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What is "theory of mind"? Concepts, cognitive processes and individual differences

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Research on "theory of mind" has traditionally focused on a narrow participant group (preschool children) using a narrow range of experimental tasks (most notably, false-belief tasks). Recent work has greatly expanded the age range of human participants tested to include human infants, older children, and adults, has devised new tasks, and has adopted methods from cognitive psychology and neuroscience. However, theoretical work has not kept pace with these changes, with the result that studies using one kind of method or participant group often inherit assumptions about the nature of theory of mind from other research, with little regard for whether these assumptions are appropriate. I argue that three distinct approaches to thinking about theory of mind are already implicit in research practice, and that future work, whether with infants, children, or adults, will benefit from articulating these approaches more clearly and following their different implications for what theory of mind is and how it should be studied.

Keywords: Theory of mind; False belief; Cognitive.

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Papers on "theory of mind" invariably start with a definition, telling readers that theory of mind is the ability to reason about mental states, such as beliefs, desires, and intentions, and to understand how mental states feature in everyday explanations and predictions of people's behaviour. I suspect that most researchers would agree with some such definition, and after thirty years of research and many hundreds of papers it may seem strange, even impertinent, to question what it is that we are talking about. My contention will be that the appearance of consensus on what theory of mind is, and how we should study it, is misleading. Although the very great majority of research on theory of mind has focused on a narrow age range of children, recent work has looked much more widely to younger infants, older children, and adults. This, in turn, has forced researchers to go beyond the very narrow set of tasks and measures typically used with young children. Both the methodological innovations and the diversification of participant groups provide motivation for questioning the nature of theory of mind. I suggest that, under the veneer of an agreed definition, the questions routinely asked by researchers assume three rather different interpretations of "theory of mind". All three interpretations are theoretically interesting, and by distinguishing carefully between them we can advance our understanding of theory of mind and our ability to investigate it empirically.

Looking through the lens of false-belief tasks

In later sections I describe a variety of paradigms that have been used to investigate theory of mind (henceforth, ToM) in both adults and children. However, one type of task—the false-belief task—continues to be by far the most widely used task in the literature. Given this intensity of effort, it seems a worthwhile project in its own right to examine the rather different assumptions commonly made about these tasks. But also, starting out with this narrow focus, on ground that will be familiar to many readers, serves my broader purpose of drawing attention to the different ways in which ToM is understood by researchers.

A common false-belief task, designed for use with young children, involves a story with two characters, Sally and Andrew (e.g., Wimmer & Perner, 1983). Sally is playing with her toy and then puts it away in the cupboard before going outside to play. While she is outside, Andrew moves the toy from the cupboard to the chest of drawers. Sally then returns inside to play with her toy. At this point, participants are asked the critical question, which is to judge where Sally will first look to find her toy. Of course, the correct answer is that she will look in the cupboard, where she left it, and this is the answer given by a rapidly increasing majority of children through their fifth year (Wellman, Cross, & Watson, 2001). However, younger children are much more likely to give the wrong answer by predicting Sally's behaviour on the basis of their own, privileged knowledge of the toy's location. The consistency of this pattern of age-related improvement is illustrated in a meta-analysis of 178 studies using false-belief tasks (Wellman et al., 2001).

Besides these robust age-related changes, it is also the case that in any given sample of children in this sensitive age range there will be variability in performance. Let us imagine a hypothetical but typical study, in which each child undertakes two variations of a false-belief task. A typical outcome would be that some children give a correct answer on both tasks (scoring 2/2), some give a correct answer on neither task (scoring 0/2), and some give a correct answer on only one task (scoring 1/2). This pattern will be familiar to any researcher in the field. More surprising, though, are the different implicit assumptions that researchers make when interpreting this pattern.

To one way of thinking, false-belief tasks diagnose children's conceptual understanding of beliefs. Indeed, if anything is the original or mainstream interpretation of such tasks, this is it (e.g., Gopnik & Meltzoff, 1997; Perner, 1991; Wellman et al., 2001). On this "conceptual" interpretation, children who score 2/2 are assumed to have the conceptual understanding of belief that is necessary for the task, and those who score 0/2 are assumed to lack this conceptual understanding. Children who score 1/2 are not

easy to interpret, since it is far from clear what it would mean to have a correct concept of belief on one task but not on another conceptually equivalent task. So from this perspective, scores of 1/2 are best seen as "measurement errors", where for reasons of distraction, confusion, or luck, children who should have scored either 2 or 0 end up with a score of 1.

