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Mental imagery, text illustrations, and children's story comprehension and recall

At the end of the 1970s, Durkin's (1978-79) observational study provided striking evidence of the dearth of comprehension instruction in elementary classrooms. This classic study stimulated in part a major line of research that began in the 1980s and focused on the development and study of comprehension strategy instruction (Dole, Duffy, Roehler, & Pearson, 1991). The goal of comprehension strategy instruction is to develop metacognitive awareness over a set of strategies that students can use independently when reading text (Paris & Oka, 1986; Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989). Successful initiation and use of appropriate comprehension strategies depend on the reader's awareness of specific strategies and the employment of these strategies to assure better comprehension. Such strategies include determining importance, summarizing, drawing inferences, generating questions, and monitoring for understanding (Dole et al., 1991; Pressley et al., 1992).

Mental imagery has also been identified as a strategy for enhancing reading comprehension performance (Gambrell & Bales, 1986; Long, Winograd, & Bridge, 1989; Pressley, Borkowski, & Johnson, 1987; Pressley et al., 1992; Sadoski, 1985). The construction of mental images encourages use of prior knowledge as part of creating vivid representations of prose. Teaching children to construct mental images as they read enhances their abilities to construct inferences, make predictions, and remember what has been read (Gambrell, 1981; Gambrell & Bales, 1986; Pressley, 1976; Sadoski, 1985). This ability to use imagery as an aid to understanding and remembering (i.e., to organize and store information as mental images) is associated with efficient reading comprehension (Pressley et al., 1989; Sadoski, 1983; Sadoski, Goetz, & Kangiser, 1988).

A number of theories bear on mental imagery and its relationship to text processing, including Paivio's (1971, 1991) dual-coding theory, Wittrock's (1981) theory of generative learning, and Rosenblatt's (1978, 1985) transactional theory. The comprehension and memory

Mental imagery, text illustrations, and children's story comprehension and recall

THIS STUDY investigated the effects of instructions to induce mental imagery and attend to text illustrations on fourth graders' reading comprehension and recall of narrative text. The 120 subjects were randomly assigned to one of four treatment conditions: instructions to induce mental imagery (nonillustrated text version), instructions to attend to text illustrations (illustrated text version), instructions to induce mental imagery *and* attend to text illustrations (illustrated text version), and general memory instructions (nonillustrated version). After receiving instructions according to treatment condition, subjects silently read a narrative story, rendered a free recall, and responded to 16 cued recall questions (8 text explicit and 8 text implicit). The major findings of this study were that images and illustrations independently enhanced reading performance, and that, in combination, these two strategies resulted in impressive increases in children's comprehension and recall of stories. The authors interpret these findings as support for the imagery-illustration interaction theory.

Imagerie mentale, illustrations de texte, et rappel et compréhension de récit par les enfants

CETTE RECHERCHE a examiné les effets de consignes destinées à induire l'imagerie mentale et à prêter attention à l'illustration de textes sur le rappel et la compréhension de textes narratifs. 120 sujets ont été distribués au hasard dans chacune des quatre conditions de traitement: consignes pour induire l'imagerie mentale (version non illustrée du texte), consignes pour prêter attention aux illustrations du texte (version illustrée du texte), consignes pour induire l'imagerie mentale *et* prêter attention aux illustrations du texte (version illustrée du texte), et consignes générales de mémorisation (version non illustrée du texte). Après avoir reçu les consignes correspondant à leur condition de traitement, les sujets ont lu en silence un texte narratif, fourni un rappel libre, et répondu à 16 questions à choix multiple (8 questions explicites sur le texte et 8 implicites). Les découvertes majeures de cette recherche ont été que les images et les illustrations améliorent la lecture indépendamment l'une de l'autre, et que la combinaison de ces deux stratégies produit des améliorations impressionnantes de la compréhension et du rappel des récits. Les auteurs interprètent ces découvertes comme un soutien à la théorie de l'interaction illustration-imagerie.

Imágenes mentales, ilustraciones textuales y comprensión y relato de cuentos en niño

ESTE ESTUDIO investigó los efectos de instrucciones para inducir imágenes mentales y atender a ilustraciones textuales sobre la comprensión y el relato de texto narrativo en niños de cuarto grado. Se asignó al azar a los 120 sujetos a una de cuatro condiciones: instrucciones para inducir imágenes mentales (versión no ilustrada del texto), instrucciones para atender a las ilustraciones (versión ilustrada del texto), instrucciones para inducir imágenes mentales *y* atender a las ilustraciones (versión ilustrada del texto) e instrucciones para recordar en general (versión no ilustrada del texto). Luego de recibir instrucciones según las condiciones, los sujetos leyeron en silencio un cuento, hicieron un relato libre y respondieron a 16 preguntas sobre pistas del texto (8 explícitas en el texto y 8 implícitas). Los principales hallazgos de este estudio consistieron en que las imágenes e ilustraciones, en forma independiente, mejoraron el desempeño en lectura y que, en conjunto, estas dos estrategias resultaron en aumentos notables sobre la comprensión y el recuerdo de los niños. Las autoras interpretan estos hallazgos como fundamento de la teoría de la interacción imagen-ilustración.

