CHILD DEVELOPMENT PERSPECTIVES

Using Theory of Mind

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ABSTRACT—*The ability to flexibly predict others' behaviors has been ascribed to a theory of mind (ToM) system. Most research has focused on formal conceptual definitions of such a system, and the question of whom to credit with a ToM. In this article, I suggest shifting perspective from formal definitions to a usage-based approach. This approach views action within human interaction as central to the emergence and continuous development of the ability to flexibly predict others' behaviors. Addressing the current debate about whether infants have a ToM, I illustrate how infants use flexible action expectations to interact with others appropriately. I also discuss the continuous development of ToM and its natural structure from a usage-based perspective.*

KEYWORDS—*action prediction; usage-based theory; false belief; prelinguistic communication*

THEORY OF MIND: WHAT FOR?

Theory of mind (ToM) is a cognitive system that "can be used to make predictions about the behavior of others" (Premack & Woodruff, 1978, p. 515). The system not only associates familiar behavioral sequences but flexibly predicts novel sequences. Flexibility is apparent when predicting unfamiliar and especially mistaken actions (Dennett, 1978). Predictions of flexible behavior in human adults and some primate species, although not in human infants or other animal species, may be guided by a system of internal theory-like rules—like internal rules that guide flexible language use—that may enable inferences about others' unobservable mental states (Premack & Woodruff, 1978).

The initial focus on what ToM is *for*—that is, predicting others' behaviors—shifted to what ToM *is*, that is, what concepts it involves and what evidence constitutes a formally defined ToM. A conceptual understanding of others' mental states, especially false beliefs, has become a defining core of ToM. The focus on mental-state inferences has led to investigating a formal ToM, in particular the formal aspects of false belief and other theory-internal concepts, like propositional attitudes, normativity, causality, and abductive inferences (see Apperly & Butterfill, 2009; Rakoczy, 2012). Other mental-state concepts, like intentions, desire, and knowledge, are considered precursors to a full, representational ToM (e.g., Wellman & Liu, 2004), but these still follow the logic of formal conceptual definitions of ToM.

One problem with formal conceptual approaches is that the postulated definitions of ToM and their empirical operationalizations influence each other. The validity of the widely used standard false belief tests has been questioned because additional task demands like language and executive skills conceal conceptual understanding (Bloom & German, 2000). When removing these demands, apparently even 1-year-olds understand false belief (Baillargeon, Scott, & He, 2010). For other researchers, however, the very conceptual definitions require some of the removed demands, such as language to entail hypothetical—not only practical—belief scenarios (Perner, 2010), executive skills to enable flexibility in perspective shifting (e.g., Moses, Carlson, & Sabbagh, 2005), or other general reasoning skills to get from premises to conclusions. This results in the ambiguous use of the term ToM (Rakoczy, 2012) and leads to auxiliary terms like *infant ToM* and the postulation of separate ToM systems (Apperly & Butterfill, 2009).

A second problem is that formal approaches bewitch us to conceptualize ToM as a stage-like all-or-nothing affair, obscuring

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the natural and continuous development of ToM from birth throughout life. On one end of the developmental continuum, it remains unclear how one gets from simple to complex, for example, from newborn reactions to complex ascriptions of hypothetical false belief. Some researchers have invoked processes of conceptual growth (e.g., Wellman & Liu, 2004), but it is unclear how even a single mental-state concept is acquired, and how or why concepts change over development (e.g., German & Leslie, 2000). Others have postulated an innate belief-tracking system (Leslie, 1994), or evolutionarily inherited intention-reading skills shared with nonhuman primates (Tomasello, 2008). However, although some cognitive processes are certainly biological adaptations, we should not assume that newborns understand false belief or other mental states (given the optimal tests) right away or after some period of maturation. On the other end of the continuum, understanding others' behavior still develops after the conceptual ToM watershed of false belief understanding, enabling individuals to use irony, sarcasm, lying (e.g., Evans & Lee, 2011; Winner et al., 1987), and other complex discourse. Individual differences in social understanding and behavior are apparent at school age (Hughes, 2011), and presumably some people develop a better social understanding than others. However, it is unclear what advanced ToM concepts other than false belief underlie advanced forms of social understanding (see Apperly, 2012). Developmentally, a formal ToM is thus too broad to begin with and too narrow to end.

