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## Developmental aspects of consciousness: How much theory of mind do you need to be consciously aware?

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### Abstract

11 When do children become consciously aware of events in the world? Five possible  
12 strategies are considered for their usefulness in determining the age in question.  
13 Three of these strategies ask when children show signs of engaging in activities for  
14 which conscious awareness seems necessary in adults (verbal communication, exec-  
15 utive control, explicit memory), and two of the strategies consider when children  
16 have the ability to have the minimal form of higher-order thought necessary for  
17 access consciousness and phenomenal consciousness, respectively. The tentative  
18 answer to the guiding question is that children become consciously aware between 12  
19 and 15 months ( $\pm 3$  months). © 2002 Elsevier Science (USA). All rights reserved.

20 *Keywords:* Theory of mind; Development; Higher-order thoughts; Explicit memory; Executive  
21 tasks; Access consciousness; Phenomenal consciousness

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## 22 1. Introduction

23 We organize this paper around a particular question: When do children become  
24 consciously aware of events in the world? To answer the question we first specify the  
25 meaning of conscious awareness. We outline five strategies for zeroing in on the age  
26 in question. Three of these strategies ask when children show signs of engaging in  
27 activities for which conscious awareness seems necessary in adults (sufficient con-  
28 ditions for conscious awareness). The other two strategies assume that some minimal  
29 form of higher-order thought about one's own mental state is required for conscious  
30 awareness and focuses on the question when children acquire the prerequisite un-  
31 derstanding of their own mental states (necessary conditions for conscious aware-  
32 ness). Our attempt at obtaining a coherent answer to our question raises interesting  
33 issues about each strategy; in particular, the question about what minimal under-  
34 standing of mind suffices for a higher-order thought. The tentative answer to the  
35 leading question is that children become consciously aware between 12 and 15  
36 months ( $\pm 3$  months).

## 37 2. Conscious awareness

38 As we are trying to pin down the meaning of conscious awareness by our expe-  
39 rience of it without an initial theoretical position, it is best introduced by example.  
40 The paradigm distinction is between the (conscious) awareness that a blindsight  
41 patient has about stimuli presented in his healthy, sighted field of vision and the  
42 (unconscious) awareness he has about stimuli in his blind field. Although the patient  
43 claims that he is blind in this part of his visual field he still processes information  
44 about stimuli in it. We know this because the patient unwittingly moves his eyes to  
45 the location of the stimuli (Pöppel, Held, & Frost, 1973) and can—what seems to  
46 him as a pure guess—point fairly accurately at the stimulus location and describe  
47 other features of the stimulus (Weiskrantz, Sanders, & Marshall, 1974; Weiskrantz,  
48 1998). A similar distinction can be observed for people with unimpaired vision under  
49 special testing conditions with visual illusions. A dot inside a frame is briefly pre-  
50 sented followed by a new brief exposure in which the dot remains stationary but the  
51 frame is displaced to the right. People report that the dot has moved to the left  
52 (induced Roelofs's effect; Bridgeman, Kirch, & Sperling, 1981). However, when asked  
53 to point to the spot where the dot was last seen (a declarative action) only some  
54 people are subject to the illusion. The other ones point accurately. When asked to  
55 touch the spot of the dot (a simple action) all people are accurate (Bridgeman,  
56 Gemmer, Forsman, & Huemer, 2000).

57 The blindsight patient has some awareness about the stimulus in his or her blind  
58 field, and the participants in Bridgeman's Roelofs experiment have information of  
59 the dot's actual location or else their fingers could not be pointing to/touching the  
60 correct spot. This awareness, however, is not conscious because the blindsighted  
61 person does not consciously experience any stimulus and the participant in the  
62 Roelofs experiment consciously experiences an incompatible event, i.e., a movement  
63 of the dot.

64 The same or similar difference in awareness is perhaps familiar to all of us when  
65 we engage in a highly routine activity like driving our car home from work. One can  
66 do this quite absentmindedly (no conscious awareness of one's actions) while en-  
67 gaging our full attention (conscious awareness) in a conversation with our passen-  
68 ger.<sup>1</sup> One common denominator of all these cases of nonconscious awareness is that  
69 feats (pointing to the stimulus accurately, steering the car through dense traffic)  
70 based on nonconscious information come—when they are pointed out to us by  
71 others—as a complete *surprise*, in a way that one would not be surprised if the in-  
72 formation had been available in fully conscious awareness (Rosenthal, in press).

73 How do we know that this difference in informational status is a difference be-  
74 tween conscious and nonconscious awareness? Well, that is how we experience it,  
75 and how we communicate it among ourselves: “I was not (consciously) aware of it,  
76 but I must have known (or done) it unconsciously.” In other words, without the  
77 blindsight patient's adamant denial of seeing anything in his or her blind field and  
78 without the clear claim by the participants in Bridgeman's experiment that they saw  
79 the dot move (and thereby deny that they had any knowledge of it remaining sta-  
80 tionary) we could not ascertain that the observed accurate performance was based  
81 on nonconscious information. It could be that it was based on conscious information  
82 considered unreliable hence not reported and the behavioral performance was based  
83 on it “by mistake.” This reliance on adults' verbal communication of conscious  
84 awareness raises a problem for investigations with young children or animals, who  
85 cannot talk and even if they could would find it difficult to convey their phenomenal  
86 experiences. So we need to get an indirect answer to the question as to whether  
87 children are consciously aware.

88 To get indirect access to children's conscious awareness we pursue five strategies.  
89 We look for evidence for when children can engage in activities that are thought to  
90 require conscious awareness and we look for evidence for abilities that are deemed  
91 necessary for conscious awareness by the higher-order thought (HOT) theory of  
92 consciousness.