Vorstellungsbilder, Textillustrationen und das Verstehen und Erinnern von Kindergeschichten

DIESE STUDIE untersuchte die Auswirkungen von Anweisungen, imaginative Bildersprache zu gebrauchen und Illustrationen beim Verstehen und Erinnern von Texten bei Viertklässlern zu berücksichtigen. Die 120 Teilnehmer wurden je zufällig einer von vier Behandlungsmöglichkeiten zugeteilt: Aufforderungen, imaginative Bildersprache einzusetzen (nichtillustrierte Textversion), Aufforderungen, Textillustrationen zu beachten (illustrierter Text), Anweisungen, imaginative Bilder einzusetzen und die Textillustrationen zu beachten (illustrierter Text) und allgemeine Erinnerungsanweisungen (nichtillustrierte Textversion). Nach den Anweisungen zu den Behandlungsmöglichkeiten lasen die Teilnehmer still eine narrative Geschichte, gaben eine freie Inhaltsangabe und sollten 16 verschlüsselte Gedächtnisfragen beantworten (je 8 direkt und indirekt aus dem Text abzuleiten). Die Hauptergebnisse dieser Studie sind, daß imaginative Bilder und Illustrationen unabhängig voneinander die Leseleistung erhöhen und sie in Verbindung beachtliche Verbesserungen im kindlichen Verstehen und Erinnern von Geschichten brachten. Die Autoren werten diese Ergebnisse als Untermauerung der bildersprachlichen Interaktionstheorie.

increases observed following imagery instructions are consistent with all three of these theories.

Dual-coding theory attempts to explain verbal and nonverbal cognition as well as relationships between the two. Paivio's dual-coding theory holds that verbal and nonverbal information are represented and processed in distinct, but interconnected, mental subsystems (Paivio, 1971, 1974, 1975, 1986, 1991). The verbal subsystem is specialized for dealing with language, while the nonverbal subsystem is specialized for the representation and processing of information concerning nonverbal objects and events (Paivio, 1983; Sadoski, Paivio, & Goetz, 1991). Information in the verbal system is organized in a way that favors abstract and sequential processing. Paivio (1991) theorizes that the verbal subsystem contributes to logic, order, direction, and organization of thought. In contrast, information in the nonverbal system is organized more in the form of holistic nested sets of information (such as images). It is theorized that the nonverbal system is relatively free of logical restraints, and is better at coping with concreteness and the parallel processing of spatial information (Paivio, 1991). The nonverbal system, according to Sadoski et al. (1991), "is often referred to as the imagery system because its functions include the analysis of scenes and the generation of mental images" (p. 473). Of particular importance to the nonverbal system is the "conceptual peg" hypothesis, which asserts that key images serve as mental "pegs" to which associated information is hooked for storage and retrieval.

According to Paivio (1991), both subsystems are capable of functioning in a dynamic and flexible way to reorganize, manipulate, or transform cognitive information. A major hypothesis of the dual-coding theory is that these verbal and nonverbal subsystems perform independent functions, but they can also perform in parallel, or in an integrated manner. This interconnection is revealed in the concept that language can evoke imagery, and imagery can evoke language (Sadoski et al., 1991).

According to Wittrock's (1981) theory of generative learning, reading comprehension occurs when readers build relationships (a) between the text and their knowledge and experience and (b) among the different parts of the text. The research of Wittrock and his colleagues (Linden & Wittrock, 1981; Wittrock, 1981, 1986, 1987) has demonstrated that mental imagery is an effective generative learning strategy. According to generative learning theory, mental images induce learners to construct relations among the parts of the text, their knowledge, and their experiences (Linden & Wittrock, 1981).

Transactional theory focuses on the nature of the relationship between the reader and the text. This theory emphasizes the active role of the reader in "creating" the literary work and the importance of the evocation of the "lived through" experience of the reader during the transaction with text. According to Rosenblatt (1986), the "lived through" experience evolves through attention to the personal meaning of the text. Recent work by Sadoski and his colleagues (1985, 1988) and Long et al. (1989) suggests that imagery often plays an important role in allowing the reader to enter the secondary world of the text, thereby making the stories "come to life" for the reader.

All three of these theories provide insights about the role of imagery in the reading comprehension process. They reflect the notion that the meaning of a text is not inherent in the print on the page but is the result of *constructive processes* that the reader brings to bear on the message (Bransford & Johnson, 1972; Paivio, 1991; Rosenblatt, 1985; Wittrock, 1981). This constructivist position emphasizes the importance of interaction between the reader and the text. Clearly, research that explores ways in which readers respond to and interact with text holds much promise for expanding our theories of reading process.

Reader-generated images and text-relevant illustrations

In a review of the literature on reader-generated internal images and text-relevant illustrations, Schallert (1980) concluded that both images and illustrations resulted in increased comprehension of prose. She suggested that these results may be due to the increase in the amount of attention readers bring to the task when given instructions to induce images or attend to illustrations. More importantly, Schallert (1980) hypothesized that the positive effects of self-generated images and text-relevant illustrations may be due to the similarity of the roles that images and illustrations play in the processing chains involved in text comprehension.

