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Infants' prosocial behavior is governed by cost-benefit analyses

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ABSTRACT

Cost-benefit analyses are central to mature decision-making and behavior across a range of contexts. Given debates regarding the nature of infants' prosociality, we investigated whether 18-month-old infants' ($N = 160$) prosocial behavior is impacted by anticipated costs and benefits. Infants participated in a helping task in which they could carry either a heavy or light block across a room to help an experimenter. Infants' helping behavior was attenuated when the anticipated physical costs were high versus low (Experiment 1), and high-cost helping was enhanced under conditions of increased intrinsic motivational benefits (Experiments 2 and 3). High-cost helping was further predicted by infants' months of walking experience, presumably because carrying a heavy block across a room is more effortful for less experienced walkers than for more experienced walkers demonstrating that infants subjectively calibrate costs. Thus, infants' prosocial responding may be guided by a rational decision-making process that weighs and integrates costs and benefits.

1. Introduction

Cost-benefit calculations are central to decision making: humans and animals consider not only the rewards associated with obtaining a particular outcome but also the costs required to achieve an outcome when selecting amongst alternatives (Bautista, Tinbergen, & Kacelnik, 2001; Croxson, Walton, O'Reilly, Behrens, & Rushworth, 2009; Kool, McGuire, Rosen, & Botvinick, 2010; Walton, Kennerley, Bannerman, Phillips, & Rushworth, 2006). Indeed, such calculations are so ubiquitous that some scholars have recently suggested that cost-benefit calculations not only guide individual choices and actions but may also form the basis for the inferences and evaluations that we make about other people and their behavior (Jara-Ettinger, Schulz, & Tenenbaum, in press). Strikingly, however, little is known regarding when, in the course of human ontogeny, the ability to compute costs and benefits, and integrate them to make decisions, first arises.

We investigated whether infants use cost-benefit calculations to guide their prosocial behavior. Prosocial behavior, such as helping individuals in need (Warneken & Tomasello, 2006), sharing objects with others (Brownell, Svetlova, & Nichols, 2009), and comforting those in distress (Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992), is present and prolific by the end of the second year of life. Yet, there is ongoing debate regarding the degree and nature of selectivity in infants' prosocial responding (Burns & Sommerville, 2014; Hay & Cook, 2007; Kuhlmeier, Dunfield, & O'Neill, 2014; Warneken & Tomasello, 2009; see Martin & Olson, 2015). One means of informing this debate is to investigate the impact of the costs associated with producing a prosocial response, and the impact of the benefits that coincide with acting prosocially, on infants' behavior.

Empirical work on the impact of costs on children's prosocial behavior has yielded mixed results. Some experiments have found that increasing personal costs diminishes prosocial behavior in children; for example, 2.5-year-old children are less likely to give up one of their own toys to help another individual than to give up someone else's toy (Svetlova, Nichols, & Brownell, 2010). Other research demonstrates that personal costs have no impact on prosocial responding: 4-year-old children are equally likely to help an adult retrieve a reward from a novel box when there is no cost to the self versus when choosing to help could lead to fewer rewards (i.e., jellybeans) for the self (Nielsen, Gigante, & Collier-Baker, 2014). Additionally, and critically, the impact of costs on prosocial behavior earlier in life, in the course of infancy, has been relatively unexplored.

We investigated the impact of physical or energetic costs, on infants' prosocial behavior in the context of an instrumental helping paradigm. Given the evolutionary importance of conserving energetic resources, physical or energetic costs may be one of the first costs that infants or young children are capable of recognizing or reasoning about. Considerable work has demonstrated that infants apply a principle of

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efficiency (which may or may not encompass notions of effort per se) to their expectations of others' actions (e.g., Biro, 2013; Gergely, Nádasdy, Csibra, & Bíró, 1995; Skerry, Carey, & Spelke, 2013), expecting agents to take the most efficient path to their goals and to minimize the costs of their actions (Liu & Spelke, 2017). Yet, little work has investigated whether or how infants use effort to guide their own actions, and, in particular their prosocial responses. In Warneken, Hare, Melis, Hanus, and Tomasello (2007), children who had helped in a previous experiment continued to help in a follow-up study where they had to navigate obstacles in their path to help another person, showing that children help when costs are raised. However, no prior study has directly compared low- and high-cost helping situations that allow us to quantify/assess the effect of cost on helping rates.

