Finding Consciousness in the Brain

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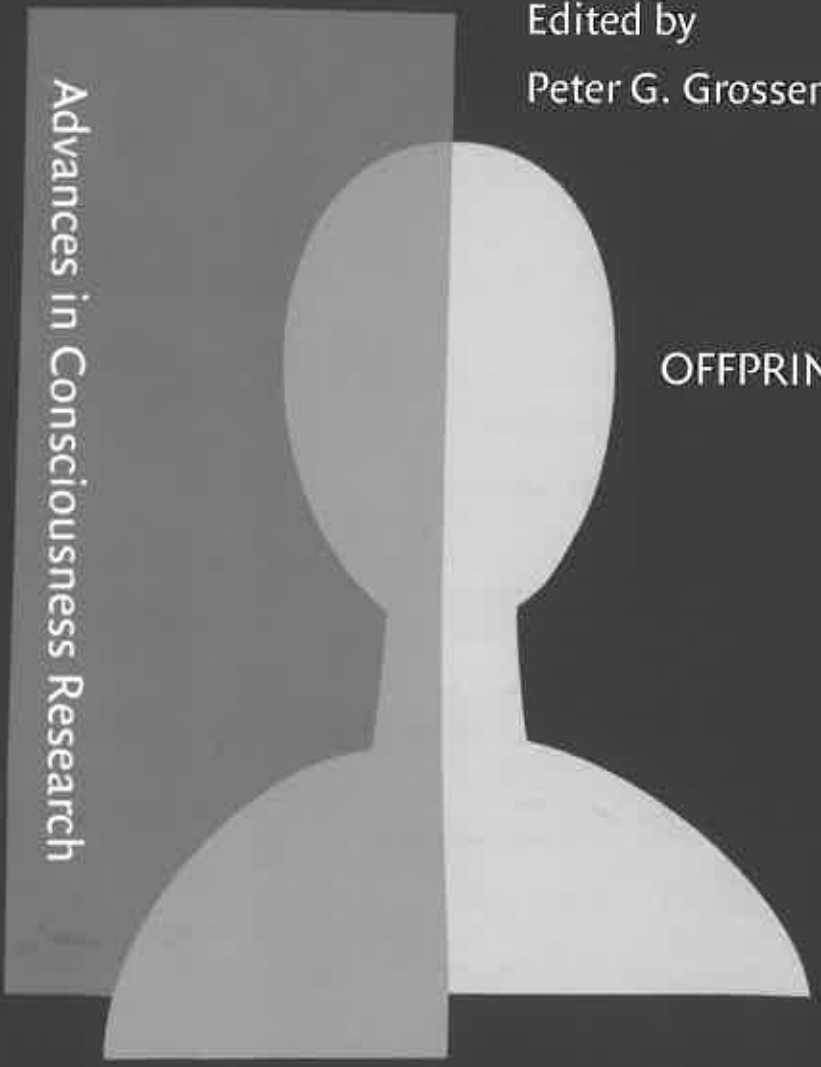
Peter G. Grossenbacher

Advances in Consciousness Research



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CHAPTER 3

Consciousness of the Physical and the Mental

Evidence from autism

Simon Baron-Cohen
University of Cambridge

At the close of the last millennium and in the dawn of the new one, scientists and philosophers of all hues (Crick, 1994; Dennett; 1993; Penrose, 1992; Gray, 1995; Bloch, 1995) are seizing on one big question: the explanation of consciousness. Presumably this recent surge of interest is because we think that if we can crack this one, we will finally have understood what it is that makes humans special. But by a strange irony, almost all accounts seem to focus on one type of consciousness that in all likelihood makes humans indistinguishable from many (if not all) animals: consciousness of the physical world. In Dennett's (1978) terminology, this is first-order consciousness. Thus, questions driving most accounts are along the lines of "Why do we 'see' something when our visual system is stimulated?", or "Why do we 'feel' something when our tactile system is stimulated?", or "Why are we 'aware' of some things, but unaware of others?" etc., These are important questions all right. But they all center on what I call our *consciousness of the physical world.* That side of consciousness will figure very small in this essay. The other side of consciousness — and let's for the moment assume there are only two aspects to this slippery thing — I call *consciousness of the mental world.* Exactly which entities count as mental needs a little more spelling out, which I do next.