Instructing students to attend to illustrations that accompany text has been documented as a strategy which increases both listening and reading performance, at least with respect to information coded dually in text and pictures (Levie, 1987; Pressley & Miller, 1987). In their review of the research Levie and Lentz (1982) concluded that illustrations have little, if any, effect on learning nonillustrated information. However, there have been a few notable demonstrations of positive effects on learning information not illustrated in pictures accompanying text (e.g., Anglin, 1987; Rusted & Coltheart, 1979; Waddill, McDaniel, & Einstein, 1988). Taken together, the research suggests that illustrations help readers to focus their attention on information in text and to reor-

ganize the information into useful mental models.

One possibility is that illustration effects might be more pervasive if more than simple attention to pictures was instructed. Although pictures are intended to stimulate mental images, they may not do so as completely as they could, suggesting the hypothesis that inducing mental imagery in reaction to text illustrations might affect learning more than illustrations alone. Levin, Bender, & Pressley (1979) studied this possibility with regard to listening comprehension. They found that second and fifth graders who received instructions to attend to text illustrations and construct mental images while listening to sentences outperformed those in a control group on central and peripheral sentence information. In a study with kindergarteners, second graders, and third graders, Guttman, Levin, and Pressley (1977) demonstrated that complete pictures (depicting the complete contents of each sentence of a story) and partial pictures (depicting only a portion of the contents) enhanced listening comprehension as compared to imagery and text-only treatment conditions. In a follow-up study on listening comprehension, Digdon, Pressley, and Levin (1983) found kindergarten children benefited from text illustrations when instructed to make mental images. The relatively few studies conducted to date on combining imagery and illustrations have focused on listening comprehension rather than reading comprehension. None of the studies used ecologically valid text, and most relied on line drawings rather than the richer and more colorful illustrations that are typical of most illustrated text for younger readers. In addition, the designs of these studies were not sufficiently analytical to provide information related to some important issues related to reading comprehension. Thus, this study sought to answer the following questions: Which is more effective in enhancing elementary school students' comprehension of stories—attending to illustrations or generating mental images? Does the combined strategy of attending to illustrations and generating mental images hinder or enhance reading comprehension relative to either strategy alone?

The major hypothesis underlying the present study is that mental imagery and text-relevant illustrations play similar roles in the processing chains involved in comprehension (Schallert, 1980), and that these two strategies, when used in combination, interact in positive, interconnected ways that result in enhanced reading comprehension. In this study, we investigated the effects of instructions to induce mental imagery and attend to text illustrations on the story comprehension of fourth-grade students. Specifically, we directly compared the effectiveness of four treatment conditions: imagery, illustrations, imagery and illustrations, and a no-intervention control condition.

Method

Subjects

The subjects for this study were 120 fourth-grade students enrolled in three Florida public elementary schools. Criteria for inclusion in the study included the following: (a) reading comprehension scores within one standard deviation above or below the mean on the California Achievement Test, (b) Cognitive Abilities Test scores within one standard deviation above or below the mean, and (c) teacher verification of reading ability at the fourth-grade level.

Materials

Text. The story used in this study was selected according to specific criteria so that the practical effectiveness of induced mental imagery and attention to text-relevant illustrations could be determined with ecologically valid reading materials. The subjects read an intact story that met stringent criteria for both imagery-evoking qualities of the text (Paivio, 1975) and text-relevant illustrations (Manzo & Legenza, 1975). The story, "The Case of the Blueberry Pies" (Sobol, 1976), contained five text-relevant illustrations, was 925 words in length, and was written at the 4.5 readability level (Fry, 1977). (See Appendix A.) The story was selected from a basal text approved by the school system but not in use by the three schools involved in the study.

Illustrations. Schallert (1980) developed criteria for identifying characteristics of text-relevant illustrations: (a) The information in the illustrations is central to the text, (b) the illustrations are congruent with the text content, and (c) the illustrations provide a spatial or schematic representation of the interrelations of the text content. Four doctoral students served as judges for rating the illustrations in the story used in this study. There was 100% agreement that the illustrations met Schallert's criteria.

Six classroom teachers then analyzed the illustrations for picture potency according to the Manzo and Legenza (1975) classification system. This scale also substantiated the text-relevant nature of the illustrations. The Manzo and Legenza classification system includes analysis of 10 observable factors (Appendix B). Three certified reading specialists served as raters for the picture potency and text-relevant nature of the illustrations. The pictures were first scored for the 10 factors to yield a raw score. The raw score was then converted to a scaled score that was used to determine the picture potency rating category (high, medium high, medium low, or low). One illustration from the story was rated medium high, and the remainder were rated high. Interrater reliability

of 100% was obtained on the Manzo and Legenza classification system.

To assess the generalizability of the specific qualities of the story used in this study, four narrative stories were randomly selected from each of three fourth-grade basals approved for use in the district where the study was conducted. These stories were evaluated with respect to the number and quality of the illustrations according to Schallert's (1980) criteria for text-relevant illustrations. The story used in the study had 5 illustrations, while the mean number of illustrations for the 12 stories selected for analysis was 5.3. Of the 68 illustrations that appeared across the 12 stories, only one illustration failed to meet Schallert's (1980) criteria for text-relevant illustrations. This analysis confirmed that the story selected for this study was similar to other stories with respect to the quantity and quality of illustrations accompanying narrative stories.