To another way of thinking, children's difficulty with false-belief tasks lies with deficiencies in one or more executive processes, which may be necessary for thinking about false beliefs, for learning to think about false beliefs, or for expressing an understanding of beliefs in the context of a false-belief task (e.g., Baillargeon, Scott, & He, 2010; Carlson & Moses, 2001; Leslie, German, & Polizzi, 2005; Russell, 1996). For example, it is often suggested that inhibitory control is particularly important for success, perhaps because of the need to inhibit a prepotent response or to resist interference from one's own privileged knowledge. Importantly, whereas concept possession tends to be seen as an all-or-nothing fact of the matter, the fact that executive capacity admits degrees leads to a rather different interpretation of children's scores. It suggests that children who score 2/2 have the necessary inhibitory resources, children who score 0/2 lack sufficient resources, whereas children who score 1/2 can be seen as falling genuinely in between those who score 0 or 2. Such children have the requisite inhibitory resources either only intermittently, or only at an intermediate level, and so are able to pass task variants that happen to make lower inhibitory demands but not variants that make higher demands.

A yet further interpretation is motivated by the idea that some people are simply more socially able than others. From this perspective, children's performance on false-belief tasks is viewed as an age-appropriate measure of their social competence or social motivation, which can then be related to measures of earlier or later social ability or outcome (e.g., Hughes, 2011). For example, Astington (2003) found that children's level of success on false-belief tasks was related to teachers' judgements about their sociability, and Razza and Blair (2009) found that preschool performance on false-belief tasks was associated with teacher-assessed social competence. On this "social individual differences" account, children who score 2/2 are assumed to be the most socially competent, children who score 0/2 are the least competent, and children who score 1/2 are considered to have some intermediate level of social ability. Importantly, this account is committed to a view of false-belief tasks that is quite different from either of the others. For although cognitive processing presumably does contribute to social abilities, social individual difference accounts assume that false-belief tasks are more than just another measure of executive function. Rather, the thought behind social individual differences accounts is that there is, in addition, some essentially social competence that varies in a continuous manner across people, and that is captured by children's performance on false-belief tasks. Likewise, although social concepts are presumably important for social abilities, on a conceptual account, false-belief tasks only tell us *whether or not* a child has a belief concept during a sensitive acquisition period, and not *why* they have that concept. Therefore, a conceptual interpretation of false-belief task performance gives no way of explaining how that child's score could be related to their later social competence, once the concept of false belief has been acquired.[1]

Altogether, it is striking that different studies using the very same false-belief tasks assume very

[1] This may at first seem incorrect, for does it not make sense to suppose that children who acquire the concept of belief earlier will be just those children who are more socially competent? Although this intuition clearly does make sense, it does not work as an objection because it essentially confounds the conceptual and the social individual differences accounts. The distinctive claim of conceptual accounts is that false-belief tasks diagnose the presence or absence of a concept of belief, and this entails that once you pass such tasks you accrue whatever benefits follow from merely possessing a belief concept. It may, of course, be the case that children who are more socially competent acquire a concept of belief earlier than less socially competent children, and if this is true, then scores on false-belief tasks may very well predict later social competence. But the predictive work in this case is done by the underlying social competence, not the concept of belief.

different interpretations of children's performance. These reflect three quite different ways of thinking about ToM: as a conceptual problem to be understood, as a set of cognitive processes, and as a social competence or motivation that might vary between individuals. I return briefly to the implications of these differences for false-belief tasks in the final conclusion. But of course, the literature on ToM has never been concerned only with a single type of task, and the variety of tasks, types of study, and categories of participant have all increased dramatically in recent years. In the following sections I hope to make some sense of this emerging picture by exploring all three ways of thinking about ToM.

ToM as a conceptual domain

There is no doubt that older children and adults have a conceptual grasp of mental states: Beliefs, desires, knowledge, and the like are things we can discuss, reflect upon, and distinguish from one another and from other things. Moreover, these are not merely concepts to be understood in isolation from one another. Rather, they form a coherent set of interrelated notions that combine together in explanations, predictions, and justifications of behaviour. It is this interrelatedness that puts the "theory" into "theory of mind", and the question of how this web of concepts emerges has motivated the largest proportion of studies of children's developing ToM.

Evidence from young children does indeed show some important signs of coherence, which would be expected on this conceptual view. When three- to four-year-olds start to pass false-belief tasks, they do not just succeed on the Sally–Andrew task described earlier, but also on a variety of other tasks that require judgements about a character's false belief or their action based on a false belief, or that require the child to cite a character's false belief to explain their behaviour (Perner, Leekam, & Wimmer, 1987). These tasks may be quite diverse in terms of their demands on language, memory, and the need to make predictions or give explanations. What they share is a requirement to understand false beliefs, and evidence that success on such tasks emerges coherently in a short space of time clearly fits with the view that an emerging concept of false belief is the crucial driver behind this change.

The counterpart to this evidence for coherent emergence of a one particular concept is evidence that a wide range of ToM concepts emerge in a coherent manner over developmental time. For example, children successfully predict the action of two people who have different desires before similar judgements about two people with different beliefs, and each of these emerges before correct judgements about knowledge versus ignorance, which in turn is easier than judgements about false belief (Wellman & Liu, 2004). Such evidence clearly fits with the view that children are acquiring an increasingly sophisticated grasp of different mental states, with simpler concepts emerging earlier, and forming the basis for the later acquisition of more sophisticated concepts.

