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ABSTRACT

Evidence regarding children's incidental learning has been derived largely from tasks in which the incidental stimulus features have been independent of the task-relevant information. The present study examined children's incidental learning with compound pictorial stimuli under conditions in which the relevant and incidental features were: (a) depicted together in an action relation; (b) depicted together in a static relation; or (c) represented as independent entities. These materials were compared in two experiments, one involving 8-, 11- and 14-year-old children and the other involving 8- and 14-year-olds (the static condition was excluded in the second experiment). Following a learning task requiring attention to a single element in each stimulus, incidental learning was measured by having the Ss, in effect, reconstruct the compounds. While incidental learning was found to be higher with the action materials than in the standard condition, the developmental trend in incidental learning scores was little affected by the pictorial integration. On one hand, these results extend the generality of the finding that children's incidental learning undergoes little change with age. On the other hand, the results contrast with evidence obtained from two sources--one showing that stimulus integration of another type can influence the developmental trend in incidental learning and the other showing an increase with age in the effects of action portrayal on international (paired associate) learning of pictorial associations. (Author/KM)

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Abstract

Evidence regarding children's incidental learning has been derived largely from tasks in which the incidental stimulus features have been independent of the task-relevant information. In contrast, the present study examined children's incidental learning with compound pictorial stimuli under conditions in which the relevant and incidental features were (a) depicted together in an action relation (two types--weak action and strong action), (b) depicted together in a static relation, or (c) represented as independent entities. These materials were compared in two experiments--one involving 8-, 11-, and 14-year-old children and the other involving 8- and 14-year-olds (the static condition was excluded in the second experiment). Following a learning task requiring attention to a single element in each stimulus, incidental learning was measured by having the subjects, in effect, reconstruct the compounds. While incidental learning was found to be higher with the action materials than in the standard condition, the developmental trend in incidental learning scores was little affected by the pictorial integration. On one hand, these results extend the generality of the finding that children's incidental learning undergoes little change with age. On the other hand, the results contrast with evidence obtained from two sources--one showing that stimulus integration of another type can influence the developmental trend in incidental learning, and the other showing an increase with age in the effects of action portrayal on <u>intentional</u> (paired associate) learning of pictorial associations.

THE EFFECT OF PICTORIAL INTEGRATION ON CHILDREN'S INCIDENTAL LEARNING[1]

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Several studies of incidental learning have observed little developmental increase in children's recall for extraneous features of stimuli but a vast improvement in intentional or central learning--thus a decrease with age in the proportion of incidental to central learning (Baker, 1970; Druker & Hagen, 1969; Hagen, 1967; Hagen & Sabo, 1967). While the consistency of this effect has been clearly demonstrated, its generality might be limited primarily to situations in which the incidental stimulus feature is independent of the material to be learned. Specifically, in the studies cited children were shown compound stimuli each containing two adjacent pictures, and after learning a task involving only one picture in each pair (central learning) they were required to indicate the other picture that had appeared in each pair (incidental learning). The proportional decline in incidental learning reflects a decrease in attention to incidental relative to central features (Hagen, 1967), and at first glance this result would suggest that young children have difficulty analyzing compound stimuli into components in order to attend to the relevant feature. However, with compound stimuli of the type used in these studies, the results may simply reflect an age difference in children's propensity to look at peripheral aspects of stimuli rather than a difference in ability to analyze them. That is, these stimuli were clearly presented as pairs of independent elements, so that the effort required to analyze them into their components was probably minimal; thus, the younger children's greater proportional attention to incidental features may have been due merely to a greater curiosity about such features or perhaps a belief that they were actually relevant to the task.

It is proposed that stimuli whose central and incidental components are integrated into a scene would provide a more appropriate test of children's ability to analyze stimuli into their relevant and extraneous features and attend selectively to the former. To this end, the present study examined 8- to 14-year-old children's incidental learning with pictorial stimuli similar to those of the studies cited above, but varying in degree of integration among components. Different sets of materials were compared, the stimuli in each set containing pairs of animals and objects depicted in various relations to each other. In the two action conditions, each animal was shown performing an action upon an object, while in the standard task the two pictures were presented as independent entities (although nearly adjacent). In a fourth condition the animal and object were depicted in a static relation (animal holding object).