Text versions. Two text versions of the basal story were devised: illustrated and nonillustrated. The illustrated text format contained five text-relevant, colored illustrations (exactly as they appeared in the basal). The nonillustrated text format contained no illustrations but retained the same number of pages. In addition, two pages that included attentional directions according to treatment condition (e.g., "Remember to make pictures in your head") were added to each version of the text. The purpose of the directions was to remind the students of the instructions they were given at the beginning of the session.

Reading comprehension assessment. The two reading comprehension assessment tasks employed in this study consisted of a prompt to elicit free recall and 16 cued recall questions. The cued recall task consisted of eight questions designed to elicit textually explicit story information and eight questions designed to elicit textually implicit story information. Three certified reading specialists reached 100% agreement with respect to the explicit and implicit nature of the cued recall questions.

Procedure

This study focused on the effects of strategy instructions that directed students to use mental imagery and illustrations, imagery only, and illustrations only. A general memory instructions group served as the control and was given instructions to "read to remember." Thus, the study employed four treatment conditions (induced mental imagery *and* attention to text illustrations, induced mental imagery, attention to text illustrations, and general memory) and two text versions (illustrated text and nonillustrated text). Subjects were randomly assigned to one of the following four treatment conditions:

1. *Induced mental imagery and attention to text illustrations.* In this condition subjects were given instructions to induce mental imagery *and* to attend to text illustrations. This condition was designed to explore the effects of readers' *combined* use of imagery and illustrations. Subjects in this treatment condition (imagery + illustrations condition) read an *illustrated* version of the text.

2. *Induced mental imagery.* In this condition subjects were given instructions to induce mental imagery. This condition was designed to investigate the effects of readers' use of imagery (imagery-only condition). Subjects in this treatment condition read a *nonillustrated* version of the text.

3. *Attention to text illustrations.* In this condition subjects were given instructions to attend to text illustrations. This condition was designed to investigate the effects of readers' use of illustrations (illustrations-only condition). Subjects in this treatment condition read an *illustrated* version of the text.

4. *General memory.* The general memory condition served as the control group. Subjects were given instructions to try to remember the story. Subjects in this condition read a *nonillustrated* version of the text.

A researcher met with the subjects in small groups of 5 to 7 students to conduct the reading lesson. All subjects were informed that they would be reading a story, writing about the story, and answering some questions about the story.

The procedure for each treatment condition was identical in content, time, and procedure with the exception of the two text versions and the specific comprehension strategy instructions. Subjects who received instructions to induce mental imagery and attend to the text-relevant illustrations were told: "A good way to understand what you read is to look very carefully at the pictures on each page. Then try to make as many pictures as you can in your head about the things that you read." Subjects who received instructions to induce mental imagery (nonillustrated text) were told: "A good way to understand what you read is to make as many pictures as you can in your head about the things that you read." Subjects who received instructions to attend to text-relevant illustrations were told: "A good way to understand what you read is to look very carefully at the pictures on each page." Subjects who received general memory instructions (nonillustrated text) were told: "A good way to understand what you read is to try very hard to remember what you read."

Subjects were then directed to read the story silently. Immediately upon completing the silent reading, subjects completed an unrelated maze activity as an intervening task to mask the effects of short-term memory.

Students were then asked to "write the story you just read for a friend who has not read or heard the story before."

Scoring. The free recall protocols were scored for the number of propositions on the basis of procedures developed by Kintsch (1974). In this scoring system a proposition is defined as a predicator or relational word and one or more arguments that stand in some specific relation to the predicator. Three independent raters divided the stimulus basal story into propositions. Disagreements were resolved through discussion and consensus. In scoring the subject's recall protocols, interrater agreement of 90% was reached among the three raters on the scoring of the propositions. In the scoring procedures used in this study a proposition was considered appropriate if it preserved the semantic form of the proposition in the passage. Strict criteria were adhered to so that scores were not artificially inflated. Only text-based propositions were scored, and repetitions were not counted. This scoring procedure provided information about the *amount* of text-based information recalled.

The free recall protocols were also scored for the number of story structure elements recalled, on the basis of procedures developed by Morrow (1985) and Stein and Glenn (1979). This scoring procedure focuses on the internal organization of the story and provides information about the *quality* of the recall protocols. Three independent raters read the story and identified the essential story structure elements. The interrater reliability among the three raters was 84% on identification of essential story structure elements. Items of disagreement were resolved through discussion and consensus. A scoring guide was then developed for use in scoring the recall protocols for presence of story structure elements (Appendix C). Interrater reliability established among the three raters was 85% on the scoring of the story structure elements. Based on the scoring of story structure elements, the number of complete stories was calculated by identifying stories that contained all the basic story structure elements: setting, characters, more than one episode, and resolution.

