images on the other. Indeed, the two picture types are often referred to interchangeably. Why, then, should we bother to make the distinction here? There are two related reasons, one basically empirical and the other theoretical.

The empirical reason for distinguishing between illustrations on the page and images in the head is a simple one. The findings associated with the two types of manipulation are often not identical. In particular, if one operationalizes the imagery generation process in terms of explicit instructions to learners to generate mental pictures, with accompanying practice at doing so or training in the process, then--as will soon become apparent in this section--the consistently positive effects obtained with illustrations are not nearly so consistently positive with imagery. This discrepancy, in fact, substantially shaped the conceptual framework to be developed later.

The theoretical reason behind the distinction relates to speculations about what goes on inside a learner's head when looking at an illustration, as opposed to when creating an original image. Although it might be argued that once an illustration has been internalized, it resembles a visual image, the two types of pictures are most certainly associated with different companion cognitive processes and abilities. Visual perception and interpretation skills are required in internalizing an

illustration, whereas cognitive constructions and elaborations are required in creating imaginal representations of verbal messages. Assuming that the illustrations provided are well drawn, easily interpreted, and appropriate to the verbal message, it might be expected that at least in certain populations, picture effects would be more uniformly positive when they are associated with ready-made illustrations than when they are associated with self-generated visual imagery. This is because with good illustrations, individual differences in the requisite perception and interpretation skills should play less of a role than would individual differences in the cognitive skills underlying visual imagery creation.[2]

I will now attempt to summarize the evidence pertaining to visual imagery effects in children's prose learning. Wittrock's chapter in this volume, as well as Pressley's (1977) review article, should be consulted for additional information on the topic. Three main points, bolstered by relevant references, will be made here: (a) Positive effects associated with visual imagery manipulations often do not materialize. When positive effects do occur, they are typically (b) small in magnitude and/or (c) limited in generality. These points are offered in striking contrast to the previously discussed illustration effects, which have been found to be both ubiquitous and of impressive magnitude. This is not to suggest, however, that visual imagery must always retain a second-class citizen status as far as children's prose learning is concerned. Rather, as detailed in our framework to be presented later, a certain kind of learner-generated visual imagery may not have to take a back seat to anything.

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[2]Competing explanations of such a finding are possible, one of which will be highlighted later in this chapter.

Review of the evidence. All the studies reviewed here involve at least two basic conditions. In one condition (control), students simply listen to or read a prose passage. In the other condition (imagery), students are given explicit instructions (with varying degrees of practice or training) to create internal visual representations of the passage's content while processing it. The evidence to be summarized will be framed in terms of the three points mentioned above.

1. No positive effect of visual imagery. A number of prose-learning studies conducted with elementary school children have found no statistical difference between imagery and control groups (e.g., DeRose, 1976; Heckler, 1975; Johnson, 1975; Kulhavy & Swenson, 1975; Lesgold, McCormick, & Golinkoff, 1975; Levin & Divine-Hawkins, 1974, Exp. 2; Pierce, in press; Steuck, 1979; Triplett, 1980). The Kulhavy and Swenson study is noteworthy because no imagery effect was detected on an immediate test, even though a slight effect appeared on a test administered a week later. Steuck could not replicate this delayed finding, however. The Triplett study is noteworthy because students (fourth graders) who received considerable practice at generating images to prose passages produced no hint of facilitated performance.

At this point it should be mentioned that the children in the above studies were all at least 9 years of age (i.e., at least third graders). Why is this consideration an important one? It is important because some have speculated that the ability to profit from visual imagery instructions is developmentally sensitive (Lesgold, Levin, Shimron, & Guttmann, 1975; Levin, 1976; Pressley, 1977). That is, a child's age--chronological, mental, or both--appears to be an important

determinant of whether or not any benefits from visual imagery instructions will occur. Supporting data related to a chronological age interpretation may be found in the studies of Dunham and Levin (1979), Guttmann, Levin, and Pressley (1977), Ruch and Levin (1979), and Shimron (1974), where children less than 9 years of age experienced no facilitation whatsoever from prose-learning imagery instructions. Supporting data related to a mental age interpretation may be found in the studies of Bender and Levin (1978) and Wasserman (1979), where educable mentally retarded (EMR) children did not benefit from visual imagery instructions. Moreover, within an EMR student population that varied considerably in chronological age, Wasserman found that mental age was moderately related to students' prose recall in the imagery condition ($r = .53$), but not in the control condition ($r = .16$).

2. Small positive effects of visual imagery. There is no getting around the conclusion that the positive effects of visual imagery reported to date have generally been small in magnitude. The tiny effect of imagery on Kulhavy and Swenson's (1975) delayed test, mentioned above, is one example. Similarly unimpressive imagery effects were found in the very carefully controlled study by Pressley (1976). Even with conditions designed so as to be extremely hospitable to imagery generation, children (second graders) in the imagery condition statistically outperformed controls by only a small amount (62% vs. 53% correct, on the average). Bender (1977) also reported a small positive effect of visual imagery in his sample of normal (i.e., non-EMR) third-grade children (averages of 73% and 63% correct for imagery and control subjects, respectively). These latter figures are almost identical to those of Guttmann et al.'s (1977, Exp. 1) third graders (74% and 62%).

3. Limited positive effects of visual imagery. The previously cited Lesgold, McCormick, and Golinkoff (1975) study will be used to illustrate a

situational limitation associated with visual imagery instructions. In that study, third and fourth graders were given extensive training in cartooning and imagery generation. Following the training, however, modest prose recall gains were found only when the children read "homemade" stories similar in form to those given during training and were reminded to use an imagery strategy while reading them. Without the imagery reminder and/or for passages taken from a standardized reading test, no positive effect of imagery training was observed. Moreover, students who were given just imagery instructions (i.e., without the special training) showed no improvement even on the homemade passages.

The variables of chronological and mental age discussed earlier certainly restrict one's ability to generalize about visual imagery effects across subject populations. As has already been shown, with younger or cognitively less advanced subjects, positive effects of visual imagery instructions have not emerged in the prose-learning literature. This is in striking contrast to the positive effects of visual illustrations, which pop up with regularity even in such populations (Bender & Levin, 1978; Dunham & Levin, 1979; Guttmann et al., 1977; Lesgold, Levin, Shimron, & Guttmann, 1975; Shimron, 1974).