### 93 3. Five strategies for children

#### 94 3.1. Strategy 1: Verbal communication

95 There is the entrenched intuition that verbal communication requires conscious  
96 awareness. Dennett (1978) even made verbal reportability the hallmark of con-  
97 sciousness. This intuition is supported by our everyday experience that, e.g., although  
98 I can drive a car through dense traffic absentmindedly while talking to my passenger  
99 (Armstrong, 1968; Carruthers, 2000, p. 149), why cannot I talk absentmindedly to my  
100 passenger while concentrating on the driving? Perhaps sometimes this can happen,

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<sup>1</sup> Armstrong (1968) has described a particularly strong version of this phenomenon in the case of long-distance lorry drivers. One objection to it is the possibility of conscious awareness but instant forgetting (Rosenthal, in press).

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101 but then the conversation tends to consist of rehearsed phrases, like when singing  
102 bedtime songs to the children. One keeps singing while thinking about more impor-  
103 tant matters. When interrupted one has no idea where one was in the song and has to  
104 start again from the beginning. This mindless singing is possible only because the song  
105 is known by heart and one word follows from the one previously just sung and one  
106 need not monitor the meaning of what is being said. In contrast, when trying to  
107 communicate about some object in the room and having to choose the right word to  
108 refer to it we usually do not do this without conscious awareness. These observations  
109 suggest that referential use of language of this kind requires conscious awareness. So,  
110 when do children begin to indulge in this kind of referential use?

111 Most researchers place the emergence of infants' first words at 12–13 months of  
112 age (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Carpenter, Nagell, &  
113 Tomasello, 1998). Although single word use has been recorded as early as 10  
114 months, real vocabulary growth does not start before 13 months (Fenson et al., 1994,  
115 p. 74). Moreover, the first words are part of social routines (e.g., “bye-bye”), whereas  
116 referential use of words referring to objects or activities (e.g., “ball” and “up”)  
117 emerge a month or two later. Since referential use of language appears to require  
118 conscious awareness in adults these findings suggest that infants between the ages of  
119 13 to 15 months are consciously aware. We do, however, need to point out the  
120 dangers and weaknesses of this kind of conclusion. Although our adult verbal  
121 communication typically involves conscious awareness, our communication—unlike  
122 children's earliest productions—rarely consists of single word comments. Hence it is  
123 less than certain whether our intuitions about adult conversation transfer to chil-  
124 dren's first utterances. Perhaps they are more like the vervet monkeys' (Cheney &  
125 Seyfrath, 1990) or domestic chicken's referentially specific alarm calls (Evans, Evans,  
126 & Marler, 1993) that may be automatically elicited by the proprietary stimulus,  
127 where our intuition would be less likely to see the necessity for conscious awareness.  
128 Perhaps genuinely productive (nonroutinized) combinations of two words are a  
129 better indicator of conscious awareness. First signs of such combinations can be seen  
130 at 16 months but show in a larger proportion of children not before 19–24 months  
131 (Fenson et al., 1994, pp. 50–52).

132 The case for conscious awareness at the earlier age of 15 months may be better  
133 served by the onset of (e.g., protodeclarative pointing; Bates, Camaioni, & Volterra,  
134 1975). Carpenter et al. (1998) report that several different communicative gestures  
135 emerge between 9 and 15 months, but a particular convincing kind of gesture is one  
136 where the infant directs an adult's attention to a particular (distal) object and checks  
137 whether the adult is attending to it. This emerges between 13 and 15 months  
138 (Tomasello, 1999, p. 65). It seems particularly convincing that this requires conscious  
139 awareness because we never point out a particular object absentmindedly and check  
140 whether the other person attends to it.

### 141 3.2. *Strategy 2: Executive control and focal attention*

142 Another strong intuition is that when we feel to be in charge so that we have full  
143 (voluntary) control over what we are doing then we are necessarily consciously aware  
144 of what we are doing. This intuition is so strong that Jacoby (1991) used voluntary

145 control over one's memory retrieval as a criterion for deciding which items in our  
146 memory are explicitly (consciously) remembered and which items come to mind as  
147 part of implicit memory. Since one has the feeling that oneself is fully in charge it has  
148 been called "executive control" and the functions that it fulfils, "executive functions"  
149 (e.g., Duncan, 1986; Welsh & Pennington, 1988) and the relevant part of our mind/  
150 brain the "central executive" in memory research (Baddeley & Hitch, 1974) or the  
151 "Supervisory Attentional System" (SAS) in schema theory (Norman & Shallice,  
152 1986) and neuropsychology (Shallice, 1988). The origins of this approach reside in  
153 the finding that patients with frontal lobe insult (Luria, 1966; Bianchi, 1922) expe-  
154 rience a loss of control over their actions (Milner, 1964) and have difficulty with  
155 certain tasks (Norman & Shallice, 1986): (1) planning/decision making, (2) trouble  
156 shooting, (3) novel/ill-learned action sequences, (4) dangerous or technically difficult  
157 actions, and (5) overcoming strong habitual response tendencies or temptation.  
158 Perner (1998) argued that trouble shooting and the overcoming of habitual response  
159 tendencies requires an understanding of mind that develops comparatively late. For  
160 present purposes it is, therefore, more promising to focus on planning and novel  
161 action sequences as early indicators of executive control. What is meant by novel  
162 action sequences is not the acquisition of action sequences through gradual feedback  
163 learning but instant implementation of a novel action schema. There are two basic  
164 ways this can happen, either through verbal instruction by others or through plan-  
165 ning in one's own mind. When can children follow verbal instructions and when can  
166 they plan a new action sequence?

