The development of children's concepts of invisibility

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ABSTRACT

One of the most striking examples of appearance–reality discrepancy is invisibility—when something has no appearance yet still exists. The issue of invisibility sits at the juncture of two foundational ontological distinctions, that between appearance and reality and that between reality and non-reality. We probed the invisibility concepts of 47 3–7-year-olds using two sets of tasks: (1) an entity task, in which children were queried about the visibility and reality status of a variety of both visible and invisible entities, and (2) two standard appearance–reality tasks. Results showed that children's concepts of visibility and reality status are intertwined, and that an understanding that some entities are impossible to see develops between the ages of 3 and 7.

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1. Introduction

Visual input is a primary source of information about the environment. It allows us to know the color of something, the shape, the size, and a whole host of other properties. At a young age, children recognize the importance of vision as a source of information about the world (Piaget, 1962; Meltzoff, Waismeyer, & Gopnik, 2012; Rogoff, Paradise, Arauz, Correa-Chávez, & Angelillo, 2003; Williamson, Jaswal, & Meltzoff, 2010). Perhaps most importantly, we regularly use vision to confirm existence. If, for example, my child thinks she has lost her stuffed bear, my spotting of the bear under her bed

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will confirm the bear's location and, more importantly, its existence. Similarly, if she tells me there is an alligator under her bed, I can disconfirm this report by looking under her bed and informing her that there is nothing there. Yet visibility is not a foolproof indicator of existence, nor is existence a direct line to visibility. There are, in the real world, objects and events that we can see but are not real (e.g., illusions), and there are entities that exist yet are not visible (e.g., air). Children often confront mismatches between visibility and reality. Most characters on children's television are visible but do not exist in the real world. Germs, a common topic of conversation with children, are real but cannot be seen. The focus of this paper is how children come to understand invisibility, along with how they manage the relations between visibility and reality.

The concept of invisibility sits at the intersection of two important and well-studied ontological distinctions: (1) that between reality and fantasy, and (2) that between reality and appearance. Because visibility is so often a cue to existence, young children may easily misinterpret lack of visual evidence as a cue to fantastical status. At the same time, to understand that something invisible is actually real, one must be able to separate appearance from reality. Research reveals significant development in children's understanding of both of these distinctions between the ages of 3 and 7 (Flavell, Green, & Flavell, 1986; Moll & Tomasello, 2012; Morison & Gardner, 1978; Sharon & Woolley, 2004; Woolley, 1997; Woolley & Wellman, 1990). Yet, because the majority of children's experiences in the world involve entities that are both real and visible, conceiving of entities that are real yet invisible, or not real and visible, may be especially challenging to young children. As Harris, Pasquini, Duke, Asscher, and Pons (2006) explain, children learn much about unobservable scientific and other cultural phenomena through the testimony of other people. Although children may hear about particular instances of invisibility (e.g., germs or angels) in this way, to fully understand the concept of invisibility, children must be able to divorce appearance (or lack thereof) from reality. Without this ability, one could not comprehend, for example, that the stars and planets, although visible at night, still exist during the day when one cannot see them. As such, an understanding of invisible entities may rest upon a basic understanding of the appearance–reality distinction. Investigating this relation is a secondary goal of the present studies.

Researchers to date have explored children's knowledge of three types of invisible real entities: mental states, germs, and dissolved particles. Wellman and colleagues have shown that by age 3 children understand much about mental states such as thoughts, emotions, dreams, and imagination (Estes, Wellman, & Woolley, 1989; Wellman & Estes, 1986; Woolley & Wellman, 1993). Specifically, work by Wellman and Estes (1986), Estes et al. (1989)) showed that children understand that people have mental states even though mental states cannot be seen in the same way as physical entities. Others have shown that by age 4 or 5 children understand the existence of germs and other invisible particles (e.g., sugar dissolved in water), and can use them to reason about cause and effect (Au, Sidle, & Rollins, 1993; Kalish, 1996; Rosen & Rozin, 1993). For example, children understand that germs, although invisible, can cause disease and that sugar is still in sugar-water even though, once dissolved, one cannot see it. Although this work provides valuable information about children's reasoning, children's concepts of invisibility are not the focus of these prior studies. In our research we aim to provide insight into children's conceptions of germs and other invisible entities.

There is limited research on children's concepts of invisible not-real entities. Kiessling, Russell, Whitehouse, and Perner (2013), using a perspective-taking task, showed that children younger than 5 do not differentiate between invisible agents and absent humans in terms of their visibility. That is, not until age 5 did children appear to comprehend fully the existence of an invisible being. Research by Bering and Parker (2006) indicates that not until age 7 do children grasp the possibility that invisible beings can have communicative powers. They told 3–7-year-olds about an invisible being, Princess Alice, who would communicate with them during the course of a game by giving them signs. When an unexpected event occurred (e.g., a picture of Princess Alice fell off the wall while children were playing the game), although half of 5-year-olds thought the event was caused by the invisible being, only the oldest children (7-year-olds) acknowledged the communicative intentions of the princess. Bering and Parker also report that the ability to provide a coherent definition of the word *invisible* increases between the ages of 3 and 5.

Harris et al. (2006) investigated 4–8-year-olds' concepts of entities that are unobservable (although not necessarily invisible), both real and pretend. They presented children with a number of real (e.g.,