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The Representation of Third-Party Helping Interactions in Infancy

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Abstract

Despite numerous findings on the sophisticated inferences that human infants draw from observing third-party helping interactions, currently there is no theoretical account of how infants come to understand such events in the first place. After reviewing the available evidence in infants, we describe an account of how human adults understand helping actions. According to this mature concept, helping is a second-order, goal-directed action aiming to increase the utility of another agent (the Helpee) via reducing the cost, or increasing the reward, of the Helpee's own goal-directed action. We then identify the cognitive prerequisites for conceiving helping in this way and ask whether these are available to infants in the interpretation of helping interactions. In contrast to the mature concept, we offer two simpler alternatives that may underlie the early understanding of helping actions: (*a*) helping as enabling, which requires second-order goal attribution but no utility calculus, and (*b*) helping as joint action, which requires efficiency (i.e., utility) evaluation without demanding second-order goal attribution. We evaluate the evidence supporting these accounts, derive unique predictions from them, and describe what developmental pathway toward the mature concept they envisage. We conclude the article by outlining further open questions that the developmental literature on the interpretation of helping interactions has not yet addressed.

Contents

THE REPRESENTATION OF THIRD-PARTY HELPING INTERACTIONS IN INFANCY

Making sense of observed prosocial behaviors is a crucial component of being a competent social and moral actor, as it allows for drawing inferences about the goals, dispositions, and social relations of others. Based on findings from developmental studies, some researchers have argued that humans possess an innate moral core (Hamlin 2013a): a set of sociocognitive abilities that allows infants to understand sociomorally relevant behaviors and respond to them by preferentially approaching or interacting with prosocial actors (Van de Vondervoort & Hamlin 2016). One paradigmatic prosocial interaction that is employed in many of these studies is helping.

Appropriately interpreting helping interactions is not a trivial cognitive feat. Consider for instance a scenario often used in infancy research: One agent (the Helpee) tries but fails to open a box that contains a target object, and another agent (the Helper) comes and opens the box, allowing the first agent to grab the object inside (**Figure 1**). To make sense of this event as intended by the researcher, a naive observer not only has to infer the Helpee's unfulfilled goal (i.e., to reach the object inside the box), the necessary means to bring it about (i.e., to open the lid of the box), and relevant constraints and costs of actions (i.e., opening the lid is difficult or impossible for the Helpee), but also must work out how the Helper's behavior enables or facilitates the completion of the Helpee's goal. In doing so, the observer must discard alternative explanations of the Helper's behavior that do not directly relate to the Helpee's goal, for example, that the Helper had an object-directed goal (she may have simply preferred the box to be open for a different reason). As this example shows, naive onlookers often face the task of arbitrating among multiple available action interpretations. This is especially the case for second-order social goals such as helping, where an agent aims to generate rewards for another agent by intervening on the constraints of her goal-directed behavior.

Despite numerous findings on the purported sophistication of early reasoning about helping events, a comprehensive theoretical account of how young infants understand these events is currently lacking. Researchers often rely on their own (and the readers') intuitions when operationalizing helping events in their stimuli. Although this may be an inevitable or even justified approach, the growing developmental literature on this question does not detail the content and structure of helping representations with sufficient precision. The focus of this research has been to examine which inferences infants draw from observed helping interactions (e.g., inferences

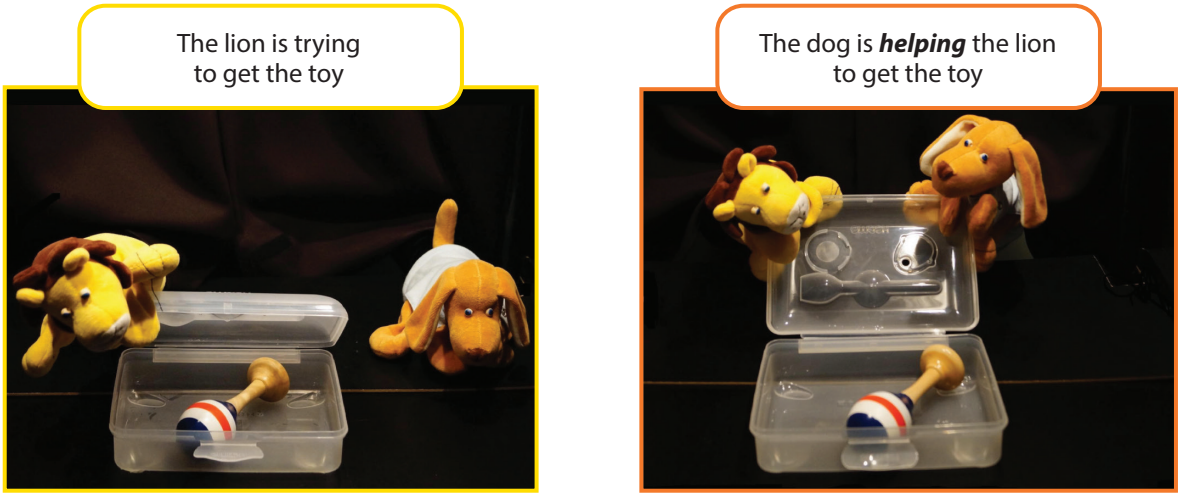

Figure 1

A helping scenario often used in infancy research. (*Left*) An agent (the lion puppet) is struggling to open a box, which is interpreted by the viewer as an instrumental action performed to reach the toy inside. (*Right*) Another agent (the dog) joins in the effort and gets the box open. Her intervention is interpreted as a helping action directed at the lion's instrumental action. Images from Study 1 in Salvadori et al. (2015) (CC BY 4.0).

about the agents' intentions or dispositions) while neglecting questions concerning the minimal input criteria an event must satisfy to be represented as helping and the cognitive operations that generate its representation.

What goal, exactly, do infants attribute to a Helper? Which criteria of well-formedness, if any, must a helping action satisfy—that is, what do infants take to be a proper act of helping? Which cues are necessary to interpret an observed event as an instance of helping? And how is helping distinguished from other types of interactions, such as collaboration, giving, or imitation?

The present article is structured as follows. We first review the existing literature on infants' understanding of helping. Then, we sketch a proposal for what a mature concept of helping consists in—which we define as any action directed at increasing the utility of another goal-directed agent by intervening on that agent's action constraints—and critically discuss whether this is the concept that infants adopt when representing observed instances of helping. Finally, we outline alternative candidates for an early helping concept and open questions derived from these accounts.

