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Presentational Features for Young Children's Production and Recall of Information

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Young children's production and recall of information presented at varying levels of action and verbal labels was compared on a computer versus a felt board. Forty children, equally distributed by Grades Preschool and Kindergarten, were randomly assigned to a computer or felt board condition. Within each condition, the same 24 objects (6 sets of 4 objects) were presented with or without action and verbal labels. Both action and labels increased children's recall of verbal information, regardless of the medium in which that information was presented. The results suggest that action facilitates, rather than disrupts, children's learning of verbal information.

Children's recall of information depends, in part, on the link between how information is presented and the ways children have to think about, encode, and retrieve that information. More specifically, effective recall requires a match between the demands of an information-processing situation and children's cognitive skills.

Although young children have often been characterized as enactive and iconic, visual information processors (Bruner, Olver, & Greenfield, 1966), recent debates have centered on the extent to which such tendencies interfere with their ability to process verbal linguistic content (Calvert, Huston, & Wright, 1987; Gibbons, Anderson, Smith, Field, & Fischer, 1986; Hayes & Birnbaum, 1980). On the one hand, visual presentation is thought to disrupt children's comprehension of the potentially more informative verbal information (Hayes & Birnbaum, 1980). On the other hand, visual presentation, particularly in the form of action, might supplement verbal information by supplying dual modes to represent content (Beagles-Roos & Gat, 1983; Calvert, Huston, Watkins, & Wright, 1982; Greenfield & Beagles-Roos, 1988). The purpose here is to examine the role of action for children's comprehension of verbal information.

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The Visual Superiority Hypothesis

Hayes and Birnbaum (1980) described the tendency for young children to focus on visual over verbal aspects of a presentation as the visual superiority hypothesis. When a visual television track is paired with an auditory track from a different program, preschoolers recall the visually presented information better than the aurally presented information, but such effects are not found for adults. Young children also recall more visual than aural information from a semantically intact program if they are told that they will be tested later (Hayes, Chemelski, & Birnbaum, 1981). Finally, children recall more dialogue from an audio/radio presentation than from an audiovisual/television presentation with the same soundtrack (Beagles-Roos & Gat, 1983; Greenfield & Beagles-Roos, 1988). Visual presentation, then, can interfere with children's comprehension of verbal content.

By contrast, Calvert et al. (1982) found that simultaneous presentation of action and dialogue was associated with children's recall of televised verbal content. Gibbons et al. (1986) found that even young children recalled character actions better than utterances in an audio-only radio presentation. The implication is that visual superiority is really action superiority and that complimentary presentation of the same information in two modalities can facilitate recall.

One reason to extend this line of research from television and radio to computer research is that experimental examination of the links between visual presentation, action presentation, and linguistic presentation with children's subsequent recall of verbal information can be tightly controlled in a computer setting. That is, a computer can be programmed to present the same visual objects either in still frame or with movement. When action supports the linguistic content, comprehension of verbally presented information is expected to be enhanced over a still frame visual presentation of that same information. A second reason to extend this line of research to computers is to assess the potential generality of presentational characteristic effects across different media.

Verbal Labeling and Linguistic Codes

Although controversy exists about the role of visual presentation for children's recall of linguistic content, the literature clearly documents that verbal labels enhance recall (Flavell, 1985). Children who verbally label information are more likely to recall that information than those who do not (Baker-Ward, Ornstein, & Holden, 1984; Flavell, 1985; Weissberg & Paris, 1986). Verbal labeling, which involves naming an object, is an early form of verbal rehearsal, a process by which information is repeated, organized, and maintained in memory (Brown, Bransford, Ferrara, & Campione, 1983). Early rehearsal strategies, like naming objects, are not often observed when young children play with objects, particularly when they are not told to remember targeted objects (Baker-Ward et al., 1984).

Whereas younger children are less likely to rehearse information than are older children (Flavell, Beach, & Chinsky, 1966), their recall improves when they are taught to do so (Brown et al., 1983). This memory strategy problem is a production deficiency: The child is able to use, but does not spontaneously produce, a strategy that will enhance recall (Flavell, 1985).