1. The mental-physical distinction

I draw this distinction not because I am a dualist (I am not - there are in my world no mental events that do not also have a physical instantiation); but because, according to Brentano (1823), we can identify two sorts of (ultimately physical) entities in the universe: things with intentionality — which I shall call 'mental' — and things without intentionality — which I shall call 'physical'.

This begs the question as to how intentionality is to be defined. Brentano's definition is probably as good as one can get. Here it is, paraphrased. Those things that refer to (or are about) things other than themselves are intentional, and everything else is not. Contrast therefore, a rock, with a thought about a rock. The rock is not 'about' anything else. It is just a rock! In contrast, a thought about a rock necessarily is about something else: a rock. The thought is both something in its own right, and is about something other than itself. It is in this sense that intentional and non-intentional objects are distinct. I will argue that humans have two dissociable forms of consciousness for these two classes of entity, and the evidence for this claim comes largely from neuropsychological experiments with children with autism.

2. Are children with autism conscious of the physical?

This section can be relatively brief, since the answer to the above question is clearly "yes." We know this because of the following pieces of evidence. First, children with autism search to find occluded objects (Sigman, Ungerer, Mundy, and Sherman, 1987; Frith and Baron-Cohen, 1987). That is, they behave in ways which are intended to cause them to *see* something. Secondly, they are capable of mental rotation (Shah, 1988). This suggests that they have representations in their mind of how physical objects appear from different visual perspectives, in the same way that the rest of us do. Thirdly, they respond to the same range of sensory stimuli as other people (though they may be hypersensitive to some sounds and tactile stimuli) (Wing, 1976; Frith, 1989). Fourthly, as far as we know, their color perception is normal. They may attend to parts of objects in a different manner to others (Shah and Frith, 1983, 1993; Frith and Happe, 1994; Jolliffe and Baron-Cohen, 1997), but there is little doubt that they have conscious experiences of the physical world.

Perhaps the best evidence for their consciousness of the physical world is that, when questioned, they can *report* their awareness of this plane of existence. After all, verbal report is pretty much the only way we have of confirming that someone (other than ourselves) is conscious. Even this is not a fool-proof form of evidence, of course. A zombie could in principle produce words which apparently report conscious experience even though s/he was totally unaware of the physical world. But if we accept what people tell us, on face-value, then we find that when asked if they can see, hear, touch, smell, or taste something, children and adults with autism will affirm that they can. (At least, those who speak do so). Since this aspect of their consciousness is relatively non-contentious, we can pass swiftly on to the next question, of whether children with autism are also conscious of the mental world.

3. Are children with autism conscious of the mental?

This section is necessarily longer than the previous one, since a long line of evidence collected over the last two decades suggests that children with autism are relatively *unaware of the mental*. Wimmer and Perner (1983) devised an elegant paradigm to test when normally developing children become conscious of the mental — specifically, when they are aware of another person's beliefs. The child was presented with a short story, with the simplest of plots. The story involves one character not being present when an object was moved, and therefore not *knowing* that the object was in a new location. The child being tested is asked where the character *thinks* the object is. Wimmer and Perner called this the False Belief test, since the focus was on the subject's ability to infer a story character's mistaken belief about a situation. These authors found that normal 4 year olds correctly infer that the character thinks the object is where the character last left it, rather than where it actually is. This is impressive evidence for the normal child's ability to distinguish between their own knowledge (about reality) and someone else's false belief (about reality).

When this test was given to a sample of children with autism, with mild degrees of mental handicap, a large majority of them 'failed' this test by indicating that the character thinks the object is where it actually is (Baron-Cohen, Leslie, and Frith, 1985). That is, they appeared to disregard the critical fact that, by virtue of being *absent* during the critical scene, the character's

mental state would necessarily be different to the child's own mental state. In contrast, a control group of children with Down's Syndrome, with moderate degrees of mental handicap, passed this test as easily as the normal children. The implication was that the ability to infer mental states may be an aspect of social intelligence that is relatively independent of general intelligence (Cosmides, 1989), and that children with autism might be specifically impaired in their consciousness of the mental.