This well-established picture of ToM concepts emerging between two and five years of age has recently been challenged by evidence suggesting that infants as young as seven months may be capable of thinking about another person's false beliefs, as well as other mental states (Baillargeon et al., 2010; Kovács, Téglás, & Endress, 2010). Such findings, and what they mean, are currently the subject of considerable debate (e.g., Hutto, Herschbach, & Southgate, 2011). My own view is that while the abilities of infants cannot be dismissed, there are clear grounds for continuing to think that young children are developing new ToM concepts that afford new and more flexible ToM abilities (Apperly, 2010; Apperly & Butterfill, 2009). But more importantly here, since this debate is typically framed in terms of whether or not infants really have ToM concepts, this question can be tackled in just the same way as in existing research on older children, by testing whether the abilities of infants are coherent. A positive answer to this question may lead researchers to a radical revision of beliefs about when children have ToM concepts, but this would not be any threat to the broad conceptual notion of ToM. To this extent, research on ToM in infants and children has been successful in generating investigative strategies for studying ToM as a conceptual domain.

Beyond typical development in children, researchers have also investigated whether ToM has a distinct neural basis and whether it can be selectively spared or impaired following brain injury, or developmental or psychiatric disorders (e.g., Frith & Frith, 2003; Leslie & Thaiss, 1992; Saxe, 2006). Such work on the domain specificity of ToM is often discussed in terms of the cognitive and neural representation of ToM concepts. Studies of children with autism and adults with brain injury indicate that ToM can be impaired even when participants appear capable of meeting the general demands that ToM tasks place on memory, language, and executive function (e.g., Leslie & Thaiss, 1992; Samson, Apperly, Chiavarino, & Humphreys, 2004). However, evidence that the same participants may also show impaired reasoning about nonmental representations suggests that the impairment may be with reasoning processes necessary for ToM, not with ToM concepts per se (Apperly, Samson, Chiavarino, Bickerton, & Humphreys, 2007; Perner & Leekam, 2008). Neuroimaging studies of adult participants have contrasted brain activation during ToM tasks with activation during a variety of non-ToM reasoning tasks and show consistent recruitment of several brain regions, including medial prefrontal cortex, temporoparietal junction, precuneus, and temporal poles. Although the interpretation of these findings is debated, many researchers conclude that ToM depends, at least in part, on specialized brain regions (e.g., Frith & Frith, 2003; Saxe, 2006; Van Overwalle, 2009). However, even if this conclusion were accepted it would remain in question whether this specialization was for the representation of ToM concepts, such as belief, desire, and intention, or for the *cognitive processing* necessary for inferring what people think, want, and intend and using such information to explain and predict their behaviour. Thus, far from providing clear evidence about the nature of ToM concepts, work on the domain specificity of ToM highlights the fact that there is likely to be more to ToM than ToM concepts.

The limited explanatory power of ToM concepts also becomes clear if one moves from research on infants and young children to consider the mature ToM abilities of adults. On any account, adults possess ToM concepts, but knowing this actually tells us rather little about how adults think about the minds of others. This highlights the need to ask how we actually make practical use of ToM concepts to infer what someone else is thinking. What is required to infer a mental state, and how do such inferences influence other processes, such as decision making or communication? Are such processes effortful or automatic, and to what degree do they depend upon memory, language, or executive control? Such questions apply to adults, but just as surely to studies of children, and they require us to view ToM in terms of cognitive processes, not merely as a body of conceptual knowledge.

Cognitive processes involved in ToM

The dominant view that ToM consists in a body of conceptual knowledge about mental states tends towards seeing ToM in isolation from other cognitive domains or abilities. I think this is a mistake for two reasons. First, for such concepts to achieve anything useful in life they must play roles in everyday reasoning, communication, and decision making, and, moreover, they must do at least some of this online, keeping up with potentially fast-moving social situations. From this perspective, ToM is just as surely something that we *do* as something that we *know*, and an adequate account of ToM should explain how we do it. Secondly, when focusing on abstract concepts about belief, desire, intention, and the like, it is easy to overlook the fact that such mental states only become useful when they are ascribed content. But putting the "*p*" into "Agent believes that *p*" is no trivial matter, since agents can, of course, entertain beliefs about absolutely anything (from the location of a hidden toy to the likelihood of global warming), and a great many factors potentially bear on what belief they might have in any given instance. Viewed this way, ToM is as deeply integrated with other cognitive domains and abilities as it is possible to be. An adequate account of ToM must explain either how

such integration is achieved, or how the need for such integration may be reduced or avoided.