Contextual determinants also affect recall. Young children, for example, recall more information in a lesson than in a play format, but the effect occurs because children are more likely to rehearse in the lesson than in the play context (Weissberg & Paris, 1986). This finding suggests that incidental memory tasks that call upon a child to produce names of objects might also improve recall.

Because young children do little to help themselves recall information in incidental memory tasks, like learning television content, adults have also labeled information for them. Friedrich and Stein (1975), for example, increased preschoolers' recall of television content by providing verbal labels of significant information. In general, children benefit from verbal labeling procedures only when information is provided that they will not spontaneously produce (Calvert et al., 1987).

Age Differences in Recall

Older children recall more information than do younger children in a wide variety of memory tasks (Flavell, 1985; Mandler, 1983; Weissberg & Paris, 1986). Recall performance improves as children increasingly use memory strategies to select, organize, and encode information. Many recall tasks are also verbal, thereby enabling an older child—who uses verbal forms of thought easily—to perform better than a younger child (Bruner et al., 1966).

Because many of the earliest memory strategies emerge around age 5 (Brown et al., 1983), preschoolers and kindergartners were compared in this study. By so doing, the spontaneous use of naming objects, which is considered an early memory strategy in a deliberate task, was examined in an incidental memory task. Children were expected to recall information better when labels were provided for them or when labeling behaviors (i.e., naming objects) were elicited from them.

Media of Information Delivery

The world in which we live is now marked by the computer revolution, a technological and societal change that has come about quickly. Computers are thought to be a panacea for education, or a Pandora's box (Lepper & Gurtner, 1989). As computers rapidly enter the educational system, little is known about their effectiveness compared to traditional methods of information delivery.

Computers, like all learning systems, must present information through the symbol systems that the user has available. For the human being, these symbol systems include the enactive, visual iconic, and verbal symbolic codes the user brings to the learning situation (Bruner et al., 1966).

Traditional learning situations have relied on the latter two symbol systems to deliver information. For example, visual and verbal processes are called upon when a teacher tells and illustrates a story on a felt board, but seldom have teachers used action as a way to "animate" the story.

A story can be told on either a computer or a felt board so that the relative effectiveness of different methods of information delivery can be compared. Techniques like movement and labels can be used to present objects in both media. A story also provides a way to maximize children's interest in an incidental memory task, perhaps providing some early glimpses into the ways in which children recall verbal information.

This Study

The purpose of this study was to examine the role of action and verbal labels for children's verbal recall of information. To examine if computers are superior to traditional forms of information delivery, the same objects were presented either on a computer or a felt board. I expected:

1. Action and labels to increase children's verbal recall of information, particularly when both features were present rather than absent;
2. Kindergartners to recall more information than preschoolers;
3. The no-label variations to enhance production of that information; and
4. Production scores in the no-label variations to enhance recall of that information.

METHOD

Subjects

Subjects were 40 children, equally distributed by Grades Preschool and Kindergarten (M = 5 years, 0 months vs. 5 years, 11 months), who attended private schools in a large metropolitan city. There were 22 girls and 18 boys. Within grades, children were randomly assigned either to a felt board control or to a computer treatment condition.

Treatment Conditions

Children's recall of objects was compared in a computer versus a felt board version of Parkworld. The background scene, which was the same size and color in both conditions, depicted a park with a grassy area, lake, train track, and sky.

Twenty-four objects, which belonged to one of the six categories of people, water animals, land animals, vehicles, nature, and toys, appeared in Parkworld. The objects, approximately ¼″ × ¼″ (.635 cm × .635 cm) in size, were either programmed to appear as visual icons on the computer screen or visual representations created from felt. The felt objects were the same color, size, and shape as the computer-generated objects. Within the six categories, objects were presented with or without action, and with or without verbal labels.

TABLE 1
Properties of the Objects in Parkworld

Category	No Action No Label	Action No Label	No Action Label	Action Label
Land animals:	Bird	Cat	Dog	Horse
Water animals:	Turtle	Frog	Fish	Duck
People:	Dad	Girl	Mom	Boy
Toys:	Kite	Ball	Wagon	Boat
Nature:	Sun	Flower	Cloud	Tree
Vehicles:	Plane	Car	Train	Truck

Action was defined as movement appropriate for the designated object. For example, the duck waddled across the grass to the pond, and the horse galloped through the park. Verbal labels were defined as naming the objects.

