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AUTHOR	McCabe, Ann E.; And Others
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ABSTRACT

The ability of nursery school children to associate pairs of toys was assessed under four experimental conditions: (1) control, (2) subjects manipulating the toys, (3) subjects generating a sentence, and (4) subjects generating a sentence while manipulating the toys. All three subject-involvement conditions produced significantly better recognition performance than the control condition; but contrary to initial predictions, the difference was not significant between sentence and manipulation-plus-sentence conditions. In contrast to previous research, subjects in the sentence condition had little difficulty producing sentences when asked. Of interest was the finding that the quality of sentence production was poorer in the manipulation-plus-sentence condition than in the sentence condition. Results are discussed in terms of the possible conflict produced when the child is required to engage in more than one overt activity simultaneously. (Author/DP)

TECHNICAL REPORT NO. 251

THE ROLE OF OVERT ACTIVITY IN CHILDREN'S SENTENCE PRODUCTION

REPORT FROM THE RESEARCH COMPONENT
CHILDREN'S LEARNING AND DEVELOPMENT

WISCONSIN RESEARCH AND DEVELOPMENT

CENTER FOR
COGNITIVE LEARNING

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Technical Report No. 251

THE ROLE OF OVERT ACTIVITY IN CHILDREN'S SENTENCE PRODUCTION

by

Ann E. McCabe, Joel R. Levin, and Peter Wolff

Report from the Research Component
Children's Learning and Development

Wisconsin Research and Development
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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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Abstract

The ability of nursery school children to associate pairs of toys was assessed under four experimental conditions: (a) control, (b) S manipulating the toys, (c) S generating a sentence, and (d) S generating a sentence while manipulating the toys. All three S-involvement conditions produced significantly better recognition performance than the Control, but contrary to initial predictions, the difference between the Sentence and Manipulation Plus Sentence conditions was not significant. In contrast to previous research, Ss in the Sentence condition had little difficulty producing sentences when asked. Of interest was the finding that the quality of sentence production was poorer in the Manipulation Plus Sentence condition than in the Sentence condition. Results are discussed in terms of the possible "conflict" produced when the child is required to engage in more than one overt activity simultaneously.

I
Introduction

In Piaget's theory of cognitive development the child's deferred imitation, symbolic play, drawing, visual imagery, and language are components of a unitary process referred to as the "symbolic function" (Piaget, 1962). These processes are all seen to develop out of the motor activity of the child. Thus, the symbolic function first appears at the end of the sensorimotor period (around two years of age) and continues to develop through the preoperational period to the beginning of the concrete operational stage (around seven years of age). In its initial form the symbolic function is rather static in character, since dynamic symbolization depends on the development of rudimentary mental operations which do not appear until the end of the preoperational period. The preschool child, then, has at his disposal symbolic representation in a static form; on the other hand, the preschool child's dynamic representations have not yet become separated from his motor activity.

Based on this rationale, Wolff and Levin (1972) utilized a paired-associate learning task with younger (first-grade) and older (third-grade) children. Since it has been well documented that a dynamic visual imagery strategy, i.e., S's imagining an interaction involving the two pair members, greatly facilitates performance on this kind of task in Ss beyond the preoperational stage (e.g., Bower, 1971; Levin, 1972), Wolff and Levin (1972) expected that the imagery strategy would be relatively more effective (as compared to a no-strategy control group) for the third graders than for the first graders. Not only was the prediction completely supported, but in the Wolff and Levin (1972) experiment as well as in a subsequent one (Wolff, Levin, & Longobardi, 1972) it was found that imagery facilitation could be induced in the younger children simply by having them engage in concurrent motor activity (manipulating the pair members, which consisted of toys) while attempting to form their interactive images. That the facilitation was not due simply to visual feedback was demonstrated by the finding that comparable facilitation was obtained when the Ss were required to perform their manipulations "blind" (behind a screen).

Subsequent research has demonstrated that facilitation of paired-associate performance also results in children of this age when (a) the imagery is induced through motor activity one step removed from the objects themselves (e.g., drawing pictures) and (b) appropriate motor-imagery training has been provided for the child such that the two do not have to be temporally concurrent (Danner & Taylor, in press; Varley, Levin, Severson, & Wolff, in press).

