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Submentalizing: I Am Not Really Reading Your Mind

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Abstract

The nativist view of *mentalizing*—the view that humans have an inherent capacity to think about the mental states of others—has been recently reinvigorated by reports that adults and infants automatically represent mental states—that they engage in *implicit mentalizing*. In this article, I take a close look at the strongest evidence of implicit mentalizing in adults, which suggests that people automatically represent what others see, intend, and believe. I argue that although these experiments have been ingeniously designed and carefully implemented, they do not provide evidence of implicit mentalizing because their results could be due instead to *submentalizing*—domain-general cognitive mechanisms that simulate the effects of mentalizing in social contexts. These include the processes that mediate involuntary attentional orienting, spatial coding of response locations, object-centered spatial coding of stimulus locations, retroactive interference, and distraction. If my analysis is correct, it suggests that the same domain-general processes can provide a fast and efficient alternative to mentalizing in everyday life, allowing people to navigate a wide range of social situations without thinking about mental states. Thus, submentalizing could be both a substrate and a substitute for mentalizing.

Keywords

mentalizing, theory of mind, mindreading, perspective taking, false belief, automatic processing

Mentalizing is thinking about mental states, such as beliefs, desires, and intentions. This ability is sometimes called *theory of mind, mindreading*, or *folk psychology*. Under these various descriptions, it has been a major focus of philosophical investigation for centuries and of scientific enquiry for the last 35 years (Premack & Woodruff, 1978). Mentalizing is an object of fascination because it is thought to play a pivotal role in human social interaction and communication. Mentalizing allows people to predict, explain, mold, and manipulate each other's behavior in ways that go well beyond the capabilities of other animals. Understanding mentalizing is therefore crucial to understanding what it means to be human.

Many psychologists and philosophers believe that the capacity to mentalize depends on dedicated cognitive processes—processes that operate in a different way from those involved in any other tasks—and that, in the course of human evolution, natural selection has produced a highly specific, genetically inherited predisposition to develop these dedicated mentalizing processes (Carruthers, 2012; Leslie, Friedman, & German, 2004). This has been described as the *nativist* or *modular* view of mentalizing and has been contrasted with more *developmental* or *constructivist* accounts, which emphasize the importance of the individual's experience, and especially their social experience, in the development of mentalizing.

The nativist view of mentalizing emerged in the 1980s and was inspired by three lines of evidence. These seemed to show that the ability to mentalize (a) develops in an invariant sequence; (b) is present in our closest extant relatives, the chimpanzees; and (c) is selectively impaired in a genetically heritable developmental disorder, autism. In each of these three cases, subsequent empirical work has muddied the water. For example, (a) cross-cultural research suggests that whereas children from the United States and Australia understand that people can have diverse opinions before they distinguish knowledge from ignorance, Chinese and Iranian children

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develop these two components of mentalizing in the reverse order (Shahaeian, Peterson, Slaughter, & Wellman, 2011). Similarly, (b) methodological analysis and new data have shown that the chimpanzee behavior once thought to be indicative of mentalizing can be readily explained in other ways (Heyes, 1998; Penn & Povinelli, 2007), and (c) there is now evidence that although people with autism typically have difficulty in mentalizing, the genetically heritable contribution to this impairment is likely to impact on something much less specialized than an innate theory of mind module (U. Frith & Happé, 1994). However, in the last decade, the nativist view has been reinvigorated by studies of *implicit mentalizing* in human infants and adults. These seem to show that mentalizing emerges very early in development—too early to be socially constructed or culturally inherited (Heyes & Frith, 2013)—and that it has the kind of fast, automatic features often associated with innate modules. In this article, I take a close look at recent research on implicit mentalizing in adults, and I argue that the results reported to date could be due to *submentalizing*—general purpose cognitive mechanisms that simulate the effects of mentalizing in social contexts. If this is correct, it suggests that research on implicit mentalizing does not support a nativist view of theory of mind and, more important, that humans do not need mentalizing as much as previously thought.

Implicit Mentalizing or Submentalizing?

The term implicit mentalizing, or *implicit theory of mind*, has had some currency in developmental psychology since the early 1990s, but it is still rather slippery. At the most general level, an actor's behavior is said to be or to indicate implicit mentalizing when (a) the behavior is readily interpretable by an observer as due to mentalizing, and (b) it seems unlikely that the behavior is controlled by linguistically mediated deliberation about mental states. This can seem unlikely for various reasons. For example, the behavior may be performed by a nonhuman animal or prelinguistic infant, or it might involve rapid responding to a series of social cues. Thus, a 4-year-old child who passes the Sally–Anne test of false belief ascription (Wimmer & Perner, 1983) is assumed to be mentalizing, or engaging in *explicit mentalizing*, because he or she answers correctly linguistically posed questions about what an actor will do and why he or she will do it, and has plenty of time to answer these questions. Similarly, an adult who answers in a coherent and unhurried way questions about what he or she, or another agent, wants or believes is taken to be explicitly, rather than implicitly, mentalizing. In contrast, the behavior of a 12-month-old who follows the gaze of an adult is more likely to be described as implicit mentalizing because the infant has very little linguistic skill and did not track the adult's gaze in response to a verbally expressed question. Likewise, the behavior of a woman who is deftly following the lead of her Latin American dance partner is more likely to be labeled as implicit, rather than explicit, mentalizing. With the signals coming thick and fast, it seems that she just would not have time to think in a deliberate way about her partner's beliefs, desires, and intentions.

So these are the circumstances in which the term implicit mentalizing is used, but what does it mean? At present, implicit mentalizing can be used in at least three senses: agnostic, contrastive, and assertive. The agnostic sense sticks to the characterization of implicit mentalizing given in the preceding paragraph. If I describe behavior as implicit mentalizing in the agnostic sense, I am simply saying that the behavior makes me think the actor is mentalizing, but it seems unlikely that he or she is deliberating about mental states. The contrastive sense opposes implicit mentalizing with mentalizing. If I describe behavior as implicit mentalizing in the contrastive sense, I mean that it looks like mentalizing, but it is not. The actor is doing the things that he or she would do if he or she was mentalizing, but the cognitive processes controlling his or her behavior do not represent mental states. Finally, the assertive sense takes implicit mentalizing to be a form of mentalizing; the agent who is engaging in implicit mentalizing is thinking about mental states but in a fast, automatic way, rather than in a slow, controlled way.