The presentational features of action and labels had been randomly assigned to the objects in a previous study (Calvert, Watson, Brinkley, & Penny, 1990); examination of four different computer versions of Parkworld, which had counterbalanced the features of action and labels, revealed no recall differences across the different versions. Thus, one version was randomly selected for study here. Properties of the objects are presented in Table 1.

Procedure

Each child participated individually in one 10-min session in an empty classroom in which he or she was presented with the 24 objects (6 sets of 4 objects) on the computer or the felt board. Within sets, objects crossed two levels of action (movement vs. no movement) with two levels of verbal labels (label vs. no label).

In order to familiarize children with the properties of objects, the objects were presented in the context of a story called "An Afternoon in the Park." The experimenter read the same story in both conditions, and visual objects and printed names of those objects appeared in both conditions. In the computer condition, the experimenter typed each key word as it appeared in the story and a speech synthesizer either labeled the word or not as the object either appeared in still frame or moved across the computer screen. The experimenter then pointed at the object for one second.

In the felt board condition, the experimenter made the objects perform as they did in the computer condition. However, instead of typing the words, the experimenter turned over a ½″ × 1″ (1.27 cm × 2.54 cm) note card with the name of the object. The experimenter then placed or moved the felt objects on the felt board with a pair of tweezers, and labeled the objects in the verbal label variations. He then pointed at the object for 1 s.

The names of objects, presented later, can be determined from the story context. Targeted words appear only once in the story. All targeted words are capitalized. Words that are underscored are spoken; words that are only capitalized are not spoken. Words that are italicized move; words that are not italicized do not move.

An Afternoon in the Park

The Blue family decided to have a picnic in a nearby park. They drove their *CAR* to a grassy field and parked it next to a big moving *TRUCK*. As they got out, they heard a loud noise—they looked into the sky and saw a jet PLANE flying overhead. The family decided that they would wait until another afternoon to ride the park choo-choo TRAIN.

Mrs. Blue, the children's MOM, and Mr. Blue, the children's DAD, carried the picnic basket and blanket. Brian, their little *BOY*, and Susan, their little *GIRL*, headed for the playground.

They pulled their WAGON filled with toys. At the playground, they played catch with a *BALL* and watched someone fly a long-tailed KITE over by the water. They decided they would try to float their toy *BOAT* in the lake after lunch.

As the kids ate lunch, they noticed only one puffy white CLOUD in the blue sky. The bright yellow SUN felt warm on their faces. Susan picked a pretty *FLOWER* to give to her parents. Brian fell asleep for a while under the shade of a tall oak *TREE*.

Later, the two children walked down to the lake. They took a pole and tried to catch a FISH they saw swimming down there. Brian saw something jump in the weeds. It was a big green *FROG*. At the same time Susan thought she saw a shell moving on top of the water. When a head and legs popped out of the shell, she knew it was a TURTLE. The children heard a quack, quack, quack; a little yellow *DUCK* waddled to the pond.

Across from the pond, a galloping *HORSE* raced through the park. The kids heard loud barks coming from a DOG which was chasing a furry black *CAT*. From its nest a BIRD flew away because of the loud barking.

By late afternoon, everyone was tired. As they drove home, Susan and Brian talked about all they had done that day.

Production Responses. If a child spontaneously named an object correctly as the story was being read, the experimenter unobtrusively recorded a production response. Only overt names audible to the experimenter were scored. In the computer condition, a dot was placed immediately on an answer sheet beside the name of the object labeled. In the control condition, the note card with the name of the word was placed in a separate pile. After the session, the experimenter recorded these production responses on the answer sheet.

Recall Responses. After all objects were presented, the experimenter engaged the child in a 10-s distractor task. Specifically, the child was told that he was going to play a game. The child closed his or her eyes and counted to 10 with the experimenter while the objects were "hidden" from sight. The child then opened his or her eyes and named all the objects that he or she could remember. The experimenter consecutively recorded these recall responses on an answer sheet that had all 24 words listed in alphabetical order. If the child paused for more than 5 s, the experimenter asked if he or she could remember any more objects. When the child indicated "no," the session was ended.

