The Role of Velocity in Toddlers' Object Representations

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Introduction

Much research has focused on when children begin to show evidence that they understand object permanence, with Piaget arguing that this was achieved by one year of age, but more recent researchers arguing that it this concept could be present as early as two months (Spelke et al., 1992). Other recent research has shown that children as old as two years, while demonstrating knowledge of a hidden object's existence, do not appear to have the ability to reason about that object's exact location (Berthier et al., 2000). Here children watched an object roll down a ramp and go behind an occluder, stopping at a wall visible above the occluder that could be placed in one of 4 locations. The children then searched behind one of 4 possible doors corresponding to each of the wall spots. Although the two-year-olds could not reliably find the object (unlike three-year-olds), they were not just guessing: many showed a bias to the second door down the ramp. Thelen & Whitmyer (2004) attributed this to more perceptual and/or task-specific factors and showed that two-year-olds could search successfully when lights were added to the doors to make them more salient.

In dispute then is to what extent object representations are conceptual versus perceptual and how early children form them. This paper is about the former question, examining what other factors are involved in object representations. We assert that in order to represent a moving object, children must be representing more than just its location at any instant, but also its trajectory and velocity. This should have an influence on their search.

Experiment 1

There were three between-subjects conditions for object speed. Data from thirty two-year-olds (M=28.6m) were analyzed, 10 in each condition. The ramp was the same as used by Thelen & Whitmyer (2004) with two additions: 1) an extension to modify its height and thus the rolling speed and 2) pictures added to each of the doors (randomly varied across subjects) to serve as a possible memory aid. Each child did 4 warm-up trials, once for each wall position, with all the doors opened, followed by 12 randomly-ordered test trials, 3 per wall position, with all doors closed. The child viewed the object roll down the ramp from about 4-5 feet away and then was allowed to retrieve it. The first door opened was recorded.

A repeated-measure ANOVA revealed no effect of wall position on children's responses ($p > .3$) and accuracy was no different from chance ($p > .8$), replicating Berthier et al.'s (2000) finding. However, door choice was affected by the object's speed ($p < .001$). Figure 1a shows the effects on choosing doors 1 ($p < .04$) and 4 ($p < .03$).

Experiment 2

The design was extended to include another between-subjects factor, the speed of the training trials during the warm-up phase (now 10 trials): medium or fast. This was followed by either a medium- or fast-speed test phase of 12 trials. Data from forty two-year-olds (M=28.1m) was analyzed, 10 in each of the four conditions.

Figure 1b shows the effect of training and testing speed on door choice, with it again affecting doors 1 ($p < .10$) and 4 ($p < .07$) the most. Children trained on fast and tested on medium chose further down the ramp than children who viewed medium throughout.

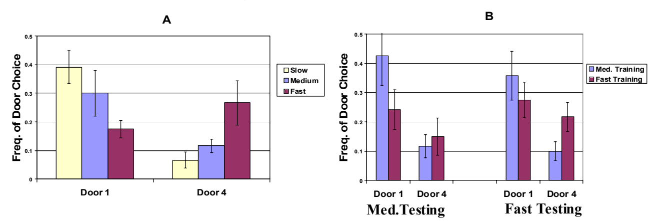

Figure 1: a) Experiment 1 results; b) Experiment 2 results

Discussion

Our results suggest that two year olds represent the velocity of an object influencing their search. Object permanence may be construed as including the ability to predict that an object will *continue to behave in the same way* rather than just continue to exist. The results also indicate that object perception is a real-time process, influenced by both the present situation *and* one's recent past. Together these findings imply that object representations may be "closer to the sensori-motor surface" than previously thought.

References

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