### 167 3.2.1. *Verbal instruction*

168 Zelazo and Reznick (1991) investigated children's ability to follow simple con-  
169 ditional rules. The earliest evidence points to 2½ years. However, the even simpler  
170 ability to follow instructions, like "Give me the doll/keys/etc.!" where the child has to  
171 choose the appropriate item from an array of objects and hand it to the experi-  
172 menter, also requires the implementation of a novel action sequence without feed-  
173 back. Evidence from psycholinguistic studies points to the age of 1½ years (Shatz,  
174 1978; Babelot & Marcos, 1999) or earlier—but younger infants have not been in-  
175 vestigated in these studies.

### 176 3.2.2. *Planning and reasoning*

177 Invisible displacement is a good indicator of logical/spatial reasoning ability. A  
178 bead is placed inside a box and the box goes underneath a cover. The box is taken  
179 from underneath the cover and opened. The bead is still inside. Then the box goes  
180 under another cover and taken from under it. Now it is empty. Where could the bead  
181 be? Children can reason correctly that it must be under the second cover by the age  
182 of about 15–18 months (Haake & Somerville, 1985; Piaget, 1937). Another indicator  
183 is the ability to spontaneously combine two familiar actions into a novel sequence  
184 (recombination of secondary circular reactions: Piaget, 1936/1953). The age esti-  
185 mates at which this can be achieved are still under dispute; somewhere around 12  
186 months (Willatts, 1989) but perhaps as early as 8 months (Willatts, 1999).

187 One problem with relying on reasoning and planning is that it is not certain that  
188 the critical processes that lead to novel combinations are indeed based on conscious,

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189 volitional processes. The incubation phase in Poincaré's description of creative  
190 problem solving takes place subconsciously. Ach (1905, p. 187) pointed out that  
191 many elements in the determining tendency leading to a wilfull determination consist  
192 of associative (unconscious) elements.<sup>2</sup> Hence we cannot be sure that novel com-  
193 binations must be based on conscious processes. The ability to implement novel  
194 actions on the basis of verbal instructions is probably a more reliable indicator.  
195 Unfortunately it is somewhat redundant because it necessarily involves referential  
196 use of language.

### 197 3.2.3. *Focal attention*

198 To keep attention on a stimulus in view of some distractor requires executive  
199 control. Gardner, Feldman, Karmel, and Freedland (2000) let infants play with  
200 interesting toys and assessed whether infants paid focal attention to the toy (looking  
201 at the toy with serious facial expression, slowed body movement, and shoulders  
202 turned in toward the object). At 10 months infants were almost as likely to turn their  
203 attention to a distractor when paying focal attention to the toy as when they were  
204 not. In contrast, at 16 months they were much less likely to do so when paying focal  
205 attention than when not paying focal attention. This finding suggests that within that  
206 age bracket children develop stronger executive control over their attention pro-  
207 cesses.

### 208 3.2.4. *Summary*

209 Although the ability to follow conditional instructions comes somewhat later, the  
210 ability to execute a novel action in response to simple instructions can be demon-  
211 strated at 18 months and probably earlier. Also demonstrations of logical/spatial  
212 reasoning and planning of novel action sequences are in place by 12 or 15 months.  
213 Finally, distractibility from focal attention seems to decrease in this age bracket.

### 214 3.3. *Strategy 3: Explicit memory*

215 In a classical definition of implicit and explicit memory conscious awareness of the  
216 remembered past event is a defining characteristic of explicit memory: "Implicit  
217 memory is revealed when previous experiences facilitate performance on a task that  
218 does not require conscious or intentional recollection of those experiences; explicit  
219 memory is revealed when performance on a task requires conscious recollection of  
220 previous experience" (Schacter, 1987). Since the time that this definition was given  
221 many experimental variables have been identified that affect explicit memory in a  
222 different way than implicit memory that lacks conscious awareness. There is now  
223 also increasing evidence reviewed by Wheeler (2000) that some early memories re-  
224 spond to the different manipulations in a similar way to explicit memory. Conse-  
225 quently the onset of these memorial abilities gives us another clue as to when infants  
226 become consciously aware.

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<sup>2</sup> Compliments to Tony Marcel for pointing this out.

227 Of particular relevance are studies of delayed imitation that is commonly found  
228 around 14 months (Meltzoff, 1985) with one study showing some evidence of it as  
229 early as 9 months (Meltzoff, 1988). Infants imitate a sequence of actions performed  
230 by a model. For instance, the experimenter bends forward to touch a box with his  
231 forehead upon which the orange top of the box lights up. A day later the infant is  
232 given the box to play with and the experimenter observes whether his action se-  
233 quence of the previous day is carried out by the infant.

234 It is not immediately apparent why the infants' carrying out the action sequence  
235 reflects explicit memory of the experimenter's performing the sequence the day be-  
236 fore. The experience of the experimenter's action may simply have given the infant  
237 the idea of what one can do with this box, which the infant would not have got  
238 without the experimenter's demonstration. However, there is evidence from amnesic  
239 patients that suggests involvement of explicit memory in delayed imitation task  
240 (McDonough, Mandler, McKee, & Squire, 1995). Patients with amnesia (moderate  
241 to severe long-term memory impairment without short-term impairment and intact  
242 implicit memory), did not engage in target action sequences demonstrated a day ago  
243 more frequently than inexperienced controls (who hadn't seen the actions per-  
244 formed), whereas experienced controls and patients with frontal lobe injury did so  
245 two or three times as frequently. The interpretation is that without explicit long-term  
246 memory of the demonstrated acts people will not perform the demonstrated action  
247 sequences more often than with some baseline frequency.

