



## Short Communication

## Social awareness and early self-recognition

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## ABSTRACT

Self-recognition by 86 children (14–52 months) was assessed using the mirror mark test in two different social contexts. In the classic mirror task condition, only the child was marked prior to mirror exposure (*Classic* condition). In the social norm condition, the child, experimenter, and accompanying parent were marked prior to the child's mirror exposure (*Norm* condition). Results indicate that in both conditions children pass the test in comparable proportion, with the same increase as a function of age. However, in the *Norm* condition, children displayed significantly more hesitation while removing the mark, often touching it without removing it or, if so, promptly putting the mark back onto their forehead. In the *Classic* condition, only one child showed such hesitation. These results suggest that from the outset, mirror self-recognition can refer to social awareness. This link is interpreted as the trademark of human self-consciousness, a deeply rooted "looking glass" self-awareness.

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## 1. Introduction

Self-concept or the idea of *me* as an objectified entity among other entities is taken to be a major cognitive landmark from both an evolutionary and developmental perspective. Such a landmark has been classically indexed by the passing of the mirror mark test (Amsterdam, 1972; Gallup, 1970; but see also Heyes, 1995; Rochat & Zahavi, 2010 for a critique). Individuals of only a few other species (Gallup, 1970; Plotnik & de Waal, 2006; Prior, Schwarz, & Gunturkun, 2008; Reiss & Marino, 1998) and most children from about 22 months of age pass the test by demonstrating self-orientation, touch and removal of a mark surreptitiously placed on the face that they discover in the mirror (Amsterdam, 1972; Asendorpf, Warkentin, & Baudonnière, 1996; Bard, Todd, Bernier, Love, & Leavens, 2006; Bertenthal & Fisher, 1978; Lewis & Brooks-Gunn, 1979; Lewis & Ramsay, 2004; Nielsen, Dissanayake, & Kashima, 2003; Schulman & Kaplowitz, 1976).

The mirror mark test is taken to be the index of a capacity of an internal representation or the early foundation of a self-concept (Gallup, 1970; Keenan, 2003; Lewis & Brooks-Gunn, 1979). In both the phylogenetic and ontogenetic perspective, mirror self-recognition tends to be viewed as a solipsistic process by which an individual begins to contemplate herself for herself, as an objectified and differentiated entity (Keenan, 2003; Lewis, 1994; Plotnik & de Waal, 2006; Povinelli, 1995, 2001). The prevailing cognitive account of mirror self-recognition in development is that it is an index of emerging secondary representations and the ability to generate mental models of the self (Keenan, 2003; Perner, 1991; Suddendorf & Whiten, 2001). Note that although the view of others, particularly the canonical (perceived) aspect of their face must contribute to such mental models, these models remain in essence solipsistic as they are typically not considered in relation to the evaluation and potential sanction of others. Such representational ability is linked to the evolution and maturation in

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human ontogeny of specific brain structures (i.e. rostralateral region of the prefrontal cortex (Zelazo, Gao, & Todd, 2007)). Aside from maturation, questions remain however as to what might motivate the developing child to eventually get rid of a mark she discovers on her face via the mirror.

Here we asked whether social factors such as the need to match the appearance of self to the appearance of others might drive the behaviors of young children by the time they first show signs of passing the mirror mark test. The study was designed to explore the extent to which the expression of early mirror self-recognition depends, not only on an ability to recognize and objectify the self for itself, but also for others that are evaluative of how one looks.

### 1.1. Larger developmental context

Existing research suggests that by the time children pass the mirror mark test, they also demonstrate a new sensitivity to norms, rules, and social standards (Kagan, 1981; Rakoczy, Warneken, & Tomasello, 2008; Rochat, 2010). Cross-cultural evidence suggests that children respond differently to their marked image depending on the social context (Broesch, Callaghan, Henrich, Murphy, & Rochat, 2010). They begin to behave with the construal of others in mind as they express unmistakable self-conscious emotions such as embarrassment and guilt (Lewis & Ramsay, 2004; Rochat, 2009). They also begin to show a sense of pride in work well done or in successfully resolving a problem (Kagan, Reznick, & Gibbons, 1989). Inversely, they show the first signs of shame when they are not able to master a task and are quick to notice that something is not the way it 'ought' to be (Kagan, 1981; Lewis, Sullivan, Stanger, & Weiss, 1989; Stipek, Recchia, McClintic, & Lewis, 1992). Interestingly, it is at the same developmental juncture that children manifest first explicit signs of empathy and pro-social helping behaviors (Eisenberg & Fabes, 1998; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992).

