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Comparing humans and nonhuman great apes in the broken cloth problem: Is their knowledge causal or perceptual?

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ABSTRACT

When presented with the broken cloth problem, both human children and nonhuman great apes prefer to pull a continuous cloth over a discontinuous cloth in order to obtain a desired object resting on top. This has been interpreted as evidence that they preferentially attend to the functionally relevant cues of the task (e.g., presence or absence of a gap along the cloth). However, there is controversy regarding whether great apes' behavior is underpinned by causal knowledge, involving abstract concepts (e.g., support, connection), or by perceptual knowledge, based on percepts (e.g., contact, continuity). We presented chimpanzees, orangutans, and 2-, 3-, and 4-year-old children with two versions of the broken cloth problem. The Real condition, made with paper strips, could be solved based on either perceptual cues or causal knowledge. The Painted condition, which looked very similar, could be solved only by attending to perceptual cues. All groups mastered the Real condition, in line with previous results. Older children (3- and 4-year-olds) performed significantly better in this condition than all other groups, but the performance of apes and children did not differ sharply, with 2-year-olds and apes obtaining similar results. In contrast, only 4-year-olds solved the Painted condition.

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We propose causal knowledge to explain the general good performance of apes and humans in the Real condition compared with the Painted condition. In addition, we suggest that symbolic knowledge might account for 4-year-olds' performance in the Painted condition. Our findings add to the growing literature supporting the idea that learning from arbitrary cues is not a good explanation for the performance of apes and humans on some kinds of physical task.

Introduction

When presented with a desired object that is not directly reachable but rests on a cloth that is within reach, human infants at around 9 or 10 months of age pull the cloth in order to obtain the object (e.g., Piaget, 1952; Willatts, 1984). This is relevant because, according to Piaget, the deliberate and planful execution of subgoals to achieve goals, or "means–end" behavior, marks the emergence of thinking in infants (Piaget, 1952, 1955). Other species have been shown to be able to pull cloths or strings attached to objects, and although some animals required training (e.g., rats; Tolman, 1937), others pulled spontaneously (e.g., chimpanzees; Köhler, 1925) or learned to do so (e.g., dogs; Osthaus, Lea, & Slater, 2005). Surprisingly, there is a paucity of studies that compare the performance of humans and other species in this and other related tasks, although such comparisons are crucial for understanding the evolutionary history of our cognitive traits.

Several versions of the support task have been designed to explore subjects' knowledge about the functional properties of cloths as tools. In the on–off problem (Hauser, Kralik, & Botto-Mahan, 1999), subjects are presented with two identical objects: one resting on a cloth and the other resting close to another cloth, both at the same distance from the subjects. To pick the cloth that will bring an object, subjects need to pay attention to the presence or absence of contact between the objects and the cloths. Unlike younger infants, 9- or 10-month-olds can solve similar tasks (for reviews, see Willatts, 1984, 1999), as can nonhuman great apes, monkeys, Asian elephants, and some avian species (Auersperg, Gajdon, & Huber, 2009; De Mendonça-Furtado & Ottoni, 2008; Hauser, Santos, Spaepen, & Pearson, 2002; Hauser et al., 1999; Herrmann, Wobber, & Call, 2008; Irie-Sugimoto, Kobayashi, Sato, & Hasegawa, 2008; Povinelli, 2000; Redshaw, 1978; Russell, Lyn, Schaeffer, & Hopkins, 2011; Spinozzi & Potí, 1989, 1993; Yocom & Boysen, 2010). Several nonhuman species have also mastered a related problem, the broken cloth problem (Hauser et al., 1999), where both cloths hold an object but one cloth is broken into two pieces and cannot bring it into reach (Auersperg et al., 2009; Hauser et al., 1999, 2002; Herrmann et al., 2008; Irie-Sugimoto et al., 2008; Russell et al., 2011; Schmidt & Cook, 2006). In this case, subjects need to attend to the presence or absence of a gap along the cloths.

Interestingly, in both the on–off and broken cloth problems, there were marked species differences in the number of trials required to attain the solution to the task. Humans and many of the nonhuman apes tested, as well as some of the monkeys and a few keas, solved the tasks within the first 6 to 12 trials. In contrast, most of the monkeys and elephants, one blue-fronted parrot, and four pigeons required more than 100 to solve these tasks (Auersperg et al., 2009; De Mendonça-Furtado & Ottoni, 2008; Irie-Sugimoto et al., 2008; Schmidt & Cook, 2006). Because pulling an object to bring food within reach is a situation that is probably encountered by numerous species (e.g., pulling a branch to get an out-out-reach fruit attached to it), the interspecific differences mentioned above are not easily explained by the ecological relevance of the task alone. Apparently, some primate and bird species preferentially attended to those cues in the task that were functionally relevant (i.e., cues that signaled whether the cloth would bring an object or not: contact between objects and cloths and gap along the cloths) while ignoring those that were not. Other species might not have had such a preference, which would explain the large amount of trials they needed to learn to solve these tasks (Kummer, 1995; Schmidt & Cook, 2006).