248 With support from this finding the infant data on delayed imitation are sugges-  
249 tive. Around 12–15 months (with first signs as early as 9 months) children have  
250 explicit memory, that is, they are consciously aware of past events. One should,  
251 though, point out the following—not implausible—possibility that infants have no  
252 explicit memory. In this respect they do not differ from the amnesic patients. The  
253 difference is that infants freely play with an object and do with it whatever comes to  
254 their mind, unencumbered by any social embarrassment. Adults are reluctant to  
255 engage in playful actions with toys. They need the social facilitation of the experi-  
256 menter's model. Adults with unimpaired memory have the required facilitation in  
257 their memory of the experimenter's modeling act; the amnesic patients lack this  
258 memory and, therefore, are reluctant to execute the modeled activity.

259 Rovee-Collier (1997) boldly argued that infants as young as 2 to 3 months have  
260 explicit memory. She investigated this in her so-called foot kicking studies. Infants  
261 learn to kick with their feet to make an interesting mobile move. They spontaneously  
262 kick again after a week or more when seeing the mobile again because—so the  
263 claim—they have *explicit recognition* of the mobile. In contrast after too long a  
264 delay, infants need a brief reexposure to the mobile for *reactivation* of their memory  
265 before they start kicking. The reactivated memory is supposed to reflect implicit  
266 memory. Rovee-Collier backed this claim by investigating the effects of 13 experi-  
267 mental manipulations that are known to affect explicit memory more strongly than  
268 implicit memory in adults. She reports that spontaneous foot kicking (allegedly  
269 based on recognition) was indeed influenced by most of these 13 factors more than  
270 foot kicking after reactivation (due to implicit memory). Unfortunately, all 13 fac-  
271 tors were ones that affect spontaneous kicking more strongly than reactivated  
272 kicking. This leaves the much simpler explanation that reactivated memory is more

273 robust than memory underlying spontaneous kicking. If another set of factors could  
274 be found that is known to affect implicit memory more strongly than explicit  
275 memory and that would affect reactivated kicking more strongly than spontaneous  
276 kicking, then we would have much more convincing demonstrations of very early  
277 explicit memory (and conscious awareness). As it stands we reserve judgement about  
278 the possibility of such early onset.

279 *In sum*, on the strength of the inability (rather than unwillingness) of patients with  
280 amnesia to engage in delayed imitation infants' ability to do so suggests that explicit  
281 memory develops between the ages of 12 to 15 months (perhaps 9 months). And  
282 under the assumption that explicit memory requires conscious awareness in infants  
283 as it does in adults then the data suggest that infants at this age are capable of  
284 conscious awareness.

#### 285 3.4. Strategy 4: Access consciousness and theory of mind

##### 286 3.4.1. A guarded commitment to higher-order thought theories

287 HOT theories (Rosenthal, 1986) developed from a Lockean (Locke, 1959, p. 138)  
288 suggestion, more recently expanded by Armstrong (1968) that conscious awareness  
289 consists of awareness of inner states. This original suggestion proposed this aware-  
290 ness as a type of inner perception; HOT theories deny the perceptual analogy (see  
291 Carruthers, 1998, for genealogy). Our initial considerations of how conscious  
292 awareness registers in our phenomenal awareness (e.g., the contrast between normal  
293 seeing and the visual information uptake by a blindsight patient or by our action  
294 system when absentminded or under illusion) suggests that HOT theories of con-  
295 sciousness capture something essential about conscious awareness. Here is an at-  
296 tempt to argue that some sort of higher-order thought is necessary to capture this  
297 distinction.

298 From our own experience, the following strong link seems to hold empirically: If  
299 we are *consciously aware* of *this pencil lying on the table*, then we are also *consciously*  
300 *aware* that we are *seeing the pencil lying there*. It never happens that we can genuinely  
301 claim being consciously aware of it and at the same time deny being consciously  
302 aware of whether we *see* it, just *dream* of it, *know* by touch, *want* the pencil to be  
303 there, and so on. This means that whenever we consciously *see* (the pencil lying  
304 there), then we *are consciously aware* [that we *see* (the pencil lying there)]. Or, at least  
305 on demand, we need to be *able to form* such higher-order awareness about our seeing  
306 the pencil (see Carruthers, 1996 for a "potentialist version" of the theory). When we  
307 close our eyes we are still consciously aware of the pencil lying on the table, but we  
308 are also aware that we do not see it in that moment. It is difficult (nay, impossible) to  
309 think of an incident of being consciously aware of some event or state of affairs  
310 without awareness of the first order mental state by which we behold that event or  
311 state of affairs.

312 From these considerations we might try to track the onset of conscious awareness  
313 by looking at the age when children develop the prerequisite concepts for repre-  
314 senting first order mental states. This strategy, however, leads to quite different  
315 answers due to a difference in views about when children possess a particular con-  
316 cept. We now illustrate this issue with the concept of knowledge.

317 3.4.2. *Children's concept of knowledge*

318 The answer to the question about when children acquire a concept of knowledge  
319 (required for attributing to them conscious awareness) depends on one's theoretical  
320 approach. One very influential approach is the so called "theory theory" (Sellars,  
321 1956; Premack & Woodruff, 1978; Churchland, 1984; Gopnik, 1993) according to  
322 which mental concepts are constituted as the theoretical terms in a theory of be-  
323 havior. In the case of knowledge this means that the child has to understand the  
324 causal role that knowledge serves in connecting access to information with the ability  
325 to act as intended. There is very consistent evidence that the connection with in-  
326 formational access is not understood until the age of about 3-4 years or even later.