Of course, simply failing one test would not necessarily mean that children with autism lacked awareness of the mind. One swallow does not make a summer. There might be many reasons for failure on such a test. (Interestingly, control questions in the original procedure ruled out memory, or language difficulties, or inattention as possible causes of failure). The conclusion that children with autism are indeed impaired in the development of a normal awareness of the mind only becomes possible because of the convergence of results from widely differing experimental paradigms. These are reviewed in detail in two edited volumes (Baron-Cohen, Tager-Flusberg, and Cohen, 1993, 2000) and for that reason are only briefly summarized here, next.

3.1 *Summary of results suggesting that children with autism are impaired in their awareness of the mental*[1]

The majority of children with autism

i. are at chance on tests of the *mental-physical distinction* (Baron-Cohen, 1989a). That is, they do not show a clear understanding of how physical objects differ from *thoughts* about objects. For example, when asked which can be touched: a biscuit, or a thought (about a biscuit), young normal 3 year olds rapidly identify the former, whereas most children with autism respond at chance levels.

ii. They also have an appropriate understanding of the functions of the brain, but have a poor understanding of the functions of the mind (Baron-Cohen, 1989a). That is, they recognize that the brain's physical function is to make you move and do things, but they do not spontaneously mention *the mind's mental function* (in thinking, dreaming, wishing, deceiving, etc.,). Again, contrast this with normal 3 year old children who do spontaneously use such mental state terms in their descriptions of what the mind is for (Wellman and Estes, 1983).

iii. Most children with autism also fail to make the *appearance-reality*

distinction (Baron-Cohen, 1989a), meaning that, in their description of misleading objects (like a red candle in the shape of an apple), they do not distinguish between what the object *looks* like, and what they *know* it really is. For example, the normal 4 year old child will say of an ambiguous object, when asked what it looks like, and what it really is, that "It *looks* like an apple, but *really* it's a candle made of wax" (Flavell, Flavell, and Green, 1983). In contrast, children with autism tend to refer to just one aspect of the object (e.g., saying "It looks like an apple, and it really is an apple."

iv. Most children with autism fail a range of *first-order false belief* tasks, of the kind described in the previous section (Baron-Cohen et al., 1985, 1986; Perner, Frith, Leslie, and Leekam, 1989; Swettenham, 1996; Reed and Petersen, 1990; Leekam and Perner, 1991). That is, they show deficits in thinking about someone else's different beliefs.

v. They also fail tests assessing if they understand the principle that *"seeing leads to knowing"* (Baron-Cohen and Goodhart, 1994; Leslie and Frith, 1988). For example, when presented with two dolls, one of whom touches a box, and the other of whom *looks inside* the box, and when asked "Which one *knows* what's inside the box?", they are at chance in their response. In contrast, normal children of 3-4 years of age correctly judge that it is the one who looked, who knows what's in the box. (This experimental procedure is schematically shown in Figure 3.1).

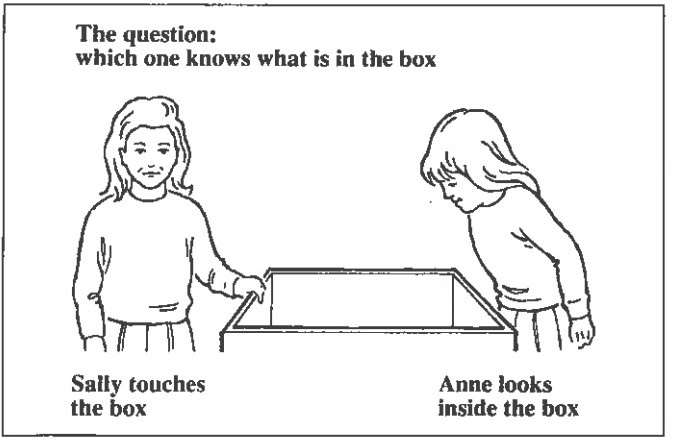

Figure 3.1. The seeing leads to knowing distinction. After Baron-Cohen and Goodhardt (1994).