RESULTS

Production and recall scores were computed for each child by summing all objects that were named or remembered, respectively, representing each of the 2 × 2 factorial cells of action and labels. Within the four cells, which had a maximum score of 6, scores ranged from 0 to 6 for both production and recall scores.

The correct number of production and recall responses were submitted, in turn, to a 2 × 2 × 2 × 2 (Age × Medium × Label × Action) mixed analysis of variance (ANOVA). Age and medium were between-subjects factors; action and labels were within-subjects factors. Duncan's multiple-range tests were used to identify significant differences among means, given a significant F.

Effects of Presentational Features on Production Scores

The four-factor ANOVA computed on children's production scores yielded main effects of label, $F(1, 36) = 23.74$, $p < .001$, and action, $F(1, 36) = 12.46$, $p < .001$, which were qualified by an Action × Label interaction, $F(1, 36) = 4.82$, $p < .05$. As expected, children produced more names of objects when verbal labels were absent rather than present (1.80 vs. .91), but produced more names when action was present than absent (1.60 vs. 1.11). As seen in Table 2, children produced the most names in the action-only variation, followed by the no-action and no-label variations; objects in the label variations were named the least. There were no effects of age or medium on production scores.

Effects of Presentational Features on Recall Scores

The four-factor ANOVA computed on children's recall scores yielded main effects of label, $F(1, 36) = 46.62$, $p < .001$, action, $F(1, 36) = 4.22$, $p < .05$,

TABLE 2
Mean Number of Words Produced as a Function of Action and Verbal Labels

	Verbal Labels	
	Absent	Present
Action Absent	1.43[b]	.80[c]
Action Present	2.18[a]	1.03[c]

Note. Means with different letter superscripts are significantly different at $p < .05$. Cell means are based on 40 subjects.

TABLE 3
Mean Number of Words Recalled as a Function of Grade, Verbal Labels, and Action

	Preschoolers		Kindergartners	
	Verbal Labels		Verbal Labels	
	Absent	Present	Absent	Present
Action Absent	1.20^{d}	2.30^{bc}	2.10^{bc}	2.60^{b}
Action Present	1.80^{c}	2.30^{bc}	2.00^{bc}	3.35^{a}

Note. Means with different letter superscripts are significantly different at $p < .05$. Cell means are based on 20 subjects.

and grade, $F(1, 36) = 8.12, p < .01$, which were qualified by a Label × Action × Grade interaction, $F(1, 36) = 7.49, p < .01$. As expected, children recalled more words presented with than without labels (2.63 vs. 1.75), with than without action (2.35 vs. 2.03), and at older than at younger ages (2.51 vs. 1.86). As seen in Table 3, patterns of recall in the action and label variations varied by age. For preschoolers, recall declined when both features were absent, but for kindergartners, recall declined when either feature was absent. Put another way, kindergartners recalled the names of objects extremely well when action and labels were both present whereas preschoolers performed very poorly when both action and labels were absent. There were no effects of medium on recall scores.

The Relation Between Production and Recall Scores

Children who produced names of objects in the no-label and no-action variation were expected to recall more of those words than were children who did not name those objects. Because patterns of recall varied by age, Pearson partial correlations, controlling for grade, were computed between children's production and recall scores as a function of action and labels. In addition, Pearson correlations between production and recall scores were examined separately for each age group.

As predicted, there was a significant partial correlation between children's production and recall of object names in the no-action and no-label variation, $r(37) = .34, p < .05$. There was also a significant partial correlation between children's production and recall of object names in the verbal label variation, $r(37) = .38, p < .05$. There were no significant links between production and recall scores in action variations.

Correlations computed between production and recall scores for each age group yielded significant patterns for kindergartners, but not for preschoolers. For kindergartners, there were significant correlations between production and recall scores in the verbal label variation, $r(18) = .68, p < .001$.

