concealed closed-circuit television system. Unfortunately, technical difficulties with the camera forced the abandonment of this attempt, and only six Ss could be observed carefully. Of these, five glanced momentarily at the majority of the distracting slides, and one did not appear

to glance at any of the distracting slides. No obvious differences in physiological responses were apparent between these Ss or between periods in which glances did or did not occur, although the number of observations was, of course, too small for an adequate analysis.

The effect of verbal and pictorial presentation on class-inclusion competence and performance

J. RICHARD JENNINGS*

University of California, Berkeley, Calif. 94720

Wohlwill (1968) reported that young children correctly answer more class-inclusion questions when these items are presented entirely verbally as compared to when verbal presentation is supplemented by pictures. Wohlwill interpreted these results as showing that perceptual factors influence the ability to apply class-inclusion operations. Wohlwill, however, did not explore adequately the cognitive basis of the children's answers. In the present study of 78 kindergarten-to-third-grade boys, cognitively justified class-inclusion answers were facilitated by pictorial rather than verbal presentation, particularly among older boys. Verbal items produced some facilitation in kindergarten boys, but only for unjustified correct answers.

Wohlwill (1968) compared children's answers to a standard class-inclusion presentation utilizing pictures with their answers to a purely verbal presentation of items, such as, "Suppose I have 7 dogs and 3 horses, do I have more animals or more dogs?" The children (mean ages: 4 years 11 months to 6 years 10 months) gave more correct solutions to the purely verbal items than to the pictorial items. Thus, the verbal procedure seemed to produce evidence of class inclusion ability occurring at a younger age than had previously been found (Inhelder & Piaget, 1964, for example).

Wohlwill (1968) maintained that the difference between verbal and pictorial class-inclusion performance was due to the high number of errors caused by misleading cues present in pictorial class inclusion. Pictorial presentation, he argues, induces a perceptual set to compare the pictured subsets. When one subset has more

members than the other subset, the resulting perceptual disparity causes erroneous solutions, e.g., more dogs than animals. Verbal presentation, it is further argued, weakens this distorting "subclass comparison set." Wohlwill therefore hypothesizes that verbal items should be answered correctly more often than pictorial items.

Wohlwill's evidence and subsequent work by Ayr & Youniss (1970) indicate that perceptual disparity of the subsets does lead to errors in pictorial class inclusion. The facilitating effect of verbal presentation on class inclusion competence, however, can be questioned. Wohlwill (1968) failed to present complete data on the child's understanding of verbally presented questions and on the child's justification for his answers.

With regard to the child's understanding, Wohlwill has assumed that verbal presentation clearly poses the class inclusion problem in which two subsets, A_1 , A_2 , exhaustively compose a superordinate, B , such that $A_1 + A_2 = B$. However, if the child does not understand that the verbal questions refer only to the subsets given him, e.g., seven dogs (A_1) and three horses (A_2), it is difficult to interpret a child's correct response. As Wohlwill (1968) notes, the child may either be making a global superordinate-subclass judgment, $B > A_1$, e.g., there are more animals in the world than dogs, or be judging whether one subclass is larger than its complement, $A_1 < A_1$, e.g., are there more dogs or more things that aren't dogs? In either case, the child's correct response

is based on a misrepresentation of the class-inclusion question.

The child's justifications must be considered in order to separate correct operational solutions based on an adequate understanding of the question from correct answers based on misunderstanding. The operational child understands that $B = A_1 + A_2$ and can operate on these concepts, producing such combinations as $B - A_1 = A_2$, e.g., taking the dogs away from the animals leaves the horses. The preoperational child may be able to represent or misrepresent these classes to himself, but he cannot operate on them.

Wohlwill's method and interpretation by ignoring the child's understanding and justifications is unable to distinguish between correct solutions based on operative competence and correct answers based on misrepresentation of the questions.

METHOD

In the present inquiry the child's justifications and understanding of verbal and pictorial class inclusion questions were examined as part of a larger study (Jennings, 1969). Seventy-eight boys were tested. Their mean ages were: kindergarten, 5 years 11 months; first grade, 7 years 1 month; second grade, 8 years, 2 months; and third grade, 9 years 6 months.

Ss received either the verbal condition or the pictorial condition. The verbal condition was given to 10 kindergarten, 12 first-grade, 10 second-grade, and 9 third-grade boys. The pictorial condition was given to 10 kindergarten, 10 first-grade, 11 second-grade, and 6 third-grade boys.

The verbal condition consisted first of two test items drawn directly from Wohlwill's items: (1) "Suppose I have 7 dogs and 3 horses, do I have more animals or more dogs?" (2) "Suppose I have 4 owls and 2 pigeons, do I have more birds or more owls?" These were followed by two items drawn directly from Inhelder & Piaget (1964): (3) "Suppose I have a bunch of 8 different flowers and a bunch of 8 daisies, do I have more flowers or more daisies?" (4) "Suppose I have a bunch of 4 red daisies and a bunch of 4 daisies that are other colors, do I have more red daisies or more daisies?"