327 Wimmer, Hogrefe, and Perner (1988) either showed or told children what they put  
328 inside a box. Three-year-olds had no problem answering the question about the  
329 contents of the box. They did, however, fail to answer questions about the origin of  
330 their knowledge ("How do you know that there is X in the box?"). Only children of  
331 about 4 years understood the question and answered with "because you showed me"  
332 or "because you told me." The younger children simply seemed to have no con-  
333 ception of how knowledge depended on access to relevant information. Young  
334 children's difficulty in this respect is confirmed in their inability to distinguish be-  
335 tween whether they had learned some word (e.g., "mauve") just a few minutes ago  
336 and whether they had known it before (e.g., "red"; Taylor, Esbensen, & Bennett,  
337 1994). Even those up to 6 years of age have difficulties with understanding that  
338 particular sense organs give information about certain properties and not others,  
339 e.g., looking with the eyes about color but not weight and lifting by hand about  
340 weight but not color (O'Neill, Astington, & Flavell, 1992). A younger child may  
341 suggest that the color of an object can be determined without looking by just lifting  
342 the object. The child is then totally perplexed when this method does not yield a  
343 satisfactory answer. The theoretical consequence of this finding is that children be-  
344 fore that age cannot be consciously aware because they do not have a concept of  
345 knowledge to form a second order thought that they know something.

346 It is, of course, possible to weaken the theoretical requirements for the possession of  
347 a concept of knowledge that just suffices for forming the content of higher-order  
348 thoughts. Perhaps, an understanding of the informational origins of knowledge is not  
349 necessary and an understanding of the ability to provide relevant answers is sufficient.  
350 Gordon (1995) pointed out that within one's own perspective there is a one-to-one  
351 correspondence between what is a fact and what one knows. Hence one can ascend  
352 within one's perspective from "X is a fact" to "I know that X" (ascent routine). Sep-  
353 arating knowledge from fact only pays when concerned about other people as others  
354 may, e.g., not know about things that are facts for oneself. Since higher-order thought  
355 theory of consciousness is not concerned about thoughts about others but only about  
356 one's own thoughts, this aspect of knowledge seems essential. Gordon's proposal also  
357 seems intuitively correct when one considers being asked whether one knows some-  
358 thing. To answer one usually does not need to treat oneself (as theory theory would  
359 have it) like another person and check whether one had appropriate informational  
360 access. One can simply judge by whether one has factual information on the matter.

361 We can now ask when children acquire this minimal understanding about their  
362 own knowledge, i.e., when they can attribute knowledge and ignorance to them-

363 selves. The experimental evidence for this is sparse. It is clear from the investigations  
364 by Wimmer et al. (1988) on children's understanding of the sources of knowledge  
365 from the age of 3 years and onward, that even the youngest children in their study  
366 had no problem answering whether they knew (because they had seen something put  
367 inside or were told what it was) or did not know what was inside a box (because they  
368 had not been given any information).

369 From recordings of children's spontaneous language use the earliest mention was  
370 reported by Bretherton, McNew, and Beeghley-Smith (1981, p. 369) for a 15-month-  
371 old infant who said "I don't know" while gesturing with hands turned up when  
372 asked about the location of an object. Other reports point to a somewhat later age.  
373 First uses were observed at 24 months (Furrow, Moore, Davidge, & Chiasson, 1992)  
374 or 28 months (Bartsch & Wellman, 1995, Table 3.10). Fabricius, Bailey, and Prost  
375 (2001) engaged children with their mothers in a 10- to 25-min-long game in the  
376 laboratory and counted the children's use of mental terminology. In these short  
377 sessions none of the 50 children referred to own knowledge at 14 months. Only three  
378 did at 20 months and 59% did at 32 months. Analyzing the 90-s samples three times  
379 an hour during one day of the Wells (1981) corpus of the CHILDES database  
380 (MacWhinney, 2000), Fabricius et al. (2001) found no mention to own belief at 18  
381 and 21 months but from 13% of the 32 children at 24 months.

#### 382 3.4.3. *Other mental concepts*

383 If we look at children's verbal self-attributions of other mental states the picture  
384 does not change much. Fabricius et al. (2001, Study 2) provide a nice comparison in  
385 line with other data. Attribution of perceptual states (seeing, hearing, ...) follows  
386 closely the attribution of knowledge and belief to themselves. Only attribution of  
387 desire ("I wanna...") occurs noticeably earlier. A quarter of the children as young as  
388 18 months referred at least once to their own desire.

389 At this point we can conclude that from around 18 months onward children refer to  
390 their own mental states, a sign that they have concepts for first order mental states.  
391 Their ability to talk about these states also shows that they are able to form a second  
392 order state about the first order state and, thus, have mastered a prerequisite for  
393 conscious awareness according to the HOT theory of consciousness—provided we  
394 admit the ability to verbally refer to a mental state as sufficient for possessing the  
395 concept. This approach depends essentially on children's verbal ability and raises the  
396 question if we can find nonverbal signs of higher-order mental states at an earlier age.

#### 397 3.4.4. *A nonverbal indicator of surprise?*

398 In search of an earlier, nonverbal indicator one might think of infants' looking  
399 time in the habituation–dishabituation paradigm, which has brought so many in-  
400 sights into infants' early perceptual (e.g., Eimas, Siqueland, Jusczyk, & Vigorito,  
401 1971) and cognitive abilities (e.g., Spelke, 1988; Baillargeon, Spelke, & Wasserman,  
402 1985). This technique is based on the finding that infants look longer at novel stimuli  
403 than to familiar stimuli to which they have been repeatedly exposed. This difference  
404 occurs because—it is often loosely claimed—infants are more "surprised" by the new  
405 stimuli. It is tempting to take surprise as an indicator of conscious awareness because  
406 a blindsight patient would be equally surprised by a stimulus whose presence he or

407 she discovers for the first time in his or her sighted field as by a stimulus appearing in  
408 his sighted field about which he or she has already had information from his or her  
409 blind field. Unfortunately, we do not know whether infants' looking time is governed  
410 by surprise in that sense or whether it is a function of ease of processing. That is,  
411 stimuli that have been (unconsciously) processed before take less time for renewed  
412 processing without any conscious awareness being involved. In fact, faster reaction  
413 to unconsciously primed stimuli (e.g., a subliminal prime indicates where a target will  
414 occur and speeds up the reaction to the target; Neumann & Klotz, 1994) is one of the  
415 main means for investigating unconsciously perceived stimuli. In sum, from the  
416 habituation–dishabituation paradigm that has been used so productively with young  
417 infants it is difficult to draw strong conclusions about consciousness of processing.