The issues discussed here are relevant for several reasons. First, research on infants' responses to observed helping interactions and related prosocial behaviors, such as distributing resources (for reviews see Sommerville 2018, Sommerville & Enright 2018) or intervening on behalf of victims (Kanakogi et al. 2013, 2017; Geraci 2020), informs long-standing debates on the origins and development of sociomoral reasoning. Clarifying the representational structure of an early helping concept can thus shed light on the characteristics of moral reasoning in early childhood. Second, insights into infants' helping concept have an important bearing on theories of early action understanding. For instance, it has recently been suggested that shared computational processes—namely, a naive utility calculus (Jara-Ettinger et al. 2020)—may guide the representation of both nonsocial instrumental actions and social interactions (Powell 2022). Spelling out the mechanism by which preverbal infants comprehend certain events as helping can contribute to evaluating this proposal and to specifying which processes drive learning in these two domains. Finally, insights into how young children represent third-party helping interactions can inform the research

program investigating infants' and children's own helping behavior. From the second year of life, infants provide help to others, for example, by handing over an out-of-reach object (Warneken & Tomasello 2010). It is not clear, however, how infants in such contexts conceive of their actions or precisely what goal they pursue (Hobbs & Spelke 2015). There is an ongoing debate as to whether helping in young children reflects a genuine altruistic concern for others and an attempt to address the Helpee's specific unmet needs and desires (Hepach & Warneken 2018, Warneken 2018), a mere preference for goal completion (Michael & Székely 2017), or a general motivation to interact with people (Allen et al. 2018, Barragan & Dweck 2014, Dahl & Paulus 2019). Knowing whether representations of third-party helping interactions are undergirded by a utility-based concept may provide a relevant piece of evidence to this debate by suggesting that infants factor the utility of the Helpee into their own helping behavior (for related evidence that infants take into account their own costs when deciding whether to help, see Sommerville et al. 2018).

However, while research on the representation of helping from a third-party perspective may shed light on the representations recruited in the infants' own helping behavior, the opposite may not be the case. Indeed, the first-person deployment of helping involves motivational challenges (such as overcoming social hesitancy or incurring costs on behalf of others) that are missing altogether in the interpretation of social events as uninvolved bystanders. These challenges limit what we can reasonably infer about the representations undergirding helping based on the infants' readiness (or lack thereof) to appropriately intervene in situations of need (for a related argument in the domain of distributive fairness, see Blake et al. 2014). Thus, while research on infants' own helping behavior is key to clarifying the motivational determinants of early social behavior, it may not be particularly pertinent to the issue of how infants construe helping actions from an allocentric perspective. For this reason, this literature (and the related debate on whether social interactions play an enabling or facilitatory role in scaffolding helping behavior; see Brownell 2013, Dahl et al. 2017, Lancy 2020, Pettygrove et al. 2013) is not the subject of this review.

Moreover, while helping can encompass many means of assistance, such as providing information, support, or material benefits (for example, we talk of helping lost tourists by giving them directions or helping flood victims by donating money), these means fall outside the scope of instrumental helping that we discuss here. This is the case especially when helping is achieved by handing a recipient an out-of-reach object—a scenario that has been employed in several studies on early sociomoral evaluation (e.g., Hamlin & Wynn 2011, Hamlin et al. 2011, Köster et al. 2016). Considering that infants default to interpreting the active transfer of an object as a prosocial action, irrespective of whether the object was sought by the recipient (and hence constituted her goal or not) (Geraci & Surian 2011, Tatone et al. 2019), infants may be leveraging assumptions about giving actions in general rather than about instrumental helping per se when making sense of such scenarios. This possible source of ambiguity motivates our decision to focus on instances of helping in which the Helper intervenes on the constraints that the Helpee faces in reaching her goal rather than directly donating resources to her.

Contrary to previous work on helping, which framed the question of how infants engage in (Dahl 2020) or evaluate (e.g., Van de Vondervoort & Hamlin 2016, Woo et al. 2022) such a prosocial behavior in the context of moral development, the present analysis deliberately sidesteps this issue. While spelling out the representational constituents of helping that infants leverage may be relevant to adjudicate whether, for instance, there is ontogenetic continuity in the construals that people recruit to apprehend such behaviors, this analysis is orthogonal to the question of how sociomoral intuitions develop. Recognizing an action's goal and evaluating it as good or bad are, in fact, functionally distinct operations and as such are likely subserved by different mechanisms (Mikhail 2011). Insofar as the primary aim of this review is not to identify the types of sociomoral

inferences that infants draw from observing helping, but rather the conceptual structures they may use to understand this behavior, here we sidestep the question of moral development.

Infants' Responses to the Observation of Helping

Beginning with a study by Premack & Premack (1997), a wealth of experiments have probed preverbal infants' understanding of third-party instrumental helping interactions. These experiments generally implement the act of helping as follows. One agent, a Helpee, tries and fails to perform an instrumental action, which is directed at either gaining access to an out-of-reach target or arriving at a particular location. Another agent, a Helper, intervenes either on the environment or directly on the Helpee such that as a result of the intervention, the Helpee reaches her goal. The majority of studies used either the hill scenario (Kuhlmeier et al. 2003), where one agent tries to reach the top of a hill and is pushed there by another, or the box scenario (Hamlin & Wynn 2011), where one agent tries to access an object inside a box and another agent opens the box so that the first agent can retrieve the object. Other studies presented infants with the Helper lifting or pushing the Helpee toward a goal object or location (Holvoet et al. 2019, Premack & Premack 1997), acting on other kinds of physical constraints impeding the Helpee's action toward her goal (Hamlin et al. 2013; Woo et al. 2017), or transferring an out-of-reach goal object directly to the Helpee (Hamlin 2014; Hamlin & Wynn 2011; Hamlin et al. 2011; Jin & Baillargeon 2017; Köster et al. 2016, 2019; Singh 2020; Steckler et al. 2018).

These studies measured either (*a*) the infants' own preference for the Helper, operationalized as the propensity to manually choose this character over another (typically, a Hinderer), or (*b*) the infants' expectations about subsequent interactions among the participating agents, probed via common gaze measures (looking times) and neurophysiological measures (electroencephalogram).