BOX 1
USAGE-BASED APPROACHES TO LANGUAGE: A MODEL FOR TOM RESEARCH

Formal approaches to language focus on a core structure of abstract algebraic rules (grammar) and treat symbolic meaning (words) as variables at the periphery. In contrast, usage-based approaches view the use of symbols as central (Tomasello, 2003). Through their natural use, symbols are combined in specific ways and result in linguistic constructions. These constructions are not empty algebraic rules but meaningful symbolic patterns. Core and periphery blend in a continuum of symbolic complexity. The acquisition of grammar becomes much less impenetrable than by conceptual definitions, which are deemed "theory-internal affairs" (Tomasello, 2003, p. 7).

Formal approaches to theory of mind (ToM) focus on a core set of mental-state concepts (ultimately, false belief). Simple expectations about action sequences are considered peripheral and excluded from the real thing or treated as a separate system. The usage-based approach to ToM views action expectations within interaction as central and proposes a continuum that ranges from predicting simple to complex action sequences. It aims at dissolving artificial dichotomies and avoiding "theory-internal affairs" (Tomasello, 2003, p. 7) by assuming continuous development and emerging structure from usage.

TOM: A USAGE-BASED APPROACH

To understand how ToM is "used to make predictions about the behavior of others" (Premack & Woodruff, 1978, p. 515), how this use develops, and what the structure of the system looks like, we need a usage-based approach. Usage-based approaches to language provide a model (see Box 1). In parallel to language theories, ToM has been conceptualized as a cognitive system that applies internal rules (Premack & Woodruff, 1978). Just what these rules are and how they emerge has been debated over the past 30 years (Apperly & Butterfill, 2009; Baillargeon et al., 2010; Leslie, 1994; Perner, 2010). At the same time, usage-based approaches to language have argued that no language-specific system exists that applies internal rules but that linguistic rules are symbolic constructions that arise from patterns of symbol use (see Box 1). Similarly, the problem with formal approaches to ToM is that they center on abstract concepts as the core of ToM and view the actions they predict as peripheral. But to understand the natural structure and development of ToM requires turning away from formal conceptual definitions and focusing on the natural use of ToM as a system for action predictions.

Human beings are ultra social and biologically adapted to cooperatively interact and communicate with each other (Tomasello, 2008). Monitoring others' actions is essential to interacting, and action predictions enable rapid and successful interactions and communication. Thus, action expectations within interaction are central to ToM. Through the use of more complex actions within interaction, including linguistic interactions, the web of expectations becomes more complex and abstracted. The usage-based approach abandons a discrete all-or-none perspective and assumes continuous development of the action prediction system within interaction (for related views, see Carpendale & Lewis, 2004; Reddy, 2008). The goal of this approach is to reveal the natural structure of ToM as a system that enables action predictions within interaction and to account for its development through its interactive use.

Do infants have a ToM? Answering this question depends entirely on the formal definitions of ToM (Rakoczy, 2012). From a usage-based perspective, the question is how infants *use* a ToM system and how this use emerges. In the following section, I review infants' flexible use of action expectations in interactive situations. Next, I defend the idea that competence in language-mediated tasks does not cause the ability to flexibly predict others' behaviors. Instead, such competence results from metainteractional discourse about others' behaviors. I then discuss the structure of such a system.

ToM Use in Infancy

Experimental studies of infants' interactions reveal that infants have flexible expectations about the behaviors of those with

whom they interact that depend on the other person and the situations within which the interaction occurs.

Infants react flexibly to another person's behavior, reflecting different expectations about the same action depending on the social context. For example, when an adult ambiguously requests one of several objects, 12- to 18-month-olds expect the request to refer to the object with which the adult has not yet interacted and offer the object that is new to her (Moll & Tomasello, 2007). However, when the adult has interacted with all of the objects, but with one in a special way, infants expect that her ambiguous request now refers to the object that is most familiar to her. In contrast, when another adult who has not interacted with that object in a special way now makes an ambiguous request, infants have no expectation about the new person's reference and simply offer the objects randomly (Moll, Richter, Carpenter, & Tomasello, 2008).

Parallel findings occur when 12-month-olds observe an adult searching for something. When two objects have disappeared, infants help the searching adult by pointing to the object with which he was interacting, reflecting the expectation that he wants to find the object he has interacted with (Liszkowski, Carpenter, Striano, & Tomasello, 2006). When he has interacted with the objects equally, infants point to the object for which the adult does not know its location, reflecting the expectation that he needs information to find the object (Liszkowski, Carpenter, & Tomasello, 2008).

Finally, when an adult points to one of two opaque boxes, each containing a toy, 17-month-olds offer her that toy, interpreting her pointing to mean that she wants the toy in that box. However, when the adult has not seen that the objects in the boxes have been swapped, infants respond to her pointing by offering the toy that is now in the other box (Southgate, Chevallier, & Csibra, 2009). Similarly, when an adult tries to open an empty box, infants help him open the empty box. But when the adult has not seen that his toy has been moved to another box, 18-month-olds now open the *other* box (Buttelmann, Carpenter, & Tomasello, 2009). In each of these cases, infants' response to another person's behavior varies depending on their expectations about that person's behavior.