### 418 3.5. Strategy 5: *Phenomenal consciousness and theory of mind*

#### 419 3.5.1. *From access to phenomenal consciousness*

420 Block (e.g., 1995) distinguished several concepts of consciousness of which the  
421 distinction between access and phenomenal consciousness has become widely ac-  
422 cepted (e.g., Carruthers, 1998). *Access consciousness* captures the intuition that the  
423 contents of which we are consciously aware are accessible to us, i.e., to our other  
424 mental processes. Access to higher-order thoughts (reflective access) is a kind of  
425 access consciousness. In contrast, the notion of *phenomenal consciousness* is to  
426 capture the subjective feel of our experiences as highlighted in the provocative  
427 question of Nagel's (1974) paper, "What is it like to be a bat?" Or one could ask in  
428 our case, "What is it like to taste a Chateau so-and-so?" or more mundanely, "What  
429 is it like to perceive a certain hue of red?" This aspect of consciousness has been  
430 dubbed the "hard problem" (Chalmers, 1996) because this subjective aspect is dif-  
431 ficult or even impossible (McGinn, 1991) to integrate within our scientific world  
432 view.

433 Some claim that (reflective) access consciousness and phenomenal consciousness  
434 are independent (Block, 1995; Tye, 1995). This is counterintuitive. Carruthers, 2000  
435 and Rosenthal (2000) provide sustained arguments that higher-order thoughts are  
436 both necessary and sufficient for phenomenal consciousness. Carruthers also ad-  
437 dresses the consequences for child development. His argument is based on the as-  
438 sumption that the "subjectivity" of consciousness can in principle be explained by  
439 the fact that mental representations inevitably present the world under a certain  
440 *mode of presentation* (perspective, Frege's sense). However, this only explains what  
441 the *world is like* for the organism (*worldly subjectivity* due to the fact that the world  
442 takes on a subjective aspect by being presented). It does not account for—what we  
443 really need—*experiential subjectivity* (mental state subjectivity), what the organism's  
444 *experience of the world is like* for the organism (that the organism's experience takes  
445 on a subjective aspect). This would follow from a higher-order representation of the  
446 experience of the world because the higher-order representation presents the expe-  
447 rience under a certain mode of presentation and thereby conferring a subjective  
448 aspect to the experience.

449 The important developmental implication of this analysis is that one needs the  
450 ability to form a higher-order representation of a first-order mental state. Before we

451 can ask when children can do this we need to know what feature of being a first-  
452 order mental state needs representing so that the higher-order representation yields  
453 the experiential subjectivity. Carruthers (2000, p. 196) gives a clear answer to this  
454 question: it needs a notion of “seeming” (or appearance or perspective), and Car-  
455 ruthers makes clear that he means a fairly explicit understanding as it develops  
456 around the age of 4 years (p. 202, footnote 11). There is converging evidence from  
457 different studies that this development takes place at this age. Most directly relevant  
458 are the appearance–reality studies by Flavell, Flavell, and Green (1983). For in-  
459 stance, when shown a piece of sponge that looks deceptively like a rock children say  
460 that it is a rock. As soon as they take that “rock” in their hands they realize that it is  
461 just sponge. When now asked what this *really is* most children correctly answer with,  
462 “piece of sponge,” but when asked what it *looks like*, when one is just looking at it,  
463 the children younger than 4 years answer again with, “piece of sponge,” whereas the  
464 older children answer correctly with, “rock.” It seems that the younger children  
465 cannot understand that visual appearance can specify something as being a rock  
466 when they know that it is a piece of sponge.<sup>3</sup>

467 Earlier work by Flavell, Everett, Croft, and Flavell (1981) on Level 2 visual  
468 perspective taking also showed that young children cannot understand that someone  
469 else can interpret a drawing differently than the way they see it themselves. For in-  
470 stance, the child sits facing the experimenter over a small table with a piece of paper  
471 depicting a turtle from its side. When the picture is oriented so that the turtle’s feet  
472 are pointing toward the child, the 3-year-old interprets it as “the turtle is standing on  
473 its feet.” When the picture is rotated by 180° the child interprets it as “it is lying on  
474 its back.” However, only at around 4 years can children understand that another  
475 person sitting opposite would interpret the drawing differently (e.g., “it’s standing on  
476 its feet”) from the child herself (e.g., “it’s lying on its back”).

477 Also understanding of false belief demonstrates an understanding of perspective  
478 which is not acquired before the age of 4 years (Wimmer & Perner, 1983; Perner,  
479 Leekam, & Wimmer, 1987; Wellman, Cross, & Watson, 2001). Children have to  
480 understand that a story character Maxi, who did not witness an unexpected transfer  
481 of his chocolate bar to a new location, will look mistakenly for his chocolate in its  
482 original location. This requires an understanding that Maxi has a different per-  
483 spective on the chocolate’s location than the children themselves. The younger  
484 children incorrectly claim that he will look in the location where the chocolate ac-  
485 tually is. Moreover, since many children with autism, despite a mental age (verbal  
486 and nonverbal intelligence) well above 4 years, have difficulty with such false belief

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<sup>3</sup> A problem with the appearance–reality task is that the question, “what does it look like,” can be interpreted nondeceptively to simply mean, “what kind of features does it have?” For instance, when one says that a child *looks like* her father, one means that she has the same or similar facial features. One does not mean that she *appears to be her father*. Under this interpretation of “looks like” the task does not pose a perspective problem because a single perspective can be construed that states that *the object is a sponge that has features of a rock*. For this reason children’s mastery of this task does not establish (as unambiguously as the false belief and ignorance tasks) that they are able to understand perspective (see Perner, in press).

