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Relativity in Toddlers' Understanding of the Physical World as Key to Misconceptions in the Science Classroom

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Abstract : Within their first year, infants can differentiate between objects based on their weight. By at least 5 years children hold consistent weight-related misconceptions about the physical world, such as that heavy things fall faster than lighter ones because of their weight. Such misconceptions are seen as a challenge for science education since they are often highly resistant to change through instruction. Understanding the time point of emergence of such ideas could, therefore, be crucial for early science pedagogy. The paper thus discusses two studies that jointly address the issue by examining young children's search behaviour in hidden displacement tasks under consideration of relative object weight. In both studies, they were tested with a heavy or a light ball, and they either had information about one of the balls only or both. In Study 1, 88 toddlers aged 2 to 3½ years watched a ball being dropped into a curved tube and were then allowed to search for the ball in three locations – one straight beneath the tube entrance, one where the curved tube lead to, and one that corresponded to neither of the previous outcomes. Success and failure at the task were not impacted by weight of the balls alone in any particular way. However, from around 3 years onwards, relative lightness, gained through having tactile experience of both balls beforehand, enhanced search success. Conversely, relative heaviness increased search errors such that children increasingly searched in the location immediately beneath the tube entry – known as the gravity bias. In Study 2, 60 toddlers aged 2, 2½ and 3 years watched a ball roll down a ramp and behind a screen with four doors, with a barrier placed along the ramp after one of four doors. Toddlers were allowed to open the doors to find the ball. While search accuracy generally increased with age, relative weight did not play a role in 2-year-olds' search behaviour. Relative lightness improved 2½-year-olds' searches. At 3 years, both relative lightness and relative heaviness had a significant impact, with the former improving search accuracy and the latter reducing it. Taken together, both studies suggest that between 2 and 3 years of age, relative object weight is increasingly taken into consideration in navigating naïve physical concepts. In particular, it appears to contribute to the early emergence of misconceptions relating to object weight. This insight from developmental psychology research may have consequences for early science education and related pedagogy towards early conceptual change.

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