Manual Choice and Preference for Helpers

Manual choice has traditionally been interpreted as a measure of social preference under the assumption that infants would preferentially explore agents they seek to affiliate with. Though commonly used in studies on helping, this measure has its caveats. First, it inevitably conflates infants' understanding (of helping) and their preference (for Helpers), limiting its use in assessing the former. For instance, the finding that infants prefer a Helper who is knowledgeable about the Helpee's goal but not one who lacks such knowledge (Hamlin et al. 2013) could be taken as evidence that infants do not consider the latter a genuine helping action or that they are not motivated to associate with an unwitting aide. Second, it presupposes that observing the Helper interacting with third parties is enough for infants to attribute to this agent a broad prosocial disposition—sufficiently broad, in fact, to encompass interactions with unrelated others, such as the infants themselves (Wynn 2009). The reason why infants are expected to produce such an inductive leap are, to our knowledge, yet to be clarified. It is not obvious why infants would have such a dispositional bias in interpreting others' social behaviors. Several studies suggest that infants do not generalize (affiliative or antagonistic) social behaviors to novel targets [e.g., dominance (Mascaro & Csibra 2012), giving (Tatone et al. 2015), helping (Pepe & Powell 2023), and comforting (Kudrnova et al. 2023)]. Instead, they form stable representations of the particular interactions within which such behaviors originally occurred, which allow them to monitor underlying social relations. Rather than being prepared to inductively infer individuals' dispositions, this literature suggests that infants may instead attend to social interactions primarily to discover the relational make-up of their social surroundings. Compounding the issue, it is not clear how infants relate the characters presented on stage or on the screen to the replicas they are prompted to choose from during the manual choice test: Do they assume identity between the two sets, treat them as

different tokens of the same abstract concept, or interpret them as equivalent symbols standing for a fictional agent (cf. Revencu & Csibra 2020)? Finally, replication attempts using this measure have yielded mixed results (for studies replicating the effect, see Chae & Song 2018, Fortin 2019, Shimizu et al. 2018, but only in 15- to 18-month-olds; for unsuccessful replications, see Colaizzi 2016, Cowell & Decety 2015, Maxwell & Rafetseder 2015, Nighbor et al. 2017, Salvadori et al. 2015, Schlingloff et al. 2020, Vaporova & Zmyj 2020).

Caveats notwithstanding, infants' selective preference for Helpers over Hinderers (Hamlin 2015, Hamlin et al. 2007) as well as neutral agents (Chae & Song 2018, Hamlin et al. 2007) provides evidence that infants consider helping a prosocial action. Furthermore, this early social evaluation appears to be surprisingly nuanced, being influenced, for example, by infants' assessment of the Helper's mental state and intentions. Infants reach for an agent who intends to help, even if not successful (Hamlin 2013b, Woo & Spelke 2020), but only when she knows what the Helpee's goal is (Hamlin et al. 2013). Such preference is not observed for agents who help accidentally (Woo et al. 2017) or inconsistently (Steckler et al. 2017). Moreover, infants choose Hinderers over Helpers if these characters previously directed their action toward another Hinderer, as if to punish him (Hamlin 2014, Hamlin et al. 2011). Taken together, these studies suggest that infants take into account several contextual factors (e.g., intent, knowledge, and previous history) when assessing an agent's helping disposition.

Infants' Expectations About the Social Contexts of Helping

Beyond preferring Helpers over Hinderers, infants expect the recipients of helping actions to exhibit a similar preference (Fawcett & Liszkowski 2012, Kuhlmeier et al. 2003), even if the Helper merely attempts to help without succeeding (Lee et al. 2015). Infants have also been shown to infer social groups from selective helping patterns. For instance, infants consider agents who helped each other to belong to the same group and to be united against an out-group (Rhodes et al. 2015). Conversely, social structure affects infants' expectations about the occurrence of helping; specifically, infants expect helping to occur when directed toward an in-group, rather than an out-group, member (Jin & Baillargeon 2017, Pun et al. 2021). In the absence of group-relevant information, infants and toddlers default on expecting agents to help those in need rather than to withhold help (Lee et al. 2020; Hepach et al. 2012, 2016), as well as to preferentially help agents in greater need (Köster et al. 2016, 2019; see also Schuhmacher et al. 2018).

As this brief literature review attests, preverbal infants seem readily able to apprehend third-party helping actions and to generate expectations and preferences on that basis. These findings suggest a sophisticated understanding of helping as a prosocial behavior, which incorporates agents' goals and mental states (e.g., intentions and knowledge) and can be modulated by contextual factors (e.g., the recipient's prior history). Infants seem to understand in which situations helping is more likely to occur, who may be an appropriate recipient, and what type of intervention would satisfy the Helpee's goal; further, they seem to draw rich social inferences (about individual dispositions or relationships) from the observation of helping. However, while this work sheds light on the broad range of factors that influence infants' preferences and expectations, the fundamental question of how infants represent social interactions that adults commonly interpret as helping has been largely overlooked.

The Mature Helping Concept: Increasing the Utility of the Helpee's Action

What kind of helping concept are these findings evidence of? To address this question, we first sketch what a mature folk concept of helping might consist in. Adults' understanding of helping is plausibly more sophisticated and nuanced than that of infants. Adults have more knowledge about

the types of goals that agents may pursue, the different rewards that action outcomes yield, the different types of costs that their completion might entail, and the various means by which these goals can be brought about. Adults also come to learn that helping may be carried out preemptively, which entails predicting what goal the Helpee may require assistance with (e.g., handing a tool to someone who does not yet know she will soon need it), or paternalistically, which requires appreciating that actions that do not align with the Helpee's short-term goals may nevertheless promote the Helpee's welfare (e.g., a mother putting a scarf and hat on their resistant child who is impatient to play outside in the snow).

That said, even for the more basic instances of instrumental helping such as the ones discussed earlier, it is not immediately clear how adults solve the task of ascribing the goal of helping. One promising approach is to ground the understanding of helping within the general framework of the naive utility calculus (Jara-Ettinger et al. 2016, Powell 2022). In such a framework, helping can be described as an action where one agent (the Helper) derives a reward from increasing the utility of another agent (the Helpee) by intervening on the constraints that the Helpee faces toward the completion of her goal.

This framework is based on two key elements: (*a*) an assumption of rationality (i.e., agents behave in a way that maximizes their utility) and (*b*) a reverse-engineering process through which the internal states that caused the action, or the goal states that justify the action, can be probabilistically inferred from observation (Baker et al. 2009). Research in this framework demonstrates that modeling action understanding as Bayesian inverse planning indeed captures people's intuitions when they attribute goals and mental states to abstract agents (Baker et al. 2009, 2017), such as the ones often used in infant research (Kominsky et al. 2020). Action understanding via naive utility calculus is likely present in young infants, and the reasoning it affords is inferentially rich from early on (Csibra et al. 2003, Gergely & Csibra 2003, Liu et al. 2017, Pomiechowska & Csibra 2020).