We continue our survey of the evidence relevant to a 'consciousness of the mental' deficit in autism here:

vi. Whereas normally developing children are rather good at picking out *mental state words* (like "think", "know", and "imagine") in a wordlist that contains both mental state and non-mental state words, most children with autism are at chance (Baron-Cohen, Ring, Moriarty, Shmitz, Costa, and Ell, 1994). In contrast, they have no difficulty in picking out words describing physical states.

vii. Nor do most children with autism *produce* the same range of mental state words in their spontaneous speech (Tager-Flusberg, 1992; Baron-Cohen et al., 1986). Thus, from about 18-36 months of age, normally developing children spontaneously use words like "think", "know", "pretend", "imagine", "wish", "hope", etc., and use such terms appropriately (Wellman, 1990). In contrast, such words occur less frequently, and are often even absent, in the spontaneous speech of children with autism.

viii. They are also impaired in the production of *spontaneous pretend play* (Baron-Cohen, 1987; Wing, Gould, Yeates, and Brierley, 1977; Lewis and Boucher, 1988). Pretend play is relevant here simply because it involves understanding the mental state of *pretending*. The normal child of even 2 years old effortlessly distinguishes between when someone else is acting veridically, versus when they are "just pretending" (Leslie, 1987). Sometimes mommy is *actually* eating (putting a real spoon with real food into her mouth), whilst at other times mommy is just pretending to eat (holding a pen to her lips, and making funny slurping noises, in between her smiles).

Young normal children make rapid sense of such behavior, presumably because they can represent the latter case as driven by the mental state of "pretending." They also spontaneously generate examples of pretense themselves, and do not show any confusion as they switch back and forth between pretense (the mental world), and reality (the physical world). In contrast, most children with autism produce little pretense, and often appear confused about what pretense is for, and when someone is or is not pretending.

ix. Whilst they can understand simple causes of emotion (such as reactions to *physical* situations), the majority of children with autism have difficulty understanding more *mentalistic* causes of emotion (such as beliefs) [Baron-Cohen, 1991a; Baron-Cohen, Spitz, and Cross, 1993]. For example, they can understand that if Jane *actually* falls over and cuts her knee, she will feel sad, and that if John *actually* gets a present, he will feel happy. But they are poor at understanding that if John *thinks* he's getting a present (even if in reality he is

Figure 3.2. The "Which one is thinking?" test. Reproduced from Baron-Cohen and Cross (1992), with permission.

not), he will still feel happy. In contrast, normal 4 year old children comprehend such belief-based emotions.

x. Most children with autism also fail to recognize *the eye-region of the face* as indicating when a person is *thinking* and what a person might *want* (Baron-Cohen and Cross, 1992; Baron-Cohen, Campbell, Karmiloff-Smith, Grant, and Walker, 1995). Children and adults without autism use gaze to infer both of these mental states.

For example, when presented with pairs of photos like those in Figure 3.2, normal 3-4 year olds easily identify the person looking upwards and away as the one who is thinking. Children with autism are less sure of this. And when shown a display like the one in Figure 3.3, normal 4 year olds identify the candy that Charlie is looking at as the one he wants. Children with autism mostly fail to pick up that gaze can be an indicator of what a person might want.

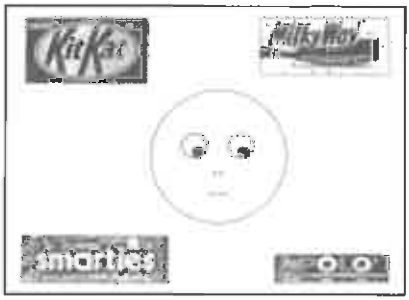

Figure 3.3. The "Which sweet does Charlie want?" test. Reproduced from Baron-Cohen et al. (1995), with permission.

In addition:

xi. Many children with autism fail to make the *accidental-intentional distinction* (Phillips, Baron-Cohen, and Rutter, 1998). That is, they are poor at distinguishing if someone "meant" to do something, or if something simply happened accidentally.

xii. They also seem unable to *deceive* (Baron-Cohen, 1992; Sodian and Frith, 1992), a result that would be expected if one was unaware that people's beliefs can differ and therefore can be manipulated. In contrast, normal children of 4 begin to be quite adept at lying, thus revealing their awareness of the mental lives of others.

xiii. Most children with autism also have disproportionate difficulty on tests of understanding metaphor, sarcasm, and irony — these all being statements which cannot be decoded literally, but which are only meaningful by reference to the speaker's *intention* (Happé, 1994). An example would be understanding the phrase "the drinks are on the house," which one adult with autism (of above average IQ) could only interpret literally. This suggests that children with autism are aware of the physical (the actual words uttered), but are relatively unaware of the mental states (the intentions) behind them.