Much confusion could be avoided if implicit mentalizing was used only in the assertive sense. Therefore, in this article I take it that behavior constitutes or indicates implicit mentalizing only if there are good reasons to believe that it is controlled by thinking about mental states. To replace the contrastive sense, I recommend a new term: submentalizing. Submentalizing behavior looks as if it is controlled by thinking about mental states, but it is not. Submentalizing processes are domain-general cognitive processes that do not involve thinking about mental states but can produce in social contexts behavior that looks as if it is controlled by thinking about mental states. Instead of using implicit mentalizing in the agnostic sense, I simply identify certain behavior as suggestive of mentalizing.

Evidence of implicit mentalizing in adults would be important for two reasons. First, it would support the theory that humans have two cognitive systems for mentalizing: one early developing, automatic, or fast-and-efficient system (implicit), and a later developing, controlled, slow-and-flexible system (explicit; Apperly, 2011; Apperly & Butterfill, 2009; Butterfill & Apperly, in press). Second, it would support the view, on the basis of eye movement studies, that young infants are capable of mentalizing

(Onishi & Baillargeon, 2005). These infant studies have been the subject of several critical reviews (Heyes, in press; Moore & Corkum, 1994; Perner, 2010; Perner & Ruffman, 2005). In this context, evidence from adults that mentalizing can be done by a no-frills, fast-and-efficient system would make it more plausible that cognitively limited creatures, such as infants, could be capable of mentalizing. Evidence of mentalizing in early infancy would, in turn, suggest that learning—and especially language-based learning—plays a limited role in the development of all kinds, or an important kind, of mentalizing.

In the following sections, I examine the five leading sources of evidence that adults engage in implicit mentalizing. In each case, I identify an alternative submentalizing explanation for the results, and I discuss experiments that have or could distinguish the implicit mentalizing and submentalizing explanations.

Attentional Orienting in the Dot Perspective Task

The dot perspective task has been used repeatedly and in an unusually systematic way to test for implicit mentalizing in adults. In each trial, the participant sees a picture in which a human-like figure, an *avatar*, is standing in a room facing to the left or to the right (see Fig. 1, Panels a and b). There are dots on the wall in front of the avatar, on the wall behind the avatar, neither on the wall in front nor behind the avatar, or both on the walls in front and behind the avatar. A digit (0–3) is presented just before the picture appears. In *self* trials, the participant's speeded task is to confirm whether the digit corresponds to the number of dots that he or she can see in the picture—the number of dots in front of the avatar plus the number behind. In *other* trials, the participant's task is to confirm whether the digit corresponds to the number of dots that the avatar can see—the number of dots in front of the avatar. Both self and other trials are of two kinds: *consistent* and *inconsistent*. In consistent trials, the participant and the avatar can see the same number of dots. For example, there are two dots in the picture, both on the wall in front of the avatar. In inconsistent trials, the participant and the avatar can see different numbers of dots. For example, there are two dots in the picture, but one is in front and the other is behind the avatar. Therefore, the participant can see two dots, but the avatar can see only one.

The primary result from the dot perspective task—the result taken to indicate that older children and adults

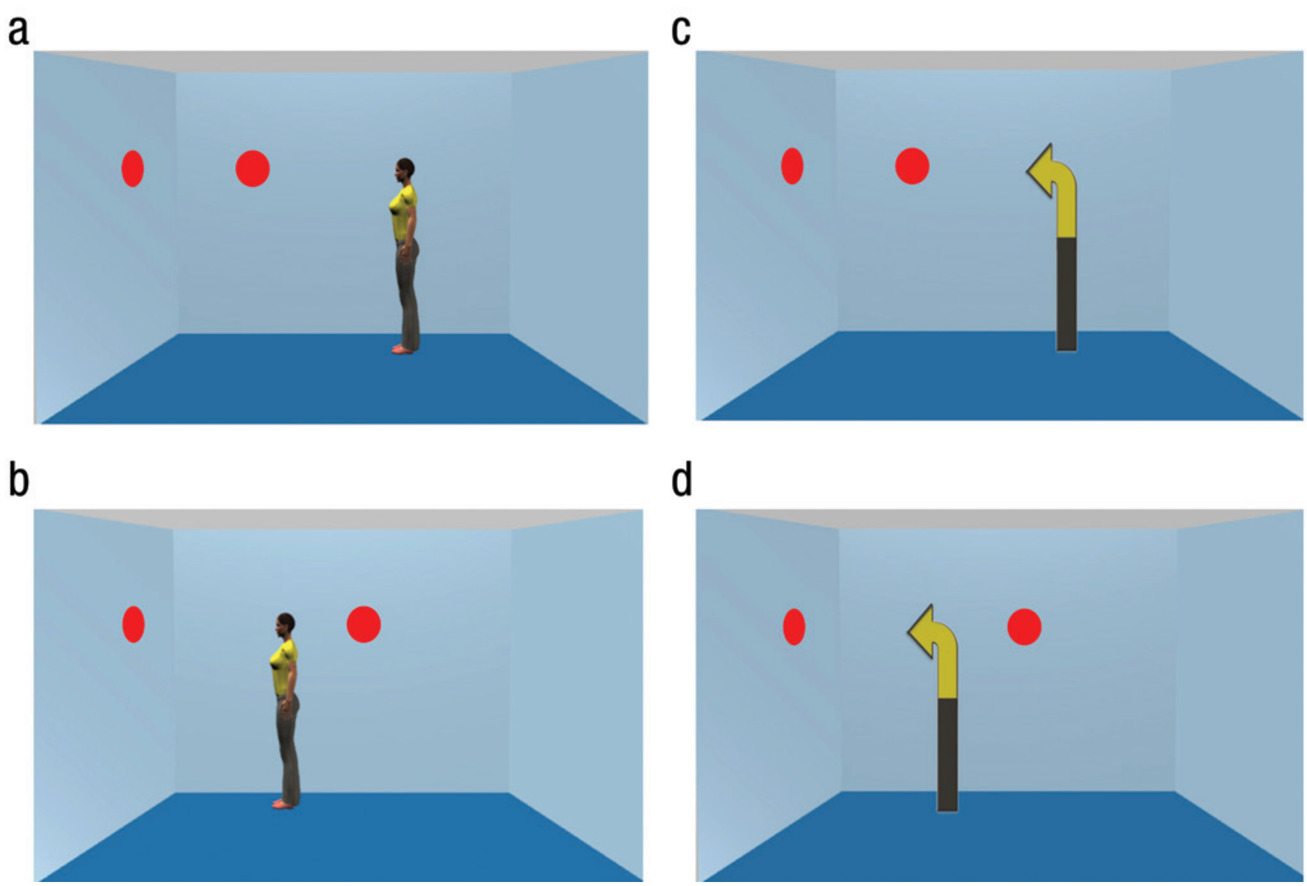

Fig. 1. Examples of stimuli used in the dot perspective task. Participants judge the number of dots that they can see (two in these examples) faster when all dots are in front of the avatar (a) or arrow (c) than when some dots are behind the avatar (b) or arrow (d). Reprinted with permission from Samson, Apperly, Braithwaite, Andrews, and Bodley Scott (2010) and Santiesteban, Catmur, Hopkins, Bird, and Heyes (in press).