Apart from age and intellectual development indicators, interactions of selected individual differences and the ability to profit from visual imagery instructions are suggested in the literature. For example, in an experiment with fourth graders, Levin (1973) found that imagery instructions improved the reading comprehension of below average readers with adequate vocabulary/decoding skills. In contrast, imagery instructions were not helpful to below average readers with inadequate vocabulary/decoding skills. In another study, Levin, Divine-Hawkins, Kerst, and Guttmann (1974) found that fourth-grade students who were relatively adept at pictorial paired-associate learning benefited from

prose-learning imagery instructions. Students whose pictorial paired-associate learning performance was relatively low did not benefit from prose-learning imagery instructions. Finally, Pierce (in press) recently attempted to relate imagery strategy effectiveness to the cognitive style variable of field independence, but with only marginal success.

Thus, based on the evidence reported in the literature, as well as that related at conventions or via personal communications of (typically nonsignificant) results, I am forced to respond to the initiating question of this section--Are visual images helpful?--with reluctance: Slightly, perhaps! Because of this, some of my initial enthusiasm directed toward visual imagery as an effective--and teachable--prose-learning strategy (e.g., Levin, 1972) must surely be dampened. On the other hand, there is no justification for across-the-board pessimism. Some types of students seem to profit substantially from visual imagery instructions such as, for example, those with adequate word recognition skills but who, nonetheless, exhibit comprehension failure (Levin, 1973). For such students, generating images of the passage content may be just the organizational strategy they need to foster comprehension. Thus, the potential of visual imagery to assist poor comprehenders should not be minimized. At the same time, and as has been alluded to already, the deployment of a different kind of visual imagery strategy may be required to produce more globally positive effects.

A Conceptual Framework for Prose-Learning Pictures

Can we account for the fact that in the prose-learning studies considered so far, text-relevant provided illustrations invariably facilitate children's recall of passage content to a nontrivial degree, whereas

instructions to generate visual imagery are not nearly so consistent in producing positive effects? Or, better yet, can we begin to specify the prose-learning conditions under which illustrations and images would be expected to yield the greatest returns? By "prose-learning conditions," I am referring to learner and text characteristics, both of which are likely to interact with picture manipulations. I think we can respond affirmatively to each of these questions. To do so, however, requires that we give consideration to a variety of functions that pictures might be presumed to serve.

Two prefatory comments need be made with respect to the conceptual framework proposed here. First, some of the functions listed will apply more (or even exclusively) to pictures as visual illustrations, and others to pictures as visual imagery. Which is for which should be clear by context, however, and no special problems seem to have been created by incorporating the two types of pictures into a single table. Second, even though the functions are discussed separately, it is not reasonable to regard them as mutually exclusive competitors (i.e., one function is "right" and the others are "wrong"). In all probability, multiple aspects of pictures contribute to improved prose learning. These effects could be additive or interactive depending on the prose-learning conditions alluded to earlier. For purposes of the present discussion, however, the several picture functions will be treated as separate components, each contributing to prose-learning facilitation. The necessary component-isolating research has not yet been conducted to allow for definitive statements concerning additive and interactive effects.

Hypothesized Functions of Prose Pictures

As has already been claimed, a variety of functions can be served by prose pictures. Table 1 summarizes eight that come to mind, arranged in their likely increasing order of prose-learning benefits. By "benefits," I am considering here only improved recall of explicitly stated text information. Other benefits such as improved recall of implied text information (i.e., inferences derived from text information, or inferences about the text's theme) and improved student affective characteristics (i.e., attitudes toward the specific text or toward prose in general) are beyond the scope of the present chapter. We now examine the eight proposed functions of Table 1, some in more detail than others.

1. Decoration function. This function is listed strictly as a courtesy to those who believe that visual illustrations should be included in text simply because they enhance a book's attractiveness. Since this aesthetic motive has no obvious bearing on the present criterion of enhanced prose recall, however, the function will not be considered further.

2. Remuneration function. This is the commercial byproduct of the decoration function. That is, since many book purchasers share the decoration function view, if book publishers include visual illustrations in their books, sales will increase. In this sense, then, increased decoration leads to increased remuneration. But just as the former is

Table 1

Proposed Functions of Prose Pictures

Function	General operating principle	Anticipated contribution to improved prose learning
1. Decoration	Pictures increase a text's attractiveness.	Not applicable
2. Remuneration	Pictures increase publishers' sales.	Not applicable
3. Motivation	Pictures increase children's interest in the text.	Little or none
4. Reiteration	Pictures provide additional exposures of the text.	Little
5. Representation	Pictures make the text information more concrete.	Moderate
6. Organization	Pictures make the text information more integrated.	Moderate to substantial
7. Interpretation	Pictures make the text information more comprehensible.	Moderate to substantial
8. Transformation	Pictures make the text information more memorable.	Substantial

irrelevant to increased recall of text information, so is the latter. Let us, therefore, resolve to dismiss this pecuniary function forthwith.

3. Motivation function. Some people believe that prose illustrations serve to increase children's interest in the text. The empirical data related to this belief are, however, far from conclusive (e.g., Samuels, 1970). Moreover, even if children's interest, motivation, and the like, are positively affected by illustrations, there exist no convincing data to relate increased motivation per se to increased prose recall. In a study by Heckler (1975), for example, increased motivation defined in terms of monetary incentives for learning did not improve children's prose recall. Moreover, if illustrations are purely motivators, then their specific relationship to the information presented in the text should make little difference as far as text recall is concerned. Some unpublished data by Michael Pressley and myself show that this is simply not the case.

When 4- year-old children were explicitly instructed to remember information presented in a text, providing illustrations per se was not sufficient to improve text recall. When the illustrations conveyed the same information as the text, recall was indeed enhanced, but when the illustrated information contradicted that in the text, recall suffered. Children continued to recall the illustrated content rather than the text they were told to remember. A strict (content-free) motivation function of illustrations would be hard pressed to account for these findings.