xiv. Indeed, most children with autism fail to produce most aspects of *pragmatics* in their speech (reviewed in Baron-Cohen, 1988; and Tager-Flusberg, 1993), and fail to recognize violations of pragmatic rules, such as the Gricean Maxims of conversational cooperation (Surian, Baron-Cohen, and Van der Lely, 1996). For example, one Gricean Maxim of conversation is "Be relevant." If someone replies to a question with an *irrelevant* answer, normal young children are very sensitive to this pragmatic failure, but most children with autism are not. Since many pragmatic rules involve tailoring one's speech to what the listener *expects*, or needs to *know*, or might be *interested* in, this can be seen as intrinsically linked to a sensitivity to another person's mental states.

xv. Crucially, most children with autism are unimpaired at understanding how *physical* representations (such as drawings, photos, maps, and models) work, even while they have difficulty understanding *mental* representations (such as beliefs) [Charman and Baron-Cohen, 1992, 1995; Leekam and Perner, 1991; Leslie and Thaiss, 1992].

xvi. They are also unimpaired on logical reasoning (about the physical world) even though they have difficulty in psychological reasoning (about the mental world) [Scott and Baron-Cohen, 1996].

This long list of experiments provides strong evidence for children with autism lacking the normal consciousness of the mental. For this reason, autism can be conceptualized as involving degrees of *mindblindness* (Baron-Cohen, 1990, 1995).

It is important to mention that a minority of children or adults with autism pass first-order false belief tests. First-order tests involve inferring what one person thinks. However, these individuals often fail second-order false belief tests (Baron-Cohen, 1989b), that is, tests of understanding what one character thinks another character thinks. Such second-order reasoning is usually understood by normal children of 5-6 years of age, and yet these tests are failed by individuals with autism with a mental age above this level.

We can therefore interpret these results in terms of there being a *specific developmental delay* in mind-reading at a number of different points (Baron-Cohen, 1991c). Some individuals with autism who are very high functioning (in terms of IQ and language level), and who are usually adults, may pass even second-order tests (Bowler, 1992; Ozonoff, Pennington, and Rogers, 1991; Happe, 1993). Those who can pass second-order tests correspondingly also pass the appropriate tests of understanding figurative language (Happé, 1993). However, their deficit shows up on tests of adult mind-reading (Baron-Cohen, Jolliffe, Mortimore, and Robertson, 1997). Thus, being able to pass a test designed for a 6 year old when you are an adult may mask persisting mind-reading deficits by ceiling effects.

In summary, there appears to be a relative lack of the normal consciousness of the mental in the majority of cases with autism. This finding has the potential to explain the social, communicative, and imaginative abnormalities that are diagnostic of the condition, since being able to reflect on one's own mental states (and those of others) would appear to be essential in all of these domains. This deficit has been found to correlate with real-life social skills, as measured by a modified version of the Vineland Adaptive Behaviour Scale (Frith, Happé, and Siddons, 1994). In the next section, we turn to consider the origins of this cognitive deficit.

3.2 *The brain basis of our consciousness of the mental*

One possibility arising from these studies is that there may be a particular part of the brain which in the normal case is responsible for our consciousness of mental states, and which is specifically impaired in autism. If this view is

correct, the assumption is that this may be for genetic reasons, since autism appears to be strongly heritable (see Bolton and Rutter, 1990). The idea that the development of our consciousness of the mental is under genetic/biological control in the normal case is consistent with evidence from cross-cultural studies: Normally developing children from markedly different cultures seem to pass tests of 'mind-reading' at roughly the same ages (Avis and Harris, 1991).

Quite which parts of the brain might be involved in this is not yet clear, though candidate regions include right orbito-frontal cortex, which is active when subjects are thinking about mental state terms during functional imaging using SPECT (Baron-Cohen, Ring, et al., 1994); and left medial frontal cortex, which is active when subjects are drawing inferences about thoughts whilst being PET scanned (Fletcher et al., 1995; Goel et al., 1995). Other candidate regions include the superior temporal sulcus and the amygdala (for reasons explained below). These regions may form parts of a neural *circuit* supporting theory of mind processing (Baron-Cohen and Ring, 1994).

