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Preschoolers' understanding of graded preferences

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ABSTRACT

To navigate the social world, children must learn about others' preferences. Though people can use emotional and verbal cues to express their preferences, these cues are often unavailable or unreliable. Previous research has found that preschoolers and toddlers use statistical information to infer the existence of a preference. However, in the real world, preferences are not binary; they can also be graded. In two experiments, we find that preschoolers use statistical information about an agent's choices to infer the graded strengths of preferences. From observing an agent's choices, preschoolers inferred that objects the agent chose less consistently were less preferred than objects the agent chose more consistently. Additionally, preschoolers' responses indicated that preschoolers make more sophisticated transitive inferences than previously attributed to this age group.

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Inferring others' mental states from their actions is an indispensable social skill. As adults, we often observe others' actions to infer what they like or dislike. For example, if our colleague Jim buys an orange soda every day from a vending machine with many other options available, we might infer that Jim has a preference for orange soda. Because preferences are relatively stable dispositions, identifying a person's preferences can help us predict how an agent may behave in the future (e.g., Jim will likely buy orange soda again), how to become a better social partner (e.g., buying Jim an orange soda as a thank-you for a favor), or how much we will like something new based on our shared preferences with that person (Fawcett & Markson, 2010).

How does the ability to infer preferences develop? One prerequisite for inferring preferences is the recognition that other people are intentional agents. Infants as young as 3 months old can interpret agents' reaching behavior as goal-directed (Sommerville, Woodward, & Needham, 2005; Woodward, 1998), and 6-month-olds take into account others' perceptual access when making judgments about agents' preference for objects they consistently reach towards (Luo & Baillargeon, 2007; Luo & Johnson, 2009). By 12 months, infants track multiple agents' behaviors and understand that goals are person-specific (Buresh & Woodward, 2007).

To infer others' preferences, children must also recognize what cues are informative, and when. Previous studies suggest toddlers and preschoolers infer preferences from emotional or verbal cues (Lumeng, Cardinal, Jankowski, Kaciroti, & Gelman, 2008; Repacholi & Gopnik, 1997). However, these cues are not always available; people do not always wear their emotions on their sleeves. Even worse, these cues could be unreliable. Our emotional states are not always a result of our choices, and could be misleading if taken to represent our attitudes towards our choices. For instance, a coworker who appears irritated as she buys coffee is probably not irritated by her choice of beverage—instead, she may have just had a bad morning.

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In the case of inferring preferences, the *choices* an agent makes are often more reliable cues than their emotional or verbal responses. Actions often reflect preferences, as people tend to choose options they like or avoid options they do not. Recent studies suggest children use statistical evidence to infer preferences; preschoolers and 20-month-old toddlers infer that a puppet has a preference when its choices are inconsistent with random sampling (Kushnir, Xu, & Wellman, 2010; Ma & Xu, 2011). Preschoolers also use non-random sampling and multiple agents as cues to the generalizability of preferences (Diesendruck, Salzer, Kushnir, & Xu, 2014).

Children's ability to identify a preference for one object over another – i.e., an agent likes object X more than object Y, or Y more than X – is well established. However, inferring the gradedness of preferences is more complex. When inferring the existence of a preference, one can succeed by using a binary heuristic – for instance, violation of randomness – as cues, but inferring graded preferences requires an extra step: comparing the *degree* of preference of multiple options to one another.

Previous developmental research suggests children may have some key skills to help them recognize and compare graded preferences. Five-year-olds have been found to understand scalar implicature—specifically, they are able to recognize the distinction between "all" and "some" (Papafragou & Musolino, 2004; Papafragou & Tantalou, 2003). Research on preschoolers' transitive inference abilities also suggests that children may have some of the elementary skills necessary for inferring graded preferences. The earliest transitive inference studies found that 4-year-old children struggle with transitive inference in word problems (Piaget, 1928, 1955), but this failure could have been due to memory limitations. Other studies found that 4-year-olds can make transitive inferences about spatial position with help from visual cues like ordered rods or block towers to aid memory (Andrews & Halford, 1998; Bryant & Trabasso, 1971; Halford, 1984; Pears & Bryant, 1990).