The responses to the 16 cued recall questions were scored according to a template of acceptable answers. Three independent raters reached 100% agreement with respect to acceptable answers to the questions. The split-half reliability of the cued recall test, as estimated by the Spearman-Brown coefficient of internal consistency, was .80.

Results

Bartlett's test of sphericity was used to determine the appropriateness of multivariate versus univariate tests. When the dependent measures were shown to be correlated, MANOVA procedures were applied. The first MANOVA tested for the intercorrelations of the following dependent measures: the number of propositions recalled, number of correct responses to the implicit questions, and number of correct responses to the explicit questions (Wilks's $\lambda = 3.89$, $p<.01$). The second MANOVA tested for the intercorrelations of the following story structure dependent variables: setting, characters, episodes, and resolution (Wilks's $\lambda = 2.64$, $p<.01$). The MANOVA procedures were followed by univariate analyses and post hoc multiple comparison analyses, when indicated. When significant F ratios were produced, the Tukey HSD multiple comparison procedure was performed. The MANOVA procedures revealed no significant interaction effects across the four treatment groups for the illustrated and nonillustrated text versions. In addition, chi-square analysis was used to test for significant differences with respect to the number of complete story recalls among the four treatment conditions.

Table 1 Means and standard deviations for number of propositions recalled on the free recall task

	Propositions recalled	
Treatment condition[a]	*M*	*SD*
Imagery + illustrations	52.97	21.53
Imagery-only	48.80	28.68
Illustrations-only	44.63	22.06
Control	28.20	16.24

[a] $n = 30$ for each group.

Free recall

The means and standard deviations for the number of propositions recalled are displayed in Table 1. The analysis of variance procedure revealed statistically significant differences among the four treatment conditions on number of propositions recalled, $F(3, 116) = 7.47$, $p<.01$. The Tukey HSD procedure indicated that the imagery + illustration group, the imagery-only group, and the illustrations-only group were statistically superior to the control group.

The means and standard deviations for the number of story structure elements recalled are displayed in Table 2. The analysis of variance procedure revealed statistically significant differences among the four treatment groups with respect to recall of total story structure elements, $F(3, 116) = 8.01$, $p<.01$. The results of the Tukey HSD procedure indicated that the performance of the subjects in the mental imagery + illustrations group was

Table 2 Means and standard deviations for the number of story structure elements recalled on the free recall task

Treatment condition[a]	Story structure elements recalled				
	Setting *M* (*SD*)	Characters *M* (*SD*)	Episodes *M* (*SD*)	Resolution *M* (*SD*)	Total *M* (*SD*)
Imagery + illustrations	.53 (.51)	2.97 (.72)	.90 (.96)	.23 (.43)	4.63 (1.61)
Imagery-only	.27 (.45)	2.57 (.93)	.54 (.90)	.30 (.46)	3.67 (1.45)
Illustrations-only	.37 (.49)	2.17 (1.31)	.57 (.77)	.10 (.31)	3.30 (1.97)
Control	.17 (.38)	1.97 (1.10)	.13 (.35)	.23 (.43)	2.50 (1.57)

Note. Total possible scores for each category are as follows: setting, 2; characters, 4; episodes, 5; resolution, 2.
[a] $n = 30$ for each group.

superior to that of all other treatment conditions. In addition, there was a statistically significant difference between the performance of subjects in the imagery-only condition and that of subjects in the control condition, in favor of imagery only.

With respect to specific story elements recalled, the results of analysis of variance procedures indicated statistically significant differences among the four treatment conditions for the categories of setting, $F(3, 116) = 3.48$, $p<.05$; characters, $F(3, 116) = 5.45$, $p<.01$; and plot, $F(3, 116) = 4.83$, $p<.01$. There were no statistically significant differences among the four treatment conditions for the category of resolution, $F(3, 116) = 1.24$, $p>.05$. The Tukey HSD procedure revealed a statistically significant difference between the imagery + illustrations group and the control group for the categories of setting, characters, and plot, in favor of the imagery + illustrations group. In addition, a statistically significant difference was found for the category of characters between the imagery + illustration group and the illustrations-only group, in favor of the imagery + illustrations group.

The complexity level of the story recalls was determined by counting the number of stories that included all the elements of a well-formed story (setting, characters, multiple plot episodes, and a resolution). Chi-square analysis, with Yates's correction applied, detected significant differences among the four treatment conditions with respect to the number of complete stories recalled, χ^2 (3, $N = 120$) = 9.88, $p<.01$.

Cued recall

The means and standard deviations for the number of correct responses to the cued recall task are shown in Table 3. The results revealed statistically significant differences among the four treatment conditions for total cued recall, $F(3, 116) = 7.48$, $p<.01$; explicit cued recall, $F(3, 116) = 4.63$, $p<.01$; and implicit cued recall, $F(3, 116) = 6.15$, $p<.01$. The multiple comparison Tukey procedure revealed that on the total cued recall task the performance of the subjects in the imagery + illustrations group was statistically superior to that of the subjects in the other three treatment conditions. With respect to explicit cued recall, the only significant difference occurred between the imagery + illustrations group and the control group, in favor of the imagery + illustrations group. On implicit cued recall, however, the performance of the subjects in the imagery + illustrations group was statistically superior to that of the subjects in the other three treatment conditions.

