

Preschooler's Performance in Three Visual Perspective Taking Tasks

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Introduction

•Visual perspective taking (VPT): the ability to imagine or to represent how objects look relative to one another from another person's point of view (Cox, 1977, p. 254). Children pass some VPT tasks at 2 years of age (Flavell, Everett, Croft, & Flavell, 1981), but fail other VPT tasks when they are 8 (Piaget & Inhelder, 1963). Why?

•Transformation hypothesis: different requirements of spatial computation cause different performance across tasks (Easton & Sholl, 1995, Rosser, 1983). Evidence: response time and error increases as a function of the increases of rotation angle (Easton & Sholl, 1995; Presson & Montello, 1994).

•Interference hypothesis: different requirements of solving perspective conflict cause different performance across tasks (May, 1996, 2004; Newcombe & Huttenlocher, 2000). This hypothesis emphasizes the ability to hold two views in mind and suppress one's own view when needed. Evidence: turning the participants to make them disoriented can improve performance (May, 1996).

•Hypothesis for this study: both transformation and interference processes affect VPT performance in preschoolers, and their relative importance depends on age.

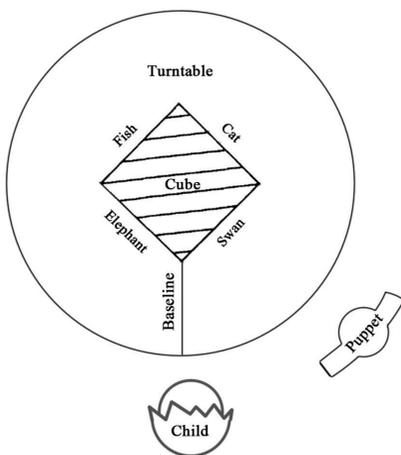
Method

•Participants: 84 Chinese preschool children (14 boys and 14 girls for each of the 3-, 4- and 5-year-old age group), plus 8 college students to establish mature level.

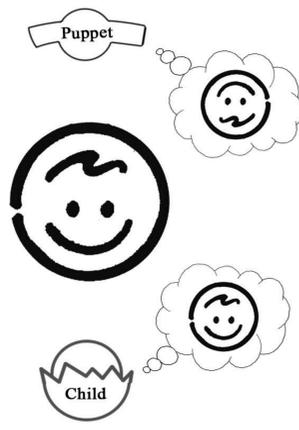
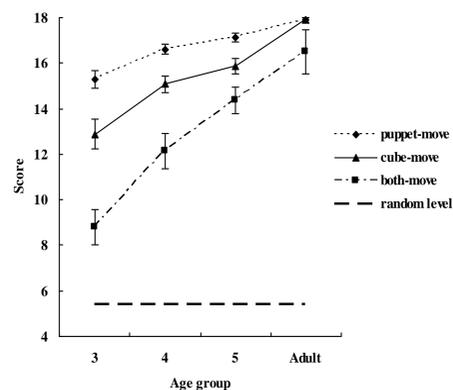
•Turntable task (adapted from Guo, Wang, & Wang, 2004): On the turntable sat a cube with 4 animals on 4 sides. Children were asked to tell what they would see after the cube turned certain angle (cube-move condition); what the puppet would see after it turned certain angle (puppet-move condition) and what the puppet would see after both cube and puppet turned certain angle (both-move condition).

•Upside-down picture task (adapted from Hobson, 1984): We used 3 pictures that reveal one figure on one side and another on the reverse side. Children first recognized the two figures. Then the experimenter placed a puppet opposite to them and asked "what does the baby bear see in the picture?" Children's answers are scored as correct (the puppet see the reverse as they see), egocentric (the puppet see the same as they see) or other.

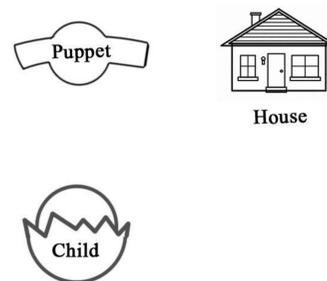
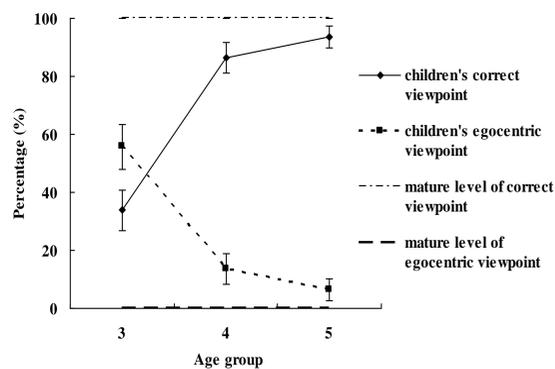
•Left-right discrimination task (adapted from Roberts & Aman, 1993): Children were taught that a puppet could either turn to its "red hand side" (counterclockwise) or to its "blue hand side" (clockwise). The puppet was then placed in the same direction as the children (0° condition), in the lateral direction (90° /270° condition) or facing the children (180° condition). The puppet's house was placed on the left or right side of the puppet. Children were asked "to which side should the baby bear turn if he wants to see his house?"