In the pictorial condition the same two Inhelder-Piaget items were followed by two different Wohlwill items: (3) "3 strawberries and 2 tomatoes. Are there more strawberries or more things to eat?" (4) "5 butterflies and 3 birds. Are there more butterflies or more things that fly?" Pictorial items portrayed the two subsets grouped separately on a Masonite display board (see Wohlwill, 1968, Condition B, Experiment III). The use of the same

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Table 1
Mean Response Scores for the Different Items and Conditions

Grade Level	Initial Answers			Justified Answers		
	Verbal Class Inclusion	Pictorial Class Inclusion	Significance of Row Difference	Verbal Class Inclusion	Pictorial Class Inclusion	Significance of Row Difference
Wohlwill Items						
Kindergarten	.90	.40	$p = .18$	.40	.30	$p > .50$
First to Third	.53	1.05	$p = .01$	.60	1.03	$p = .06$
Significance of Column Difference	$p = .17$	$p = .02$		$p > .50$	$p = .03$	
Inhelder-Piaget Items						
Kindergarten	.70	.70	$p < .50$	.30	.20	$p > .50$
First to Third	.70	.61	$p < .50$	.60	.64	$p > .50$
Significance of Column Difference	$p > .50$	$p > .50$		$p = .36$	$p = .08$	

Note—In all instances the highest possible score is 2.00. For ease of comparison, the justified response scores were collapsed into three score levels: 2, 1, and 0. Scores of 4 and 3 were set equal to 2 and scores of 2 and 1 to 1.

Inhelder-Piaget items in both conditions and different Wohlwill items was fortuitous as the initial assumption of the study was that the two types of items would produce similar cognitive performance. After each question the child was asked to justify his answer and was questioned about his understanding of the question.

The children's answers were scored using two different criteria, initial and justified. For the initial criterion, the child's first verbalization in answer to an item was scored 1 if correct and 0 if incorrect. The justified criterion took account of the child's ability to express the subordinate-superordinate class-inclusion relationship. Answers properly justified were scored as 2, incompletely justified as 1, and answers justified on irrelevant grounds or wrong answers were scored 0. Two independent raters agreed on 97% of the initial scores and on 93% of the justified scores. After the independent rating, disagreements between raters were resolved. All answers were then used in the analysis.

RESULTS AND DISCUSSION

The means of both types of scores for the verbal and pictorial groups are shown in Table 1, with performance on Wohlwill and Inhelder-Piaget items shown separately. The significance of the differences between verbal and pictorial conditions and between grade levels are also presented. An exact form of the Wilcoxon two-sample average-rank test developed by Uleman (1968) was used. The test operates on the rank of the S's score rather than on the value of the score per se.

The results for the Inhelder-Piaget items support Wohlwill's emphasis on the perceptual disparity of the subsets within an item. The Inhelder-Piaget items have equal subsets, e.g., four red daisies and four daisies that are other colors, and, therefore, perceptual disparity is not present. Verbal

presentation cannot further reduce perceptual disparity and thus verbal facilitation should not occur. Support for this prediction is seen in Table 1, no differences occur between verbal and pictorial presentation for the Inhelder-Piaget items.

Turning to the Wohlwill items, which do contain disparate subsets, the results question the facilitating effect of verbal presentation. If Wohlwill is correct, verbal presentation, by reducing perceptual disparity, should lead to higher class-inclusion scores than pictorial presentation. The results indicate, however, that the first-through-third-grade children give significantly more correct initial and justified answers to the pictorial items. The kindergarten boys tend to answer verbal items more correctly than pictorial items, but this verbal facilitation effect occurs primarily for their initial answers. The scores based on the answers that the kindergarten boys were able to justify show essentially no difference between the verbal and pictorial conditions. Thus, although the degree of disparity between class-inclusion subsets is a factor in class inclusion, the current results question whether or not verbal presentation eliminates the influence of this factor.

The current results also suggest that Wohlwill's verbal facilitation effect may be confined primarily to the initial class-inclusion answers of young preoperational children. A clue to the nature of this verbal facilitation effect may be the occurrence of a peculiar type of justification in the kindergarten and first grade samples. Nine Ss (six kindergarten and three first grade) referred to a global set beyond the E-defined sets in justifying their answers, e.g., "more animals, cuz there's cows, pigs, sheep . . ." When required to answer in terms of the E-defined sets, these global justifications occurred *only* in response to the Wohlwill

items. The Inhelder-Piaget items, the items with equal subsets, did not produce any global justifications. Verbal items produced six of these justifications and pictorial items produced five.

Global justifications may be related to figurative functioning. Inhelder (1965) has argued for the existence of a preoperational figurative ability that may be facilitated when the perceptual disparities inherent in a situation are removed. Figurative structures are capable of reflecting or symbolizing aspects of the environment, but are not capable of operating upon these aspects of the environment. Verbal meanings may be figurative in this sense. It is possible that prior to the operational level of class inclusion certain conditions may produce a correct, but purely verbal-figurative, solution to a class-inclusion problem. Such solutions might be based on the semantic extension of the words for the child, e.g., *animals* refers to more things than *dogs*. Such an hypothesis might account for the occurrence of global justifications. This hypothesis does not explain why only the Wohlwill items produce global responses or why so many global responses occur in the pictorial condition. The factors that affect figurative processes are not well understood.

The possibility is raised by the current results that young preoperational children react differently to verbal items than do older preoperational children. The current evidence is far from conclusive, but the results illustrate the necessity of using a methodology that considers not only the child's answer, but also the child's justification of his answer and his understanding of the question. A full assessment of a child's development level is necessary in order to understand the effect of experimental manipulations.

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