engage in implicit mentalizing—shows that "yes" responses are slower in self-inconsistent than in self-consistent trials (Samson, Apperly, Braithwaite, Andrews, & Bodley Scott, 2010). Thus, in self trials, in which the participant is not required to take the avatar's perspective into account, he or she is slower to confirm that the digit represents the number of dots that he or she (the participant) can see when the number of dots seen by the avatar differs from the number of dots seen by the participant.

The view that this self-consistency effect provides evidence of implicit mentalizing rests on two assumptions. The first is that the effect is produced by an automatic (implicit) rather than a controlled (explicit) process. Participants do not intend to initiate the cognitive process that produces the effect; it just happens. This automaticity assumption has been tested in a variety of interesting ways and has been found to be valid (Qureshi, Apperly, & Samson, 2010; Samson et al., 2010).[1]

The second assumption is that the implicit or automatic process producing the self-consistency effect is a process representing what the avatar can see. Because seeing is usually regarded as a mental state, a process that represents seeing would be a mentalizing process. This mentalizing assumption is plausible—the self-consistency effect really is suggestive of mentalizing—but it has not been tested effectively against an alternative submentalizing hypothesis. A plausible submentalizing alternative suggests that (a) it is the directional, rather than the agentive, features of the avatar that are important, and (b) these features modulate a process that simply represents the number of dots on one side of the screen; it does not represent this number as the number that an agent can see. For example, like the point of an arrow, the front features of the avatar (forehead, eyes, nose, etc.) automatically trigger a shift of attention to the dots on the left side of the screen, which enhances processing of their number. In inconsistent trials, the number on the left conflicts with the total number on the screen, calculated in parallel and according to task instructions. Before a correct "yes" response can be given, this conflict has to be resolved, and therefore response times are slower than in consistent trials in which there is no conflict.[2]

The implicit mentalizing account has been tested against the submentalizing account in experiments in which participants completed the dot perspective task with either an avatar or an arrow as the central stimulus (see Fig. 1; Santiesteban, Catmur, Hopkins, Bird, & Heyes, in press). In these experiments, self-consistency effects of comparable magnitude were obtained in the avatar and arrow conditions. Arrows have directional but not agentive features, and they are not appropriate targets for the attribution of mental states. Therefore, the effectiveness of arrows in producing the self-consistency effect supports the submentalizing hypothesis over the implicit mentalizing hypothesis.

The implicit mentalizing interpretation could be defended by supposing that participants represent the number of dots in front of the arrow as the number of dots that the arrow can see. This suggestion would gain some plausibility if arrows produce a self-consistency effect only when participants are likely to confuse conditions in which mentalizing is and is not appropriate—for example, when avatar and arrow trials are mixed rather than blocked. Without independent support of this kind, an appeal to the possibility that participants represent what arrows can see would threaten to make the implicit mentalizing hypothesis untestable. Researchers know that explicit mentalizing can be extended to virtually any object, including Lady Macbeth's "damned spot." However, in the case of implicit mentalizing, researchers cannot, by definition, use the participant's verbal report to confirm that the participant is thinking about mental states. Therefore, if scientific hypotheses do not constrain the circumstances in which implicit mentalizing can be expected to occur, there is a danger that it will be found everywhere and therefore nowhere. Under these circumstances, the dot perspective task would have no greater claim to demonstrate implicit mentalizing than the many experiments showing that eye and arrow stimuli induce involuntary shifts of attention (e.g., Guzzon, Brignani, Miniussi, & Marzi, 2010).

Spatial Coding and the "Social" Simon Effect

In the second group of studies that seems to provide evidence of implicit mentalizing in adults, researchers have used the social Simon procedure. In a standard Simon task (Simon, 1969), participants typically make a spatially defined choice response to nonspatial stimulus attributes. For example, they are told to press a left button when the stimulus is red and to press a right button when the stimulus is green. Although the location of the stimuli is technically irrelevant to the task, participants show a spatial compatibility effect; responding is faster when the stimulus appears on the same side of the screen as the response. For example, responding is faster when the green stimulus, requiring a right response, appears on the right, rather than the left, of the screen. This spatial compatibility effect is usually absent when participants are given a go–no-go task, rather than a Simon task (Hommel, 1996). For example, if they are asked to press the right key when the stimulus is green, and to do nothing when the stimulus is red, responses are equally swift when the green stimulus appears on the right and on the left of the screen. However, the spatial compatibility effect is restored when two people perform a Simon task together (Sebanz, Knoblich, & Prinz, 2003). Thus, when I am responding to green with the right button, and you, a *confederate*, are responding to red with the left button, I respond faster when my green stimulus appears on the right rather than the left of the screen. This is known as the *social Simon effect*.

The implicit mentalizing interpretation of the social Simon effect assumes that it is generated by (a) an automatic process that (b) represents the confederate's intentions (C. D. Frith, 2012). Both of these assumptions are plausible. It is likely that an automatic process is involved because participants are responding under time pressure, they have not been asked to take the confederate's behavior or mental states into account, and doing so has a detrimental effect on performance—it slows responding in spatially incompatible trials. Similarly, the idea that the automatic process represents the confederate's intentions is plausible given that the standard Simon effect, observed during solitary testing, depends on the participant him- or herself having two intentions rather than one—to press the right button in response to green and to press the left button in response to red. It is also fortified by evidence that the social Simon effect is modulated by variables that seem likely to influence mentalizing. For example, the effect is enhanced when participants are in a good, rather than in a bad, mood (Kuhbandner, Pekrun, & Maier, 2010); when the confederate behaves in a friendly and cooperative, rather than in a hostile and competitive, way (Hommel, Colzato, & Van Den Wildenberg, 2009); and when the confederate is a robot described as "active and intelligent" rather than "passive and purely deterministic" (Stenzel et al., 2012).[3]