Turntable task



Upside-down picture task



Left-right discrimination task

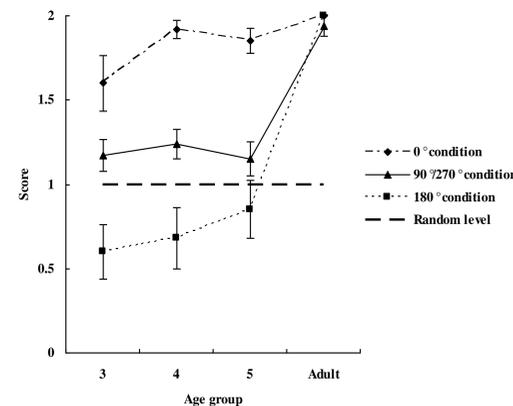


Figure 1. The illustrations of each task and their corresponding results

Task	Left-right discrimination	Upside-down picture task	Turntable task			Left-right discrimination		
			Condition	0°	—	puppet-move	cube-move	both-move
Performance by age group	3	Mature level	Not above chance	Above chance	Above chance	Above chance	Not above chance	Not above chance
	4	Mature level	Mature level	Mature level	Above chance	Above chance	Not above chance	Not above chance
	5	Mature level	Mature level	Mature level	Mature level	Mature level	Not above chance	Not above chance
Feature of the task/condition	Children and puppet look at the object from the same direction	Children and puppet look at the object from different directions, don't need to track the position of the object relative to the puppet	Children track the position of the object relative to themselves	Children and puppet look at the object from different directions, need to track the position of the object relative to the puppet				
Require interference?	No	Yes	Yes	No	Yes	Yes	Yes	
Require transformation?	No	No	No	Yes	Yes	Yes	Yes	

Table 1. Summary of children's performance in different VPT tasks and conditions. For the performance, "not above chance" means a group average that is either lower or not significantly different from chance level. "Above chance" means a group average that is significantly higher than chance level but significantly lower than that of the adult group. "Mature level" means a group average that is not significantly different from that of the adult group.

Results and Discussion

•Age differences: significant for turntable task ($F(2, 77) = 27.97, p < .001$) and upside-down picture task ($F(2, 50.8) = 28.3, p < .001$). The results are summarized in Table 1.

•The result shows a pattern of 3 stages: 3-year-olds do well only in the VPT tasks that don't require interference or transformation; 4-year-olds reached mature level in tasks that require interference but not transformation, but they still couldn't reach mature level in tasks that require transformation. Even 5-year-olds don't do well when the task has a combined requirement of interference and transformation.

•Individual differences: For the whole sample, the bivariate and partial correlations between age and task performances are shown in Table 2.

•After we separate age groups, significant correlation was observed in the 4-year-old group between the upside-down picture score and the score for puppet-move condition of the turntable task ($r = 0.60, p = .001$), but not for the other two conditions ($r_s < 0.27, p_s > .1$). This correlation may be explained by a common requirement on interference. It is most significant in 4-year-olds because this is a time of change when children start to succeed in these tasks.

	Age	Upside-down	Turntable	Left-Right
Upside-down picture task	0.31*	—	0.60**	0.04
Turntable task	0.48**	0.65**	—	0.15
Left-right discrimination	0.16	0.21	0.38*	—

Table 2. Correlation between children's age and performance in VPT tasks. The numbers on the left-bottom corner are bivariate correlations coefficients. The numbers on the right-top corner are partial correlation coefficients, using age as a covariant variable. * $p < .05$, ** $p < .001$.

Conclusion

•The reason why children pass different VPT tasks at different ages may be due to the tasks' requirements on spatial transformation and solving interference. These two components have different impact on different ages.

•The major improvement from 3-year-olds to 4-year-olds occurred in the ability to solve interference between one's own view and another's view. Four-year-olds could pass the tasks with high requirement on interference and low requirement on transformation.

•Preschooler's limited ability of spatial computation may confine them from passing more spatially demanding VPT tasks. Five-year-olds still have difficulties in some VPT tasks that require a combination of spatial transformation and solving interference.

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