Discussion

This study was designed to investigate the effects of instructions to induce mental imagery and to attend to text-relevant illustrations on fourth-grade readers' story comprehension. The major finding of this study was that comprehension performance was enhanced when students received instructions to induce mental imagery and attend to text illustrations. The results of this study suggest that when readers combine the two strategies of inducing mental imagery and attending to illustrations something happens apart from that which occurs when imagery and illustrations are employed in isolation. One hypothesis that emerges concerning the facilitative effects of the combined use of mental imagery and illustrations is that the combined strategy use results in deeper processing than is achieved with single strategy use. The results of this study are viewed as support for an *imagery-illustration interaction theory,* which posits that readers use mental imagery and text-relevant illustrations in dynamic, flexible, and interconnected ways that result in enhanced comprehension of text.

In this study three treatment groups, imagery + illustrations, imagery-only, and illustrations-only, outperformed the control condition on the number of propositions recalled. A clearer picture in favor of the combined mental imagery + illustrations strategy group emerged, however, with the analysis of the number of story structure elements recalled, which revealed that the combined strategy group outperformed all other conditions on the total number of story structure elements recalled.

Another indicator of the qualitative superiority of the combined strategy group was the number of complete stories generated by the students who received instructions to attend to illustrations and induce mental

imagery as compared to the other conditions. In the combined strategy group, mental imagery + illustrations, 70% of the students wrote complete stories as compared to 58% in the imagery-only group, 40% in the illustrations-only group, and only 33% in the control group.

On the cued recall assessment the combined strategy group outperformed all other conditions on total number of questions answered correctly. For explicit questions, however, a statistically significant difference occurred only between the combined strategy group and the control group. On the implicit questions the combined strategy group outperformed all other conditions. This finding is particularly noteworthy given that implicit comprehension questions require answers that reflect integration of story information and the use of higher cognitive processes (Anderson, 1972). The results of the present study substantiate prior research by Rasco, Tennyson, and Boutwell (1975) and Digdon, Pressley, and Levin (1983), which found that illustrations in text, combined with induced mental imagery, significantly increased implicit comprehension for young children in listening situations. The present investigation extends these findings to elementary school-age students in reading situations using narrative text.

It is important to note that in this study the only group to receive instructions to "read to remember" was the general memory or control group. The other three groups, however, outperformed the control group, even in the absence of instructions to recall, on all free recall and cued recall measures.

A methodological limitation of the present study that should be acknowledged is that only one story was used in this investigation. The specific qualities of the story, however, are generalizable in that most current basal programs contain children's literature narratives with text-relevant illustrations similar to the one selected for this investigation. The findings of this study, are limited to narratives that have clear presence of story structure elements (Morrow, 1985) and text-relevant illustrations (Schallert, 1980) with a high picture potency rating (Manzo & Legenza, 1975). Future research will need to be conducted to determine if the findings of this study generalize to other stories, other types of illustrations, and other text structures, as well as other age groups and other types of readers.

In the present study the combined mental imagery + illustrations strategy was more potent than either imagery alone or illustrations alone. Perhaps the simple imagery instructions were not as effective because the children were not clear about *what* to image. In the combined imagery + illustrations strategy group, the illustrations in the story may have provided concrete representations, which allowed the children to make more elaborate mental images. These more elaborate mental images may be more efficiently encoded into memory and thus are easier to retrieve and manipulate.

Table 3 Means and standard deviations for the number of cued recall questions answered correctly

Treatment condition[a]	*Explicit*		*Implicit*		*Total*	
	M	*SD*	*M*	*SD*	*M*	*SD*
Imagery + illustrations	4.00	1.44	4.27	1.75	8.27	2.53
Imagery-only	3.07	1.61	2.80	1.40	5.87	2.47
Illustrations-only	3.07	2.03	3.00	2.07	6.07	3.63
Control	2.40	1.43	2.40	1.72	4.80	2.65

Note. Maximum score for explicit = 8, for implicit = 8, and for total = 16.
[a] n = 30 for each group.

Providing text-relevant illustrations along with instructions to induce mental imagery enhanced the reading comprehension performance of the fourth-grade students in this study. This finding is interpreted as support of the imagery-illustration interaction theory, which posits that the imaginal coding of young children is enhanced by illustrations. Basic to this theory is the notion that text-relevant illustrations provide a knowledge base from which the children can begin to construct appropriate mental images about the text. It may be that illustrations act as a bridge or transitory step in the process of transforming prose into mental images.

One noteworthy trend in the data relates to the differential effects of induced mental imagery as compared to attention to text-relevant illustrations. There is some evidence in this study that mental imagery was more effective than attending to illustrations with respect to reading comprehension performance. Students in the imagery-only condition recalled more story structure elements than the control group while there was no statistically significant difference between the illustrations-only condition and the control. Also, 58% of the students in the imagery-only group wrote complete stories as compared to only 40% in the illustrations group. These findings suggest that instructions to induce mental imagery may be superior to attention to text illustrations with regard to holistic story comprehension.