In spite of its plausibility, the implicit mentalizing interpretation of the social Simon effect has been tested against a submentalizing alternative and has been found to provide a weaker fit with the data (Dolk et al., 2011; Guagnano, Rusconi, & Umiltà, 2010). The submentalizing alternative suggests that (a) it is the spatial, rather than the agentive, features of the confederate that are important, and (b) these features modulate a process that represents the participant's responses, rather than the confederate's intentions. More specifically, the submentalizing hypothesis proposes that a confederate sitting on the participant's left is just one of many types of stimulus—animate and inanimate—that can induce the participant automatically to code his or her own response, not merely as a button press but as a "right" button press. A stimulus represented as "left" (e.g., a green stimulus on the left of the screen) interferes with a response represented as "right" but not with a response that lacks spatial representation. Thus, this submentalizing interpretation predicts that a spatial compatibility effect will be observed whenever a confederate, or another salient object, is located such that it provides a frame of reference provoking spatial coding of the participant's response. Confirming this prediction, there is now evidence that the social Simon effect (a) breaks down when the confederate is active and visible but beyond arm's reach of the participant (Guagnano et al., 2010) and (b) is sustained when there is no confederate present but the "rightness" of the participant's response is defined by a *stroking device*—a moving brush attached to a metal box—located on the left of the experimental apparatus (see Fig. 2; Dolk et al., 2011). Further research will be needed to identify precisely the class of features that an object needs for it to provoke spatial coding of the participant's response. However, these findings, in combination with previous research on response coding (Ansorge & Wühr, 2004; Hommel, 1996), strongly suggest that they will be features that attract attention to an object (e.g., movement, proximity to the participant, friendly behavior, an active and intelligent description), rather than, more specifically, features that make the object an appropriate target for mental state attribution (e.g., self-propelled motion, human morphology).

Spatial Coding and Dancing Triangles

Research on stimulus-response compatibility also casts light on an intriguing report that participants adopt the *visuospatial perspective* of a triangle when the triangle is construed as an agent (Zwickel, 2009). In this study, participants saw two isosceles triangles floating around in a random way; apparently responding to each other's movements in a goal-directed way (e.g., "chasing" or "dancing"); or reacting to one another in a manner that is typically described by observers with reference to mental states (e.g., "mocking" or "coaxing"). While participants were watching these animations, occasionally a dot appeared on one side of the large triangle. The participant's task was to press a right button if the dot was, from the participant's perspective, on the right of the triangle, and to press a left button if the dot was, from the participant's perspective, on the left of the triangle. Half of the trials were perspective congruent: The acute angle of the triangle was pointing upward, and, therefore, if the acute angle was regarded as the front or face of the triangle, the visuospatial perspectives of the participant and the triangle were the same. For example, a dot that was on the right from the participant's perspective was also on the right from the triangle's perspective. The other half of the trials were perspective incongruent: The acute angle was pointing downward, and, therefore, the visuospatial perspectives of the participant and the triangle were different. For example, a dot that was on the right from the participant's perspective was on the left from the triangle's perspective. The results indicated that there was a

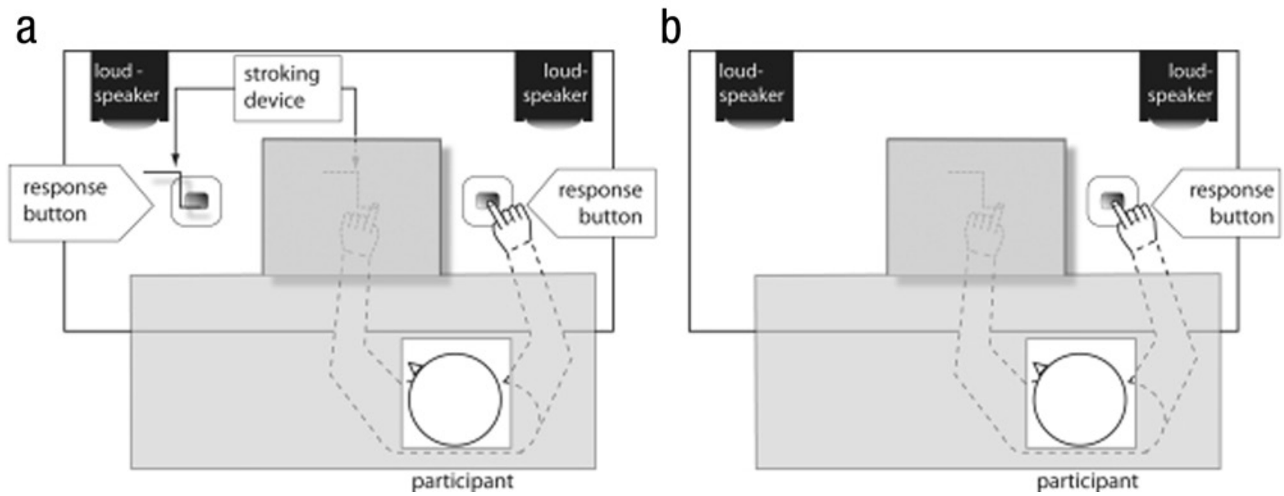

Fig. 2. Diagrams of the experimental setup used by Dolk et al. (2011). A Simon effect was observed when the stroking device was present and located on the participant's left (a) but not when it was absent (b). Reprinted with permission from Dolk et al. (2011).

congruency effect—faster responding in congruent than incongruent trials—when participants were watching the animations that evoked goal-related and mental state descriptions but not when they were watching the triangles that moved in a random way.

An implicit mentalizing interpretation of this result suggests that participants automatically represented what the triangle could see or what it believed about the location of the dot, and that in incongruent trials, this slowed responding because it conflicted with what they, the participants, saw or believed. An alternative, submentalizing interpretation suggests that it was an object-centered spatial code, rather than a representation of the triangle's mental state, that was automatically generated. Thus, the conflict that slowed responding in incongruent trials was between spatial codes in object-centered and egocentric frames of reference. For example, the dot was on the left of the triangle and on the right of the participant.