Studying the cognitive basis of ToM requires a different approach from studying ToM as a conceptual domain. If one's target question is when and how children acquire ToM concepts, then the only imperative is to ensure that experimental tasks test for a particular concept in the most sensitive manner possible. To this end, it may, for example, be expedient to remove from ToM tasks a requirement to make a verbal response (Onishi & Baillargeon, 2005) or to ignore one's own knowledge of an object's location (Southgate, Senju, & Csibra, 2007). In contrast, if one's objective is to understand how ToM works at a cognitive level, then it is of interest to know *why* verbal responses might make a difference to processing and *how* it is that people overcome their own knowledge to reason from another's point of view. This leads researchers to try to manipulate such factors within experimental tasks, rather than to eliminate them.

Research taking a cognitive approach to ToM has rapidly expanded in recent years and is making significant progress in studying distinct processes involved in making ToM inferences, holding ToM information in mind, and putting ToM to use in social interaction or communication (see e.g., Apperly, 2010, for a recent review). For current purposes I focus on just one phenomenon —that of self-perspective interference—which has been studied widely, using a range of investigative methods.

It has long been observed that children may suffer severe interference from their own point of view when trying to make judgements about others. For example, one of Piaget's classic demonstrations of childhood "egocentrism" suggested that children up to the age of seven years struggled to imagine how a three-dimensional array of three mountains would appear to a person who viewed it from a different angle (e.g., Piaget & Inhelder, 1948/1967). Similarly, children who "fail" false-belief tasks, such as the Sally–Andrew task described earlier, do not err at random, but systematically judge that Sally will think the same thing that they themselves know to be the case (Wellman et al., 2001). Within the developmental literature, it has sometimes been suggested that such egocentrism arises from young children having an incorrect conceptual understanding (for example, their "theory of belief" might be that other people think the same as they do; Wellman, 1990). However, it has also been proposed that egocentrism arises because children struggle to resist interference from their own "self" perspective when judging the perspectives of others (e.g., Mitchell, 1996; Russell, 1996).

The fact that egocentrism is also observed in adult participants (e.g., Nickerson, 1999; Royzman, Cassidy, & Baron, 2003) suggests that immature concepts are an insufficient explanation for egocentric phenomena.[2] For example, when judging how a target person will interpret an ambiguous message, participants who know the speaker's intended interpretation overestimate the likelihood that the target will also interpret the message this way (e.g., Epley, Keysar, Van Boven, & Gilovich, 2004). Likewise, for cases—such as in the standard false-belief task—where there should be no uncertainty about a target's incorrect belief or action, adults are less confident in their predictions when they themselves know what would be the right thing to think or do than when they do not know (e.g., Birch & Bloom, 2007; Mitchell, Robinson, Isaacs, & Nye, 1996). Even for the very simplest of judgements about how many dots a target person can see on the walls of a room, adults are significantly slower to judge correctly when they happen to see more dots than the target can see from their position (Samson, Apperly, Braithwaite, Andrews, & Bodley, 2010). And adults are also prone to egocentrism when interpreting instructions from a speaker who does not share their privileged visual perspective (e.g., Keysar, Barr, Balin, & Brauner, 2000; Keysar, Lin, & Barr, 2003). Altogether, in adults, as well as in children, the process of judging others' mental states appears vulnerable to interference from participants' own "self" perspective.

[2] Nonetheless it may be that at least some egocentric phenomena seen in children are due to immature concepts.

A range of studies have tried to manipulate the need to resist self-perspective interference within ToM tasks. For example, Mitchell and Lacohee (1991) attempted to raise the salience of Sally's perspective in a false-belief task by having children make a record of her belief before it became false. Manipulations of this kind result in a significant, though modest, improvement in the performance of three- to four-year-old children (Wellman et al., 2001). A more dramatic effect of a similar manipulation was observed in a neuropsychological study of a patient with right frontal brain injury (Samson, Apperly, Kathirgamanathan, & Humphreys, 2005). Patient W.B.A. performed without error over 12 trials of a false-belief task designed to lower the salience of the patient's own perspective. However, he performed significantly below chance over 12 trials of a more standard false-belief task and showed similar egocentric interference on other tasks that required judgements of desires and visual perspectives. Given that W.B.A.'s brain injury had also resulted in impaired executive control, we argued that his ToM impairments most likely arose from difficulty with recruiting executive control processes to resist interference from his own perspective when judging that of another.

