Developmental Psychology
1981, Vol. 17, No. 1, 99–103

0012-1649/81/1701-0099$00.75

Young Children's Knowledge About Visual Perception: Further Evidence for the Level 1–Level 2 Distinction

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Three studies were done to test the hypothesis that there is a development in early childhood from a less advanced (Level 1) to a more advanced (Level 2) form of knowledge and thinking about people's visual experiences. Study 1 replicated and further validated a previous finding that 3-year-olds perform very well on tasks that call for Level 1 knowledge but very poorly on those that require Level 2 knowledge. Study 2 showed that children of this age did not perform better when critical aspects of Level 2 tasks were designed to be familiar to them and similar to what they might encounter in everyday life. Study 3 showed that most of the children who performed poorly on Level 2 tasks in Study 2 continued to perform poorly on a retest given 2–19 weeks later. In addition, a brief training period following the retest proved largely unsuccessful in inducing Level 2 knowledge and thinking in these children. The results of these three studies appear to provide strong support for the Level 1–Level 2 developmental hypothesis.

Flavell and his co-workers have hypothesized that there are at least two developmental levels of knowledge about visual perception (Flavell, 1974, 1978; Lempers, Flavell, & Flavell, 1977; Masangkay et al., 1974). At earlier developing Level 1, the child can nonegocentrically infer what object another person does and does not see, given adequate cues. At later developing Level 2, the child further knows that an object simultaneously visible to both the self and the other person may nonetheless give rise to different visual impressions or experiences in the two if their viewing circumstances differ. Thus, the Level 1 child is quite capable of recognizing that the other person currently sees an object that the child does not see, or vice versa. However, the Level 2 child has the additional insight that an object seen by both may still present a different appearance to both if they see it from opposite sides, from different distances, and so on. Hughes (1975) has independently proposed a very similar developmental model, in which "projective" and "perspective" abilities correspond to Level 1 and Level 2 knowledge, respectively.

There is now a fair amount of research evidence that is consistent with the Level 1–Level 2 developmental hypothesis (Abrahams, 1979; Coie, Costanzo, & Farnill, 1973; Flavell, Flavell, Green, & Wilcox, 1980; Flavell, Shipstead, & Croft, 1978, in press; Hughes, 1975; Lempers et al., 1977; Liben, 1978; Masangkay et al., 1974; Walker & Gollin, 1977). However, most of this evidence did not result from strong, direct experimental tests of the hypothesis expressly carried out for that purpose. The studies reported here were designed to provide such tests.

Study 1

Method

Subjects. The subjects were 10 girls and 5 boys ranging in age from 3 years 1 month to 3 years 11 months of age (M age = 3 years 5 months). All were of middle-class background and attended a suburban nursery school.

This research was supported by Grant BNS-76-16830 from the National Science Foundation.

We are very grateful to the children, teachers, and parents whose cooperation made these studies possible.

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Materials and procedure. All children were given two Level 1 tasks and two Level 2 tasks. In one Level 1 task (dog/cat$_1$), a card with a picture of a dog on one side and a cat on the other was held vertically between the child and experimenter, and the child's task was to indicate which animal the experimenter saw. In one Level 2 task (turtle$_2$), a picture of a turtle was placed horizontally on the table between the child and experimenter so that it appeared upside down (or right side up) from the child's side and right side up (or upside down) from the experimenter's. The child's task was to indicate in which of these two orientations it appeared to the experimenter. Masangkay et al. (1974) found that 3-year-olds performed without error on dog/cat$_1$ but quite poorly on turtle$_2$, whereas 4-year-olds performed virtually without error on both tasks. One purpose of the present study was to see if the former results could be replicated on a new group of 3-year-olds.

In the second Level 1 task (turtle$_1$), the same picture of a turtle used in turtle$_2$ was again placed flat on a table between the child and experimenter. In turtle$_1$, however, it was bisected vertically by a plain white card so that the turtle's back but not its feet was visible from one side, and its feet but not its back from the other. The child was then asked whether the experimenter saw the turtle's back or the turtle's feet (a Level 1 question) rather than, as in turtle$_2$, whether the turtle looked right side up or upside down to the experimenter (a Level 2 question). Comparing performance on turtle$_1$ and turtle$_2$ should provide a cleaner test of the Level 1–Level 2 hypothesis than comparing performance on dog/cat$_1$ and turtle$_2$ because level of knowledge assessed is much less confounded with variation in stimulus materials used in the former case.

In the second Level 2 task (worm$_2$), the child was shown a horizontally placed picture of a worm lying between a red blanket and a blue blanket. The child was then asked if the worm appeared to the experimenter, seated opposite, to be lying on the red blanket or on the blue blanket.