Modeling Effects on Production Scores

Interspersing verbal labels, by the computer or the adult, with objects that are not labeled may have provided children with a model of behavior for production. When children hear labels, perhaps they begin to generate their own labels when none are presented by the adult or computer. Thus, as the session continues, a child may be more likely to produce labels. If kindergartners are more sophisticated than preschoolers in imitating labeling behaviors, then one might expect kindergartners to imitate this behavior earlier in the session than preschoolers.

To test these propositions, the targeted objects in the story were divided in half. The first 12 targeted objects fell into the first half of the story, and the second 12 targeted objects fell into the second half of the story. Production scores were then classified by this median split.

As expected, a chi-square analysis on the frequency of children's production scores revealed that children produced more labels from the second than the first half of the story, $\chi^2(1, N = 40) = 26.72, p < .001$. However, kindergartners were no more likely than were preschoolers to produce labels in the first half of the story.[1] Thus, young children were equally likely to imitate the adults labeling behavior.

DISCUSSION

The purpose of this study was to examine the role of action and linguistic features for children's verbal recall of information. Feature effects were compared for two media: a computer and a felt board.

The first hypothesis was that children would recall more objects presented with both action and labels than objects presented in visual still frame without labels. As expected, this pattern was true for both preschoolers and kindergartners. This finding sheds light on the visual superiority hypothesis in two ways. First, visual superiority is really action superiority (Gibbons et al., 1986). Second, when action compliments the audio presentation, action increases rather than disrupts verbal recall (Calvert et al., 1982; Greenfield & Beagles-Roos, 1988).

The developmental hypothesis that kindergartners would recall more information than would preschoolers was supported, but only for certain variations of action and verbal labels. In particular, kindergartners recalled more information than did preschoolers when both features were either present or absent. Thus, preschoolers depend more on features, but kindergartners become increasingly adept at integrating visual and auditory content. Young children benefit when skills like verbal labeling are supplanted (e.g., Salomon, 1979) which they do not have, or perhaps, do not spontaneously produce (Flavell et al., 1966).

[1]The author thanks Lynette Cofer for this suggestion.

As expected, children of both ages did spontaneously produce more object names when verbal labels were absent than present, particularly in the action variation. Fabricius and Cavalier (1989) suggested that modeling processes may lead to children's initial acquisition of verbal rehearsal processes like naming objects. More specifically, an adult may point to or name items, thereby providing a model for rehearsal strategies that children can imitate. In the study reported here, the adult or computer interspersed names of objects throughout the story. Because children spontaneously produced more labels in the second than in the first half of the story, procedures that model and then call upon (e.g., Salomon, 1979) children to produce names may well facilitate the early development of such skills.

Although this study used an incidental rather than an intentional memory paradigm, the use of models in such a way could cultivate young children's memory strategies in a variety of learning situations at school and at home. Materials could be as simple as a felt board or as complex as a computer program because both media work equally well. This approach seems particularly promising given that young children rarely name objects spontaneously, particularly if they are not asked to memorize targeted groups of objects (Baker-Ward et al., 1984).

The final analysis linked production scores to recall scores. The production of object names in the no-label variations was expected to enhance recall of that information. When age was controlled, links were found between production and recall scores in no-action, but not visual action, variations. Production and recall scores were also significantly related in the verbal-only variation. These findings suggest that children's recall is more dependent on verbal production processes when action is absent, perhaps because children are more likely to think about action visually rather than verbally, thereby increasing the chance that children will use iconic modes to represent content.

Although there were no age differences in production scores, kindergartners were better able to recall information that was associated with their production efforts than were preschoolers. More specifically, when age groups were examined separately, significant links between production and recall scores were present for kindergartners in the verbal label variation. This finding suggests that production efforts by preschoolers may have been more imitative and less active than those of kindergartners, a premise that has not been supported or refuted in previous empirical studies (Weissberg & Paris, 1986).

