The Development of Three Spatial Perspective-taking Rules

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FLAVELL, JOHN H , FLAVELL, ELEANOR R , GREEN, FRANCES L , and WILCOX, SHARON A *The Development of Three Spatial Perspective-taking Rules* CHILD DEVELOPMENT, 1981, **52,** 356–358 Children of 4½, 5, and 5½ years of age were tested for their knowledge of 3 spatial perspective-taking rules (1) any object will appear the same to the self and another person if both view it from the same position, (2) a heterogeneous-sided object (in this study, a tangle of wire) will appear different to the 2 observers if they view it from different sides, and (3) a homogeneous-sided object (a cylinder) will appear the same to the 2 if they view it from different sides The data suggested that at least rules 1 and 2 undergo development during this age period and that 5½-year-olds have a good grasp of all 3 rules There was no evidence that the 3 rules differed in difficulty or age of acquisition

The purpose of this study was to investigate the possible development of the following three spatial perspective-taking generalizations or rules (Fishbein, Lewis, & Keiffer 1972, Flavell, Omanson, & Latham 1978)

1 Any object will present the same visual appearance to the self and to another person if the two observers view it from the same position

2 An object that continues to present different appearances to the self when rotated around its vertical axis (thus, a heterogeneous-sided object) will present different appearances to the self and another person if they view it from different sides

3 An object that continues to present the same appearance to the self when rotated around its vertical axis (a homogeneous-sided object, such as a cylinder or sphere) will present essentially the same appearance to the self and to another person if they view it from different sides

The data of previous studies (Flavell et al 1978, Salatas & Flavell 1976) suggest that rules 1 and 2 may not be acquired until the early to middle elementary school years However, it is possible that the more straightforward and natural testing procedures used in the present study will show that children grasp these two generalizations at an earlier age than that We know of no previous research concerning rule 3 On the contrary, Piaget and Inhelder (1956) and all subsequent investigators (ourselves included) seem to have tacitly assumed that visual displays always look different from different sides and that this is the fundamental insight the developing perspective taker needs to acquire

The subjects were 48 preschool and kindergarten children of largely middle-class origin, eight girls and eight boys at each of ages 4½ (4-7 to 5-0), 5 (5-1 to 5-6), and 5½ (5-7 to 6-0) years

The stimulus used to assess understanding of rule 2 resembled an abstract wire sculpture roughly 8 × 7 × 7 cm in size It was made by twisting a piece of thin stiff wire around and through itself to create an irregular and asymmetrical tangle that presented a different configuration of loops and curves from each viewing position around it Its rule 3 counterpart was a 9-cm × 4-cm wooden cylinder, painted flat black, that looked the same from all view-

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ing positions around it Other heterogeneous- and homogeneous-sided objects were used in pretraining

Pretraining was given to establish the meaning of "looks the same" and "looks different" as referring to the visual appearance of a single object when seen from various perspectives and to show how the appearance of the wire sculpture and cylinder changed or did not change when these objects were rotated The children were first shown that two identical round plastic lids looked different "to their eyes" when one was presented broadside and the other edgewise Then, they saw that one of the lids looked the same to them when first presented broadside and then rotated 360° into the identical broadside orientation again, but looked different from the way it did in that orientation when presented again edgewise, following a 90° rotation Following this, it was demonstrated that a heterogeneous-sided object (corkscrew) looked different to them when rotated to a different orientation while a homogeneous-sided object (cup), rotated simultaneously, continued to look the same Then, just before the test questions concerning the wire sculpture were asked, the subjects were shown that it kept looking different to them when rotated around its vertical axis Likewise, just before the cylinder test questions were asked, they were shown that it kept looking the same to them when similarly rotated In order to prevent children from automatically associating only "same" responses with cylinder questions, they were also shown that the cylinder looked different to them when moved from the vertical to the horizontal position On each pretraining item the children were first asked the same-different views question, followed by corrective feedback and explanation of the correct answer