My best guess about the role of illustrations as motivators in children's prose-learning situations is that, in general, they have little effect. As long as the passages presented are sufficiently interesting, there is no reason to believe that illustrations increase children's interest

in the text. Even if they do, how much does this increased interest (however slight) contribute to improved prose recall? Perhaps with extremely dull passages, illustrations serve a No Doz function, thereby improving recall (i.e., children who were awake when the passages were read tend to recall more than childre no were asleep). But such an antisoporific explanation is merely a sophomoric explanation until the relevant data have been collected.

4. Reiteration function. A fourth proposed function of prose pictures is that they simply repeat the information presented in the text. This would be especially true of illustrations that are substantially redundant with the text content (Levin & Lesgold, 1978). According to this explanation, illustrations provi tional exposures of the text (especially in comparison to sin uditory receptions). Because learning theorists subscribing to such notions as "repet tion," "exercise," and "frequency" would advocate that more is better than less, the contribution of illustrations to improved prose recall can be accounted for in purely quantitative terms: Providing illustrations guarantees a second exposure of the prose content, and two exposures are better than only one.

There may well be some truth to this picture function. For example, Levin, Bender, and Lesgold (1976) found that children who were presented each sentence of a prose passage twice in succession recalled more passage content in comparison to children who were presented each sentence only once. That is, repetition per se did elevate recall. But illustrations have been found to afford something more than just a simple repetition of the prose content. In the first place, children in the Levin et al. (1976) study who viewed story-relevant illustrations recalled more prose

content in comparison to children in the just described repetition condition. Second, Ruch and Levin (1977) found pictures and repetition to produce qualitatively different recall patterns: Pictures facilitated recall of prose content cued by both verbatim and paraphrased questions, whereas repetition only facilitated recall of prose content cued by verbatim questions. Moreover, a repetition procedure is sometimes not even facilitative at all, even though providing illustrations produces striking gains (Bender & Levin, 1978).

Thus, although something akin to a repetition component may underlie the positive prose-learning effects that are attributable to illustrations, such a component can account for neither the magnitude nor the generality of illustration effects. In short, to view a text-relevant illustration is to do more than simply "play it again, Sam."

The final four proposed functions of prose pictures constitute a more serious attempt to get at exactly what pictures are getting at. This is not to say that the third and fourth proposed functions ought to be dismissed so readily; rather, they are comparatively less interesting according to the cognitive-psychological perspective adopted by the present author. In particular, the final four functions focus on the concreteness, relatedness, meaningfulness, and memorableness aspects of pictures. Moreover, as will become apparent, none of these specific functions is necessarily unique to pictures. Rather, each may be thought of as a general strategy for improving children's prose learning (Levin & Pressley, in press), which in turn subsumes such alternative techniques as question answering, paraphrasing, classifying, note taking, and verbal analogues to the pictorial strategies discussed here.

5. Representation function. This function and the next assume that prose content presented in a format or mode that is different from that of the original will aid learning. Tabular, graphic, or taxonomic representations of a text, and underlining, segmenting, or summarizing important text sections constitute commonly applied format changes that characterize the present intent. In terms of the representation function as applied to pictures, text-relevant illustrations and images take information that was represented in one mode (verbal) and represent it in another (pictorial). Enhanced recall of such pictorially represented information would be anticipated from a number of theoretical perspectives (cf. Ghatala, Levin, & Wilder, 1973; Nelson, Reed, & McEvoy, 1977; Paivio, 1971) which will not be detailed here. Suffice it to say that pictures make the to-be-learned information more specific. They also provide a second modality through which the text information can be directly represented in the brain (i.e., visually in the right hemisphere in addition to verbally in the left). For present purposes, however, we will regard the representation function of pictures as one of simply rendering the prose content more concrete.

According to the representation function, pictures lay down a "memory trace" that--for any or all of the theoretical reasons just alluded to--is stronger than that associated with a strict verbal representation of the text. This greater trace strength is assumed to pay off both during initial storage of the passage content and during subsequent retrieval of that content. More about these notions will be presented in the next section.

6. Organization function. The assumption underlying this function is that well-organized text information will be better recalled than only loosely organized or fragmented text information. In most of the children's pictures-in-prose studies reviewed by Levin and Lesgold (1978), concrete narrative passages were used. Such passages are typically straightforward and well structured. For less-than-optimally-structured passages, however, pictures may help to organize the content better. This is essentially the rationale adopted by Steingart and Glock (1979). In their study, it was expected that a visual imagery strategy would serve an important organization function for passage content that was potentially classifiable, but which was not presented according to its optimal structure. Unfortunately, a number of methodological difficulties compromise interpretation of the results, but application of pictures to the kind of texts used by Steingart and Glock illustrates the present organization function.

The organization function was also assumed to be operative in the previously mentioned Levin (1973) study. In that study, well structured narrative passages were used. However, some of the children were poor comprehenders for whom it could be reasoned that effective encoding of passage content did not occur during the normal reading process. When these students were instructed to apply a visual imagery strategy, their prose recall increased dramatically. A plausible interpretation of this finding is that the imagery strategy forced integration of information that otherwise would have been encoded only in fragmentary bits and pieces. Thus, one of the few impressive demonstrations of imagery strategy effects in the children's prose-learning literature is believed to have capitalized primarily on the organization function of pictures.

The amount of facilitation anticipated from this function is likely intimately connected to specific text and learner characteristics of the kind discussed here. The corresponding entry in Table 1 reflects the variable benefits assumed to be associated with the organization function.

7. Interpretation function. Arguments similar to those just made also characterize the interpretation function. That is, in comparison to the representation function (where easy-to-follow text is represented literally), a greater amount of facilitation would be expected when relatively complex or difficult-to-comprehend information is made more understandable. In general, such an interpretation function would reflect content clarifications that are directed toward enhancing the student's understanding of that content. In some cases, the clarifications may be substantial, as when the provision of an advance organizer or analogy permits apparently incomprehensible prose (or poetry!) to be understood, or when these same devices contribute to one's processing of text from a totally new, extraliteral, perspective. One of the basic premises associated with the interpretation function is that to understand new information, one must relate it to existing knowledge. Given this description, the reader should have little difficulty incorporating contemporary schema theory notions (cf. Anderson, Spiro, & Montague, 1977) into what is intended by the interpretation function.