Social actions can be captured in a utility-based framework by modeling the interdependency of the agents' utility functions (Baker et al. 2008, Kleiman-Weiner et al. 2016, Shum et al. 2019, Wang et al. 2020). While an agent performing a nonsocial object-directed action maximizes her own utility directly by bringing about the intended outcome (e.g., by acquiring a valuable good), a Helper does so indirectly by maximizing the Helpee's expected utility (e.g., by allowing the Helpee to retrieve her own valuable goods). In other words, the Helpee's expected utility function is embedded in that of the Helper. Under this account, an observer can attribute the goal of helping to an agent by recognizing that this agent is acting efficiently with respect to the goal of increasing the utility of another agent's own action. Thus, the interpretation of an action as helping is a second-order goal attribution to the Helper, whose proximate goal is dependent on the goal attributed to the Helpee. The assumption that helping generates rewards for the Helper follows directly from the normative standard of rational action theory, according to which the hallmark of goal-directed behavior is the increase of the agent's utility. While it may seem paradoxical to hold such an assumption for prosocial behaviors, as these result in the voluntary imposition of net cost for the agent, it is worth nothing that rewards need not be either immediate or direct. For instance, the Helper's action may positively affect the well-being of valuable kin, engender subsequent reciprocation from the assisted partner, or produce reputational gains in the eyes of third parties (well-known examples of indirect rewards). Which types of rewards (if any) infants may infer from the occurrence of helping behavior is orthogonal to the validity of this assumption and is not the subject of our inquiry.

The Helper can increase the utility of the Helpee's action in two ways: either by reducing the action cost that the Helpee has to pay to bring about her goal or by increasing the reward that

she obtains because of the Helper's intervention.[1] Using the rationality assumption, the observer can infer that the increase in the Helpee's utility, however small or large, offsets the Helper's costs of intervening on the Helpee's behalf. People may hold prior assumptions about what is a reasonable trade-off between the Helper's and Helpee's utility (Jara-Ettinger et al. 2020), but they may also treat skewed cost-reward distributions as indicative of the Helper's evaluation of her social target. For example, when witnessing a Helper voluntarily incurring large costs to bring about a negligible utility increase for the Helpee, one may infer that the Helper greatly values the Helpee. Importantly, however, not all agents' utility functions are the same (Pomiechowska & Csibra 2020, 2022): What is costly for one agent may not be so for another.

The intuition that people understand helping as increasing the utility of another agent was formalized through Bayesian modeling and tested by Ullman et al. (2009). In their account, helping is an event in which "agent A rationally maximizes utility by maximizing. . .the expected utility of B, where this expectation comes from As model of Bs goals and plans of action" (p. 2). Ullman and colleagues found that their inverse planning model matched participants' judgments about an animated agent's likely goal (nonsocial object approach versus help/hinder) better than a cue-based model, which disambiguates goals by simple cues such as physical proximity (cf. Shu et al. 2020, Netanyahu et al. 2021). This study suggests that actions do not need to exhibit particular visuospatial cues for adults to identify them as instances of helping; instead, what matters is that the Helper's behavior is apprehended as promoting the utility of the Helpee in the most efficient way possible, given the constraints that both agents operate under.[2] Corroborating this suggestion, He et al. (2020) showed that adults were most likely to interpret an ambiguous transitive action as helping (*a*) when it was inefficient with regard to the nonsocial goal of approaching a target object and (*b*) when the Helpee's costs of goal fulfillment were reduced as a result.

These studies suggest that people may infer the goal of helping by recruiting the same mechanisms that guide the interpretation of nonsocial instrumental actions. They also suggest that, while possibly facilitating the identification of helping, behavioral cues that may commonly accompany these actions in the real world (e.g., behavioral synchrony, contingency, communication) are neither necessary nor sufficient for adult observers to identify an interaction as helping. A second, perhaps more important, reason to doubt the usefulness of perceptual cue-based approaches is that, unlike other social goals such as giving (Tatone et al. 2015, Yin et al. 2022) and chasing (Gao et al. 2009), which can be exhaustively defined with respect to particular event features (giving meaning that one agent transfers the possession of an object to another agent and chasing meaning that one agent moves in the direction of another in a heat-seeking manner), helping can occur in a multitude of ways and can be directed toward any conceivable first-order goal. Furthermore, as different goals can generate similar-looking behaviors, reliance on perceptual cues alone is of limited use in allowing observers to disambiguate helping from other types of social scenarios, for example, agents pursuing individual goals side-by-side or jointly working toward a shared goal. As

[1] Cost reduction is generally easier for an observer to compute than benefit increase. Parametric variations in cost cues tend to closely correspond to variations in inferred costs; for example, if movement is energetically costly for an agent, a longer path may be promptly evaluated as costlier than a shorter one because it requires more movement. In contrast, this correspondence may not hold as reliably for rewards; for example, one may charitably assume that having more of something is better, but this heuristic does not apply to all kinds of resources—are two phones better than one if one needs to make a call?

[2] It is, however, important to note that the responses of the participants in these studies are constrained to a set of available options; for example, participants are asked to rate to what extent an event looks like a "social interaction" or "helping" (He et al. 2020) or to make a forced choice between a finite set of goal descriptors, among which "help" is one of the options (Ullman et al. 2009).

these considerations suggest, cue bootstrapping is unlikely to play a constitutive role in guiding the representation of helping for two reasons: on one side, because paradigmatic helping cases are not restricted to particular means or outcomes, and on the other, because the social cues that tend to accompany helping events also occur across a suite of social interactions modeled on different payoff distributions.

This is not to imply that people do not exploit information conveyed by interaction cues in naturalistic settings. These cues play an important role in reducing ambiguity, as they can reflect processes that play a functional role in social interactions; for instance, communication or eye contact can be used to signal common knowledge or commitment (Siposova et al. 2018, Wyman et al. 2013), and spatiotemporal coordination can help make behaviors more predictable to one's social partner (Vesper & Sevdalis 2020). Moreover, especially in ambiguous situations, where an action results in an outcome that may be helpful for another but that may also constitute an end in itself for the agent (e.g., removing the cap on a bottle of Coke held by another person), people may leverage contextual cues (e.g., the person holding the bottle shows gratitude) or prior knowledge (e.g., bottle caps are not valuable goods) to constrain interpretation.

DO INFANTS UNDERSTAND HELPING AS A SECOND-ORDER GOAL WITH AN EMBEDDED UTILITY FUNCTION?