Approaching the problem from another point of view, it has been shown that S-generated verbalizations in the form of subject-verb-object sentences similarly facilitate performance on the paired-associate task in cognitively mature Ss (Levin, 1972). At the same time, previous research has suggested that this particular skill also develops toward the end of the preoperational period (age six or seven). For example, the earliest experiment in this area was conducted by Jensen and Rohwer (1965) who found that second graders, but not kindergartners, benefitted from an S-generated sentence strategy. In that paper Jensen and Rohwer attributed the lack of facilitation in the kindergarten sample to their observation that ". . . although children in this group are able to utter sentences in their ordinary conversation, many of them seemed unable to construct sentences on call, as it were" (p. 608).

The purpose of the present study was to establish whether facilitated paired-associate performance due to sentence generation could be demonstrated in children who are presumably too young to produce such sentences on call. Following the Wolff and Levin (1972) result, we expected that successful sentence generation in these children would also be dependent on overt manipulation of the object pairs.

Since language and imagery are seen by Piaget as components of the same process, one would anticipate the same pattern of results with sentence generation as with imagery generation. Accordingly, we hypothesized that facilitation due to sentence generation (as well as the quality of the sentences generated) on a children's paired-associate task would be more evident when concurrent motor activity was permitted than when it was denied.

The age of the Ss selected for this experiment was considered to be important. Montague (1970) reported that first graders were able to benefit from self-generated sentences in a paired-associate task, whereas Jensen and Rohwer (1965) found that kindergarten Ss were not. In another experiment concerned with the development of language in young children, Horowitz, Lampel, and Takanishi (1969) noted that children three and one-half to four years old experienced difficulty in describing (in sentence form) an E-provided interaction between object pairs. Using these limits as guidelines (and following some pilot testing of kindergartners), we selected nursery school children as the target population.

II
Method

Subjects

Forty children from two nursery schools in the Midwest served as Ss. The children ranged in age from four years to five years, one month.

Design and Materials

The objects used for the paired-associate task were 24 common children's toys, e.g., a plastic bracelet, a wooden doll, a toy truck, a felt giraffe. The toys varied in size from 1 to 6 in. on the longest dimension. The paired-associate list was formed by randomly pairing the 24 toys, thereby producing 12 pairs. During the experiment the stimulus and response toys were kept in separate boxes and out of S's sight.

Subjects were randomly assigned to one of the four following incidental learning conditions[1]:

Control - Each pair of toys was placed in S's hands and he was instructed, "Look at each pair of toys very carefully."

Manipulation - The S was instructed, "Make the toys play together."

Sentence - The S was instructed, "Make up a story about the toys playing together, but don't move your hands."

Manipulation Plus Sentence - Ss were instructed, "Make the toys play together and at the same time make up a story about what they're doing."

Procedure

The child was seated at a low table opposite E, who presented the toys during both the study and test trials. A second E recorded the motor interactions produced by the child. The child's sentence productions were recorded by a tape recorder which was under the table and out of the sight of S.

After S was seated, attempts were made by E to put S at ease in the experimental situation. Then each of the toys was presented singly in a random order, and S was asked to label it. This was done to insure that sentence production would not be hindered if the child did not have a name for a toy. (In fact, it was found that Ss generally had no difficulty in naming the toys.)

Next, the procedure was explained to the child and an example pair was presented. The Ss in all but the Control condition were asked to generate a sentence and/or a motoric interaction for the pair. If they were unable to do so, an appropriate example was presented by E. The S was then given a second example pair. All Ss appeared to understand the instructions. The toys used in the examples were not used in the actual task.

Following the practice pairs, Ss were told that now they were going to see "a whole bunch of toys, two at a time," and the instructions appropriate to the condition were reiterated. Then the 12 experimental pairs were presented, one pair apiece for approximately 10 sec. The S was not interrupted if he was in the middle of a sentence or a motor production.