Although much empirical evidence points to the synchrony between the emergence of an objectified sense of self and an objectified sense of acceptable ways of being, little is known of their actual relation in development. The overarching goal of the research is to probe the relation between the development of self and social awareness by young children, in particular the link between these two kinds of awareness at the origins of self-concept.

### 1.2. Specific aim and question

In the context of the classic mirror mark test, the specific aim was to determine why children touch and remove the mark on their face and whether such action might or might not depend on an awareness of the social context. There are at least two possible explanations for the behavior observed by children passing the mirror mark test. First, children may recognize that it is themselves in the mirror with something unexpected on their face – e.g., something odd that does not fit with how they typically see faces. Alternatively, they may recognize themselves in the mirror with something unexpected that is a stigma (in the literal sense of “stain”) when compared to how others look in the immediate environment. In other words, we asked whether children passing the mirror mark test do so with or without evaluative others in mind. Theoretically, the question is not trivial as it probes the role of social cognition (i.e., the perception and understanding of evaluative others) as well as children's propensity to compare to others (i.e., social affiliation and normative conformity) as a potential motive behind the self-reflective capacities and explicit self-concept presumably revealed in the passing of the mirror mark test.

### 1.3. Working hypothesis

We observed and analyzed the behaviors of eighty-six 14–52 month-olds as they discovered themselves in a mirror in one of two conditions: (1) the *Classic* condition in which the child is the only one among others to have a mark on her forehead and (2) the *Norm* condition in which the child and others in the room also have a mark on their forehead. We deliberately tested a large age range in both conditions in order to capture an eventual developmental trend on the expected differences between the two conditions (see below).

We reasoned that the synchronous co-emergence, i.e., the developmental link between mirror self-recognition and social awareness would be supported if the ways children pass the mark test are noticeably different between the two conditions. In general, we expected no difference in the proportion of children passing the test, with a comparable number of children self-referring across the two conditions. However, we did hypothesize that children passing the test would differ in the way they self-referred in the *Norm* compared to the *Classic* condition.

In the *Norm* condition, we expected that regardless of age, passing children would demonstrate significantly more signs of hesitation and reluctance to remove the mark in conformity of others wearing the mark. Independent of age, we expected that children would pass the test with others in mind, not just for themselves.

We hypothesized that mirror self-recognition, indexed by the mark test, does not develop in independence of developing social awareness, in particular an awareness of social norms. Social awareness and self-presentation is what would drive children's behavior as they pass the mirror mark test by touching and removing the mark. Again, the age range of our sample allowed us to assess whether the dependence of the two kinds of awareness (self and social) is expressed from the onset of development, or contrary to our hypothesis, only months after the typical passing age of the mirror mark test (around 22 months) that is the index of a capacity for self-objectification.

## 2. Method

### 2.1. Participants

Eighty-six children aged 14–52 months (mean age 33 months,  $SD = 12$  months) participated in this study (39 females). Participants were randomly assigned to one of two conditions: *Classic* (only the child is marked,  $N = 40$ ) and *Norm* (the child, experimenter, and accompanying parent are marked,  $N = 46$ ). *T*-tests yielded no significant differences in the age and age range of children between the two conditions. All children were predominantly from white/Euroamerican middle class families living in a large metropolitan area of the United States.

### 2.2. Procedure

The two conditions were identical in all aspects except for the experimental manipulation that contrasted them – the presence or absence of a sticker on the forehead of the experimenter and the accompanying parent present during testing.

### 2.3. Classic condition

A small digital video camera (Canon Mini DV) was placed 3.5 m away, above and behind the experimenter who faced the child. The child was seated at a small table with the experimenter sitting directly across holding a hand puppet while the mother was seated in a chair 2–3 m behind the child. Testing was preceded by a short pre-test phase during which the experimenter engaged playfully with the child, ‘tickling’ the child, tapping the ‘tummy’, shoulders, and forehead lightly. As she tapped the head of the child, she surreptitiously placed a yellow ‘post-it’ mark ( $5 \times 4$  cm) on the child’s forehead at the hairline. ‘Post-it’ marks at the hairline were used to control for any cutaneous feedback that could lead the child to touch his or her face independent of self-recognition proper (Nielsen, Suddendorf, & Slaughter, 2006). Following the mark placement, 15–30 s elapsed prior to actual mirror testing, enabling the experimenter to ensure that the child did not notice that something was placed on her forehead (e.g. touching or reaching for the mark or shaking the head). No participant indicated an awareness of the mark on her forehead during pre-test, meeting the basic criterion for inclusion in the study.