The notion that executive control processes may be critical for resisting interference from self-perspective receives converging support from several sources. Performance on false-belief tasks is correlated with individual differences in performance on tests of executive control in both children (e.g., Carlson & Moses, 2001) and adults (e.g., German & Hehman, 2006). Adults' egocentric interference during simple visual perspective taking can be increased by concurrent performance of a task that requires inhibitory control (Qureshi, Apperly, & Samson, 2010), and their tendency to ignore a speaker's perspective during an instruction task is increased by a concurrent memory load (Lin, Keysar, & Epley, 2010). And neuroimaging studies that manipulate the need for self-perspective inhibition report recruitment of frontal brain regions associated with executive control, in addition to those regions typically activated during ToM tasks (e.g., Dohnel et al., 2012; Hartwright, Apperly, & Hansen, 2012; McCleery, Surtees, Graham, Richards, & Apperly, 2011; Saxe, Schulz, & Jiang, 2006). Notable among these regions is bilateral inferior frontal gyrus, which in independent studies is implicated in inhibitory control and in formal reasoning when a logical response requires participants to ignore a "common sense" alternative answer (Goel, Buchel, Frith, & Dolan, 2000). Altogether, these studies identify the need to resist interference from self-perspective as one component process of ToM. Moreover, they suggest that this may be just one member of a family of phenomena observed during general, online reasoning and discourse processing, when the likelihood of an inference depends on the availability of executive control processes to assist with integration of information and resolution of conflicting responses.

This view of ToM as just one instance of online reasoning makes sense of a wide range of phenomena observed in studies of ToM in both children and adults. However, there are also striking counterexamples, which suggest that this is unlikely to be the full story. Perhaps most obviously, the very fact that infants do not appear to be egocentric on suitably adapted ToM tasks suggests that cognitive control processes cannot always be necessary for ToM, since infants are notably lacking in cognitive control. This possibility receives support from recent studies that use eye-tracking and response time methods to suggest that, in some circumstances, adults process the perspectives of others in a way that is relatively implicit (Schneider, Bayliss, Becker, & Dux, in press), automatic (Kovács et al., 2010; Samson et al., 2010), and undemanding of executive control for self-perspective inhibition (Qureshi et al., 2010). For example, Samson et al. (2010) had participants judge how many dots they saw on the walls of a cartoon room. The room also contained a human avatar, though participants made no judgements about it. Nonetheless, participants' judgements of their own perspective were slower when the avatar's position meant that she or he saw only some of the dots on the wall rather than all of them. It appeared that participants were calculating the avatar's perspective, even though it was wholly irrelevant to their

task and even though this actually interfered with judgements about their own perspective. Such findings have led to recent suggestions of a "two-systems" account of ToM (Apperly, 2010; Apperly & Butterfill, 2009) whereby infants, children, and adults all have capacities for ToM computations that are cognitively efficient but limited to simple problems (Surtees, Butterfill, & Apperly, 2012), whereas only older children and adults are capable of ToM reasoning, which is much more flexible, but also more cognitively demanding.

Whatever the correct interpretation of these rapidly emerging findings turns out to be, it should be clear that a cognitive approach to ToM is complementary to conceptual approaches, rather than an alternative. Importantly, it leads researchers to ask a distinctive set of questions, about the architecture and processing characteristics of ToM in infants, children, and adults. This is motivating the development of new experimental methods that make it possible to study ToM processes in participants who clearly do have ToM concepts, as well as those who might not. The promise of this approach is to provide a much clearer basis for understanding how ToM actually operates, how it is enabled by cognitive functions such as executive control, and how ToM contributes to other cognitive functions, such as social interaction and communication.

Individual differences in ToM

A moment's reflection on everyday social interactions leads to the strong intuition that some people are better at this kind of thing than others. It seems very natural to ask whether, among other things, such variation reflects individual differences in ToM. However, posing such questions requires clarity about what ToM tasks actually measure. This turns out to be a more complicated question than it might at first appear, because the answer varies across tasks and across theoretical perspectives.

The conceptual perspective

The conceptual perspective on ToM assumes that ToM tasks index whether an individual has the conceptual knowledge required to answer correctly. This offers a ready interpretation of individual differences among young children. If one were to test a sample of 48-month-old children on a mixed battery of ToM tasks, there would be considerable variability in performance, but also a strong tendency for "later emerging" abilities (such as success on false-belief tasks) to be present only if an individual also succeeded on tests of "earlier emerging" abilities (such as diverse desires tasks; Wellman & Liu, 2004). Although there may be other explanations for such patterns, it is clearly coherent to suppose that the children who pass fewer tasks have fewer ToM concepts than those who pass more tasks, and to expect such children to have less sophisticated social abilities. However, difficulty arises in extending this conceptual perspective to study ToM in older children or adults, the most obvious problem being that children over the age of around six years typically "pass" tasks designed to assess their understanding of key ToM concepts, such as belief, desire, and intention.

Researchers have taken a number of approaches in attempting to test more "advanced" abilities. One line of work has examined the development of an increasingly sophisticated series of "epistemic stances" by which older children, adolescents, and adults understand the evidential basis for beliefs. For example, young children appear to be epistemic absolutists, judging that two people with the same information access (e.g., the same limited view of a picture) should necessarily arrive at the same belief (about the identity of the picture). In contrast, older children and adolescents progress through various stages of epistemic relativism, in which they accept that different people can believe different things, even on the basis of the same objective information (e.g., Chandler, Boyes, & Ball, 1990). But although progress from absolutist to more relativist epistemic stances may indeed be evidence of continued conceptual change in the ToM domain, this is probably not the kind of thing that makes some people better than others at everyday social interaction.