After all the pairs had been presented, Ss were tested by the recognition method. The child was told that now he would have to try to remember which toys he saw together. The response toys were arrayed on the table in

[1] Since the work of Flavell and his colleagues (e.g., Appel, Cooper, McCarrell, Sims-Knight, Yussen, & Flavell, in press)--as well as some unpublished work of our own--has indicated that intentional and incidental learning instructions have comparable effects in young children, the latter paradigm was selected due to its lower probability of creating reactivity in children.

front of S and the stimulus toys were presented one at a time. The S was allowed to indicate his choice however he preferred as long as it was clear which toy he was selecting. Responses were recorded by the second E. The order of presentation of the stimulus toys for the test was randomly determined but was constant across all Ss.

III
Results

Dependent Measures

In addition to the major performance variable of "number of correct recognitions," two other dependent measures were obtained. It was mentioned previously that S's verbalizations were recorded (by a tape recorder), as were his manipulations (by the second E). The transcripts of these recordings were submitted to two independent "blind" judges, whose task was to tally the number of interactions (verbal and/or motor) actually generated by each S. Following the Wolff et al. (1972) experiment, the criterion for deciding whether or not an interaction was generated hinged on the transcript's indicating that S related the pair members to one another in a meaningful way. That is, an utterance such as "the pig blowed the whistle" was acceptable, while "the whistle you blow and the pig eats things" was not. Similarly, for the motor conditions a "relational" activity such as S's placing the pig's nose in the whistle as if it were blowing it was acceptable, while a "nonrelational" activity such as the child's blowing the whistle and then making the pig hop along the table was not. For Ss in the Manipulation Plus Sentence condition two independent sets of ratings were produced by each judge. A comparison of the two judges' sentence ratings yielded an interjudge reliability of .946, while the reliability for the motor ratings was .964. Each S's sentence and/or manipulation "score" was subsequently determined by averaging the two judges' ratings for that S.

Recognition Performance

The average performance (by experimental condition) on the 12-item recognition task was as follows: Control, 1.6; Manipulation, 9.5; Sentence, 6.7; and Manipulation Plus Sentence, 7.4. Three orthogonal sets of comparisons had been formulated to assess questions of interest. Contrary to the major prediction, no significant performance differences were detected between Ss in the Manipulation Plus Sentence condition and those in the Sentence condition ($t < 1$). Rather, based on Dunnett's test it was found that each of the S-involvement conditions (Manipulation, Sentence, and Manipulation Plus Sentence) differed significantly from the Control (all p's $< .01$), while a final comparison revealed that the performance of Ss in the Manipulation condition was superior to that in the two conditions which called for sentences ($t = 2.25$, $df = 36$, $p < .05$).

Manipulation and Sentence Ratings

The motoric and verbal interactions generated by Ss in the combined Manipulation Plus Sentence condition were rated descriptively lower than those in the two single conditions: (a) manipulation ratings, 8.7 in the Manipulation Plus Sentence vs. 9.9 in the Manipulation only, (b) sentence ratings, 7.0 in the Manipulation Plus Sentence vs. 9.8 in the Sentence only, with the latter difference approaching conventional standards of statistical significance ($t = 1.99$, $df = 18$, $p < .10$). In addition, the variability associated with these ratings tended to be greater in the Manipulation Plus Sentence condition: (a) manipulation ratings, $S^2 = 5.90$ vs. $S^2 = 2.72$; (b) sentence ratings, $S^2 = 14.74$ vs. $S^2 = 3.46$, with the latter difference once again attaining statistical significance ($F = 4.26$, $df = 9/9$, $p < .05$).

IV
Discussion

Clearly, the major prediction of this study was not supported, since Ss' recognition performance under sentence generation instructions did not improve when the Ss were permitted concurrent motor involvement, as has been previously reported with young children generating visual images (Wolff & Levin, 1972; Wolff et al., 1972). Not only was recognition performance not improved in the Manipulation Plus Sentence condition (relative to the Sentence condition), but the rated number of appropriate interactions--especially sentences--was actually depressed and more variable.