The order of presentation of the four tasks was randomly determined for each child, with the constraint that Level 1 and Level 2 tasks alternated in the sequence. Before administering each Level 2 task, the experimenter made sure the subject could both produce and recognize, from his or her own point of view, the two perceived states of affairs that would be repeatedly referred to in that task. Subjects were asked to identify the experimenter's perspective three times on each Level 1 task and six times on each Level 2 task and were asked to report their own perspective at the conclusion of each sequence of questions. Two children who erred in reporting their own perspective on one or more tasks were not retained as subjects.

Results and Discussion

The children scored 1 point for each experimenter-perspective question they answered correctly. Thus, the maximum possible score was 3 for each Level 1 task and 6 for each Level 2 task. All children answered all Level 1 questions correctly. The number of children receiving each score on the Level 2 tasks is shown in Table 1. Assuming that a score of 5 or 6 probably reflects Level 2 understanding, no child showed such understanding on turtle$_2$ and four children did so on worm$_2$. A sign test revealed no significant differences in performance on these two Level 2 tasks. As Table 1 shows, the modal response pattern on both was to report the child's own perspective on all six trials; about half of the children showed this pattern on each task.

These results provide further support for the Level 1–Level 2 developmental hypothesis. First, as Masangkay et al. (1974) found, 3-year-olds performed perfectly on dog/cat$_1$ and poorly on turtle$_2$. Second, the methodologically cleaner comparison between performance on turtle$_1$ and turtle$_2$ supports the hypothesis just as strongly. Third, the 3-year-olds performed almost equally poorly on a new and different Level 2 task (worm$_2$), despite its more concrete and possibly more familiar and meaningful wording.

Study 2

Method

Subjects. The subjects were 21 girls and 15 boys ranging in age from 3 years 2 months to 3 years 11 months of age (M age = 3 years 6 months). All were

Table 1
Score Distributions on Level 2 Tasks

Study	Task	Number correct						
		0	1	2	3	4	5	6
1	Turtle$_2$	7	3	2	3	0	0	0
	Worm$_2$	8	3	0	0	0	1	3
2	Turtle$_2$	9	2	4	5	3	2	11
	Turtle(m)$_2$	7	4	3	11	1	2	8
	Book$_2$	5	4	7	4	4	1	11
3								
Before training	Turtle$_2$	7	0	0	4	2	—	—
	Turtle(m)$_2$	4	3	1	4	1	—	—
After training	Turtle$_2$	0	0	3	6	3	1	0
	Turtle(m)$_2$	1	0	3	3	5	1	0

Note. Study 1, N = 15. Study 2, N = 36. Study 3, N = 13.

of middle-class background and attended suburban nursery schools.

Materials and procedure. All subjects were given three Level 2 tasks. One was the turtle$_2$ task with a minor change: To add variety to the task, two experimenter-perspective questions were asked about each of three depicted animals (turtle, bird, pig) rather than all six being asked about the turtle. These same three pictures were used in a modification of the task, turtle(m)$_2$, in which the child was asked whether the animal appeared to the experimenter to be "standing on its feet" or "lying on its back" rather than the more abstract-sounding "right side up" or "upside down." In the third task, book$_2$, a picture book was spread open on the table between the child and experimenter so that it appeared upside down to one of them and right side up to the other. The child was then asked if the experimenter saw the picture in the book "the right way" or "the wrong way." As in Study 1, seven questions were asked on each task, the first six about the experimenter's perceptual experience and the seventh about the child's. The three tasks were presented in each of the six possible orders, six children receiving each order. The experimenter verified comprehension of upside down and right side up prior to turtle$_2$ as in Study 1, but using a cup rather than the turtle picture to illustrate the meaning of these terms.

All but 4 of the 36 children answered all three own-perspective questions correctly. The 4 who did not were retained in the sample, however, because their incorrect own-perspective answers appeared to result from a kind of "realism" interpretation. That is, they would decide that the turtle, as depicted, really was permanently upside down, or really kept standing on its feet, and would systematically give these answers no matter how the turtle was oriented vis-à-vis the experimenter or them. They clearly understood the meaning of these terms and were as task oriented and attentive as the other subjects, so we decided to keep them in the sample.

Results and Discussion

As in Study 1, the children scored 1 point for each of the six experimenter-perspective questions they answered correctly. A 3 (task) × 6 (task order) × 2 (perspective order) mixed analysis of variance revealed no significant main effects or interactions. Subjects' performance on turtle$_2$ was better in this study than in Study 1. For example, 13 of 36 Study 2 subjects versus 0 of 15 Study 1 subjects received scores of 5 or 6, $\chi^2(1) = 5.49$, $p < .02$. Possible reasons might include better maintenance of attention and interest due to the change of animals on each trial and less fixation on one's own perspective of the turtle by having the orientation terms introduced in connection with a different object, the cup. Nevertheless, the performance of the Study 2 subjects on this task was not very good, certainly not good enough to be inconsistent with expectations based on previous research and the Level 1–Level 2 hypothesis. Moreover, only 10 children achieved scores of 5 or 6 when wording was changed from upside down and right side up (turtle$_2$) to standing on its feet and lying on its back (turtle[m]$_2$). Performance on turtle(m)$_2$ thus appears to have been roughly comparable to performance on worm$_2$ in Study 1, another task with wording that should be easily understandable by 3-year-olds.