It was hypothesized that children's incidental recall of the animal-object associations would increase with age in the action conditions but not with the standard materials. The basis for this prediction derives from an earlier study by the present authors (Hale & Piper, in press). With shape and color as the central and incidental stimulus features, incidental learning was found to increase with age when the color was contained within the shape but not when the two features formed a figure-ground relation. The critical factor was believed to be the degree of stimulus integration: when stimulus components are integrated into a single unit, children are more prone to attend to the incidental feature along with the central component, thus producing a developmental increase in incidental as well as central learning. The present study provided a further test of this stimulus integration hypothesis, with integration in this case defined in terms of a thematic relation between pictorial elements.

This study also bears on the general issue of the similarity between children's incidental learning and intentional learning of associations. In studies using a paired-associate procedure, children's learning of pictorial associations has been improved by depicting the components in an action relation, and the degree of facilitation has been found to increase with age (Milgram, 1967; Reese, 1965; Rohwer, 1970). In these studies the learning of picture pairings was purposeful or intentional, whereas in the present study the learning of associations between pictorial elements was incidental to the purpose of the task. To the extent, then, that the effects of action depiction in the present study were found to differ from those observed in paired-associate studies, pictorial integration could be said to affect children's purposeful learning and incidental learning through different processes.

Method

Subjects

The sample in Experiment 1 consisted of 64 subjects at each of ages 8, 11 and 14 (mean ages = 8.6, 11.7 and 14.9 years, respectively). The subjects were drawn from four elementary schools and a junior high school in a middle class area of Middlesex County, New Jersey. Children at each age level were randomly assigned to the four tasks described below to yield 8 boys and 8 girls in each group. Experiment 2, a replication with selected subgroups from the first experiment, consisted of 48 subjects at each of ages 8 and 14 (mean ages = 8.9 and 14.1 years), drawn from two elementary schools and a junior high school in a middle class area near Somerville, New Jersey. At each age level, 8 boys and 8 girls were randomly assigned to three of the four tasks to be described (all except the Static condition).

Materials

The four types of stimuli used are depicted in Figure 1. Each stimulus was composed of an animal as the relevant component (ca. 10 cm in height)

Insert Figure 1 about here

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and an object as the incidental feature (between 3 and 7 cm in height). In the Standard condition, the two pictures were presented separately, one approximately 2 mm above the other. In the Weak Action and Strong Action conditions each animal was shown performing an action on an object; the action involved little movement in the former case but vigorous activity in the latter. Comparison of these two conditions would help to determine whether the strength of the activity portrayed would affect the likelihood that the stimuli would be recalled as compounds. In the fourth, Static condition, each animal was depicted holding an object. If a difference were observed between the Standard and action conditions, data for the Static condition would determine whether this difference was due to the action portrayal per se or simply to the depiction of animal and object together.

Procedure

The procedure has been described in detail elsewhere (Hagen, 1967; Hale & Piper, in press), and will be outlined only briefly here.

Central learning phase. The subject was given a 12-trial short-term memory task. On each trial he was shown the six stimuli (pairs of pictures) in a horizontal array on a 14 cm by 61 cm card. After the array was displayed for five seconds, it was turned face down, and the subject was shown a "cue card" containing one of the animals. He was asked to point to the position in which he had seen that particular animal. After the subject's response, the array was reexposed briefly to provide feedback, followed by the next trial. A given animal was always paired with the same object, but the arrangement of stimuli in the array varied from trial to trial. The task was preceded by a two-stimulus practice test with stimuli comparable to those encountered in the main task, but with different animal and object pictures. The number of trials in which the subject responded correctly in the learning phase was his central learning score.

Incidental learning test. Immediately following this phase, an incidental learning test was administered. The six objects were placed on the table, and as the subject was shown the animals, one by one, he was asked to point to the object that had appeared with each animal. The number of correct associations constituted his incidental learning score.