Each object was placed at the child's eye level on top of a box that rested on a table 122 cm wide and 61 cm across Half the subjects in each age × sex subgroup were questioned about the objects in the order sculpture-cylinder, the other half in the opposite order The question about each object was always, "Does it look the same to your eyes as it does to my eyes or does it look different?" The order of "same," "different," "your," and "my" in the question was varied unsystematically from trial to trial The question was asked six times for each object, three with the female experimenter crouched just behind the child with her head next to his (0°) and three with the experimenter crouched across from him at one or the other (unsystematically varied) of the opposite corners of the table (roughly 135° or 225°) The order of the six trials was randomly selected for each subject individually, with the constraint that only two trials of the same type (0° or 135°/225°) could occur in immediate sequence The child was asked to explain his answer ("How come?") on the third trial of each type After a trial was concluded, the experimenter walked to her new position If the new position was to be the same as the preceding one, she walked 360° After the second set of six trials was concluded, the experimenter asked two questions concerning whichever object was in front of the child (1) "Is there any place (else) I can go so that it will look the same to my eyes as it does to your eyes?" (2) "Is there any place I can go so it will look different to my eyes than it does to your eyes?" The experimenter asked question 1 first if she had been at 135°/225° on the preceding trial, question 2 first if at 0° After each question the experimenter moved to the position designated by the child's answer She then put the other object on the box and repeated the two questions

There were four dependent measures used in data analysis (*a*) correct answers to the "same/different" questions (maximum of three per task), (*b*) correct explanations of these answers, (*c*) correct answers to the final "place to go" questions (e g , "nowhere" to the cylinder-different question, anyplace the child indicates for the cylinder-same question, and "over here with me" to the wire sculpture–same question), (*d*) judged understanding of each task situation, based on at least two out of three correct "same/different" answers plus any other convincing evidence in the protocol, such as a correct explanation or some other indication of insight Measures requiring judgments (*b* and *d*) were scored independently for all subjects by two judges, disagreements were subsequently resolved by discussion Interjudge agreement was 95% for explanations and 94% for understanding

Table 1 shows the results of this study The data appear to support the following three conclusions

1 Some developmental progress in perspectival rule knowledge occurs between 4½ and 5½ years of age, at least with respect to rules 1 and 2 The age trends for rule 3 shown in table 1 are less marked and are not statis-

TABLE 1

NUMBER OF SUBJECTS AT EACH AGE LEVEL (4½, 5, and 5½ Years, N = 16 per Group) SCORED FOR EACH DEPENDENT MEASURE ON EACH TASK

	TASKS AND AGE LEVELS														
	Rule 1 (Wire-0°)			Rule 1 (Cylinder-0°)			Rule 2 (Wire-135°/225°)			Rule 3 (Cylinder-135°/225°)			All Tasks		
PERFORMANCE MEASURE	4½	5	5½	4½	5	5½	4½	5	5½	4½	5	5½	4½	5	5½
Correct answer (3/3)	7	10	14*	11	10	13	6	12	12*	11	10	13	2	6	9*
Correct explanation	7	6	12	6	7	11	5	9	15*	5	7	9	3	4	8
Correct place to go	6	9	13*	15	10	16*	11	10	15	9	14	14	3	6	11*
Judged as understanding	8	10	16*	11	10	16*	7	10	16*	8	9	13	5	8	13*

* The χ^2 (2) value for the age comparison is significant at $p < .05$

tically significant The near-ceiling performance of the youngest group on the place-to-go measure for cylinder-0° is probably due to the fact that any location the child indicated was scored correct, we cannot explain the poorer performance of the 5-year-olds, however

2 There is no clear evidence that the three rules differ appreciably in difficulty or age of acquisition For example, table 1 shows that the numbers of 4½-, 5-, and 5½-year-olds judged as understanding the relation between the two observers' perspectives on the two rule 1 tasks were 8, 10, and 16 for wire-0° (34 subjects) and 11, 10, and 16 for cylinder-0° (37 subjects) The comparable figures for the other two rules are similar 7, 10, and 16 (33 subjects) for wire-135°/225° (rule 2), 8, 9, and 13 (30 subjects) for cylinder-135°/225° (rule 3)

3 Most of the 5½-year-olds appear to have developed a good grasp of all three rules Nine of them correctly answered all 12 "same/different" questions and four others correctly answered 11 of the 12 It is hard to imagine what erroneous, nonperspectival rule or rules could generate the exact pattern of nine "same" and three "different" answers needed for perfect performance on this set of four tasks The other three figures (8, 11, and 13) shown in the rightmost column of table 1 also testify to quite a high level of rule knowledge by this age Moreover, there is reason to believe that the children were actually using rule knowledge here rather than view computations (Flavell et al 1978, Flavell, Flavell, Green, & Wilcox 1980) That is, they tended to respond to the questions quickly, as though they were not actually trying to determine exactly how the object appeared to each observer before answering In fact, they often responded without even looking at the object Moreover, in the case of the almost featureless wire sculpture, such view computations and comparisons would have been very difficult to carry out, to say the least We conclude, then, that knowledge of fundamental perspective-taking rules 1 and 2 is acquired earlier than previous investigations would suggest, and that rule 3—hitherto unstudied but also fundamental—is acquired at about the same time

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