Other work has examined "higher order" ToM, starting with second-order tasks that require

judgements about one person's false belief about another's false belief (Perner & Wimmer, 1985) and ranging to fifth-order judgements (Kinderman, Dunbar, & Bentall, 1998). But although there is no doubt that higher orders of ToM are more difficult than lower orders, it is really not clear that these tasks require conceptual knowledge beyond that required for "standard" tasks passed by younger children. In contrast, it seems quite clear that by asking participants to put basic ToM concepts into embedded hierarchical structures, higher order ToM tasks make far higher demands on working memory and executive function. This makes it likely that individual differences in performance on such tasks will be driven more by these cognitive demands than by variation in conceptual understanding of ToM.

Finally, a further strategy for creating "advanced" tests of ToM has been to pose problems that are somehow more subtle or indirect. For example, the "strange stories" task (Happe, 1994) assess participants' comprehension of stories involving metaphor, irony, deception, or double-bluff, which depends upon comprehending the mental states of the story characters. Such tasks do appear to capture individual variability in ToM skills: Performance is impaired in high-functioning individuals with autism, who may pass "standard" ToM tasks, and performance on these tasks increases reliably with age in typically developing children (e.g., Hughes, 2011). However, the conceptual account provides no basis for explaining why such tasks should be harder than standard ToM tasks, first because the conceptual account does not specify what would count as an "advanced" ToM concept, and secondly because it is unclear why "standard" concepts of belief, desire, and intention should be insufficient for understanding irony, metaphor, or double-bluff.

Of course, this does not invalidate such tasks as "measures" of ToM, but it does raise the question of what ToM-related requirement these tasks actually test. I suggest that they test participants' ability to use "standard" ToM concepts in a flexible, pragmatically appropriate, context-sensitive manner. As mentioned above, working out precisely what someone is thinking and when they are thinking it is no trivial matter, and this ability is absolutely essential for putting ToM concepts to any practical use. Viewed this way, the strange stories, and other related tasks, may indeed be a valid index of everyday ToM abilities. But this is not because they test for more advanced ToM concepts, but because these tasks capture individual differences in this cognitive ability to put standard ToM concepts into use. A cognitive perspective is likely to prove better than a conceptual perspective at uncovering what it means for someone to be more or less able to do this.

The cognitive perspective

A cognitive perspective on ToM aims to understand the representations and processes that make ToM possible, whether these are specific to ToM, or more generally involved in reasoning. Naturally, variation in such representations and processes across individuals should account for at least a proportion of individual variability in ToM. Importantly, though, it does not follow that tasks designed to investigate the cognitive basis of ToM will necessarily be good measures of individual variation in "ToM capacity".

For example, the case of W.B.A. dramatically illustrates how successful ToM judgements depend on successfully resisting interference from self-perspective and suggests that an individual with significantly limited executive function may have severe difficulty with this process (Samson et al., 2005). Such phenomena also appear to generalize to healthy adults. As already described, there is growing evidence of a relationship between individual differences in executive function and levels of "egocentrism" on ToM tasks within the normal range of adult variability. Besides casting light on at least one role served by executive function in the service of ToM, these results suggest that at least some variability in ToM, both in the lab and in the wild, will be explained by variability in executive capacity required for resisting interference from self-perspective.

Equally, however, the case of W.B.A. illustrates a key difficulty with viewing ToM tasks as "measures" of ToM. For although W.B.A. performed poorly on several ToM tasks, he performed much better on a conceptually equivalent task that

reduced the need for self-perspective inhibition. So does W.B.A. have less ToM than you or me? It seems to me that the problem here lies with the question's assumption that ToM is a simple quantitative entity. There is both a meaningful sense in which W.B.A. has a reduced capacity to judge other people's mental states and a meaningful sense in which his conceptual capacity appears fundamentally similar to that of other adults.

Similar points generalize across a wide range of tasks designed to investigate the cognitive processes involved in ToM. Taking an example from my own work, Apperly et al. (Apperly, Riggs, Simpson, Chiavarino, & Samson, 2006; Back & Apperly, 2010) presented adults with unpredictable probe questions while they watched videos of false-belief tasks and similar event sequences. Critically, although participants were free to attend to the mental states of human actors, they had no specific reason for doing so. On average, participants were slower to respond to probes about an actor's beliefs than to matched probes; a processing cost that we took as evidence that participants had not automatically inferred the actor's beliefs in the course of the video. Of course, in addition to this effect, it was necessarily the case that some participants actually responded to belief probes faster than others. Was this because they had more ToM? Asking this question is a little like asking a psycholinguist whether participants who show greater lexical priming effects have "more language". In both cases it is conceivable that a factor responsible for the effect (such as greater general processing speed) does indeed influence general aptitude in the relevant domain (by influencing the speed of language or ToM processing). But in both cases it seems wrong to think that language or ToM have been "measured" in any general sense, and, clearly, this is not what the tasks were designed to do.