Our present interpretation of this finding is that when a young child is required to generate an interaction overtly in simultaneous motoric and verbal form, a "conflict" situation is produced which, for a child of this age, might be analogous to the coordination required of a novice playing the piano or driving a golf ball while engaging in a concurrent conversation. The fact that a "conflict" situation seems to arise from joint motor and sentence production, but not from joint motor and imagery production, could be taken as evidence that visual imagery is more compatible with the child's motor activity than are his verbalizations. After all, images are akin to visual feedback from a motor production, while sentences lack any such phenomenal correspondence. However, it can also be agreed that a fair test of the proposition was not made in the present experiment. Imagery, as it has been investigated in this context, is a covert private affair supposedly going on inside the child's head and mediated through his motor involvement. The sentence production requested here, on the other hand, was of an overt public nature in which the child was forced to "think out loud," as it were. It is not unreasonable to assume that the simultaneous execution of these dual overt events presented a difficult-to-achieve and possibly unnatural task for the child. There is evidence that for children of this age, producing overt verbalizations interferes with the production of other overt motor acts (Luria, 1971; Meacham, 1972; Levina, cited in Zaporozhets, Zinchenko, & Elkonin, 1971). According to these authors it is only at a later point in development that the child is able to coordinate these two motor acts. Therefore, it may be argued that the appropriate verbal analogue to visual imagery consists of covert speech. Until the necessary experiment is conducted, however, the preceding arguments must remain tentative.[2]

On the basis of the present data there are a number of conclusions which do appear warranted. For example, in the Wolff et al. (1972) experiment moderate correlations between manipulation ratings and recognition performance were reported (average $r = .32$). Similar positive relationships were found here in both the Manipulation and the Manipulation Plus Sentence conditions (r's = .54 and .75, respectively). Concerning the relationships between sentence ratings and recognition performance, however, the picture changes. Only in the Sentence condition was a moderate correlation observed ($r = .50$); in the Manipulation Plus Sentence condition, there was virtually no (linear) relationship between sentence ratings and recognition performance ($r = -.03$). At the same time, in this condition the manipulation and sentence ratings were essentially uncorrelated ($r = -.05$).

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[2] Another potentially important consideration which may influence the motor-verbalization relationship is whether or not the child is permitted visual access to his manipulations. With regard to the relative facilitation from imagery generation on this kind of task, it appears to make little difference whether the child is provided with visual feedback. On the other hand, it may be just this visual feedback--rather than motor activity *per se*--which is responsible for the effects observed here.

Thus, on the basis of these correlational data it is clear that in both "single involvement" conditions the child's memory for the response member is at least in part related to the quality of his activity. In the "double involvement" condition, on the other hand, the activity-memory relationship may be traced to the quality of the child's motoric activity only, as though his manipulations come to "dominate" his verbal utterances. Just why the asymmetry in favor of motor activity occurs is open to speculation. One possibility is that motor and verbal processes are unequally developed at this age or, in other terms, that they are differentially well-practiced. Obviously, the child has been operating motorically for a longer period of time than he has been operating verbally. In a situation where he has the opportunity to employ either process, he may well rely upon the better developed or more practiced of the two.

Another possibility, however, is that materials of the kind used in the present study lend themselves more to manipulation than to sentence production. Certainly toys hold a great deal of fascination for children of ages four and five. Since toys are meant to be played with rather than talked about, the result could be explained in terms of the child's attending more to his manipulations than to his utterances. What is clear, however (from the previously reported mean sentence ratings and their associated variability), is that the quality of the child's verbalizations suffer as a result of the motor "dominance."

There is one additional issue that was resolved by the present experiment. Children as young as four and five years of age definitely can produce sentences on call. Contrary to the Jensen and Rohwer (1965) data which show no facilitative effects due to sentence generation in five- and six-year-old children (which they attributed to the inability of children this young to generate sentences consistently), Ss in the present Sentence condition performed significantly better than Control Ss. In comparing the two experiments, however, it should be remembered that Jensen and Rohwer's materials were pictures while those in this study were toys (which may be more sentence-evoking), and that performance in the Jensen-Rohwer study was assessed by recall while here it was assessed by recognition. Finally, in the present experiment concerted efforts were made to establish rapport with the children (in addition to the examples that were given to illustrate the sentence-generation strategy), which may or may not have been achieved in the Jensen and Rohwer study. It surely goes without saying that such rapport-establishing efforts are crucial if one wants to infer with reasonable certainty that what a child is doing in the experimental setting is what he can do.

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