A case for pictures in this regard can be found in Levin and Pressley's (in press) discussion of "stage-setting" and other content-clarifying

strategies used to enhance children's prose learning. The reader is referred to the Levin and Pressley chapter for illustrations of the kinds of strategies that have proven successful. The dependence of each of these strategies upon the student's prior knowledge is obvious. What needs to be reiterated here, however, is that the amount of success to be expected from any of these strategies likely depends upon the familiarity and/or complexity of the material being learned. With easy-to-understand materials, pictures would not serve an interpretation function; rather, whatever benefits are observed would have to be associated with one or more of the other Table 1 functions. In contrast, when content-clarifying pictures accompany difficult-to-understand prose passages, the role played by the interpretation function of pictures becomes preeminent, with correspondingly substantial recall gains anticipated as a result. The position in Table 1 occupied by this function is based on the assumption that the type of text being studied merits the use of content-clarifying pictures.

8. Transformation function. If the interpretation function is associated with prose materials that are difficult to comprehend, then the transformation function is reserved for prose passages whose constituents may not be that difficult to comprehend, but which contain information that is difficult to remember. Examples of such texts include historical passages where names, events, sequences, and dates are important to remember; and medical and other scientific texts, where easily identified concepts, principles, and functions have to be associated with unfamiliar technical terminology. According

to the transformation function, the existing content must be changed into a form that promotes better long-term memory for that content. Such changes also include the creation of new (extratextual) information to aid in storage and retrieval of the passage content. Although appropriate verbal transformations of the passage can certainly be prescribed, pictorial transformations are viewed here as being especially helpful. As will be argued shortly, illustrations' representation and transformation functions can be effectively combined to produce a powerful effect on students' prose recall.

As will also be seen, maximum prose-learning facilitation is believed to occur when the transformation function, rather than just the representation function, is operative. That is, pictures serving as mnemonic devices are hypothesized to yield the very greatest prose-learning benefits. Until only recently, however, little if any attention has been paid to pictures serving in this capacity. Indeed, the hypothesized transformation function holds the key to understanding why the prose-learning imagery effects reported to date have been singularly unimpressive. This key will now be used to unlock the illustration-versus-imagery dilemma that has surfaced repeatedly throughout the chapter.

"Functional" Analysis of Illustrations Versus Imagery

The general analysis to be presented here can perhaps best be captured by the graph that is Figure 2.[3] The basic message conveyed

[3]Note that only two of the eight functions of Table 1 are included in this analysis. This is reflected in the author's bias that the two included are most directly related to the issue at hand. The organization and interpretation functions, though omitted here, obviously play an important role with certain classes of prose material and for certain kinds of students (see our previous discussion and Levin & Pressley, in press).

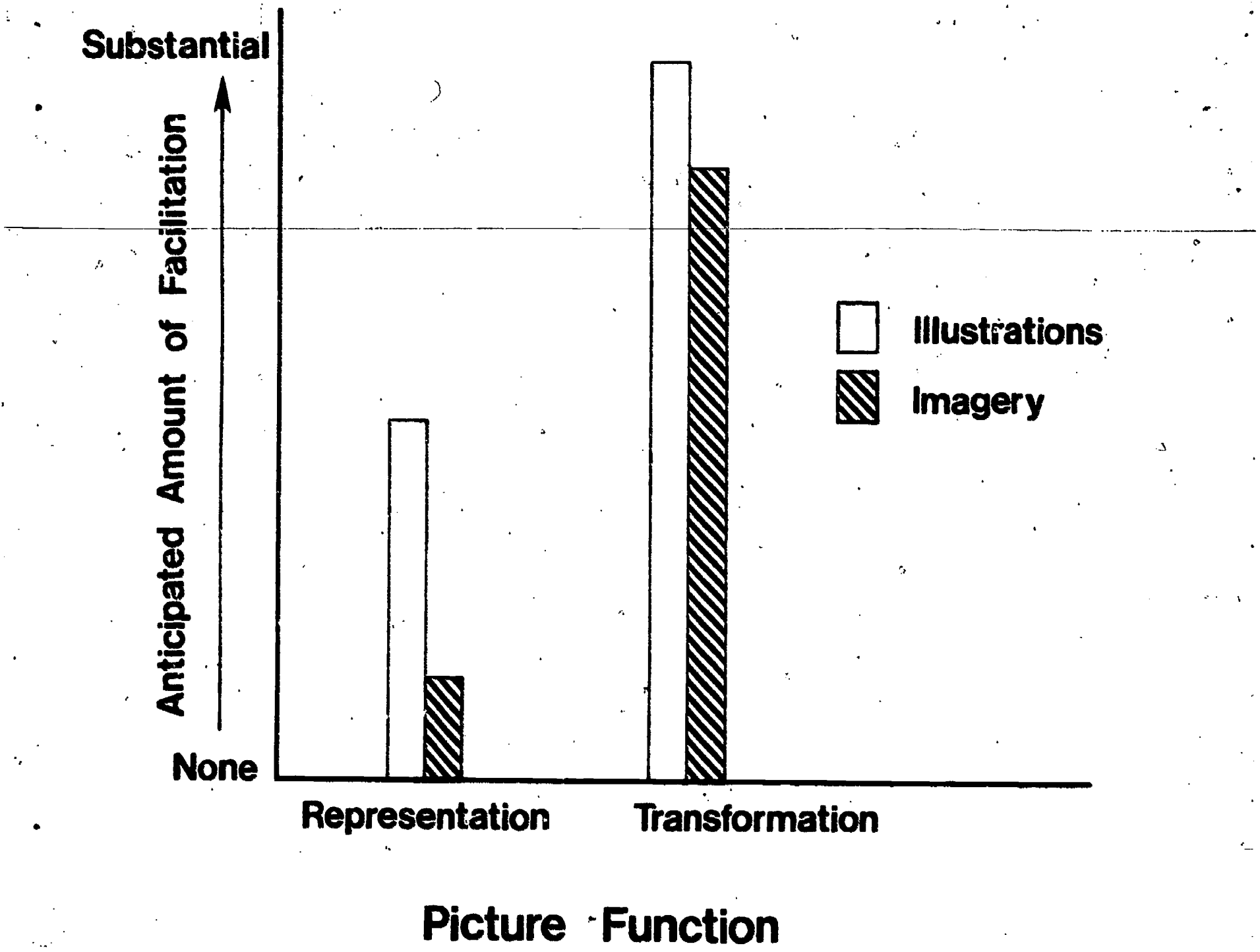

Figure 2. Anticipated learning benefits associated with illustrations and imagery.

by that figure is twofold: First, the major impact of pictures on prose-learning facilitation derives from their transformation function rather than from their representation function. Second, much larger facilitation differences between visual illustrations and visual imagery are associated with the representation function than with the transformation function. The figure as drawn applies not only to the children's prose-learning literature of present concern, but to more fundamental studies of associative learning as well. Let us briefly consider the figure in that latter context first.