In sum, by seeking to uncover the underlying mechanisms by which ToM is achieved, a cognitive perspective should provide important insights into the origins and nature of individual differences in ToM. But the very nature of this approach involves distinguishing and manipulating individual component processes of ToM, and this does not sit easily with a simple view of ToM as a quantifiable entity (e.g., Dunbar, 2011; Kinderman et al., 1998).

The social individual differences perspective

Finally, there is the perspective that individuals vary in a trait-like tendency for paying attention to or caring about what other people think and feel. For example, Meins, Fernyhough, and colleagues developed the concept of "mind-mindedness" to describe variation in mothers' propensity to think about their babies as having mental states (thoughts, desires, etc.) rather than just instrumental needs (Meins & Fernyhough, 1999). Maternal mind-mindedness shows evidence of stability over time and can selectively predict later outcomes such as attachment status of the infant–mother dyad (Meins, Fernyhough, Fradley, & Tuckey, 2001) and performance of the child on ToM tasks (Meins et al., 2002). Importantly, the same trait-like characteristic can be observed in both male and female adults' descriptions of their partner and friends (Meins & Fernyhough, 2012) and in seven- to nine-year-old children's descriptions of best friends and story narratives (Meins, Fernyhough, Johnson, & Lidstone, 2006). As an "advanced" test of ToM, the last study also included Happe's strange stories task, described earlier (Happe, 1994). Scores on this task were uncorrelated with the measure of mind-mindedness, consistent with the view that the trait of mind-mindedness is distinct from children's ability to use their ToM in a flexible way.

In a quite independent line of work, Baron-Cohen, Richler, Bisarya, Gurunathan, and Wheelwright (2003) devised the "Empathising Questionnaire" (EQ). Although "empathy" may more usually be associated with sensitivity to emotions, rather than mental states such as beliefs and desires, the EQ includes a mixture of items that ask participants to rate themselves on questions related to both emotions and mental states (e.g., "Other people tell me that I am good at telling how they are feeling and what they are thinking"; "I really enjoy caring for other people"). Scores on this questionnaire show substantial variance in the normal population and gain validity from the fact that high-functioning adults with autism—who

have social impairments—tend to score significantly below average.

Whether or not the EQ and tests of mind-mindedness actually measure related constructs, they are distinct from tests of "advanced" ToM concepts, because they are premised on the idea that people vary in their motivation for ToM, whether or not they also vary in their conceptual sophistication. Equally, the thought behind both the EQ and mind-mindedness is that there is something in people's motivation or propensity for ToM that is not reducible to their cognitive capacity for ToM or to their motivation in general. Thus, the social individual differences perspective represents a view on the relationship between ToM and individual differences in social ability that is genuinely distinct from the ones discussed so far. Nonetheless, the idea that children or adults might vary in their motivation for ToM also has clear relevance from both the conceptual and the cognitive perspectives on ToM. A child who is more socially motivated may be faster to acquire key ToM concepts and the conditions for their appropriate use than a child who is less socially motivated. Likewise, a child or adult who is more socially motivated may be more willing to invest time and effort in the cognitive processes necessary for ToM. For example, it seems possible that more socially motivated individual might prioritize resources towards inferring the perspectives of others during a communication task, while a less socially motivated individual might prioritize effort to nonsocial inferences. Both types of inference are likely to be important for overall comprehension, but individual differences in social motivation may explain differences in the inferences that people actually make with the cognitive resources that they have.

Summary

Where are we, then, in understanding individual differences in ToM? If we wanted to conduct a study with a particular population, of a particular age, how would we decide upon the best measure of ToM to use? I hope it is clear from the foregoing discussion that there is certainly no simple answer to this question, and that in many respects it really is the wrong question to ask. ToM is not a unidimensional entity that an individual simply has to a greater or lesser degree. The everyday notion that some people are better at ToM than others includes the possibility of varying conceptual sophistication, varying capacity to deploy those concepts in a timely and contextually appropriate manner, and varying motivation for doing so. By distinguishing carefully among these possibilities, and the ways in which they may be tapped by different ToM tasks, there is exciting potential for progress in understanding the rich patterns in individual variability in ToM that are likely to exist across ages, and between typical and atypical cognition.

Conclusion 1: A second look at children's performance on false-belief tasks

At the beginning of this paper, I described how administration of a small battery of false-belief tasks is often taken as the gold-standard way of assessing ToM in young children, but that researchers actually interpret performance on such tasks in three distinct ways: as reflecting conceptual understanding, cognitive processes, or social individual differences. I hope it is clear by now that I take each of these to be valid and informative perspectives on ToM. Equally, however, this very narrow experimental approach is surely problematic for research on ToM in three- to five-year-old children, for it seems highly unlikely that the very same false-belief score can simultaneously be the optimal experimental tool for investigating all three aspects of ToM. By being clearer about what question we actually wish to ask about children's ToM, it should be possible to select better tools for the job.