Experimental Design

Experiment 1 included three age levels (8, 11 and 14 years) and four tasks, producing 12 experimental subgroups, each containing 16 subjects. Experiment 2 included two age levels (8 and 14 years) and three tasks (all except the Static condition), with 16 subjects per group. Each subgroup of both experiments contained an equal representation of (a) boys and girls, (b) two orders in which the array cards of the learning phase were presented, (c) two orders in which the cue cards were presented and (d) two orders in which the incidental learning stimuli were presented.

Results

Table 1 presents the central and incidental learning scores for each subgroup of both experiments. As would be expected, the central learning scores increased with age for all groups. Analyses of variance on the central learning scores for each experiment, with Age, Tasks and Sex as factors, yielded a significant effect of Age in each case (Exp. 1: $F(2,168) = 29.61$, $p < .001$; Exp. 2: $F(1,84) = 12.83$, $p < .001$) but no other significant effects.

Insert Table 1 about here

The incidental learning scores, on the other hand, did not increase with age and, in fact, tended to decrease in some cases. Analyses of variance on these scores, with Age, Tasks and Sex as factors, yielded a significant effect of Tasks in both experiments (Exp. 1: $F(3,168) = 6.19$, $p < .001$; Exp. 2: $F(2,84) = 6.96$, $p < .01$) while no other effect reached significance. In each experiment, the effect of Tasks on incidental learning was then subdivided into two orthogonal contrasts reflecting the questions of interest in the study: (a) Standard task versus action depiction (Weak and Strong Action conditions combined) and (b) Weak Action versus Strong Action. The scores were found to be higher for the action than the Standard materials in Experiment 1 ($F(1,168) = 13.05$, $p < .01$) but not Experiment 2 (although a post hoc comparison between Standard and Strong Action was significant in Exp. 2: $F(1,84) = 6.47$, $p < .05$). Also, the degree of incidental learning was greater for the Strong Action than the Weak Action condition in both experiments (Exp. 1: $F(1,168) = 5.47$, $p < .05$; Exp. 2: $F(1,84) = 13.27$, $p < .01$). Interactions involving each of these contrasts and Age and Sex were found to be nonsignificant (in Experiment 1, interactions between the linear trend on Age and each contrast were also nonsignificant). Thus the superiority of performance in the action conditions was not significantly greater for either sex or for one age level than another. An additional contrast in Experiment 1 between the Standard and Static conditions only approached significance ($F(1,168) = 3.59$, $p < .10$).

In other studies using a task comparable to the present Standard condition, the correlation between central and incidental learning scores has been greater for young children than adolescents, and has even become negative at older age levels (Druker & Hagen, 1969; Hagen, 1967). A similar result was observed here, as the central-incidental correlation for the Standard task in Experiment 1 dropped across age levels from .14 to .10 to -.37, and in Experiment 2 from .26 to -.33. The Standard task used here thus appears to be comparable to those employed in earlier research, as indicated by the similarity in correlational data as well as in the developmental pattern of mean scores. For the remaining tasks no consistencies were readily apparent. The correlations for the three age levels of Experiment 1 and the two age levels of Experiment 2, respectively, were, Weak Action: -.02, -.23, .12, and -.46, -.24; Strong Action: -.25, .54, -.11, and -.04, .39; Static: -.04, .08, -.25.

Discussion

The most striking result of the study is the failure to observe different developmental patterns of results for the action and Standard conditions. It had been reasoned that, if the pictures in each stimulus were presented together in a unitary scene, older as well as younger children would view the stimuli as integral wholes and would maintain attention to both features; thus, the degree of incidental learning was expected to increase with age. Such was not the case, however, as the scores under all conditions either remained constant or tended to decrease. The data for all four types of material are thus consistent with those derived from the simple compound stimuli of earlier studies in showing a decline with age in the proportion of incidental to central learning. Clearly, strong support is provided for the conclusion that children's use of selective attention increases developmentally; as children grow older they become better able to maintain attention to task-relevant elements and ignore incidental features, even when some degree of analysis is required to separate these two types of information.