Associative-learning findings. The basic findings in this literature, following over 10 years of experimental investigation (see Bower, 1972; Levin, 1976; Paivio, 1971; and Pressley, 1977) are accurately reflected by Figure 2. In particular, consider the task of associating arbitrarily paired concrete nouns. It is well established that if the experimenter provides pictorial representations of those nouns (i.e., two pictures side by side), associative recall is moderately increased (relative to associating just the verbal labels). In contrast, instructing subjects to generate side-by-side imaginal representations has little or no effect on performance. Such a finding can be explained in terms of our previously discussed memory trace notions. First, it was argued in an earlier section that the process of perceiving illustrations results in a more reliable encoding of that information, in comparison to the process of generating images. Second, illustrations are more concrete than visual images in the Paivio (1971) sense. As a result, in comparison to visual imagery, the trace laid down by pictures is a stronger and

more reliable one. According to present terminology, the representation function is more effectively realized by illustrations than it is by imagery. Corroborative data in support of these assumptions are provided by Chatal.. et al. (1973), and will not be reviewed here.

Equally well established in the basic associative-learning literature is the finding that facilitation produced by providing illustrations per se is not nearly as great as that produced by creating a meaningful associative link between the paired items. Such linkings invariably involve "elaborations" (Rohwer, 1973) or--adopting the present terminology--"transformations" of the nominal stimuli, in order to render them more memorable. An illustration or image in which the two items are interacting in a meaningful way has been found to constitute a highly effective mnemonic strategy. When purposeful mnemonic activity is involved, the difference between illustration and imagery efficacy diminishes, especially when cognitively advanced (older and intellectually more capable) students represent the target population. A small difference between illustration and imagery variations has been retained in Figure 2 to remind us of the potentially weaker and more variable trace associated with the latter. Note, however, the much greater amount of facilitation expected from the two strategies capitalizing on the transformation function (likely representation plus transformation) than from the two strategies capitalizing simply on the representation function. Now, with the associative-learning findings in mind, let us consider the extant prose-learning findings from a similar perspective.

Prose-learning findings. An important distinction between basic associative learning and prose learning needs to be made at the outset. Whereas the former is inherently arbitrary and rote in nature, the latter is usually thematic and meaningful. Certainly the distinction appears to be a valid one when distinguishing between the task of recalling noun pairs and that of recalling narrative prose. With few exceptions, it can be stated that most of the pictures-in-prose literature derives from what will be described here loosely as fairly straightforward, concrete narrative passages. That is, the passages are comprehensible, they describe concrete (visualizable) incidents, and they follow a logical sequence with a prevailing theme, to name a few salient characteristics.

1. Pictures as literal representations. Consider the role played by visual imagery instructions in the vast majority of children's prose-learning studies to date. With the concrete narrative passages employed, it is a safe bet that a good deal of effective comprehension activities are being carried out spontaneously by those who are asked to process the story content. Exactly what kind of strategies are employed by normal prose comprehenders is not relevant to the present discussion. Quite possibly, however, visual imagery is involved to some extent. The point here is that explicit visual imagery instructions likely do not do much in the way of promoting effective information processing beyond that which students normally do anyway. Since we have already argued that the representation function associated with visual imagery instructions is not a potent one, certainly one cannot expect much help in that regard. In contrast, however, the more potent representation function of

illustrations might be expected to give prose recall somewhat of a boost. This is the usual empirical result, as has been discussed throughout the chapter.

Additional data support the notion of representation strength differences between illustrations and imagery in prose-learning contexts. Guttmann et al. (1977) devised a special kind of pictorial aid to increase the potency of visual instructions. These "partial pictures" were illustrations which contained some, but not all, of the story's content. What was not depicted, however, was hinted at by being just outside the picture frame or obscured by an object in the illustration. Consider, for example, the partial picture of Figure 3, where children heard the accompanying sentence: One evening Sue's family sat down to eat a big turkey for dinner. It is important to note that in each partial picture, the information that was later asked for (e.g., What did Sue's family eat for dinner one evening?) was not visible. Students who viewed such pictures were instructed to create images of the missing content. Guttmann et al. found that partial pictures produced an intermediate level of performance in second-grade children, falling somewhere between complete imagery instructions on the one hand and complete illustrations on the other. In a followup study, Ruch and Levin (1979) found that still younger children (first graders) could benefit from partial pictures only as long as they were reinstated during testing.