For example, if our concern was to estimate "how advanced" a child's ToM concepts might be, then a battery of tasks that form a reliable developmental scale, such as the one devised by Wellman and Liu (2004), will give an indication of whether a child has explicit access to more or fewer concepts than might be expected at their age. If, however, we are concerned to know a child's ability to use a particular ToM concept in a flexible and contextually sensitive manner, then it makes sense to test understanding of the different ways in which that concept works.

For instance, in the case of false belief we might, at a minimum, compose a battery of false-belief tasks that are as diverse as possible in the contexts in which false beliefs are relevant. More systematically, we might test understanding of different conditions for belief formation (e.g., seeing for yourself, being told, inferring on the basis of other information) and the different roles that false beliefs play in predictions, explanations, and justifications of behaviour. A child who passed more such tasks could reasonably be thought to have better use of the concept of false beliefs than one who passed fewer.

If our interest was to investigate a particular cognitive component of false-belief reasoning, then a contrasting strategy of narrowing in on very specific task comparisons would be appropriate. For example, "standard" false-belief tasks confound the need to infer someone's false belief with the need to resist interference from self-perspective, complicating interpretation of correlations between children's performance on standard false-belief tasks and tests of executive function. But as described earlier, these components can be separated in false-belief tasks that make high versus low demands on self-perspective inhibition. This opens up the possibility of testing whether the critical relationship in children is between executive function and belief reasoning per se, between executive function and inhibition of self-perspective, or both.

Finally, if our interest was to investigate an enduring propensity for ToM that might predate and outlast the period during which children are acquiring ToM concepts, then it would be preferable to have a measure that was not, itself, also thought to be a critical test of conceptual understanding, as is the case with false-belief tasks. For example, Davis (2011) found evidence for meaningful variation in 5-year-olds' mind-mindedness when describing friends, raising the possibility that a related measure might be possible in yet younger children.

Conclusion 2: What is theory of mind?

At the outset of this paper, I suggested that most researchers would endorse the idea that "theory of mind is the ability to reason about mental states, such as beliefs, desires, and intentions, and to understand how mental states feature in everyday explanations and predictions of people's behaviour". Nothing in what followed casts doubt on this definition, but I have made the case that there is, nonetheless, a great deal more to ToM than is commonly supposed. Although it is often unacknowledged, different traditions and approaches in research on ToM are committed to different views of what ToM is: supposing that it is a body of conceptual knowledge, that it consists in cognitive processes, and that it is a social competence that can vary across individuals. I suggest that all three views capture important aspects of ToM, but that it is critical to distinguish between them because they lead us to ask different questions that need to be addressed in different ways.

This has important consequences for research on ToM. First, there is no single task, or even battery of tasks, that functions as the best "measure of ToM" for any age group. In all cases it is necessary to ask what aspect of ToM we wish to measure, and why. Secondly, despite the preponderance of studies of ToM in children, it is quite wrong to suppose that ToM is an exclusively "developmental" topic of study, any more than language, reasoning, or mathematics are exclusively "developmental" topics. Studies of infants and children can be uniquely informative about when and how ToM concepts are acquired. But once it is recognized that there is much more to ToM than the acquisition of ToM concepts, it becomes clear that we should also look beyond children for both conceptual and practical reasons. Conceptually, studies of adults are essential for understanding the mature system that children are in the process of developing, and understanding the mature system has implications for the study of children as well as adults (Apperly, Samson, & Humphreys, 2009). Practically, studies of adults allow the use of research methods that cannot be used with children, involving hundreds of repeated trials and recording of response times, or administration of substantial questionnaires and inventories, or procedures that intervene on the healthy brain, such as transcranial magnetic stimulation. Thirdly, research on the neural basis of ToM has

typically selected ToM tasks on their face validity and has taken ToM to be either a unitary faculty or one that varies on a single dimension that distinguishes between different concepts (e.g., Frith & Frith, 2003; Saxe, 2006). Recent work has just begun to evaluate the neural basis and timing of distinct cognitive components of ToM (e.g., Apperly, Samson, & Humphreys, 2005; McCleery et al., 2011; Shamay-Tsoory & Aharon-Peretz, 2007), and the notion that individuals may vary in their propensity for ToM provides clear avenues for informative future work.

Finally, although it has long been recognized in principle that there should be important links between ToM and research on social psychology, reasoning, and experimental pragmatics, these literatures have seldom meshed well in practice. I suggest that this is at least in part because of confusion about what ToM actually amounts to and what it is that ToM tasks measure. By fully recognizing that there are different ways of thinking about ToM, and different empirical tools for studying it, future work has the exciting potential for integration across different research disciplines and understanding the diverse roles of ToM in mental life.

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