The lack of effects for medium suggests that action and verbal labels play an important role in children's recall of information if it is presented on a computer, a felt board, and as demonstrated elsewhere, on a television (Beagles-Roos & Gat, 1983; Calvert et al., 1982; Greenfield & Beagles-Roos, 1988) or a radio (Gibbons et al., 1986). Action and labels may well serve as vehicles of thought (e.g., Olson & Bruner, 1974; Salomon, 1979) that children can use to recall content in a variety of media. Memory tasks that have related labels to children's recall of static visual pictures have ignored the actions of real life, which may make visual content particularly memorable.

In conclusion, both action and labels can supplement children's recall of verbal information, but the ability to integrate audiovisual information develops with age. Perhaps the visual superiority effect partly reflects preschoolers' difficulties in coordinating two modalities, an issue that seems to be resolved by about age 6. Educators and programmers who develop software for new technologies should ask the question of how children learn, for media appear to cultivate and to call upon modes of thinking that generalize across diverse situations.

REFERENCES

Baker-Ward, L., Ornstein, P., & Holden, D. (1984). The expression of memorization in early childhood. *Journal of Experimental Child Psychology, 37*, 555–575.

Beagles-Roos, J., & Gat, I. (1983). Specific impact of radio and television on children's story comprehension. *Journal of Educational Psychology, 75*, 128–135.

Brown, A., Bransford, J., Ferrara, R., & Campione, J. (1983). Learning, remembering, and understanding. In P. Mussen (Ed.), *Handbook of child psychology: Vol. 4. Cognitive development* (4th ed). New York: Wiley.

Bruner, J.S., Olver, R.R., & Greenfield, P.M. (1966). *Studies in cognitive growth*. New York: McGraw-Hill.

Calvert, S.L., Huston, A.C., Watkins, B.A., & Wright, J.C. (1982). The relation between selective attention to television forms and children's comprehension of content. *Child Development, 53*, 601–610.

Calvert, S.L., Huston, A.C., & Wright, J.C. (1987). Effects of television preplay formats on children's attention and story comprehension. *Journal of Applied Developmental Psychology, 8*, 329–342.

Calvert, S.L., Watson, J., Brinkley, V., & Penny, J. (1990). Computer presentational features for poor readers' recall of information. *Journal of Educational Computing Research, 6*, 287–298.

Fabricius, W., & Cavalier, L. (1989). The role of causal theories about memory in young children's memory strategy choice. *Child Development, 60*, 298–308.

Flavell, J. H. (1985). *Cognitive development* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Flavell, J.H., Beach, D.H., & Chinsky, J.M. (1966). Spontaneous verbal rehearsal in a memory task as a function of age. *Child Development, 37*, 283–299.

Friedrich, L.K., & Stein, A.H. (1975). Prosocial television and young children: The effects of verbal labeling and role playing on learning and behavior. *Child Development, 46*, 27–38.

Gibbons, J., Anderson, D.R., Smith, R., Field, D., & Fischer, C. (1986). Young children's recall and reconstruction of audio and audiovisual narratives. *Child Development, 57*, 1014–1023.

Greenfield, P., & Beagles-Roos, J. (1988). Radio versus television: Their cognitive impact on children of different socioeconomic groups. *Journal of Communication, 38*, 71–92.

Hayes, D., & Birnbaum, D. (1980). Preschoolers' retention of televised events: Is a picture worth a thousand words? *Developmental Psychology, 16*, 410–416.

Hayes, D., Chemelski, B., & Birnbaum, D. (1981). Young children's incidental and intentional retention of televised events. *Developmental Psychology, 17*, 230–232.

Lepper, M., & Gurtner, J. (1989). Children and computers: Approaching the twenty-first century. *American Psychologist, 44*, 170–178.

Mandler, J. (1983). Representation. In P. Mussen (Ed.), *Handbook of child psychology: Vol. 4. Cognitive development* (4th ed.). New York: Wiley.

Olson, D., & Bruner, J. (1974). Learning through experience and learning through media. In D. Olson (Ed.), *Media and symbols: The forms of expression, communication, and education*. Chicago: University of Chicago Press.

Salomon, G. (1979). *Interaction of media, cognition, and learning*. San Francisco: Jossey-Bass.

Weissberg, J., & Paris, S. (1986). Young children's remembering in different contexts: A reinterpretation of Istomina's study. *Child Development, 57*, 1123–1129.