The research on adults' interpretation of helping events (and other collaborative interactions; see, e.g., Kleiman-Weiner et al. 2016, Shum et al. 2019) discussed above suggests that the folk concept of helping is of an action with the second-order social goal of increasing the expected utility of another agent's action by intervening on her action constraints. Such a concept is flexible enough to allow observers to identify even unfamiliar helping actions. Considering the rich literature suggesting that infants recruit the naive utility calculus to infer instrumental goals (Gergely & Csibra 2003, Liu et al. 2017), it seems natural to ask whether infants interpret helping by leveraging an adult-like concept of helping.

Here, we articulate three proposals for what an early helping concept might consist in (though this is not intended as an exhaustive list): (*a*) a mature concept of helping, where infants interpret helping the same way as adults do—as an action with the second-order goal to increase the utility of another agent; (*b*) helping as enabling, where infants interpret helping as an action that makes it possible for the Helpee to fulfill her goal; and (*c*) helping as joint action, where infants interpret helping as an interaction where two or more agents work together toward a shared goal (for an illustration, see **Figure 2**; for a summary of features, see **Table 1**). In the sections below, we discuss these accounts in more detail, spell out their respective requirements in terms of the cognitive operations to be carried out, and lay out key empirical predictions that can be derived from them.

Before proceeding further, however, it should be noted that alternative proposals attempting to explain infants' responses to helping events without leveraging a proper helping concept also exist. Most notably, Spelke and Powell (Powell & Spelke 2018a, Spelke 2016) argued that infants first conceive of helping interactions as instances of imitation, insofar as Helpers often reproduce some of the same actions that the Helpee directed toward her first-order goal. Under such an account, infants' preference for Helpers can be reframed as a preference for imitators, who display affiliation by aligning their behavior to that of the imitated agent (Powell & Spelke 2018b; for similar arguments, see also Benton & Lapan 2022, Premack & Premack 1997). Crucially, however, such an interpretation of infants' preference is at odds with studies reporting a bias toward Helpers even when (*a*) Helpers perform actions that are highly dissimilar from the Helpee's (Hamlin et al. 2013, Woo et al. 2017) and (*b*) Helpers and non-Helpers differ in their knowledge about the Helpee's goal, but not in their actions (Woo & Spelke 2022). More importantly, this account does

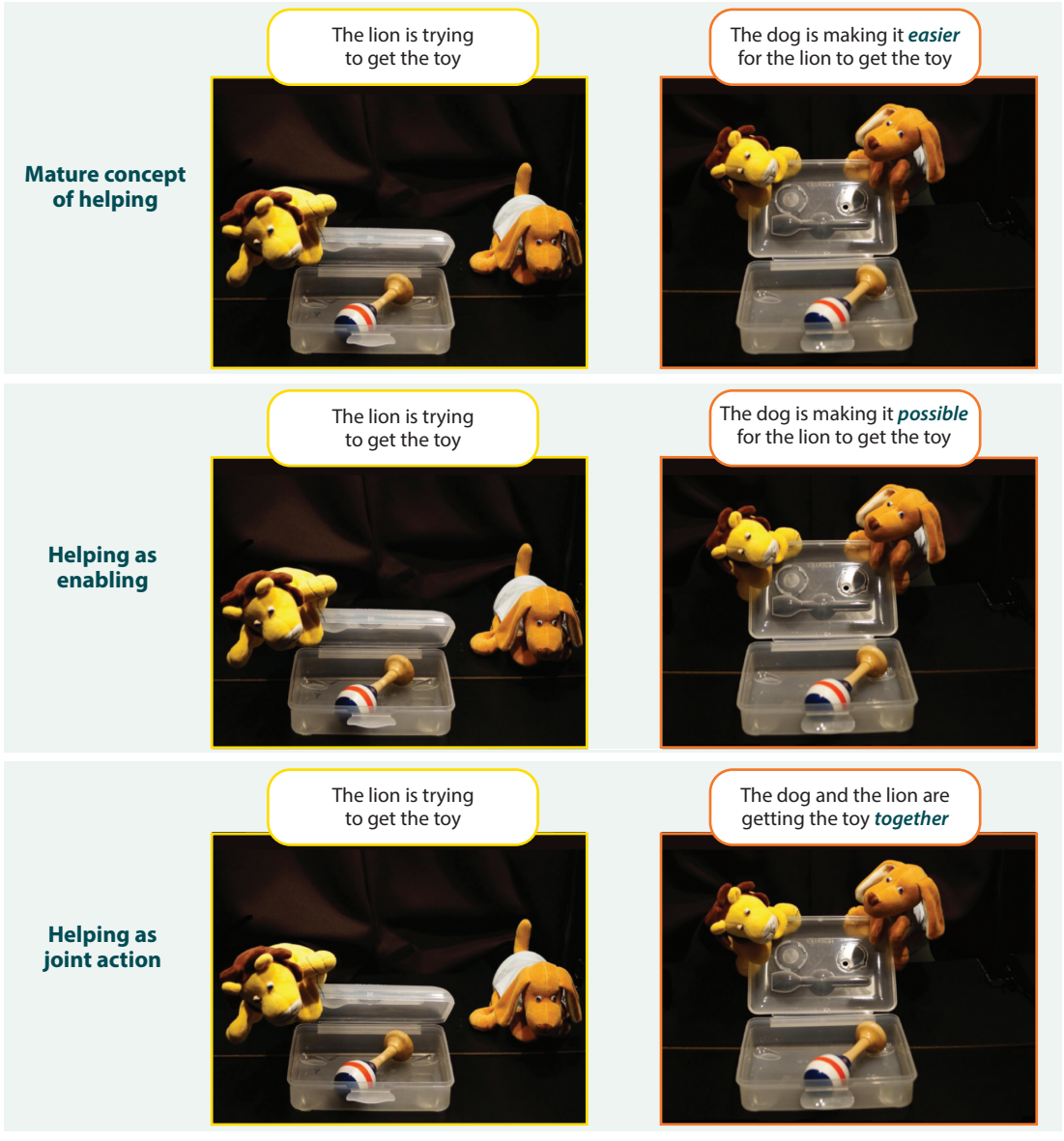

Figure 2

Schematic illustration of the three accounts of helping using the scenario depicted in **Figure 1**. The captions specify the goal description that the infant is expected to attribute to the Helper and Helpee in each of the three accounts. In a mature concept of helping (*top*), the Helper's goal is to reduce the effort of the Helpee in her goal pursuit. In helping as enabling (*middle*), the Helper's goal is to allow the Helpee to reach a previously unattainable outcome. In helping as joint action (*bottom*), the Helper has a shared goal with the Helpee of bringing about a particular outcome together. Images from Study 1 in Salvadori et al. (2015) (CC BY 4.0).