In addition to assessing the impact of physical costs on infants' helping behavior we also investigated whether infants' helping behavior was facilitated by motivational benefits associated with helping. Existing work has demonstrated that when there are concrete or explicit rewards associated with helping behavior – such as when infants receive praise, encouragement or material rewards (Warneken & Tomasello, 2013, 2014; Warneken et al., 2007) – helping behavior is unaffected or may even decrease. While these findings demonstrate that increasing *extrinsic motivation* does not facilitate helping behavior, it remains possible that factors that increase *intrinsic motivation* to produce a given response may lead to increased rates of helping behavior. Indeed, recent studies indicate that various interventions can increase infants' or children's intrinsic motivation to prosocially respond to others (Barragan & Dweck, 2014; Carpenter, Uebel, & Tomasello, 2013; Hepach, Vaish, & Tomasello, 2017; Over & Carpenter, 2009). Evidence suggests that infants are intrinsically motivated to interact with individuals that share ingroup characteristics over those that demonstrate outgroup characteristics (such as those that speak their native language; Kinzler, Dupoux, & Spelke, 2007). An intrinsic motivation to interact with ingroup over outgroup members may exist because interacting with ingroup members has functional consequences for development, including spurring social and cultural learning. Thus, we tested the impact of a subtle but important marker of ingroup versus outgroup status – shared toy preferences – on infants' prosocial responding. Critically, irrespective of whether shared preferences serve as an ingroup/outgroup marker, per se, evidence suggests that infants are more motivated to interact with those that share versus oppose their preferences.

Experiment 1 investigated whether infants' helping behavior was affected by physical costs by contrasting conditions that required high versus low physical effort: infants could choose whether or not to carry a heavy block (high effort condition) or a light block (low effort condition) across a room to help a recipient. Experiment 2 investigated whether infants' willingness to engage in high effort prosocial behavior was affected by whether the experimenter shared or opposed infants' toy preferences; Experiment 3 provided a direct replication of Experiment 2 in order to provide a highly-powered sample to investigate condition differences as well as how these behaviors play out over time. Across all experiments we measured infants' months of walking experience via parent-report. Personal costs are not only defined by objective situational characteristics (such as the weight of the block that infants carry) but also by subjective characteristics that influence the degree of effort required by individual infants to produce a particular response, such as degree of walking experience. Although all infants in our sample were experienced walkers, infants varied in their amount of walking experience which in turn could influence the degree of effort required to carry a block across a room particularly when it is heavy; carrying a heavy block is more challenging for a less versus more experienced walker. Thus, we predicted that walking experience would predict infants' helping behavior either uniquely or more strongly under conditions of high physical costs and/or reduced interpersonal benefits.

2. Materials and methods

2.1. Participants

Forty-eight 18-month-old infants (27 girls; M = 17 months, 28 days; range = 17 months, 15 days to 18 months, 18 days) participated in the experiment. The sample size (n = 24/condition; N = 48) was decided a priori based on similar paradigms with same age infants; the stopping rule involved cessation of data collection at n = 24 usable infants per condition. An additional 3 infants were tested but excluded from subsequent analyses because they did not complete the test phase of the experiment due to becoming fussy and crying (n = 1), or because English was not their native language (n = 2). Infants were recruited from a university-maintained database at a large university in the Pacific Northwest. According to parent report, 38 infants were Caucasian, 9 infants were of mixed race/ethnicity, and 1 infant was Black/African American.

Infants were randomly assigned to the low effort condition (N = 24; 14 girls, M = 17 months, 28 days) or the high effort condition (N = 24; 13 girls, M = 17 months, 28 days).

2.2. Set-up and materials

Infants were tested in a room measuring roughly 4.4 m wide by 3.4 m long. Two black blankets (roughly 125 cm by 125 cm) were placed at opposite sides of the room, 2.34 m apart; for each blanket an outer edge was aligned with the room wall. During the familiarization phase, infants and parents began the procedure on one blanket (henceforth the familiarization blanket). During the test phase the experimenter moved to the second blanket (henceforth the test blanket).

The warm-up toys consistent of 3 typical size bath toys: a plastic penguin and two different colored plastic fish. During the familiarization phase, the experimenter used 5 vinyl blocks, each a different color (green, red, purple, yellow and orange; all 14 cm by 14 cm by 14 cm). One of these blocks was unaltered and of typical weight (139 g; henceforth the light block). The remaining 4 blocks were surreptitiously weighted by opening two sides of the block, inserting a round fishing weight (each a different weight) and re-stitching the block, in order to create 4 blocks of increasing weight: 1970 g, 2220 g, 2470 g and 2720 g. The experimenter also used a transparent container (16.5 cm high by 31 cm wide, by 27 cm deep) as a receptacle to encourage infants to lift each block and place it into the bin. A multi-colored, opaque striped bin (32 cm high by 31 cm wide by 31 cm deep) was used during the test phase in order to occlude the target block from the primary experimenter's view.

2.3. Procedure

Fig. 1.

2.3.1. Warm-up

During the warm-up the primary experimenter presented infants with 3 plastic bath toys and spent roughly 1 min drawing infants' attention to the toys and commenting on them. The purpose of the warm-up phase was to acclimate infants to the test room. During the warm-up infants sat on the caregiver's lap while the primary experimenter interacted with the infant.

2.3.2. Familiarization phase

The purpose of the familiarization phase was to ensure that infants had the opportunity to learn the weight of each block, and also to determine the heaviest block each infant was capable of lifting. The familiarization phase was identical in both the high and low effort conditions.

During familiarization, infants sat on the familiarization blanket between their caregiver's legs. The experimenter sat on the same