3.3 *Developmental origins of our consciousness of the mental*

In an influential article, Alan Leslie (1987) proposed that in the normal case, the developmental origins of mind-reading (or 'theory of mind') lie in the capacity for pretense; and that in the case of children with autism, the developmental origins of their mindblindness lies in their inability to pretend. In his model, pretense was the 'crucible' for theory of mind, as both involved the same computational complexity. Thus (according to Leslie), in order to understand that someone else might *think* "This banana is real," or *pretend* "This banana is real," the child would need to be able to represent the agent's *mental attitude* towards the proposition — since the only difference between these two states of affairs *is* the person's mental attitude. One idea, then, is that consciousness of the mental is first evident from about 18-24 months of age, in the normal toddler's emerging pretend play.

However, there is some evidence that this aspect of consciousness might have even earlier developmental origins. Soon after the first demonstrations of mindblindness in autism, Marian Sigman and her colleagues at UCLA also reported severe deficits in *joint attention* in children with autism (Sigman, Mundy, Ungerer, and Sherman, 1986). Joint attention refers to those behaviors produced by the child which involve monitoring or directing the target of

attention of another person, so as to coordinate the child's own attention with that of somebody else (Bruner, 1983). Such behaviors include the pointing gesture, gaze-monitoring, and showing gestures, most of which are absent in most children with autism.

This was an important discovery because joint attention behaviors are normally well-developed by 14 months of age (Scaife and Bruner, 1975; Butterworth, 1991), so their absence in autism signifies a very early-occurring deficit. This was also important because the traditional mind-reading skills referred to above are mostly those one would expect to see in a 3-4 year old normal child. Deficits in these areas cannot therefore be the developmentally earliest signs of autism, since we know that autism is present from at least the second year of life (Rutter, 1978), if not earlier.

Implicit in the idea of joint attention deficits in autism was the notion that these might relate to a failure to appreciate other people's point of view (Sigman et al, 1986). Bretherton, McNew, and Beeghly-Smith (1981) had also suggested joint attention should be understood as an "implicit theory of mind" — or an implicit awareness of the mental. Baron-Cohen (1989c, d, 1991b) explicitly argued that the joint attention and mind-reading deficits in autism were no coincidence, and proposed that joint attention was a *precursor* to the development of mind-reading. In one study (Baron-Cohen, 1989c), young children with autism (under 5 years old) were shown to produce one form of the pointing gesture (imperative pointing, or pointing to request) whilst failing to produce another form of pointing (declarative pointing, or pointing to share interest).

This dissociation was interpreted in terms of the declarative form of pointing alone being an indicator of the child monitoring another person's mental state — in this case, the mental state of "interest" or "attention." More recent laboratory studies have confirmed the lack of spontaneous gaze-monitoring (Leekam, Baron-Cohen, Brown, Perrett, and Milders, 1997; Phillips, Baron-Cohen, and Rutter, 1992; Phillips, Gomez, Baron-Cohen, Riviere, and Laa, 1995). Early diagnosis studies have also borne this out (Baron-Cohen, Allen, and Gillberg, 1992; Baron-Cohen, Cox, Baird, Swettenham, Drew, Nightingale, and Charman, 1996). The demonstration of a joint attention deficit in autism, and the role that the superior temporal sulcus in the monkey brain plays in the monitoring of gaze-direction (Perrett et al., 1985) has led to the idea that the superior temporal sulcus may be involved in the development of our consciousness of the mental (Baron-Cohen, 1994, 1995; Baron-Cohen

and Ring, 1994). Brothers (1990) also reviews evidence suggesting the amygdala contains cells sensitive to gaze and facial expressions of mental states. A recent neuroimaging study using fMRI confirms the role of the amygdala in normal mind-reading, and its under-activity in autism (Baron-Cohen, Ring, Williams, Wheelwright, Bullmore, and Simmons, 1999).

4. Conclusions

Autism may give us an important clue that the brain in fact allows at least *two distinct kinds of conscious experience*: consciousness of the physical (e.g., seeing an object) on the one hand, and consciousness of the mental (e.g., thinking about seeing an object) on the other. The latter is likely to be parasitic on the former, and whilst the former involves direct stimulation of perceptual systems, the mechanisms underlying the latter are still relatively unknown. As our understanding of the neurobiology of autism unfolds, so also our understanding of this second-order level of consciousness should too.

Notes

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1. In the following list of studies, all of the tests mentioned are at the level of a normal 4 year old child.

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