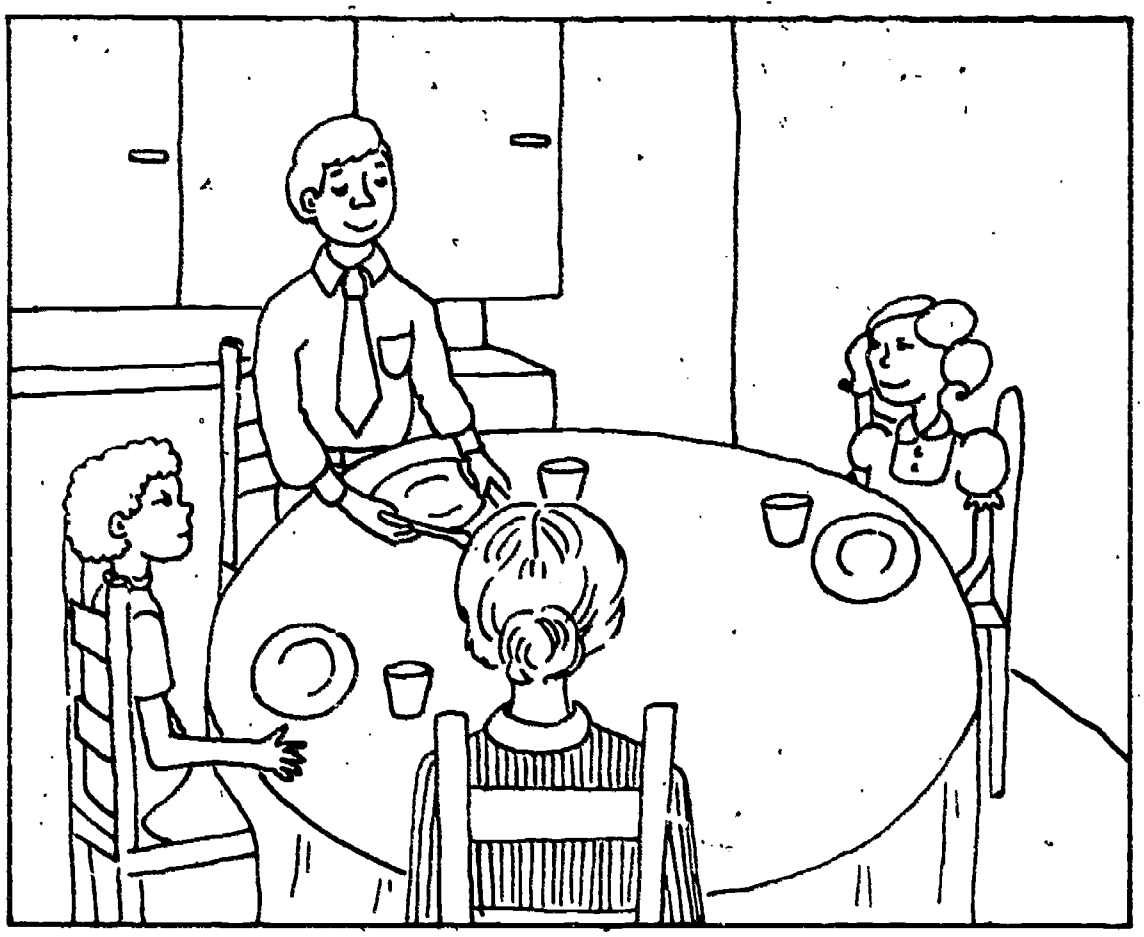

Figure 3. Example of a partial picture (Guttmann et al., 1977).

Although not previously discussed in exactly these terms, it could be argued that partial pictures serve as aids for strengthening an imagery representation. For some children, the increased concreteness afforded by partial pictures may succeed where straight imagery instructions would fail. And for still other (younger) children, the provision of partial pictures as concrete imagery-retrieval cues may serve to re-evoke an otherwise forgotten representation. Ruch and Levin (1977, 1979) have documented that retrieval pictures per se (i.e., without prior study pictures) or verbal retrieval cues do not produce comparable recall benefits. This suggests that a concrete representation must first be established before it can be re-evoked by a similarly concrete retrieval cue.

2. Pictures as mnemonic transformations. With prose that does not leap out in easy-to-process narrative fashion, the strain on one's comprehension and memory facilities can be considerably increased. Processing difficult-to-comprehend information fall under the aegis of the interpretation function which is not considered further here. But what about easily comprehended information that is difficult to code for future retrieval? As mentioned previously, such content is perhaps best represented by science and social studies passages, where lots of new information (names, dates, events, terminology) is presented. Such information is likely to require more than a passive, effortless encoding. Enter the transformation function. Here, the idea is to construct pictures that transform information that is only weakly connected into more memorable representations. In the associative-learning literature, arbitrarily paired objects were placed in a

meaningful relational context. With factual prose passages, analogous importations may well be required. Let us consider an initial research attempt by Linda Shriberg, Christine McCormick, and myself to get at some of these notions.

Shriberg, Levin, and McCormick (Note 7) constructed passages that told about "famous" people and their accomplishments. The people's names were actually randomly drawn from the phone book and paired with fictitious accomplishments. Twelve name-accomplishment pairs were generated in this fashion, with each person's accomplishment described in a three-sentence passage. In addition to the critical name-accomplishment information, each accomplishment was further detailed by two pieces of incidental information in each passage. Consider, for example, the following passage: Animal lovers all over the world are impressed that Charlene McKune has taught her pet cat how to count. The cat can count to 20 without making any mistakes. Moreover, the remarkable cat can do some simple addition. The critical name-accomplishment information is that Charlene McKune's claim to fame is her counting cat. All students (eighth graders) were told explicitly to learn that information. The passage also states that the cat can both count to 20 and do some simple addition. These are the two incidental details that students were not told explicitly to learn.

Control students were simply read the passages. Pictures students were shown illustrations in which each person's name was mnemonically linked to his or her accomplishment. The illustrations conformed to the requisites of the transformation function, as described in this chapter. That is, they took the initial information and transformed it into

something more memorable. For the present example, McKune which is not picturable sounds something like raccoon which is. The resulting illustration capitalized on the picturable name derivative, linking it to the picturable accomplishment--see Figure 4. A different set of illustrations was shown to Pictures Plus students. In addition to providing the critical mnemonic transformation, they included the incidental details mentioned in the passage. As may be seen in Figure 5, not only is the raccoon-counting cat illustrated, but so are the cat's counting-to-twenty and simple addition abilities. In terms of the present functional distinction, the details illustrated in the Pictures Plus condition are clearly of the representation variety, in contrast to the critical name-accomplishment illustrations in both picture conditions, which are of the transformation variety. Finally, it should be mentioned that although students in both picture conditions had previously learned name derivatives (e.g., McKune = raccoon) for all 12 people, they were shown actual illustrations for only the first six passages. For the second six, they were told to use the same method to make up their own internal pictures (visual images).