These results contrast with those obtained by Hale and Piper (in press), who defined stimulus integration in a somewhat different way; when the incidental component was actually contained within the task-relevant information (color within shape), incidental learning was found to increase with age. Although the present study was expected to extend the generality of this result, the failure to observe a similar effect here suggests that only a particular type of stimulus integration produces those anomalous results. Specifically, when the stimulus components are dimensions that are not naturally regarded as independent entities, such as shape and color, older children will fail to exercise their characteristic tendency to employ selective attention. With such materials, considerable effort must be expended in mentally separating the extraneous from the relevant information, and children of all ages likely find it more efficient simply to maintain attention to all stimulus features. Pictorial components, on the other hand, are naturally identifiable as separate entities, even when integrated into a scene. Whenever the stimulus components thus can be perceived as independent units, older children apparently will attend selectively to the task-relevant elements and acquire proportionally less information about incidental stimulus features than younger children.

Particularly interesting is the discrepancy between the present results and the effects of pictorial integration observed in studies of paired associate learning. In the latter research, children's intentional learning of picture pairings has been facilitated by action depiction, and the degree of facilitation has been shown to increase with age (Milgram, 1967; Reese, 1965; Rohwer, 1970). Although an effect of action portrayal was also observed in the present study, the degree of facilitation did not increase with age and, in fact, tended to be greater for the younger than the older children in the first experiment. Clearly, the <u>developmental</u> effect of pictorial integration depends on whether the child's learning of associations between pictures is the central purpose of the task or is incidental to the main purpose.

It has been argued that a major effect of action portrayal is to facilitate those processes connected with the active attempt to learn a pictorial association, such as verbalizing a relation between pictures (Rohwer, 1970). While this interpretation may account for a portion of the paired associate data, in fact a sizable part of the effect of pictorial integration appears to be unrelated to the child's intention to learn. In the present study, the children presumably did not actively attempt to learn the picture pairings, and yet the action depiction had a marked effect on their ability to reconstruct the compound stimuli after the learning phase. A two-effect model might therefore account more adequately for the influence of pictorial integration. One effect, observed where associations between stimulus elements are explicitly to be learned, is to provide information to aid the subject in his active attempt to learn these associations. This facilitative effect increases with age, as an instance of children's generally increasing efficiency in utilizing cues helpful for learning. The other effect is to "automatically" increase the likelihood that the child will recall the components of a stimulus together, regardless of his intention to do so. This latter effect, according to the present results, does not change developmentally but is of roughly the same magnitude for children throughout the range from middle childhood to adolescence.

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Footnote

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Table 1

Means and Standard Deviations of Central and Incidental Learning Scores

	Central Learning			Incidental Learning		
Task	Age 8	Age 11	Age 14	Age 8	Age 11	Age 14
Experiment 1						
Standard	4.56 (1.21)	4.31 (1.96)	6.75 (2.18)	2.00 (1.55)	1.81 (1.33)	2.00 (1.55)
Weak Action	4.06 (1.84)	6.75 (2.67)	7.25 (1.98)	3.19 (2.04)	2.50 (1.37)	2.06 (1.57)
Strong Action	4.00 (1.90)	5.56 (2.37)	7.75 (2.44)	3.75 (1.65)	3.50 (2.00)	2.81 (1.60)
Static	4.13 (1.67)	[illegible] (2.29)	6.50 (2.61)	2.38 (1.63)	2.63 (1.45)	2.69 (1.35)
Experiment 2						
Standard	4.81 (1.56)		6.25 (1.69)	2.75 (1.34)		2.50 (0.97)
Weak Action	5.81 (2.14)		6.31 (2.02)	2.50 (1.32)		2.00 (1.46)
Strong Action	4.31 (1.49)		6.69 (2.56)	3.88 (1.36)		3.13 (1.50)

Note.--Standard deviations are in parentheses. N = 16 in each group.

<u>Figure Caption</u>

Fig. 1. Stimulus materials for the four conditions. From top to bottom rows they are: Standard, Weak Action, and Strong Action conditions (used in both experiments), and Static condition (used in Experiment 1 only).