not explain how a mature understanding of helping could emerge by leveraging such an imitation-based concept. In fact, Powell has since changed her views, arguing that a utility-based concept of helping may be already present in infancy (Powell 2022). Considering the fundamental dissimilarity between a representation of helping as imitation and its mature counterpart (with which

Table 1 Summary of the different cognitive operations entailed by the three proposed helping concepts

Helping concept	Cognitive requirements			
	Utility calculus	Second-order goal ascription	Counterfactual outcome	Representing coordination
Mature	Yes	Yes	No	No
Enabling	No	Yes	Yes	No
Joint action	Yes	No	No	Yes

Utility calculus refers to evaluating the efficiency of an agent's action in terms of a graded magnitude increase (or decrease) to an individual (or aggregate) utility function (compared with enabling, where the utility change that the Helper brings about is nongraded and qualitative). Second-order goal ascription refers to setting up hierarchical representations of distinct agent-specific goals (compared with joint action, where the agents' actions can be construed by a common reference to a shared goal). Counterfactual outcome refers to comparing two different outcomes (the realized state of affairs in which the Helper's intervention leads to the Helpee's goal achievement and an unrealized one involving the Helpee's failure to achieve her goal on her own, which is required to contrastively assess the Helper's contribution). Although counterfactual reasoning is involved in all three helping accounts, only in the enabling case do the terms of the counterfactual comparison involve two outcomes rather than the same outcome achieved at different (individual or aggregate) costs. Lastly, representing coordination refers to interpreting agents' actions as directed toward a single shared goal.

it shares none of its cognitive prerequisites; see **Table 1**), as well as the lack of an identifiable developmental pathway for conceptual change, we do not discuss this proposal further.

Infants Possess the Mature Concept of Helping

It is possible that infants recruit the concept we argue that adults possess, namely, that helping is an action directed at increasing the Helpee's utility, generally by reducing the costs of the Helpee's goal fulfillment. If infants understand helping in such a way, a number of predictions follow: Infants should be able to distinguish between actions that are more or less helpful on the basis of their relative cost mitigation; they should expect a Helper to intervene when doing so would reduce the Helpee's cost, but refrain from helping when her action would have no such effect; and finally, they should default to assuming that the Helper's action costs are lower than the costs the Helpee would have incurred without her assistance.

While it is possible that infants have a helping concept of this sort from early on, this has not been conclusively demonstrated. Appropriately setting up such a representation presupposes several cognitive operations of non-negligible complexity. One of these operations is counterfactual reasoning. Infants would have to infer that the Helper's action increased the utility of the Helpee by comparing the actual costs the Helpee incurs after receiving help with the (higher) prospective costs she would have incurred had she been left unassisted. Although evaluating the efficiency of instrumental actions—something that preverbal infants are adept at (Csibra et al. 1999, Gergely et al. 1995, Liu & Spelke 2017)—may rest on counterfactual reasoning, simpler inferential mechanisms can support this type of analysis. For example, an action could be immediately flagged as being efficient or inefficient based on its matching with the ideal reference trajectory that the environment provides (e.g., a straight line to the goal), without requiring any explicit comparison of alternative options (Hudson et al. 2018). Such a strategy, however, could not scaffold the type of contrastive analysis (i.e., utility of being helped versus utility of acting unassisted) required to assess whether the Helper's action qualifies as helping—i.e., whether it increased the utility of the Helpee.

Another operation demanded by second-order goal attribution is utility embedding. To represent the goal of the Helper as directed at reducing the costs of the Helpee's goal fulfillment,

infants need to nest the agents' individual utility functions into one another. Doing so presupposes selecting as the Helper's goal not the immediate state of affairs that this agent brings about (e.g., opening a box) but the distal effects that this outcome has on the Helpee's action options (e.g., allowing her to retrieve the object inside). Appropriately solving this selection problem is not trivial, especially considering that explanatory parsimony may encourage them to privilege structurally simpler action interpretations. For instance, upon being exposed to an agent taking an object from a patient, infants interpret the agent's action as directed toward acquiring a resource, without considering the action's consequences on the object's original possessor (Tatone et al. 2015; see also Yin et al. 2022). While adults likely solve this selection problem by applying their knowledge about prototypical goal states (i.e., outcomes that generate direct or derived rewards), this strategy may not be available to infants due to their limited goal repertoire (Liu et al. 2019) and their still developing understanding of means–ends relations (Woo & Spelke 2020). This challenge is further compounded for second-order social goals, such as helping, insofar as these actions cannot be construed by a common reference to a single agent's utility (Hobbs & Spelke 2015). As such, these actions open the possibility that infants may construe (or misconstrue) the Helper's action as directed to a change of state that is immediately rewarding for the agent herself, irrespective of its effects on the Helpee's goal fulfillment.

Considering the suite of operations that the deployment of the adult-like concept of helping entails, it is plausible to assume that cognitively leaner concepts may be adopted by infants to make sense of helping interactions. If this is the case, it remains to be explained what the representational content of these concepts is, how they allow infants to generate behavioral responses congruent with researchers' predictions, and, more importantly, how children transition from these early construals to the aforementioned utility-based helping concept. In the following sections, we sketch two alternative concepts of helping, explain how they differ from the mature helping concept, and identify the most relevant developmental steps necessary for their transition into the mature state.

Infants Conceive Helping as Enabling

The helping interactions used in the studies reviewed above often feature the Helpee trying and failing to bring about a goal (e.g., climbing a hill, opening a box, or reaching for an object) before any helping occurs. These events are meant to demonstrate that the Helpee has a goal that she is unable to attain on her own, implying that the Helper's intervention is necessary to goal completion. In contrast, in the real world people often help with tasks that could have, in principle, been carried out alone (at higher costs) such that the intervention makes it easier for the Helpee to reach her goal while not being strictly necessary. Indeed, the stimuli used to study adults' helping concept involved scenarios where the Helper intervened to facilitate the fulfillment of outcomes that the Helpee could have realized by herself (He et al. 2020, Ullman et al. 2009).