The results for book$_2$ strike us as counterintuitive. Despite evidence from their responses to the own-perspective question that they interpreted "the right way" and "the wrong way" as intended, only 12 children answered five or six of these more naturalistic-seeming Level 2 questions correctly. It might not have counted too heavily against the Level 2 hypothesis had 3-year-olds performed fairly well on this task; it is well-known that task factors can have very powerful effects on a child's ability or tendency to express nascent competencies. On the other hand, we take the fact that they performed so surprisingly poorly on book$_2$ to be strong evidence in support of the hypothesis.

Study 3

The purpose of this small training study was to assess the developmental–psychological reality of the Level 1–Level 2 distinction. That is, if Level 1 thinkers cannot easily be taught to engage in Level 2 thinking, that would suggest that the differences between the two levels is genuine and robust rather than artifactual or trivial.

Method

The 19 children who received scores lower than 5 on all three tasks in Study 2 were retested on turtle$_2$ and turtle(m)$_2$ an average of 10 weeks (range = 2–19 weeks) after their participation in Study 2. One subject proved too inattentive to complete testing, 3 showed criterion responding (score or 5 or 6) on one but not both of the two tasks, and 2 reached criterion on both. The remaining 13 children continued to perform at about their previous level. These 13 children were then given about 5 minutes of training on own- versus experimenter-per-

spective upside down and right side up perceived orientation, using a picture of a bug as the stimulus object. Immediately afterwards they were tested again on turtle$_2$ and turtle(m)$_2$. The training consisted of a standardized sequence of experiences designed to induce Level 2 understanding. The children were taken around to the experimenter's side of the table and shown that the bug appeared upside down from her side when it appeared right side up from theirs, and vice versa. They were also asked to pick up the card and place it on the table so that the experimenter would see the bug right side up or upside down. Whenever they made an incorrect response, they were corrected and invited to come around the table to check.

Results and Discussion

There was significant and similar pretraining to posttraining improvement on each of the tasks, $F(3, 36) = 8.36$, $p < .001$; Newman-Keuls comparisons were significant at $p < .01$ for each task (see Table 1). Thus, there appears to have been some learning and also some transfer of that learning to the turtle(m)$_2$ task. However, only 2 of the 13 children reached criterion after training, and they did so on only one task each. Much of the significant improvement seems to be accounted for by subjects who changed from consistent egocentric responding to random or inconsistent responding. The training appears to have been effective in making a number of the 3-year-olds aware that their original, largely automatic manner of responding was incorrect but not effective in inducing real understanding of Level 2 problems. These results do not prove that more or better training could not induce Level 2 thinking, of course. They do suggest, however, that the developmental gap between Level 1 and Level 2 thinking is a real and fairly robust one.

Discussion

The results of these three studies together provide much stronger and more direct evidence for the psychological and developmental reality of the Level 1–Level 2 distinction than was previously available. They suggest that 3-year-olds, who consistently appear very competent at Level 1 inferences about others' visual percepts (e.g., Flavell et al., 1978; Lempers et al., 1977; Masangkay et al., 1974; Study 1 of the present article), have great difficulties in making Level 2 inferences. These difficulties appear on a variety of Level 2 tasks, including an extremely easy looking one (the book$_2$ task in Study 2). These difficulties also show fairly high test–retest stability over a 2- to 19-week interval and are not fully removed by a brief period of explanation, demonstration, and practice with corrective feedback designed to induce Level 2 knowledge and thinking.

Several important questions remain for further research. Could equally powerful and compelling evidence for a Level 1–Level 2 developmental progression be obtained with tasks using real rather than depicted objects? We have not yet seen such evidence in the literature. Could analogous progressions be demonstrated in other perceptual modalities? Here is a putative example of an inference at Level 2 in the area of audition: Although both of us can hear the song that is playing on the radio, you can undoubtedly hear it more clearly and distinctly than I can because you are right next to the radio, whereas I am two rooms away (cf. Flavell et al., 1980). Might there also be similar progressions in the case of social-cognitive inferences that do not concern percepts? A possible example might be a progression from inferring only what others know to inferring also how they think or feel about what they know. Finally, *how* do children develop Level 1 and Level 2 forms of social cognition—in the visual domain or any other domain?

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Received May 2, 1980 ■