The self-recognition test began with the experimenter asking the child to touch a puppet covering her right hand that held the mirror ( $40 \times 25$  cm) facing down on her lap. The puppet was presented to the child as being asleep, then the child was asked to ‘wake up the puppet’ by touching it. After the child touched the puppet, the experimenter lifted the mirror and positioned it steadily, in front of the child, approximately 0.5 m away in parallel, allowing full head and torso reflection. While holding the mirror up, the experimenter looked away and to the side of the mirror maintaining a neutral expression. We allowed up to 60 s to pass before ending the session. If the child did not self-refer (i.e., touched and/or removed the mark), the experimenter then stopped the session by saying: “Look at that silly sticker there!” and reached for it.

### 2.4. Norm condition

The procedure was identical to the Classic condition above, except that in this condition, prior to entering the testing room, the experimenter informed the parent that both she and the experimenter would wear a yellow ‘post-it’ mark on their forehead. All mothers were also asked to refrain from gesturing to any of the ‘post-it’ marks as well as to maintain a rested, un-phased facial expression throughout the duration of the procedure. The mother and experimenter were ‘marked’ after the child was marked (see ‘classic condition’ procedure) and was then sitting at a table, facing away and not paying attention to them. The ‘marking’ of the adults consisted of the experimenter cautiously placing the ‘post it’ mark on her forehead while the child was looking away. At that time, the parent, following previous instructions from the experimenter, also placed her ‘post it’ mark on her forehead. During the phase when the experimenter instructed the child to wake up the puppet, the experimenter waited for the child to look at her face ensuring that each participant noticed the mark on the experimenter’s forehead. All children in the *Norm* condition showed clear evidence of looking up toward the experimenter who was conspicuously wearing the mark on her forehead, prior to proceeding with the lifting of the mirror. The procedure lasted approximately 3 min from the moment the child and adults entered the testing room.

### 2.5. Dependent measures

Video recordings of children’s reactions to their specular image were coded for (A) the presence or absence of self-referential behavior indicating a passing of the mirror mark test, and (B) children’s expression of hesitation after they passed the mirror mark test.

*Self-referential behavior* was defined and coded as body-oriented action toward the mark (i.e. – touching) while looking at the mirror.

*Hesitation* was defined as any of the following actions *after touching the mark* while looking in the mirror: (1) leaving the mark on (2) minimum of 3 s delay *after* touching the mark, but before removing it (3) removing the mark and subsequently putting it back onto the face.

All self-referential and hesitation behaviors were coded from the moment the mirror was lifted and the child started to look at his or her specular image, until 30 s elapsed. For reliability, 30% of the participants were randomly selected and re-coded by an independent coder. There was above 95% agreement between the two independent coders on all measures.

### 3. Results

#### 3.1. Self-referential behavior

As indicated in Fig. 1, a comparable number of children self-referred in the two conditions (*Classic*,  $n = 25$ ; *Norm*,  $n = 26$ ), an index of homogeneity between the groups across conditions (see Fig. 1). More than 70% of children older than 24 months (41/58) passed the test in either condition, a proportion consistent with the range reported in the literature (Asendorpf et al., 1996; Bard et al., 2006; Bertenthal & Fisher, 1978).

To further assess potential differences inherent to the two conditions, we conducted an independent samples *t*-test on the delay to self-refer (from the time the mirror was presented until they touched the mark). There was no difference in the delay to self-refer by condition,  $t(1,49) = -.603$ ,  $p > .05$ , indicating that children passing the test touched the mark within a comparable time window across the two conditions. Thus there was no sign of 'freezing' or inhibition associated with the oddness or potentially greater cognitive complexity of the *Norm* condition (i.e., seeing the adults with a mark on their face). However, note that in both conditions, the child is always surrounded by the same number of people (mother and Experimenter) with everything being equal except from the presence or absence of the sticker on their forehead.