Consistent with the present conceptualization summarized in Figure 2, both illustrations and visual imagery instructions substantially facilitated students' critical name-accomplishment

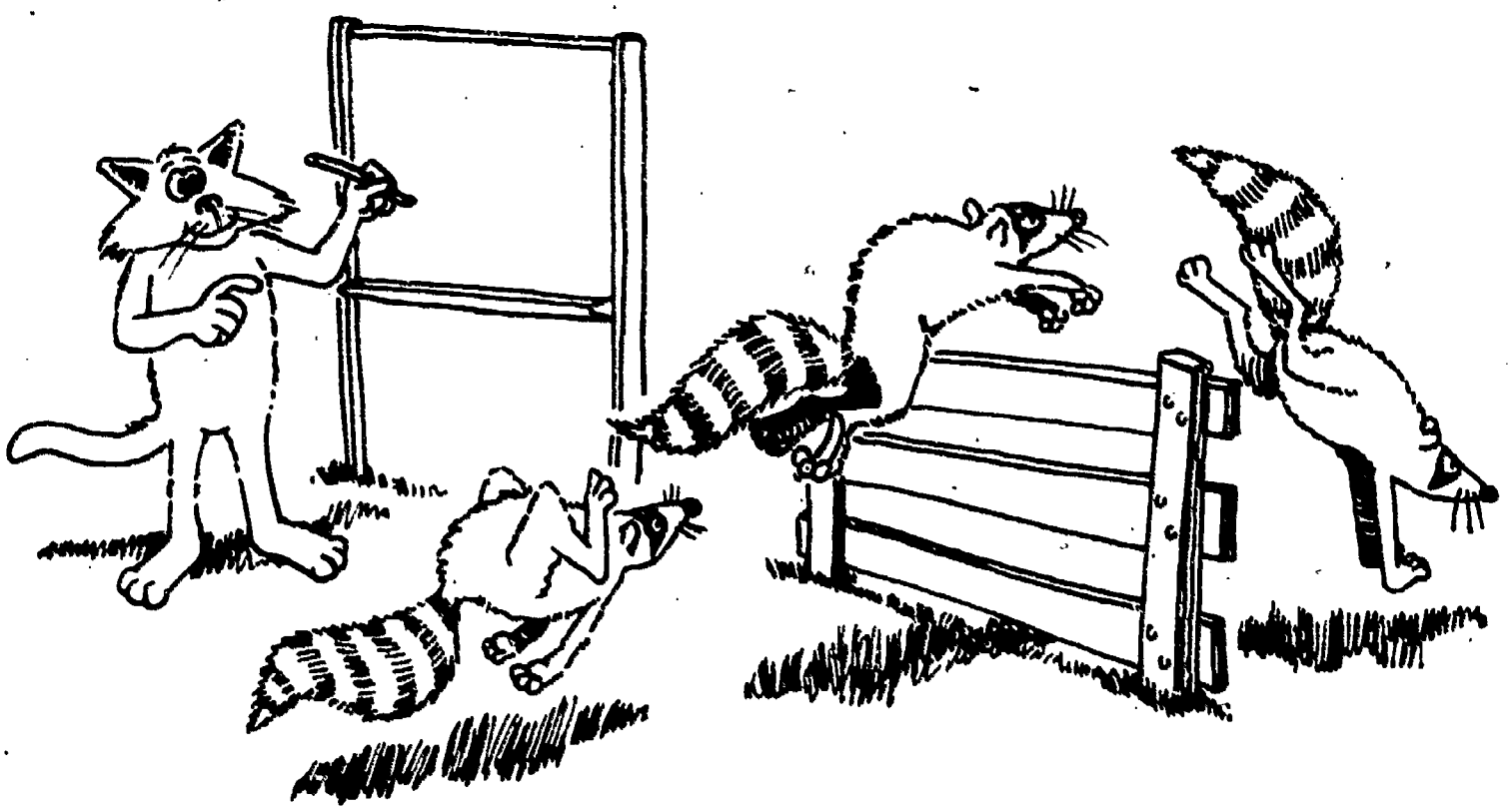

Figure 4. Example of a simple picture used to improve name-accomplishment recall (Shriberg et al., Note 2).