It may not be a coincidence that the scenarios that infants are exposed to generally feature failed attempts. Infants' success in the studies reviewed above raises the possibility that infants recruited a concept of helping as enabling: an action whose goal is to make goal fulfillment possible for the Helpee. Such a concept would still require infants to embed individual goals into one another, insofar as the Helper's goal achievement is to enable the completion of the outcome that the Helpee is trying to bring about (thereby attributing a second-order goal to the Helper in the same sense as the mature concept does). However, this concept does not require a proper utility analysis (**Table 1**); while conceiving of helping as facilitating an agent's goal achievement requires comparing graded utility magnitudes (i.e., how much it costs for the Helpee to bring about an outcome with or without the Helper's assistance), conceiving of helping as enabling goal achievement only requires comparing two discrete states: one in which the Helpee's goal is not realized (failure) and one in which it is (success). We do not mean to imply that utility analysis is

completely eschewed by adopting such a concept; infants still need to evaluate the efficiency of the Helper's action with respect to whether it minimized her own potential costs incurred to bring about her goal (to help). Doing so, however, does not additionally require computing the utility increase that the Helper's action generates for the Helpee. Here, the Helper's goal is to enable the Helpee's success, nothing more. Thus, under this concept of helping falls any intervention that has the effect of bringing about a qualitative change in the Helpee's action options (i.e., making the outcome realizable).

Because of its simplicity, the application of this concept is fairly restrictive. Helping as enabling would neither allow infants to identify helping situations that do not involve the Helpee's (imminent) failure nor to make possible fine-grained assessments of how much an agent helped, so long as the Helpee's goal was reached. Yet, even if helping as enabling is predicated on a simple transition between two discrete states (failure to success), its application would still require counterfactual analysis insofar as the Helper's contributions can only be contrastively assessed against the Helpee's failed action. This holds true even if (as in many studies) the Helpee's failing is explicitly shown before the Helper intervenes, because interpreting the outcome of the Helpee's action as a failure demands consideration of the unattained goal of the action (i.e., a counterfactual outcome). Although some research suggests that infants can infer goals from failed attempts (Behne et al. 2005; Brandone & Wellman 2009; Hamlin et al. 2008, 2009; Meltzoff 1995), it is not known under what circumstances infants interpret incomplete actions as failed attempts to bring about a goal state rather than as complete actions (e.g., an agent moving up and down a hill may be interpreted as playing rather than as struggling to climb to the top). The actions employed in these studies most often consist of behaviors that are likely familiar to the infants, the goal of which they know from experience (e.g., opening a box to retrieve an object). However, considering the limited repertoire of goal states that young infants can leverage to understand actions, it is unlikely that they would appropriately recognize failed actions whose goal state they have never seen fulfilled.

Nevertheless, if infants can infer the goal of a failed action, the observation of the Helpee's failed attempts could serve as a potential cue for construing the Helper's subsequent behavior in relation to the Helpee's goal. This construal is based on the understanding that the actions of the Helpee with and without the Helper's intervention were directed to the same goal. Comprehending the Helpee's failure and subsequent success after receiving help thus entails an appreciation that she would not have reached her goal without the Helper's assistance. In order to transition toward a mature concept of helping, infants endowed with the enabling concept would have to eventually abandon the assumption that helping can occur only in situations where this counterfactual holds. Instead, they would have to come to appreciate graded differences between utility states that could have been obtained by the Helpee with or without the Helper's assistance.

Infants Conceive Helping as Joint Action

It is also possible that infants' concept of helping is subsumed under the concept of joint action. Under such a construal, infants would teleologically link the Helpee's and Helper's actions without embedding their individual goals into one another. Joint actions can be defined as social interactions "whereby two or more individuals coordinate their actions in space and time to bring about a change in the environment" (Sebanz et al. 2006, p. 70). In contrast to helping actions that are proximately altruistic, joint actions are studied under the premise that the agents engaged in them pursue a shared goal from which both benefit in some way. In addition, unlike in helping, the individual goals of the agents participating in a joint action are not derived from each other but from a shared goal. In this sense, they are not second-order goals but rather subgoals of the shared goal in the same sense as subgoals serve further goals in individual action hierarchies (see e.g., Csibra 2007).

A number of studies on infants' understanding of third-party joint actions suggest that they can attribute a shared goal to the collaborating agents involved such that its completion generates positive utility for all participants. This research suggests that infants take joint actions to be directed at bringing about a shared goal, from which both collaborators stand to benefit (Wang & Henderson 2018) and where each collaborator may perform the action steps required to bring about this goal (Fawcett & Gredebäck 2013, 2015; Henderson & Woodward 2011; Henderson et al. 2013). Moreover, infants seem to adjust their evaluative standards for rational behavior in a joint action context. Agents directing their efforts toward a shared goal should behave in a coefficient way that minimizes aggregate, not individual, action costs (Török et al. 2019). Preliminary research suggests that, when presented with two agents coordinating, infants do not hold expectations of individual efficiency, but of joint efficiency (Begus et al. 2020, Mascaro & Csibra 2022). Importantly, much like in helping, the efficiency of joint action can warrant an asymmetric distribution of effort, such that one agent reduces aggregate costs by reducing the partner's effort at the expense of her own and thus acts in a locally helpful way toward the other within the joint-action context (Török et al. 2021).

Some of the research on infants' joint action understanding employed events very similar to the box scenario used by Hamlin and colleagues to study helping where one agent opens the lid of a container and another retrieves an object located inside (Henderson & Woodward 2011, Henderson et al. 2013, Wang & Henderson 2018). Unlike in helping, however, representing the two agents as collaborating toward a shared goal requires only that the two actions be ordered in a causally adequate means–end structure (e.g., the container must first be opened and then the object retrieved), without having to nest one agent's goal into the other.

Helping actions can resemble joint actions when one agent (the Helper) adopts the Helpee's goal and treats it as if it were shared. However, unlike in joint actions, in helping scenarios it is only the Helpee who directly benefits from bringing about her goal. In other words, the Helper does not stand to gain from putative rewards that the Helpee's goal completion generates for both agents, but solely from the fact that the Helpee's own utility has increased (as a consequence of her goal being fulfilled). Observers with a mature helping concept can appreciate this difference and appropriately infer who stands to gain from a given state of affairs, even if jointly realized. To do so, they may use contextual knowledge or behavioral cues (e.g., one of the two agents expressed an inclination for, or attempted to bring about, a certain goal). In contrast, infants may be unable to differentiate between interactions geared toward mutualistic versus altruistic outcomes. Even in the presence of skewed cost investments, infants may nevertheless interpret the Helper and Helpee as working together toward a shared goal and correspondingly evaluate the efficiency of their contributions in terms of their aggregate utility. To interpret helping as a joint action, they would not need to entertain a second-order social goal involving nested utility functions but rather a first-order goal shared by the cooperating agents (**Table 1**).