It is tempting to think that the implicit mentalizing interpretation is more likely to be correct because the congruency effect was observed in the context of animations that evoked goal-related and mental states descriptions but not in the random condition. This pumps the intuition (Dennett, 1980) that the congruency effect depended on the participants seeing the triangle not merely as an object but as an agent. If this was the case, it would imply that the effect is mediated by a process that is specialized for tracking mental states. However, earlier research on object-centered spatial coding in stimulus-response compatibility tasks has suggested that this inference would not be valid. Following Hommel and Lippa (1995), Pick, Specker, Vu, and Proctor (in press) found that both animate and inanimate stimuli support object-centered spatial coding. In their experiments, a visual stimulus (the equivalent of Zwickel's, 2009, dot) was presented above or below the center of a frontal image of Marilyn Monroe's face or of a Volkswagen Beetle car. The image was horizontally aligned but was tilted 90° to the left or right. Therefore, for example, when the object (face or car) was tilted to the right, a target appearing above was on the object's left, and a target appearing below was on the object's right. The results indicated a congruency effect in both face (agent) and car (nonagent) conditions. For example, participants responded faster when they were required to make left responses to targets above the object and right responses to targets below the object than when they were given the opposite stimulus-response mappings. Similar results were obtained by Pick et al. with a profile rather than a frontal image of the car, suggesting that the car did not support object-centered spatial coding by virtue of its similarity with a face (see Surtees, Noordzij, & Apperly, 2012, for further evidence that asocial stimuli, such as chairs, support object-centered spatial coding). These findings are consistent with the submentalizing hypothesis. They raise the possibility that Zwickel (2009) found a congruency effect in the goal-directed and mental state conditions, not because these animations evoked automatic mental state ascriptions but because these animations made the acute angle of the triangle more salient and thereby enhanced object-centered spatial coding.[4]

Retroactive Interference and Agent Smurf

Kovács, Téglás, and Endress (2010) sought evidence of implicit mentalizing in adults using a procedure similar to those commonly used to test for mentalizing in infants. Their participants watched movies showing a Smurf—as the putative target of true and false belief attribution—a ball, and an occluder (see Fig. 3). Each movie had three phases. The first and last phases were constant across conditions. In their primary experiment (Kovács et al., 2010, Experiment 1), the first phase showed the Smurf placing a ball on a table in front of an occluder and then the ball moving behind the occluder. In the last phase, the Smurf appeared on the screen and stood beside the table as the occluder fell forward to reveal that the ball was, or was not, behind it. The participant's task was to press a button as soon as he or she saw the ball. The events shown in the second stage of the movie varied across conditions. In Phase 2 of the P+A+ condition, the ball made two moves while the agent was present: It rolled out from behind the occluder, and off the screen, and then returned from the same direction and went behind the occluder again. After the final movement, the Smurf left the screen. Thus, according to the mentalizing interpretation, when the test (Phase 3) began, both the participant (P+) and the agent (A+) believed (truly) that the ball was behind the occluder. In contrast, in Phase 2 of the P−A− condition, the ball made three moves before the Smurf left the screen: It rolled out from behind the occluder, rolled back behind the occluder, and then rolled out and left the screen. Therefore, on a mentalizing interpretation, both the participant (P−) and the agent (A−) believed (truly) that the ball was not behind the occluder. In the P−A+ condition, the ball made the same three moves it made in the P−A− condition, but the Smurf left the screen before the final move. Thus, the participant (P−) believed (truly) that the ball was not behind the occluder, and the agent (A+) believed (falsely) that the ball was behind the occluder. Finally, in the P+A− condition, the ball made the same two moves it made in the P+A+ condition, but the Smurf was present when the ball left the screen and was absent when it returned to its position behind the occluder. Therefore, the participant (P+) believed (truly) that the ball was behind the occluder, whereas the agent believed (falsely) that the ball was not behind the occluder (A−).

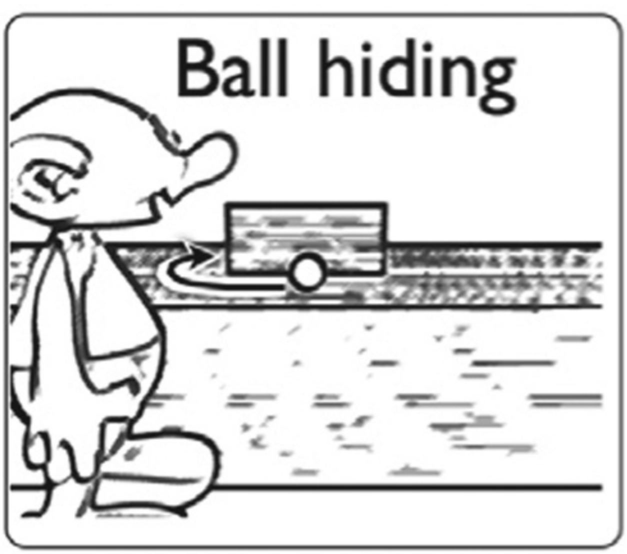

Fig. 3. An example of the stimuli used in the Smurf test of false belief attribution. Reprinted with permission from Kovács, Téglás, and Endress (2010).

The results showed that responses were faster in the P+A+ condition than in the P−A− condition, suggesting that the ball was detected faster when participants believed, on the basis of their Phase 2 experience, that the ball was behind the occluder. However, the critical result (Kovács et al., 2010) indicated that responding was faster in P−A+ trials than in P−A− trials. This was taken to provide evidence of implicit mentalizing—to show that, although they were making speeded responses and had not been asked to take the agent's beliefs into account, the participants responded faster when they attributed to the agent a belief that the ball was behind the occluder than when they attributed to the agent a belief that the ball was not behind the occluder.

An alternative, submentalizing explanation suggests that responses were faster in the P−A+ condition than in the P−A− condition not because the agent in P−A+ was absent during the final ball movement and therefore believed (falsely) that the ball was behind the occluder, but because in the P−A+ condition a perceptually salient event—reappearance of the Smurf at the beginning of Phase 3—occurred immediately after the last ball movement. The immediate occurrence of this salient event, which was delayed in the P−A− condition,[5] is likely to have caused *retroactive interference* in the P−A+ condition: poor memory for the preceding event—that is, the last ball movement (Pearce, 2008).[6] This would leave the participant less confident that the ball was not behind the occluder and therefore faster to respond when the ball appeared than in the P−A− condition.