The finding that, in general, imagery was more effective than illustrations has particular implications with respect to Rosenblatt's (1985) transactional theory. The specific strategy instructions used in this study suggested two distinct ways of responding to text. The instructions to induce imagery and attend to illustrations and the instructions simply to induce imagery encouraged children to actively engage in constructing their

own personal envisionment of the story. The instructions to attend to the illustrations while reading and the instructions to "read to remember" encouraged a highly text-bound approach to reading. The findings of this study provide support for the hypothesis that imagery may facilitate the reader's entry into the secondary world of the story, resulting in greater depth of processing and increased story comprehension and recall.

There were no statistically significant differences between the imagery-only group and the illustrations-only group on cued recall performance. This suggests that mental images and illustrations may similarly affect cued recall. The findings of this study suggest that reader-induced images are just as effective as illustrations for enhancing explicit and implicit cued recall performance. This finding is consistent with the findings of other researchers (Jusczyk, Kimler, & Bubis, 1975; Levin et al., 1979; Rasco et al., 1975). These researchers reported that imagery conditions were comparable in effectiveness to illustrations for implicit sentence information. The findings of the present study suggest that both images and illustrations can independently help students build associations, make abstractions, and make inferences based on the information in the story. In combination, however, these two strategies result in impressive increases in story comprehension.

The major finding of this study was that the combined strategy of induced mental imagery and attention to text-relevant illustrations was the most potent comprehension strategy. This suggests that there is a positive interaction between mental images and text illustrations. While the results of this study support the imagery-illustration interaction theory, this study does not provide clarity concerning the precise nature of this interaction. Additional research is warranted to explore the nature of imagery-illustration interactions in the comprehension process and to determine which combination of reading conditions, illustration types, and reader characteristics benefits most from mental imagery and text illustrations (Sadoski, 1983, 1985; Sadoski et al., 1988).

The present findings are of interest not only from a theoretical research point of view but from an educational standpoint as well. Readers may benefit substantially from combining strategies that are complementary and result in deeper processing of text. Instructions to induce mental imagery and attend to text-relevant illustrations appear to enhance both the quantity and quality of what children comprehend and recall about stories. The findings of this study suggest that combining the strategies of mental imagery and attention to text illustrations enhances the cognitive processing of text. The positive results obtained from this study and the methodology used to obtain them should encourage both teachers and researchers to examine induced mental imagery and attention to text-relevant illustrations as complementary reading comprehension strategies.

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AUTHOR NOTE

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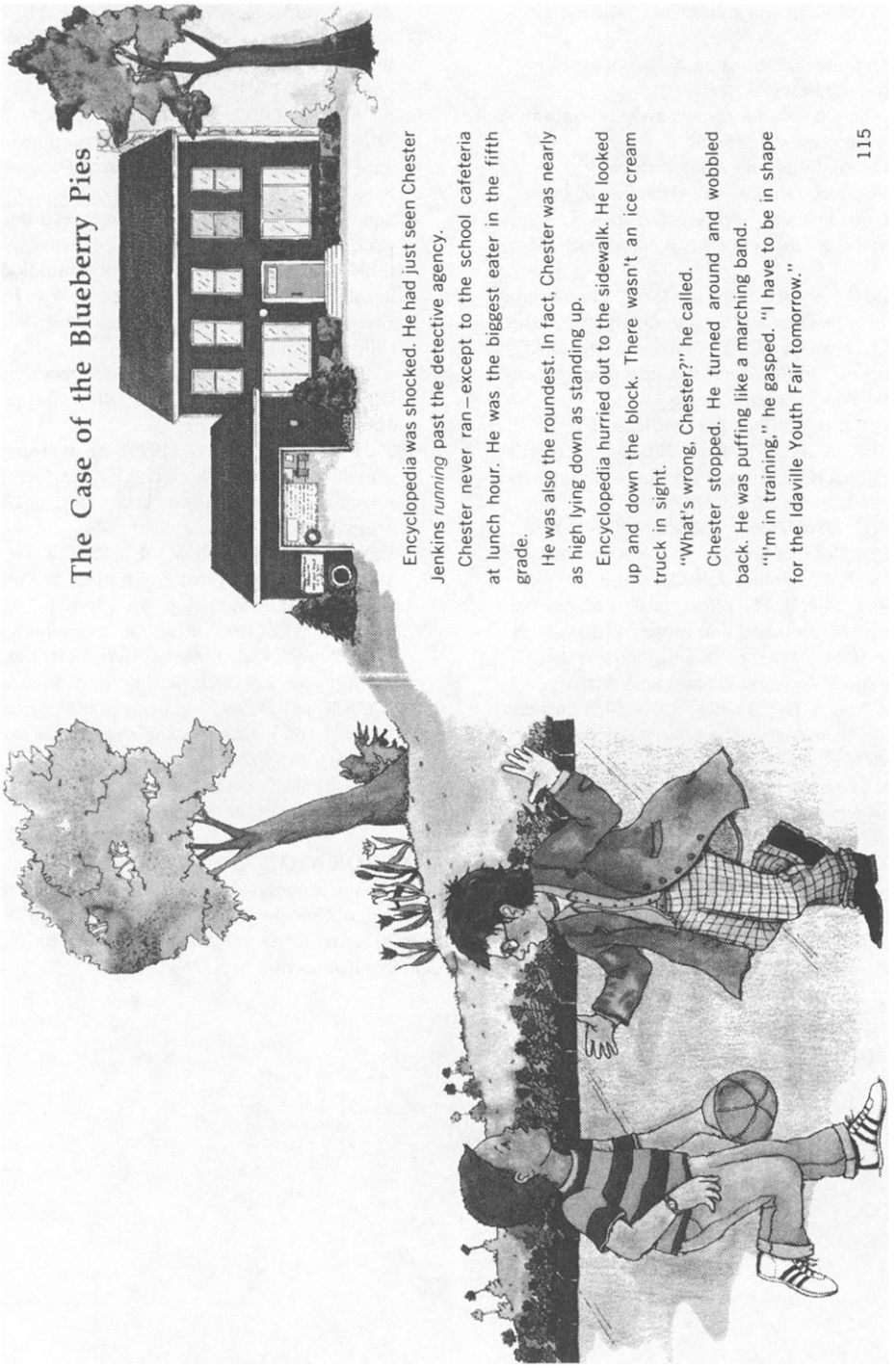
Appendix A