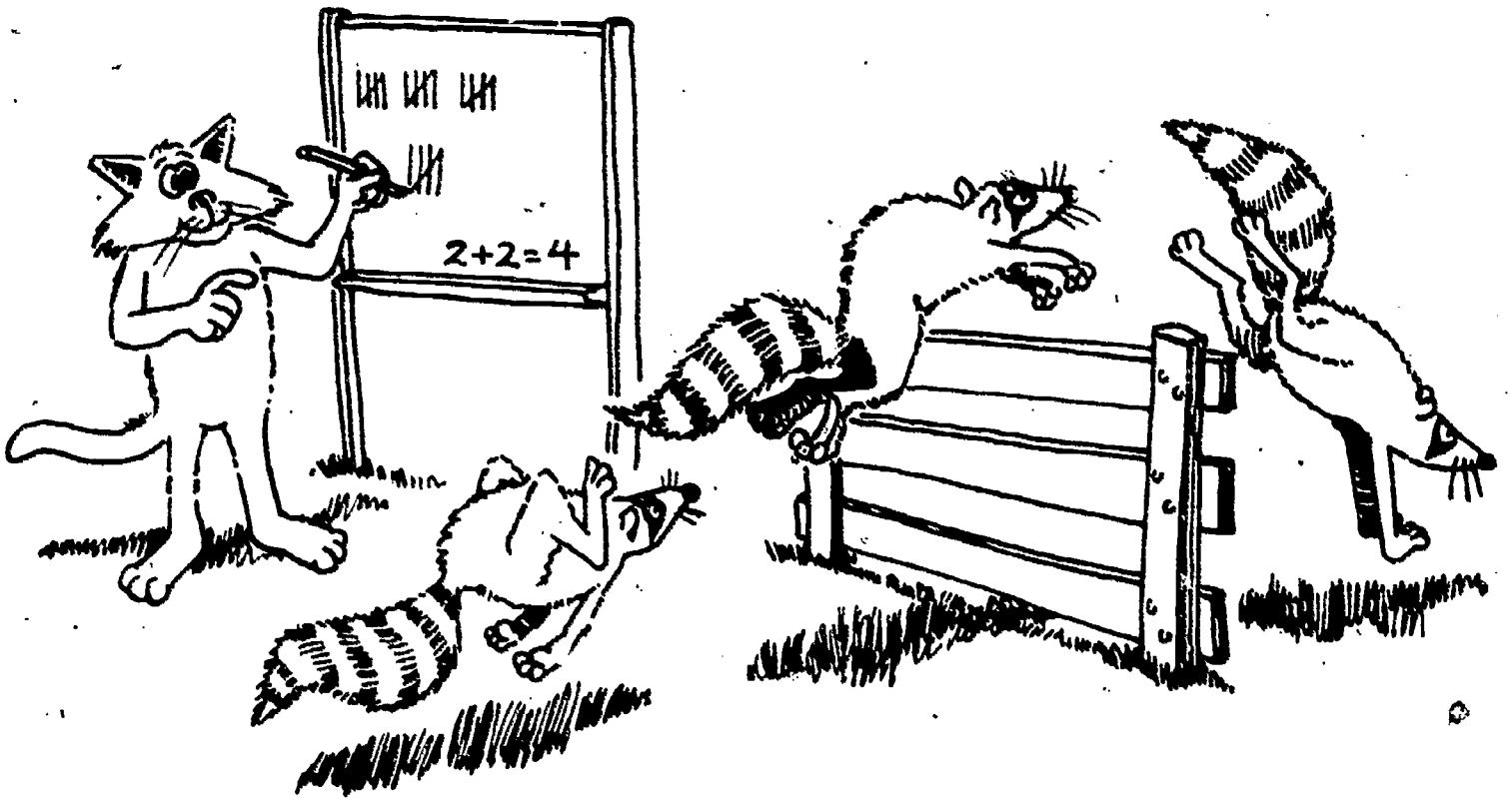

Figure 5. Example of an embellished picture used to improve name-accomplishment recall (Shriberg et al., Note 2).

recall (e.g., What was Charlene McKune famous for?). On the first six passages, students shown illustrations recalled about three times as much of that information in comparison to controls; on the last six passages, imagery instructions produced about a two-to-one advantage. Of course, picture type (illustrations vs. imagery) and order (first six passages vs. last six) are confounded in this study, so no direct comparison of illustrations and imagery should be made. The main point here is that very impressive gains in critical name-accomplishment information were effected by mnemonic imagery instructions (just as in the associative-learning literature). This is in striking contrast to previous prose-learning studies, based on simple narrative passages, where imagery instructions do little in the way of enhancing recall. Of course, the transformation vs. representation function distinction presumably is involved.

There is another aspect of the Shriberg et al. (Note 2) data that bolsters the transformation-representation distinction as well. After students were tested for critical name-accomplishment recall, they were tested for incidental detail recall in the following manner: First, they were reminded of an individual and his or her accomplishment (e.g., Charlene McKune was famous for her counting cat); then, they were asked about the two pieces of incidental information (e.g., How high can the cat count successfully? and What else can the cat do?). For students who had actually seen the incidental information pictured (Pictures Plus, first six passages), recall of that information was

moderately facilitated. This finding is consistent with a representation function account of visual illustrations when simple narrative passages comprise the prose materials. So is the finding that when the incidental information was not illustrated (Pictures, all 12 passages; and Pictures Plus, last six passages), no facilitated recall of that information was detected. Whether or not such a finding would hold up if students were told explicitly to remember the details is one of the questions we are currently pursuing in a follow-up study. We are conducting another study as well that will permit a very clean separation of the representation and transformation functions described here.

In any event, the Shriberg et al. (Note 2) data mesh well with the spirit of Figure 2. First, the benefits accruing to the transformation function of pictures (i.e., by mnemonically coding the critical name-accomplishment information) can be substantial, for both pictures on the page (illustrations) and pictures in the head (imagery). A recent prose-learning demonstration with adults also highlights the tremendous educational potential of mnemonic pictures when used in this fashion (Krebs, Snowman, & Smith, 1978). Second, the benefits accruing to the representation function of pictures (i.e., by picturing the incidental details) are moderate for illustrations and minimal or even nonexistent for visual imagery. This latter set of findings very accurately captures the differing representation strengths assumed to be served by illustrations and imagery when applied to literally encoded (rather than transformed) text.

Summary

I conclude this chapter by reiterating and expanding upon the pictures-in-prose observations of Levin and Lesgold (1978). Visual illustrations definitely do help children recall prose information. Just how much depends, of course, upon the kind of illustrations provided, as well as upon a number of other previously stated ground rules. Included in these rules is the type of prose passage presented. A very large number of studies support the conclusion that with simple narrative prose, illustration effects are moderate, amounting to at least 40% facilitation. The Berry and Levin (Note 1) study mentioned here suggests that illustrations, used in conjunction with simple newspaper articles, also produce moderate recall benefits. In contrast, with passages containing difficult-to-remember information, the advantages associated with mnemonic illustrations can be even greater. In the Shriberg et al. (Note 2) study reviewed here, illustrations improved eighth graders' recall of important information by about 200%.

With pictures defined as visual imagery, however, about the safest conclusion is that prose facilitation is only a "sometime thing." With simple narrative passages, instructions to generate corresponding visual images often do not improve recall and when they do, the amount of facilitation produced is small. Moreover, the prose-learning conditions under which visual imagery would even be expected to facilitate recall have not been carefully delineated. For example, researchers have barely scratched the surface in capitalizing on the integrative character of imagery or on its potential, through concrete analogy, to serve as a useful interpretive vehicle. Optimism stems, however, from the

Shriberg et al. (Note 2) study in which students applying a mnemonic imagery strategy were able to increase their recall of important prose information by about 100%. It is clear that a good deal of careful thinking needs to be done about what visual imagery can and cannot be expected to accomplish in various prose-learning situations.

As an initial attack on that problem, a conceptual framework was presented to permit a formal distinction among the several functions that prose-learning pictures likely serve. Two of these functions (the representation function and the transformation function) proved useful in differentiating between the magnitude and consistency of picture effects that can be anticipated from one prose-lear ing study to the next. The "functional" analysis also proved helpful in identifying both the kinds of variables that need to be controlled for when looking for pictures-in-prose effects, as well as the kind of research that still needs to be conducted to isolate the contributions of specific picture components.

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