487 tasks, Frith and Happé (1999) suggested that they have a different kind of con-  
488 sciousness than normally developing children after the age of 4 years.

489 Together, these developmental findings strongly suggest that children before the  
490 age of about 4 years do not understand perspective (or appearance and seeming) and  
491 therefore, according to Carruthers' analysis, do not have phenomenal consciousness  
492 in the sense of experiential subjectivity. Linking this developmental conclusion to the  
493 earlier discussion of access consciousness leaves us with the somewhat counterin-  
494 tuitive result that from the age of about 15 months to about 4 years children have  
495 access consciousness without phenomenal consciousness. In order to get these two  
496 diverging developments back into line we have two options. We can adhere to  
497 Carruthers' analysis but check whether its developmental consequences do indeed  
498 require an explicit conceptual understanding of appearance. Alternatively we can  
499 adopt Rosenthal's (2000) application of higher-order thought theory to phenomenal  
500 consciousness: "HOTs do not require the elaborate conceptual apparatus charac-  
501 teristic of humans; they are simply thoughts that one is in states of particular types,  
502 states which we humans classify as mental."

503 Both positions require representation of experience independently of what is ex-  
504 perienced. Hence, an organism that can only represent the world as it is would not  
505 meet this requirement. Such an organism can have different experiences (we would  
506 need to say *unconscious* experiences) but as they are inextricably tied to differences in  
507 what is experienced, there is no independent notion of experience. Hence such an  
508 organism cannot have phenomenal consciousness in terms of experiential subjec-  
509 tivity. One indicator that children do have a separate notion of mental state or ex-  
510 perience and the target of the experience is their verbal references to their own states.  
511 From the earlier discussion on children's reference of their own mental states we find  
512 this ability appearing between 15 and 24 months.

513 This indicator relies, of course, exclusively on infants' ability to verbally refer to  
514 their mental states. It remains, therefore, possible that infants are able to entertain a  
515 notion of experience distinct from the target of their experience well before they can  
516 express this verbally. Consequently, it remains a possibility within Rosenthal's the-  
517 ory that with a nonverbal indicator at hand we might be able to demonstrate phe-  
518 nomenal consciousness in much younger infants—perhaps neonates (or even  
519 prenatally).

520 In contrast to Rosenthal, Carruthers (2000) explicitly states that phenomenal  
521 consciousness requires understanding of experiences as providing a perspective  
522 (appearance) of their target (what they are about). The developmental consequences  
523 that he draws are based on evidence from children explicitly representing the dif-  
524 ference between what something is and how it appears to us in verbal discourse  
525 (Flavell et al., 1983). This evidence points to the late development of about 4 years.  
526 He does not consider the possibility that an implicit, procedural grasp of different  
527 experiences of the same thing might suffice. Consider an organism that can *pretend*  
528 that the world is different than experienced. For such an organism the world does not  
529 just present itself in the subjective way in which it is represented by the organism.  
530 Rather, the pretending organism has some voluntary control over changing its  
531 subjective representation and at the same time realizing that the world has not  
532 changed. Consequently, it has the ability to savour (subjectively experience) differ-

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533 ences in subjective experience of one and the same state of the world. Naturally, this  
534 ability to experience experiential differences about the same state of the world falls  
535 short of having a conceptual understanding of how precisely one's changing expe-  
536 riences relate to the experienced state of the world. Nevertheless, it provides some  
537 *procedural grasp* of experiential subjectivity, hence a form of phenomenal con-  
538 sciousness in line with Carruthers' analysis.

539 The only difference to Carruthers' position is that he does not consider the pos-  
540 sibility of such a procedural grasp but requires (conceptual) representation of the  
541 different experiences *as subjective perspectives* of the world. The developmental im-  
542 plications are large. The understanding of experience as subjective perspective (ap-  
543 pearance–reality distinction, false belief understanding)—as we have seen—develops  
544 late around 4 years, whereas the ability to pretend develops in the second year of life.  
545 Take Piaget's famous example of his daughter Jacqueline, who at 15 months treated  
546 a blanket as her pillow and her laughing testified to her awareness that this was not  
547 her pillow. Pretence involving an object at this early age is rare but children com-  
548 monly start pretending to, e.g., act like mother (Fenson et al., 1994, using the CDI  
549 communicative development inventory). However by 18 months pretend play with  
550 objects can be elicited (Harris & Kavanaugh, 1993).

551 In sum, following Carruthers' analysis of phenomenal consciousness as experi-  
552 ential subjectivity we get two different answers as to when children acquire the  
553 necessary cognitive sophistication. If we follow Carruthers' suggestion that a con-  
554 ceptual understanding is required to represent experiences as subjective perspectives  
555 on reality then children cannot have phenomenal consciousness before the age of  
556 about 4 years. If, however, we admit a procedural grasp of the subjectivity of ex-  
557 perience as sufficient for phenomenal consciousness then children as young as 15 to  
558 18 months display that ability in their pretend play. Moreover, if we follow Ro-  
559 senthal's suggestion that representation of the first-order state as state one suffices  
560 because the representation of that experiential state gives a subjective perspective on  
561 that state, then children's verbal reference to their own mental states also points to  
562 the similar age range of 15 to 24 months of onset. However, the plausible suspicion  
563 that infants might have an earlier emerging preverbal ability to think of being in a  
564 mental state suggests that the onset of phenomenal consciousness might be much  
565 earlier. Our problem is, that we do not even know which kind of preverbal measure  
566 to collect to find out.