Sample pages from "The Case of the Blueberry Pies"



Illustrations from A Lizard to Start With *of the Reading 720 Series. ©Copyright 1976, by Ginn and Company. Used by permission of Silver Burdett Ginn Inc.*
Text: "The Case of the Blueberry Pies," from Encyclopedia Brown Gets His Man *by Donald J. Sobol. Copyright ©1967 by Donald J. Sobol. Used by permission of Lodestar Books, an affiliate of Dutton Children's Books, a division of Penguin USA Inc.*

"Charlie Stewart entered his tooth collection in the hobby contest," said Encyclopedia. "Are you in a running race?"

"Not exactly," replied Chester. "I'm getting in trim for the pie-eating contest."

Encyclopedia was puzzled. Why roadwork? Chester was a cinch to win. Only Belly Slave, the hippopotamus at the zoo, could eat more.

"Do you remember how sick the Thompson twins, Jimmy and Johnny, became last year?" asked Chester. "Their mother said the pie-eating contest was disgusting. She said there ought to be a physical fitness contest instead."

Encyclopedia remembered last year. Chester had left the other boys lying on their backs covered with pie crumbs. The Thompson twins had to be carried home.

"The rules have been changed," said Chester. "This year each boy has only two pies to eat. But he must run half a mile to the finish line."

"Hopping hamburgers!" exclaimed Encyclopedia. "That's a tough break, Chester."

"Those Thompson twins are fast runners," said Chester. "But if apple pie is used, I'll have a good chance. Apple pie is my favorite."

"Here's to apple pie!" said Encyclopedia.

"Thanks," said Chester, and grimly resumed his running.

The next morning Encyclopedia and Sally biked to the Idaville Youth Fair. It was a city of tents and fun rides crowded into one corner of the old airstrip.

The two detectives watched the kite-flying contest and the pet show. At ten o'clock a whistle blew for the pie-eating contest.

Appendix B

Manzo and Legenza picture potency formula

Factor I	*Different things.* Count the total number of different things in the picture (e.g., people = 1 thing; birds, fish, animals = 1 thing each).
Factor II	*Significant things.* Count the total number of significant main figures around which the other things are set.
Factor III	*Total things.* Count the total number of all things; everything is counted except for nondescript things.
Factor IV	*Colors.* Count the total number of different colors.
Factor V	*Action.* Count the number of actions in progress.
Factor VI	*Children.* Count the number of children present.
Factor VII	*People.* Count the total number of people present (children are counted again).
Factor VIII	*Potential movement.* Count the total number of things with potential for movement, other than people; multiply the number of animals by 2 (e.g., cars, planes, animals x 2, bicycle).
Factor IX	*Size of plate.* Measure the size of the picture (0 points for under 2 x 2 inches, 1 point for 4 x 4 inches, 2 points for 5 x 7 inches, 3 points for 8 x 10 inches, 4 points for 11 x 14 inches, 5 points for any larger picture).
Factor X	*Empathy.* Assign the total picture a value from 1 (low) to 5 (high) for its overall compatibility with the interests and experiences of the children with whom it will be used.

Appendix C

Story structure elements, "The Case of the Blueberry Pies"

Setting (2 points possible)
- Outside detective agency _____
- Idaville Youth Fair _____

Characters (4 points possible)
- Encyclopedia Brown _____
- Chester _____
- Thompson twins _____
- Sally _____

Plot episodes (5 points possible)
- Chester is in training for the pie eating contest because the rules have changed. _____
- Mrs. Thompson explains rules, eat two pies, run 1/2 mile. _____
- Chester reaches pies last, but finishes eating first. _____
- Chester is leading near the finish as the twin speeds past and wins. _____
- The twin smiles, showing white teeth (no blueberry stain). _____

Resolution (2 points possible)
- Encyclopedia knows that the twins switched. _____
- Chester is really the winner. _____