If young infants possess a concept of helping as joint action, they should not be able to distinguish between instances of helping proper and other collaborative interactions. For instance, they may represent the outcome of helping events as a shared goal ("A or B obtains the object in the box"), rather than as the proprietary goal of the Helpee ("A obtains the object in the box"). If so, infants should also not be surprised upon observing the Helper completing the goal that previously the Helpee was pursuing. Furthermore, under this account, infants' well-known preference for Helpers would be reframed as a broader affiliative stance toward collaborators—with the surprising prediction that infants would choose randomly if asked to choose between Helper and Helpee. Moreover, unlike helping proper, which is directed to increasing the utility of the Helpee, the goal of helping as joint action is to bring about a shared outcome at the lowest aggregate costs attainable. This entails that, for instance, it may be perfectly rational for an agent

to choose an action that increases her partner's cost if doing so allows the joint action to become coefficient.

Just as failed attempts may serve as cues to guide the interpretation of an agent's action as helping (of the enabling kind), several cues commonly used in infant studies may help infants identify helping scenarios as instances of joint actions. To allow infants to link two agents' behaviors, and thus represent the scenario as a collaborative endeavor, infants may make use of cues indicating that action coordination is taking place. Examples of such cues include communicative interactions (e.g., gesturing or vocalizations), agents orienting toward each other (e.g., eye contact), proximity or physical contact, acting on the same object, and spatiotemporal contingency of the agents' behaviors (for evidence of such cues being used in the early representation of third-party interactions, see Augusti et al. 2010, Beier & Spelke 2012, Fawcett & Gredebäck 2013, Powell & Spelke 2013, Tauzin & Gergely 2018, Thiele et al. 2021). These cues help set up an interpretive prior that the observed scenario may involve coordination between the two agents. Conversely, this account also implies that when assistance occurs without conspicuous cues of interaction or collaboration between the parties, naive learners leveraging such a concept may fail to appropriately recognize the episode as an instance of helping.

To transition from a concept of helping as joint action to a mature concept, infants would have to understand that the presumed joint goal originates from the Helpee's goal, which the Helper adopts to increase the Helpee's utility. This developing understanding should be accompanied by a transition from interpreting the two agents as contributing toward a shared goal to embedding the goal of one (the Helpee) into that of another (the Helper). A full-fledged concept of helping would finally allow infants to identify altruistic goals even for interactions devoid of perceptual proxies of collaboration or in which helping occurs distally.

CONCLUSIONS AND OPEN QUESTIONS

In this article, we argue that investigation into the cognitive mechanisms underlying infants' understanding of third-party helping has been neglected in the literature. The focus of research has been mostly on the type of inferences that infants draw about agents' intentions, dispositions, or affiliations from observing helping interactions (Hamlin 2013a, Van de Vondervoort & Hamlin 2016) but not on the cognitive operations required for identifying helping in the first place.

We argue that adults conceptualize helping within a general framework of action understanding grounded in a utility calculus, whereby observers can infer agents' goals via the costs they incur and benefits they obtain. In this framework, helping corresponds to the second-order goal of increasing another agent's utility by intervening on her action constraints. A version of such an account seems to underlie many infant researchers' implicitly recruited helping concept. However, it is currently an open question whether this is actually how infants understand the goal of helping. As we pointed out, representing helping as a second-order goal with an embedded utility function entails a number of cognitive operations that may be challenging for young infants. These include embedding the individual goal of one agent (the Helpee) into that of another (the Helper), counterfactual reasoning (to assess the Helpee's utility with and without the Helper's intervention), and appropriately relating the Helper's action to the distal effects on the Helpee's behavior and selecting these, rather than proximal state changes, as the Helper's goal.

We propose two conceptual alternatives to a mature understanding of helping that sidestep some of these challenges: helping as an enabling or joint action. Helping as enabling, where the Helper's goal is to make goal completion possible for the Helpee, requires infants to nest the goal of the individual agents into one another but does not necessitate a comparison of graded utility differences. In contrast, helping as joint action, where the Helper's goal is to work with

the Helpee toward a shared outcome, requires infants to compute aggregate utility functions but not to embed the agents' goals into one another. From these two conceptual precursors, a mature concept of helping can emerge when infants acquire the respective components: the capacity to generate graded utility comparisons (in the enabling case) or to embed individual goals into one another (in the joint-action case).

To adjudicate between these candidates, we outline some outstanding empirical questions that can potentially clarify the content and inferential scope of infants' helping concept. Importantly, even when children have eventually mastered an adult-like concept of helping, further questions remain: For instance, how do they integrate different kinds of cost across agents (cf. Pomiechowska & Csibra 2022)? Do they determine an optimal utility trade-off between the two agents' respective investments for helping to occur, or do they interpret any action that increases the utility of another agent as helping, even if the action is very effortful and brings about only a negligible cost reduction? Moreover, do infants interpret the Helper's altruistic action as indicative of a partner-invariant individual trait (e.g., helpfulness) or of a specific relationship with the Helpee within which the costs of helping may be recouped (for instance, through reciprocation)?

A further open question we have thus far ignored concerns the understanding of hindering actions, which are often discussed as mirror opposites of helping. Under this interpretation, hindering is represented as the second-order social goal of lowering the utility of a Hinderee (i.e., as spite). An alternative option, however, is to represent hindering as the side effect of conflicting first-order goals (e.g., two agents seeking the same object). The difference between these two construals cannot be overstated: In the former, lowering the Hinderee's utility is the goal of the intervening agent; in the latter, it is collateral. Notwithstanding these differences, tests aimed at telling these two interpretations apart are missing in the literature. Moreover, the adoption of the former construal is unlikely to be undergirded by the same assumptions that make the ascription of helping possible: While in the case of helping, an agent's costly investment in a partner's welfare can be justified by reference to potential future benefits obtained in a cooperative relationship, such an explanation would not be available for hindering. This makes the proposal that infants may default to interpreting antisocial behaviors in terms of spite rather than competition all the more question-begging.

To address these questions, measures other than manual choice ought to be employed. While this paradigm has been undoubtedly pivotal for probing infants' sociomoral evaluation (e.g., Geraci & Surian 2011, Hamlin et al. 2011, Kanakogi et al. 2013, Thomas et al. 2018), it appears less suited to examine issues surrounding the rationality of helping (i.e., the range of utility distributions that are compatible with its ascription) and the architecture of its representation (i.e., the way in which the two agents' goals are teleologically related, whether in a nested or means–end structure). Compared with the outstanding breadth of evidence we have accumulated in the last decade about the manifold social inferences (and preferences) that infants produce on the basis of observed helping episodes, our progress into these fundamental questions has been critically stagnating.

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