Infants also *initiate* interactions flexibly, depending on their expectations about others' reactions. When 12-month-olds point to interesting events, they expect a recipient to look at and comment on these events. When the adult does not look at the events or does not comment on them, infants point again to get the expected reaction (Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004). When the adult emotes positively about the events, infants expect him to be interested in these events and keep pointing on further occasions. However, when the adult emotes neutrally about the events, infants stop pointing because they expect him not to be interested in further events (Liszkowski, Carpenter, & Tomasello, 2007).

Infants' expectations are also revealed in a request paradigm (Liszkowski, Schäfer, Carpenter, & Tomasello, 2009). Infants were familiarized with specific places for toys and undesirable objects. When infants got the chance to request the toys, the places were empty. Unlike chimpanzees in the same paradigm, infants spontaneously pointed to an empty place, apparently expecting it would spur the adult to retrieve more toys, although they did not directly point at any toys.

Infants even *intervene proactively* by anticipating others' mistakes. In one study, an adult removed an aversive object to avoid bumping into it when reaching around a barrier (Knudsen & Liszkowski, 2012a). In her absence, another adult replaced the aversive object. When the first adult returned, 12- and 18-month-olds spontaneously warned her by pointing to the aversive object before she mistakenly reached for it. However, when the object was not aversive or when the adult had witnessed the replacement, infants pointed significantly less in the otherwise identical situations.

In another study (Knudsen & Liszkowski, 2012b), an adult searched for, and found, an object in one of several containers. When she left the scene, another adult hid the object in another container. When the first adult returned, before she mistakenly approached the wrong container, 18- and 24-month-olds pointed to the correct container. In contrast, infants pointed significantly less when the adult had found the object only accidentally (while cleaning containers) or had searched for the object but seen the location switched. A follow-up study clarified that 18-month-olds intervened because they expected the adult to approach the wrong container (Knudsen & Liszkowski, 2011). When the adult returned, infants warned her selectively about that box (which together with an alternative box had been baited with aversive material). However, when the adult had seen the toy being removed and then approached the boxes, infants warned her equally about both boxes.

These diverse paradigms demonstrate that infants respond to and initiate interactions flexibly. Infants form different expectations about one and the same action, depending on the situation and the person interacting with them, and they tailor their communication to the specifics of the situation and person, including intervening proactively. The experimental situations are analogous to verbal tasks tapping into mental-state concepts like ignorance, knowledge, or false belief. But they reveal a direct usage in actions, not in conversations about others' actions.

Development of ToM Use

The usage-based approach holds not just that ToM is used in interaction, but that interactional experience drives the emergence and development of the system that predicts actions. Nativist accounts assume that early ToM competences are masked by performance limitations, but they make no predictions about their social-interactional origins (e.g., Baillargeon et al., 2010). The usage-based approach instead assumes that competence derives from performance. If infants' competences were neither employed in interaction nor derived from it, this

would severely weaken the usage-based approach. One recent study suggests that 7-month-olds have a ToM (Kovács, Téglás, & Endress, 2010). However, that study tested object expectations as a function of whether someone had attended to objects; it did not test predictions about others' behaviors. Furthermore, the origins of these skills are unknown.

The usage-based approach predicts that infants' meaningful preverbal interactions and expectations in their second year rest on earlier interactional experiences and expectations. Indeed, research shows that infants develop expectations about others' behaviors in the 1st year of life. For example, 6-month-olds expect gaze in interactional contexts to be directed at objects (Senju & Csibra, 2008). Around the same age, infants expect actions to be directed at objects (Woodward, 1998). Eight-month-olds who refrain from reaching for distal objects reach when someone else sits next to them, suggesting that they expect others to assist their object-directed actions (Ramenzoni & Liszkowski, 2012). Less is known about the mediating influence of the social environment on the development of expectations, but two studies suggest that social-interactional experience plays a role from early on. First, 8- to 15-month-olds began to point earlier and more often the more they were exposed to triadic social interactions in their social-cultural settings (Salomo & Liszkowski, 2012). Second, 10-month-olds from social-cultural settings with more triadic interactions were more susceptible to communicatively induced search errors on the classic AnotB task than 10-month-olds from social-cultural settings with less triadic interactions (Liszkowski & Zunino, 2012). These findings call on us to unravel how early social-interactional experience affects infants' interactions and developing expectations.