To ascertain further whether the perception of two extra stickers could account for our results, we tested an additional sample of children ( $N = 12$ ) aged 20–45 months (mean age = 26 months,  $SD = 7.2$  months) in a control situation where two yellow 'post-it' stickers were placed on the frame of the mirror in the middle of the left and right side, clearly visible to the child once the mirror was lifted. These marks did not cause any occlusion of the specular image. In this 'control' condition, which is comparable in cognitive/perceptual complexity of the *Norm* condition, 6 out of the 7 children that passed the test, did so by removing the mark immediately, behaving like the same age children passing the test in the *Classic* condition. None of the passing children put the mark back on their forehead or showed any of the signs of hesitation. These results suggest that a difference in cognitive/perceptual complexity between *Norm* and *Classic* conditions is an unlikely explanation of our findings.

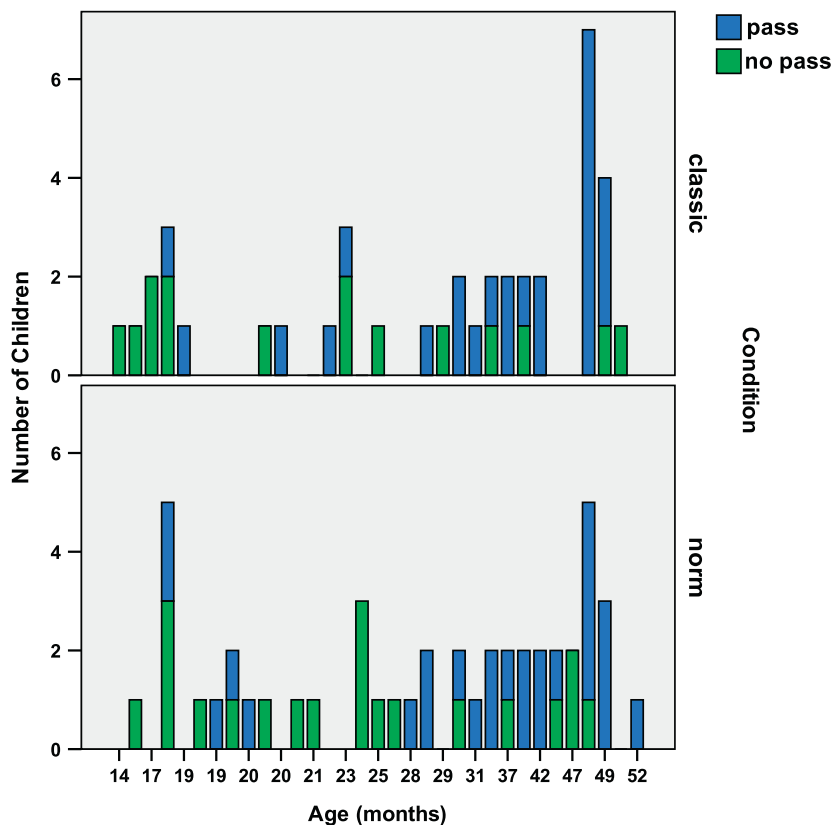
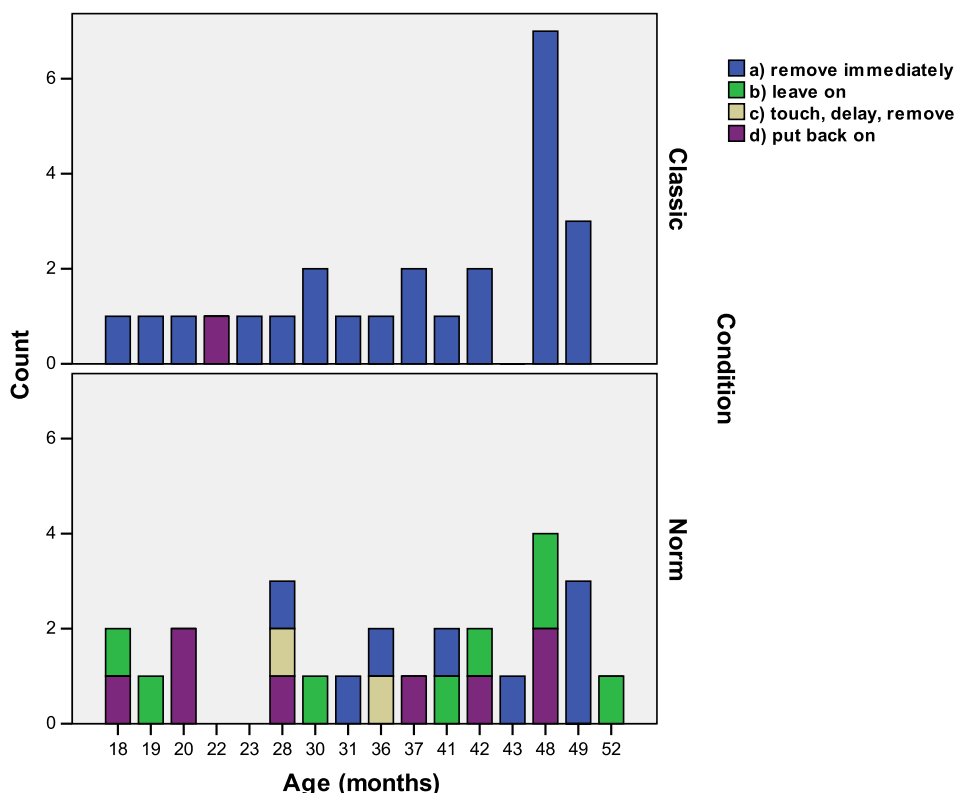