#### 567 4. Conclusion

568 We have tried to find an answer to the question about when children have con-  
569 scious awareness. Since this is not possible by simply asking children in that many  
570 words, we pursued five indirect strategies by asking when children display abilities  
571 that are deemed to be impossible without conscious awareness (sufficient conditions:  
572 language use, explicit memory, and executive control) or deemed to be necessary for  
573 conscious awareness (theory of mind for access and phenomenal consciousness).  
574 Answers within each strategy often differ depending on theoretical options. If par-  
575 ticular options are taken a fairly consistent answer is possible: 12–15 ( $\pm 3$ ) months. It

576 shows how the drive for a consistent empirical answer can help make theoretical  
577 decisions. Table 1 gives an overview of the different strategies, theoretical options  
578 within strategies, and their developmental implications.

579 Dienes and Perner (1999) provided a conceptual framework for seeing how these  
580 strategies fit together. They described a hierarchy of ways in which knowledge can be  
581 explicit, the most explicit way corresponding to a higher-order thought, i.e., the  
582 putatively necessary and sufficient condition for conscious awareness. To be con-  
583 sciously aware of a fact like, “the object in front of me is a circle,” one must form a  
584 higher-order thought like, “I see that the object in front of me is a circle.” If one saw  
585 the object as a circle, but only unconsciously, one might minimally represent ex-  
586 plicitly only a feature, e.g., “circle.” A minimal representation, “circle” would not  
587 provide conscious awareness or conscious seeing since it does not qualify as a full  
588 constituent of a higher-order thought. The representation could make more aspects  
589 of the situation explicit than just the feature, e.g., that this feature is predicated of the  
590 object in front of me: “the object in front of me is a circle.” This explicitly represents  
591 the whole proposition, but it is still not sufficient for conscious awareness. Next, one  
592 could explicitly represent the factuality (or otherwise) of the object in front of you  
593 being a circle: “It is a fact that the object in front of me is a circle.” The ability to  
594 form representations of this degree of explicitness can be compared by analyzing the

Table 1  
Age of onset of conscious awareness according to different assessment strategies

Strategy: Theoretical option	Age brackets			
	0–9 months	9–18 months	1½–3 years	3–5 years
Strategy 1: Verbal communication				
Single words—referential use	●	●●●	●●●	●●●
Productive two-word combinations	●	●●●	●●●	●●●
Strategy 2: Executive control				
Conditional rules (if-then)	●	●	●●●	●●●
Simple verbal instructions	●	●●●	●●●	●●●
Focal attention	●	●●●	●●●	●●●
Strategy 3: Explicit memory				
Delayed imitation	●	●●●	●●●	●●●
Footkicking studies (Rovee-Collier, 1997)	●●	●●	●●	●●
Strategy 4: Access consciousness and theory of mind				
Causal role ( <i>theory theory</i> ): <i>information access</i>	●	●	●	●●
Ascent routines ( <i>simulation theory</i> , Gordon, 1995)				
Pretend play	●	●●	●●	●●
Reference to own knowledge	●	●●	●●	●●
Strategy 5: Phenomenal consciousness and theory of mind				
Concept of appearance ( <i>Carruthers</i> )	●	●	●	●●
Procedural grasp of subjectivity	●	●●	●●	●●
Representation of experiential state (Rosenthal)	?	●●	●●	●●

595 stage of development in multiple models (Perner, 1991; Suddendorf & Whiten, 2001):  
596 One can consider the same individual in different models, e.g., one model being true  
597 and the other false. In the final level of explicitness, one could represent one's atti-  
598 tude toward the fact, e.g., seeing "I see that [it's a fact that (the object in front of me  
599 is a circle)]." It is this final level of explicitness that provides conscious awareness by  
600 the higher-order thought theory. Note that the final higher-order thought occurs  
601 later in the hierarchy than the representation of factuality and hence depends on  
602 factuality explicitness.

603 Now consider our five strategies for determining the age at which children become  
604 phenomenally aware. Perner (in press) argued that all the executive function tasks  
605 listed by Norman and Shallice (1986) required the use of factuality-explicit repre-  
606 sentations. Hence, the demonstration that children can perform executive function  
607 tasks indicates they have achieved a prerequisite degree of explicitness for forming  
608 higher-order thoughts. The use of language in novel ways, or as part of planning,  
609 makes the same point, in that in these cases language is being used as a tool for  
610 performing executive function tasks. Similarly, to have an explicit memory is to  
611 appreciate the remembered information as an event in the past; this minimally re-  
612 quires multiple models and appreciation that what is true at time  $t$  is not a fact now  
613 (i.e. explicit memory requires factuality explicitness).

614 Finally the considerations about access and phenomenal consciousness relied  
615 mostly on children's ability to verbally refer to their mental states and to engage in  
616 pretend play as key evidence for children having the right sort of abilities. As argued  
617 by Perner (1991), the ability to understand and use verbal description and to pretend  
618 play requires minimally the multiple models stage of development. One model has to  
619 represent the way the world is (labeled as "true" or "fact") and another model is  
620 needed to show the verbally described world or pretend scenario (labeled as "false"  
621 or "nonfactual"). In other words: verbal description and pretence also require  
622 minimally factuality explicitness.

623 All five strategies were ways of determining whether children had acquired a  
624 minimal degree of representational explicitness required for forming higher-order  
625 thoughts, namely factuality explicitness. These strategies do not require the use of  
626 language to claim one is having phenomenal experience, although many of them are  
627 based on linguistic evidence. Nevertheless, some of them do not require language at  
628 all and hence may be of use in determining which other animals also have conscious  
629 awareness (cf. Suddendorf & Whiten, 2001).

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