More recently, work by Mou, Province, and Luo (2014) found that infants demonstrate transitive reasoning abilities about others' preferences: if an agent repeatedly reaches for A over B and B over C, then 16-month-olds show surprise (i.e., longer looking time) if the agent reaches for C instead of A. Even children as young as 9 months show surprise when an experimenter grasps an object inconsistent with the hierarchy of choices she previously demonstrated (Robson, Lee, Kuhlmeier, & Rutherford, 2014). Other research suggests that these abilities could extend to the social domain. Mascaro & Csibra (2014) found 15-month-olds make incremental inferences about dominance relationships. While their study does not directly address the question of transitive inference, making incremental inferences is an essential skill for recognizing broader social structures. Interestingly, their data found children had an easier time recognizing linear relationships than circular ones, another skill that would assist with children's transitive inference abilities.

Children's performance in causal learning tasks also suggests they can make transitive inferences about causes and effects. Children as young as three years have demonstrated an understanding that if X causes Y and Y causes Z, then X causes Z, and five-year-olds can explicitly state the necessity of Y in the relationship between X and Z (Shultz, Pardo, & Altmann, 1982). Furthermore, Schulz, Gopnik and Glymour (2007) found that preschoolers successfully identify transitive relationships between causes. Children were introduced to an electronic toy that contained a switch and two gears, and watched an experimenter intervene on the toy (i.e., turning the switch on or off, or removing one of the gears) to infer the causal relationships between the components of the toy. Depending on the result of the experimenter's interventions, children inferred different transitive causal relationships between the components—for instance, that the switch causes Gear 1 to spin, which causes Gear 2 to spin, vs. the Switch causes Gear 2 to spin, which causes Gear 1 to spin.

However, transitive inference in causal relationships differs from transitive inference in preferences in a crucial way: the relationships between causes change with the omission of a causal element, whereas the relationships between preferences do not. To use the Schulz, Gopnik, and Glymour study as an example, if the switch causes Gear 1 to spin, which causes Gear 2 to spin, Gear 1 is necessary for the transitive relationship between the Switch and Gear 2; i.e., without Gear 1, turning on the Switch may not cause Gear 2 to spin. In transitive inferences about preferences; however, the existence of an intermediate preference does not change the relationship between other preferences. For instance, if one prefers X most, Y next most, and Z least, one could still infer that X is preferred to Z without any knowledge of where Y falls on the spectrum of preferences

The task we used in the current studies asked children to infer an agent's graded preferences from their choices, and further investigated children's transitive inference abilities in a social domain. Experiment 1 examined the inferences children make about an agent's preferences after observing his choices. This task required children to integrate information from two relational premises – the agent's choices between objects A and C, and B and C – to make inferences about an agent's overall preferences for A, B, and C by asking children to predict which of those objects would be preferred to a novel object D. In demonstrations, children saw that A was very consistently chosen over C, whereas B was only somewhat consistently chosen over C. Unlike other transitive inference tasks which show A > B and B > C, children could not use adjacent pairings to infer A > B > C; rather, they had to make inferences about the relative preferences of A and B *relative* to C.

Moreover, the experiment was designed to elucidate what strategies children were using to evaluate the agent's preferences: the agent was faced with the A/C pairing and B/C pairing different numbers of times, so that children would arrive at different inferences about the agent's preference. An easy heuristic to use would be for children to infer the agent had a preference for the object chosen the most absolute number of times; the more sophisticated strategy would be to infer a preference for objects based on the proportion of times the object was chosen.

1. Experiment 1: inferring graded preferences

In Experiment 1, participants watched as Duckie, a puppet, chose one of two objects. When object A and object C were presented, Duckie chose A 5 out of 5 times (100%). When objects B and C were presented, Duckie chose B 7 out of 10