Fig. 1. Number of children passing the mark test by condition and age in months.

**Table 1**

Number of children demonstrating hesitation behavior while passing the mirror mark test by either touching and not removing (Touch), touch with a 3 s delay before removal (Delay), or removing the mark and putting it back on (Put back on) as a function of condition (Norm versus Classic).

	Touch	Delay	Put back on	Total
Norm	8	2	8	18
Classic	0	0	1	1



**Fig. 2.** As a function of age and condition, number of children either (a) removing the mark immediately, (b) touching but leaving the mark on, (c) touching the mark and only removing it after a delay, (d) touching and removing the mark, then putting it back on the forehead.

To probe any age and condition effects, we analyzed the data using a binary logistic regression analysis with the dichotomous variable of self-referential behavior as the dependent measure (i.e., passing or not passing the test by either touching or not touching the mark). Condition and age were entered as predictor variables into the model. There was no difference in self-referential behavior by condition ( $\beta = -.226$ ,  $SE = .485$ ,  $df = 1$ ,  $p = .641$ ). Age was a predictor of self-referential behavior ( $\beta = .077$ ,  $SE = .021$ ,  $df = 1$ ,  $p < .001$ , Nagelkerke's  $R^2 = .223$ ) meaning that with each year, children are approximately two times more likely to self refer.

**Hesitation.** To determine whether responses to the mark were significantly different depending on the experimental manipulation, separate analyses were conducted on the children who passed the test (Total  $n = 51$ ; Classic condition,  $n = 25$ , Norm condition,  $n = 26$ ). We analyzed the data using binary logistic regression analysis with age and condition as the predictor variables and the dichotomous variable 'hesitation' (see operational definition above) as the dependent measure. Although our operational definition of hesitation included three 'kinds' of hesitation (see Table 1 for frequency distribution across conditions), we were interested only in the presence or absence of this behavior and therefore coded it as a dichotomous variable (presence or absence of at least one kind of hesitation behavior). Condition, but not age, was a predictor of hesitation behavior with condition ( $\beta = 4.31$ ,  $SE = 1.20$ ,  $df = 1$ ,  $p < .001$ , Nagelkerke's  $R^2 = .609$ ). Age was not a significant predictor of hesitation behavior ( $\beta = -.070$ ,  $SE = .042$ ,  $df = 1$ ,  $p = .094$ ). In order to further determine whether the number of children hesitating while self-referring was different between the younger and older children, we divided the participants into two evenly split groups of younger ( $<36$  months) and older ( $\geq 36$  months). We conducted a Fisher's Exact test on the number of children hesitating or not hesitating with age group as the independent variable. There was

no significant difference between the two age groups ( $p = .369$ ), therefore age is not a significant predictor of hesitation among self-recognizers. We further analyzed the younger age group separately to determine whether the finding of a significant difference in hesitation by condition would hold for children less than 36 months. Fisher's Exact test yielded once again a significant difference in hesitation displayed in each of the two conditions ( $p = .004$ , one-tailed), with more children showing hesitation in the Norm condition (8/9) versus in the Classic condition (2/8). We repeated this analysis including this time only children that were 22 months and younger and self-referred ( $N = 9$ ). The analysis continued to yield a significant difference between the two conditions ( $p = .048$ , one-tailed). The significant increase of hesitation in the Norm condition is therefore not simply driven by the older children, but characteristic of all passing children, even those younger than 22 months.