Infants' ToM skills continue to develop through further interaction, notably through the interactive use of language. Language competence leads to success on standard false belief tasks, but communicating about others' actions first and foremost reflects children's conversational use of mental-state language (Ensor & Hughes, 2008). Communicating about others' actions introduces others' behaviors and folk explanations of that behavior as a topic of conversation (Meins et al., 2002). These conversations become meaningful to children against the backdrop of preexisting ToM skills (Clements, Rustin, & McCallum, 2000), with some indication that parents attune their mental-state talk to their infants' developing social skills (Slaughter, Peterson, & Carpenter, 2009). Thus, language does not give rise to the ability to predict others' mistaken actions (cf. San Juan & Astington, 2012); language enables individuals to converse about others' actions. Mental-state talk thus introduces a *new use* of ToM for hypothetical thought scenarios in which one infers and expresses linguistically coded assumptions about others' behavior (as required to pass classic false belief tasks).

Development does not stop with successful performance on false-belief tasks. The usage-based account predicts continuous development of action predictions through continuous social interaction. For example, increasing social complexities lead to increasing social understanding (Hughes, 2011). Furthermore, the pragmatic use of language augments ToM development. Participating in more elaborate and complex discourse requires predicting and understanding more complex conversational moves, including the appropriate use of lying, irony, sarcasm, and the many more uses of linguistic actions within socially complex situations (e.g., bargaining, negotiating, arguing, and counseling).

ToM Structure

Usage-based theory holds that language structure consists of a structured inventory of linguistic constructions. Analogously, ToM structure can be seen as a structured inventory of action sequences, including linguistic actions as a form of acting. Action sequences are initially identified through pattern finding (e.g., Saylor, Baldwin, Baird, & LaBounty, 2007) and qualified by accompanying social-contextual information. Regularities within action sequences and social-contextual information lead to abstracted expectations of one about the other. This mental web of abstracted expectations allows for predictions of unfamiliar and mistaken actions. It also extends to action expectations about third parties with whom one is not interacting directly (e.g., Fawcett & Liszkowski, 2012). On this view, ToM does not consist of abstract concepts—instead, the interactive use of action predictions leads to a gradually abstracted inventory of action-context relations.

Developmentally, the system begins at 2–3 months when infants engage in dyadic face-to-face interactions that arise from an initial ability to detect contingencies within interaction (Gergely & Watson, 1999). Object-directed expectations of actions emerge a few months later, possibly through interactional experience, with some indication that these skills are evolutionarily shared with nonhuman primates (Tomasello, 2008). Around the same time, infants' attentional system becomes biased to social cueing (e.g., by the presence and specifically the gaze of a social agent). This provides the system with the relevant social-contextual information of actions. The system links the actions to the relevant social information of the contexts, allowing for predictions about others' goals and information.

THE CURRENT PERSPECTIVE

Cognitive systems exist for a purpose. I have followed the original proposal that ToM is used to "make predictions about the behavior of others" (Premack & Woodruff, 1978, p. 515). These predictions must be flexible because humans act in flexible ways. However, we do not need to assume that humans start out with a preconfigured system with internal rules (Perner, 2010) or representational capacities (Baillargeon et al., 2010; Leslie, 1994), or that the system consists of abstract ToM concepts developing one after another until a full ToM has emerged (e.g., Wellman & Liu, 2004). In adopting a usage-based perspective, I have briefly outlined a cognitive system

that starts with simple action expectations arising from contingent interactions, becomes gradually abstracted through practice within interaction, and eventually leads to predictions encompassing the hierarchical structure of actions and social contexts and to conversations about these predictions in terms of mental states.

Amid debates about the scope of ToM in infants, adults, or nonhuman primates, the issue is not who has (or does not have) a ToM, but how a ToM system is used, how that use develops, and how it is structured naturally. Infants in their 2nd year of life flexibly employ expectations about others' behaviors to interact with them appropriately, before they become competent language users and long before they pass traditional ToM tests. Verbal ToM tests are different; they test ToM use in conversations about behavior. Conversations, and their internalized use, enable one to engage offline in hypothetical scenarios about others' actions. But they are not causal in enabling online predictions of others' behavior. More evidence is needed to reveal the developmental process, but social-interactional experience plays a role in the 1st year and throughout life. Crucially, the use of language expands the scope of ToM to online predictions about linguistic discourse actions. As social life and linguistic discourse become more complex, so too does our system for predicting others' behavioral attitudes and conversational moves. In contrast to accounts invoking endpoints of conceptual development, the usage-based approach assumes an open system with gradual, continuous development across life in which new interactional experience leads to new expectations and abstractions about others' behaviors.

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