The results of the other experiments in the series by Kovács et al. (2010) are also consistent with the submentalizing interpretation. In Experiment 2, the critical result was replicated when in all conditions a pile of boxes took the place of the Smurf in Phase 3. Thus, in this experiment, as in Experiment 1, an abrupt visual onset—appearance of the boxes—of the kind that is known to be especially effective in grabbing attention and thereby causing retroactive interference (Egeth & Yantis, 1997) occurred immediately after the last ball movement in the P−A+ condition but not in the P−A− condition. In Experiment 3, the critical result was not observed. A pile of boxes replaced the Smurf in all phases of this experiment, and it was continuously present; it did not disappear in Phase 2 and reappear in Phase 3. Consequently, there was no event in any condition likely to cause retroactive interference, and, therefore, the absence of a response time difference between the P–A+ and P–A– conditions is consistent with the submentalizing account.[7]

One of the many strengths of the procedure used by Kovács et al. (2010) is that by replacing the Smurf with a pile of boxes in some later experiments, it incorporated inanimate control stimuli. However, to test the implicit mentalizing hypothesis against the retroactive interference submentalizing alternative, it would also be necessary to control the interval between final ball movements and subsequent attention-grabbing visual onset events.

Distraction and Anticipatory Looking

The *Southgate–Senju* procedure is another test of implicit mentalizing that was originally designed for infants (Southgate, Senju, & Csibra, 2007) but that has also been given to adults (Senju, Southgate, White, & Frith, 2009). Like the Smurf experiments, their procedure encouraged participants to attribute a false belief to an agent by showing them that an object had been moved when the agent could not see the displacement. However, in the Southgate–Senju procedure, performance was measured with *anticipatory looking* (Clements & Perner, 1994), in which eye movements were measured rather than manual response times. The agent was human, and the agent could not see the displacement because he or she had turned away, rather than left the scene.

In each of the movies used by Senju et al. (2009), the human agent was seated behind a panel containing two windows, on the participant's left and right, and below each window was an opaque box. The agent's head was visible at the top of the panel. There were four familiarization trials and one test trial. In the familiarization trials, a toy appeared on top of one of the boxes or was placed in one of the boxes by a puppet. Then both windows were illuminated, and a tone sounded. Then, 1.75 s later, a hand came through the window above the box supporting or containing the toy and reached toward it. By the fourth familiarization trial, all participants showed anticipatory looking; they moved their eyes toward the location where the hand would appear in the 1.75-s interstimulus interval. This indicates that the participants had learned that window illumination and the tone signaled the appearance of a hand and that the hand would appear on the toy side. The test trial always began with the puppet placing the ball in the left box. It then moved the ball to the right box and disappeared. At this point, the agent conspicuously turned his or her head away (looking up, behind, and to the participant's left).[8] While the agent's head was turned away, the puppet reappeared, took the ball out of the right box, and removed it from the scene. After the puppet had disappeared, the agent turned back so that he or she was looking down at the boxes, the windows were illuminated, the tone sounded, and recording of eye movements began.[9]

Using this procedure, Senju et al. (2009) tested typically developing adults and adults with Asperger's syndrome, matched for IQ and, unusually, performance in tests of explicit mentalizing. They found two interesting results: First, like infants (Southgate et al., 2007), the typically developing adults tended to make their first eye movement toward the location at which the agent had last seen the toy, and they looked longer at this location than at the other location. Second, the people with Asperger's syndrome did not show this anticipatory looking effect; as a group, their first eye movements and gaze durations were distributed roughly equally between the two locations. Therefore, the typically developing adults were, and the adults with Asperger's syndrome were not, infant-like in their performance. How can this pattern of results be explained?

The implicit mentalizing interpretation suggests that the infants and typically developing adults looked sooner and for longer at the location where the agent had last seen the toy because they attributed to the agent a false belief that the toy was at that location and, therefore, anticipated that the agent's hand would appear in that place. In contrast, although the participants with Asperger's syndrome had somehow learned to pass explicit mentalizing tasks, their implicit mentalizing ability was impaired. Consequently, the participants with Asperger's syndrome did not attribute a false belief to the agent and, therefore, did not look sooner or longer at the location where a false belief would place the toy.[10]

An alternative submentalizing interpretation suggests that the infants and typically developing adults were distracted by the agent's head turning. When the agent turned, they looked at his or her head and at the area to which it was now directed, and they were therefore less likely to see or to remember the toy movements that occurred while he or she was looking away (Heyes, in press). Consequently, these participants looked at the location where they, rather than the agent, falsely believed that the hand would appear. Under this submentalizing interpretation, the people with Asperger's syndrome were less distracted by the agent's head turning. They were less likely to track the agent's head movement and, therefore, more likely to know that the toy had been removed from the scene, leaving no reliable basis for predicting at which window the agent's hand would appear. This possibility—that the participants with Asperger's syndrome were more focused than the control participants—is consistent with prior evidence that people with autism show less joint attention behavior (Charman et al., 1997) and with data from the same study showing that the people with Asperger's syndrome spent less time than the typically developing adults looking at the agent's face, but they spent the same amount of time looking at other features of the apparatus (Senju et al., 2009).[11]

Conclusions and Future Directions

A range of different procedures have been used to seek evidence of implicit mentalizing in older children and adults—to test for automatic representation of what others see (Samson et al., 2010; Zwickel, 2009), what they intend (Sebanz et al., 2003), and what they falsely believe about the locations of objects (Kovács et al., 2010; Senju et al., 2009). For each of the leading test procedures, I have argued that although they have been ingeniously designed and carefully implemented, the results to date do not provide evidence of implicit mentalizing. In each case, the results could be due not to automatic thinking about mental states but to submentalizing—the operation of familiar, domain-general cognitive mechanisms. These include the processes known to mediate involuntary attentional orienting (the dot perspective task), spatial coding of responses locations (the social Simon procedure), object-centered spatial coding of stimulus locations (the triangle test), retroactive interference (Agent Smurf), and distraction (the Southgate–Senju procedure).

The most obvious implication of my analysis is that further research would be needed to show that adults engage in implicit mentalizing. For each procedure, I have made some specific suggestions regarding the kind of control procedures that would be helpful. These cannot be distilled into a single formula because research on implicit mentalizing has a variety of targets—for example, representation of what others see, intend, and falsely believe—and uses a range of tasks that are likely to enlist overlapping but distinct sets of domain-general cognitive processes. However, a common problem is that research on implicit mentalizing does not show that key effects are specific to animate, rather than to inanimate, stimuli or that animate stimuli are "special" because of their agentive features—features that make them appropriate targets for mental state attribution—rather than features that make them better able to grab and hold attention. Therefore, procedures that include closely matched inanimate control conditions, such as those of Santiesteban et al. (in press), and subtle attentional measures are likely to be particularly valuable.