In all of those children who passed the test, and independently of age, only 4% showed any sign of hesitation in the *Classic* Condition. In contrast, in the *Norm* Condition 69% of those children showed unmistakable signs of hesitation. Stated differently, out of the 51 self-recognizers, 19 removed the mark with hesitation while 32 removed the mark immediately with no hesitation. Of those 19 expressing hesitation, 18 (representing 95%) were in the *Norm* condition. In contrast, only 1 child (representing 5%) showed hesitation in the *Classic* condition (see Fig. 2).

When considering the ways children demonstrated hesitation while passing the mirror mark test in the *Norm* condition ( $n = 18$ ), we observed that 16 children manifested hesitation either by leaving the mark on, or by removing the mark and then putting it back on the face. Two children showed hesitation by manifesting a 3 s delay after touching and before removing the mark.

#### 4. Discussion

The goal of the research was to examine whether children achieve the developmental milestone of mirror self-recognition, the presumed index of explicit self-awareness, in relative independence of an awareness of their social surrounding or, on the contrary, as an intrinsic part of developing social cognition.

We hypothesized that children who begin to show explicit evidence of mirror self-recognition by passing the mark test are doing so in a social way – with others in mind. In relation to our experimental manipulation, results show that the ways in which children passed the mirror mark test differed markedly across the two experimental conditions. In the *Classic* condition children who self-referred and passed the mirror mark test did so with no apparent signs of hesitation. With the exception of one 20 month-old who removed and then replaced the mark on his forehead, all children passing the mark test, did so by immediately removing the 'post-it' mark. In contrast, out of the 26 children who passed the mark test in the *Norm* condition, more than two thirds showed signs of hesitation ( $n = 18$  or 69%, see Fig. 2). These observations are simple, yet theoretically powerful. They suggest that children passing the mark test do not construe the mirror reflection solely in terms of its reference to the embodied self, but are also capable of construing such reflection in reference to how others might perceive and evaluate them.

We conclude that explicit self-awareness at the origins of human development indexed by the mark test (i.e., objectified recognition of self in the mirror) might be socially grounded, not just the product of a solipsistic mental or introspective process, particularly when considering that children are always tested in the presence of others in our study and in others. In our case, in both the *Classic* and *Norm* conditions, children were always surrounded by the mother and an Experimenter, making both conditions socially comparable.

However, research conducted with children characteristically lacking social awareness, for example, young children diagnosed with autism, indicates that these children also pass the mirror mark test (Dawson & McKissick, 1984). This suggests that there are different ways of passing the test, including solipsistic, nonsocial ways. Interestingly, multiple studies demonstrate that autistic children passing the mirror mark test do so with flat affect, displaying "completely neutral" expressions, with no signs of either coyness or embarrassment (Dawson & McKissick, 1984; Neuman & Hill, 1978; Spiker & Ricks, 1984). As noted by Dawson (1989): "... although autistic children do not display a deficit in visual self-recognition, their affective response to mirror images differs from that of normal children" (Dawson, 1989, p. 11).

Based on the population tested in the present study, it appears that for typically developing children, early mirror self-recognition is linked to social awareness. We view such link as the trademark of human sociality that forms around a propensity toward self-consciousness and a unique concern for reputation (Rochat, 2009). Lacking the core propensity toward self-consciousness and the unique concern for reputation could be a major obstacle in human social-cognitive development, the kind of obstacle encountered by autistic children in their development.

From a comparative perspective, our findings raise the question of whether evidence of mirror self-recognition has the same social-cognitive meaning in the human child compared to individuals of non-human species who pass the mark test (Gallup, 1982; Plotnik & de Waal, 2006; Povinelli, 1995; Reiss & Marino, 1998). Future research could document whether evidence of mirror self-recognition in non-humans passing the mark test is also linked to social awareness and driven primarily by a concern for self-presentation and the avoidance of social stigma. This would inform whether the apparent drive to construe oneself in relation to others is deeply rooted in evolution, or alternatively, whether it should be viewed as a particular trait of human psychology. The synchronous developmental emergence of secondary emotions and mirror self-recognition in humans would suggest that the latter hypothesis is probably closer to the truth. The data presented here further reinforce such intuition.

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