To test for the implicit attribution of seeing and believing in nonhuman primates (Heyes, 1998) and human infants (Heyes, in press), following Novey (1975), I have recommended the use of "self-informed" belief induction variables—variables that, if the participant is capable of mentalizing, he or she knows only through extrapolation from her own experience to be indicative of what an agent can or cannot see and, therefore, does or does not believe. This experimental strategy may also be of value in research on implicit mentalizing in adults. The logic of self-informed belief induction could be implemented in many ways, in which various concrete obstacles to perception (visors, goggles, headphones, gloves) in different modalities (vision, hearing, touch) are used, and could be combined with several of the procedures currently used to test for the implicit attribution of seeing and believing in adults (the dot perspective, Smurf, and Southgate–Senju tasks).

For example, in a self-informed version of the dot perspective task, participants would initially try on two visors of the kind attached to motorcycle crash helmets: one translucent and the other opaque. The translucent and opaque visors would be of different colors, but otherwise they would be identical in appearance when worn by another agent. After discovering that, say, the red visor affords seeing, and the blue visor does not (counterbalanced), participants would complete the dot perspective task in the usual way—confirming on each trial whether a digit corresponds to the number of dots that the participant can see (self condition) or that the avatar can see (other condition)—but in each trial, the avatar would be wearing the translucent or the opaque visor. If the self-consistency effect observed in previous dot perspective experiments is really due to implicit mentalizing, one would expect this effect to be replicated when the avatar is wearing the visor that the participants know to be translucent (red) but not when the avatar is wearing the visor that they know to be opaque (blue). Thus, in the self-translucent condition, but not in the self-opaque condition, participants would be slower to make "yes" responses when the number of dots in front of the avatar differs from the total number on the screen. This pattern of results—a self-consistency effect in the translucent but not in the opaque condition—could not be due, as the submentalizing hypothesis suggests, to the directional features of the avatar stimulus because an avatar wearing a red visor is no more or less directional than an avatar wearing a blue visor.

In current research, investigators seek to manipulate the perceptual and belief states that participants implicitly attribute to agents by showing participants that the agent is present or absent during key events or that he or she is oriented toward or away from focal stimuli. Like these belief induction variables, a self-informed belief induction variable, such as red visor/blue visor, reliably correlates with whether an agent can see, and therefore has true beliefs about, key events. However, unlike the belief induction variables in common use, if the logic of a self-informed belief induction variable is properly implemented, its significance with respect to seeing and believing is not confounded by low-level stimulus features that are likely to have different effects on domain-general processes, such as those producing automatic attentional orienting, retroactive interference, and distraction.[12]

Another important implication of my analysis is that we humans may not need mentalizing as much as previously thought. Apperly and Butterfill have argued persuasively that explicit mentalizing is too slow and cognitively demanding for use in many types of everyday social interaction—for example, in competitive sports, coordinated action, and during rapid communication (Apperly, 2011; Apperly & Butterfill, 2009). One solution would be to use a fast-and-efficient implicit mentalizing module in these situations, but my analysis suggests that dedicated mentalizing processes may not be necessary—that the same jobs can be done just as effectively by domain-general processes, such as those involved in automatic attentional orienting and spatial coding of stimuli and responses. There is no reason to suppose that these domain-general processes evolved "for" the tracking of mental states, that their development especially depends on interaction with other agents, or that they operate selectively or in a distinctive way in social contexts. However, I have called them submentalizing rather than, for example, "pseudo-mentalizing," because I think these, and other domain-general processes, provide substitutes and substrates for mentalizing in everyday life.

For example, spatial coding of one's own responses relative to those of another agent (the social Simon procedure) and of stimuli relative to another agent's orientation (dancing triangles) is likely to play a crucial role in allowing smooth coordination of action. If you and I are moving furniture or dancing together, our performance will be more efficient and graceful if each of us codes our movements, and the locations of key objects and events, relative to the other's body as well as to our own. Indeed, if we are both doing this kind of spatial coding, via domain-general processes, it is not clear what we would gain—how the efficiency and grace of our movements would be enhanced—if we were also representing what the other sees, believes, and intends. Thus, in behavioral coordination tasks, domain-general processes of spatial coding may provide a substitute for mentalizing.

Similarly, domain-general attentional processes, which lead in social contexts to enhanced processing of objects (the dot perspective task) and events (the Southgate–Senju procedure) located in front of an agent, will tend to bring mental states into alignment. Regardless of whether I am representing your mental states, if I attend to the same location as you, we are more likely to have the same beliefs at the same time—to be thinking simultaneously that "the cliff edge is nearby," "there's a puddle on the floor," or "someone has just entered the room." Like spatial coding, this kind of attentional process could provide a substitute for mentalizing in many behavioral coordination tasks, giving partners' similar targets and priorities for action. In addition, it is likely that domain-general attentional processes provide a substrate for explicit mentalizing, both developmentally and in ongoing social interaction. To accurately conceptualize what an agent can see, an infant must first be able to segment a scene into parts that are and are not visually accessible to another agent. Processes that direct attention to the front of objects could contribute to this kind of segmentation, scaffolding development of the concept of "looking" prior to that of "seeing." Likewise, after explicit mentalizing has developed, if a task requires representation of what another agent can see, domain-general processes of attentional orienting could help to fix the content of the mental state ascribed—to facilitate rapid identification of what the other agent sees and therefore believes.

If domain-general submentalizing processes can act as substitutes and substrates for explicit mentalizing, it would be a mistake to regard them as "fake" and the effects examined in this article as artifacts. Rather, I have argued that in elegantly designed experiments, domain-general cognitive processes can give researchers the false impression that participants are mentalizing. If this is correct, it suggests that in everyday life, the same domain-general cognitive mechanisms can provide a smart alternative to mentalizing—they can guide us through a wide range of social situations without thinking about mental states.

A potential objection to my analysis is that it sets the bar for implicit mentalizing too high. It might be argued that any psychological process, short of explicit mentalizing, should be regarded as implicit mentalizing if it produces social behavior similar to that which would be produced by thinking about mental states. It is certainly possible that, for some purposes, this kind of liberal definition of implicit mentalizing would be useful. However, shoaling fish and pack-hunting dogs have psychological mechanisms that simulate the behavioral products of mentalizing, and processes producing retroactive interference (Grant, 1988) and Simon effects (Urcuioli, Vu, & Proctor, 2005) are present even in humble creatures, such as the pigeon. Therefore, if implicit mentalizing is understood to embrace the processes described here as submentalizing, the concept is unlikely to help researchers to understand how and why humans have come to live such extraordinary lives.

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Notes

1. Evidence that the self-consistency effect is due to an automatic process comes from data showing that it occurs not only when self and other trials are mixed but also when they are blocked. This indicates that the effect is not due to confusion about trial type leading to intentional initiation in self trials of a process that is appropriate only in other trials (Samson et al., 2010, Experiment 2). Similarly, if the self-consistency effect was due to a controlled process, it should be smaller when participants perform, alongside the dot perspective task, another task that taxes control processes. However, the effect is actually larger under these conditions (Qureshi et al., 2010).

2. This submentalizing explanation can account for all of the effects so far reported in which the dot perspective task was used. For example, the self-consistency effect goes away when the avatar is replaced by a rectangle stimulus with lines of different colors on each side (e.g., Samson et al., 2010, Experiment 3). This is what one would expect on the submentalizing account because the bar was asymmetric, but it did not have directional features. Similarly, a self-consistency effect was not detected in an analogous task in which the stimuli were single numerals rather than spatially distributed dots (Surtees, Butterfill, & Apperly, 2012). The submentalizing account would not predict an effect under these conditions because in all trials the task instructions and the front features of the avatar directed the participant's attention to the same location.

3. Like the social Simon effect, the *joint flanker effect* (Atmaca, Sebanz, & Knoblich, 2011) is a stimulus-response compatibility effect that is present when the participant is tested alongside a confederate but not usually when he or she is tested alone. The joint flanker effect is not discussed in this article because, compared with the social Simon effect, there is little evidence that it is modulated by variables that are likely to influence mentalizing—that is, the representation of mental states rather than overt responses. In one experiment, Atmaca et al. (2011, Experiment 4) failed to find the joint flanker effect when the confederate's responses were unintentional (controlled by an electromagnet), but this result depended on comparisons across experiments with different stimulus parameters.

4. In the Director's task (Keysar, Lin, & Barr, 2003), participants are instructed by a confederate (the "director") to move objects in a grid. The locations of the participant, the director, and the grid are such that the director can see some but not all of the objects visible to the participant. In responding to the director's instructions, participants commonly fail to take account of this, making many egocentric errors. The Director's task has features in common with the dot perspective task, the social Simon procedure, and Zwickel's (2009) test. However, it is not discussed in this article for two reasons. First, following an earlier report that people with autism do not show impaired performance on the Director's task (Begeer, Malle, Nieuwland, & Keysar, 2010), a recent study showed that the same pattern of results is obtained, in typically developing adults and in adults with autism, when the director and an inanimate object, a camera, provide the point of spatial reference (Santiesteban, Shah, White, & Bird, 2013). These studies suggest that performance in the Director's task may not depend on mentalizing. Second, even if one assumes that mentalizing is involved, the temporal and linguistic features of the Director's task suggest that it is more likely to involve explicit, rather than implicit, mentalizing.

5. Most details of the methods used by Kovács et al. (2010) were reported in supplementary material. That material suggests that the interval between the last ball movement and reappearance of the Smurf was 2 s in the P−A+ condition and 4 s in the P−A− condition.

6. The term retroactive interference refers to disruption of memory for Event X because it is followed by Event Y (Pearce, 2008). Retroactive interference is a robust phenomenon found in a broad range of nonhuman species—including monkeys (Fuster & Bauer, 1974) and pigeons (Grant, 1988)—and in human adults (Yoon, Curtis, & D'Esposito, 2006) and infants (Diamond, 1985; Marcovitch & Zelazo, 2003).

7. Kovács et al. (2010) reported four further experiments using a similar procedure with 7-month-old infants. The results of these experiments can also be explained by retroactive interference (Heyes, in press).

8. In the infant study reported by Southgate et al. (2007), a bell began to sound when the agent turned his or her head away and ceased when he or she turned back. Senju et al. (2009) used the same movies but did not report whether the bell sounded in their study.

9. In the text, I describe one of the two test trials used by Senju et al. (2009), designated FB1. In the FB2 test trials, the puppet disappeared immediately after placing the ball in the left box, and then the agent turned away (looking up, behind, and to the participant's right). While his or her head was turned, the puppet reappeared, moved the ball from the left box to the right box, retrieved it from the right box, and removed it from the scene. Then, as in the FB1 condition, the agent turned back, and eye movement testing began. In reporting their results, Senju et al. averaged across the FB1 and FB2 conditions.

10. In principle, given that there was only one test trial, rather than a speeded series of trials, and that eye movements can be voluntarily controlled, the results reported by Senju et al. (2009) could also be given an explicit mentalizing interpretation. This would suggest that the behavior of the typically developing adults reflected the content of verbally reportable beliefs about the agent's beliefs. However, because the typically developing group and the group with Asperger's syndrome were matched for performance on standard tests of explicit mentalizing, this interpretation would have to assume not only that anticipatory looking in the Southgate–Senju task is mediated by different processes in adults and infants but also that this procedure is a more sensitive test of explicit mentalizing than those currently in use.

11. The submentalizing interpretation of performance in the Southgate–Senju task is consistent with the results of a recent study by Low and Watts (2013), in which they sought evidence of "signature limits" on implicit mentalizing. In this study, they found that 3-year-olds, 4-year-olds, and adults passed the Southgate–Senju test, intended to assess the attribution of false

beliefs about object location, and, yet, failed a "dog-robot" anticipatory looking test, designed to detect the attribution of false beliefs about object identity. This pattern of results was taken to indicate that in participants of all ages, performance in the Southgate–Senju task was mediated by a fast and efficient implicit mentalizing mechanism that can represent false beliefs about object location but not about object identity. The search for signature limits on implicit mentalizing is a very promising empirical approach (Apperly & Butterfill, 2009). However, the submentalizing interpretation suggests that in Low and Watts's experiment, participants passed the Southgate–Senju test because they were distracted by the head-turning behavior of the agent, and they did not pass the dog-robot test because, inter alia, the procedure did not include a distractor or source of retroactive interference that would produce the same anticipatory looking behavior as the attribution of false belief.

12. A recent study using self-informed belief induction with human infants (Senju, Southgate, Snape, Leonard, & Csibra, 2011) yielded promising results but also underlined a number of important implementation issues. Because this study involved infants rather than adults, I have not discussed these issues here but in a similar article on implicit mentalizing in infancy (Heyes, in press).

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