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Young Children's Understanding of Briefly Versus Extremely Delayed Images of the Self: Emergence of the Autobiographical Stance

Daniel J. Povinelli and Bridgett B. Simon
University of Southwestern Louisiana

Eighty-eight young 3-, 4-, and 5-year-olds were scheduled for 2 testing sessions. On Visit 1, the children were videotaped playing a game while an experimenter covertly placed a large sticker on their head and covertly removed it after the game. One week later, the children were videotaped playing a different game. A sticker was again covertly placed on their heads. Half the children in each age group then observed the video from the previous week, whereas the other half observed the tape from 3 min earlier. Less than half of the 3-year-olds in both conditions reached up for the sticker. In contrast, the majority of 4- and 5-year-olds in the briefly delayed condition reached for the sticker, but few in the extremely delayed condition did so. By 4 years of age, children may have developed a causal understanding of the self's endurance through time.

The ability of young children to recognize themselves in mirrors appears to emerge at about 18 to 24 months (Amsterdam, 1972; Bertenthal & Fischer, 1978; Johnson, 1983; Lewis & Brooks-Gunn, 1979; Schulman & Kaplowitz, 1977; see also reviews, Anderson, 1984; Brooks-Gunn & Lewis, 1984). If a spot of rouge, for example, is covertly placed on some portion of their face (typically the nose or the cheek) and they are then confronted with a mirror, 60% to 70% of 18- to 24-month-old infants respond by reaching up to touch the mark. Chimpanzees and orangutans have also been shown to use mirrors to locate and inspect marks surreptitiously placed on their faces (Gallup, 1970; Lethmate & Dücker, 1973; Povinelli et al., 1997; Povinelli, Rulf, Landau, & Bierschwale, 1993; Suarez & Gallup, 1981). To date, however, there have been no compelling demonstrations of this ability in individuals outside the great ape–human group (see Anderson, 1984; Gallup, 1991, 1994, for reviews). This capacity has been termed *self-recognition* and has been linked in a number of theoretical accounts to the presence of an objective self-concept (Gallup, 1975, 1979; Lewis, 1986; Lewis & Brooks-Gunn, 1979; Lewis, Sullivan, Stanger, & Weiss, 1989).

Until recently, researchers have assumed that 18- to 24-month-old infants were capable of recognizing themselves in delayed visual feedback (photographs, previously recorded videotape) in much the same manner as they do in situations involving live visual feedback (mirrors, live video; Lewis & Brooks-Gunn, 1979). For example, on the basis of a review of existing studies, Brooks-Gunn and Lewis (1984) concluded that by 18 to 20 months of age, "self-recognition on the basis of features is clearly evident, as infants recognize their pictures and use social categories appropriately for self and other pictures" (p. 230). Thus, using measures such as (a) infants labeling their image correctly (using their proper name or saying, "That's me"), (b) viewing time, (c) affect displays, and (d) imitation, Brooks-Gunn and Lewis concluded that infants of this age are capable of recognizing themselves (vs. other infants) in delayed videotapes and photographs.

However, the mark test of self-recognition in mirrors would appear to require more than an ability to discriminate self from other. In particular, it appears to require the organism to understand that things that are true of the mirror image are also true of the self (see Povinelli, 1995, for a theoretical elaboration). In contrast to the mark test, measures such as viewing time, affect display, and imitation may only indicate an infant's ability to discriminate the difference between visual images of self and other. Given infants' extensive familiarity with mirrors prior to 18 months, it is likely that they are already familiar with the constellation of features that comprise their facial appearance. Thus, the ability to correctly label the image may only reflect the fact that the infant knows that the particular constellation of features he or she sees in mirrors are referred to by the infant's proper name, or the personal pronoun "me" (Anderson, 1984; Bigelow, 1981; Gallup, 1975). From this, it follows that the kinds of measures that have been used to demonstrate that infants recognize themselves in delayed stimuli are not suitable to address whether they understand that the image is a former instance of themselves. Although some researchers have speculated that an organism that passes the mark test of self-recognition in mirrors may possess a knowledge of his or her own identity that is continuous in time (see Brooks-Gunn & Lewis, 1984; Gallup, 1979), a more formal analysis reveals that although self-recognition in mirrors requires that an organism must be capable of constructing a representation of at least his

Daniel J. Povinelli and Bridgett B. Simon, Center for Child Studies, University of Southwestern Louisiana.

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Correspondence concerning this article should be addressed to Daniel J. Povinelli, Center for Child Studies, University of Southwestern Louisiana, P.O. Box 44287, Lafayette, Louisiana 70504-4287.

or her physical appearance and agency, it is not necessary that the organism understand the temporal–causal connections among previous instances of the self (Povinelli, 1995).

To explore the connection between an infant's capacity for self-recognition with live versus delayed visual feedback, Povinelli, Perilloux, & Landau (1996) recently developed an analog of the mark test, using briefly delayed videotapes and photographs of the self. In one study, 2-, 3- and 4-year-old children were videotaped while playing an unusual game. During the game, an experimenter covertly placed a large sticker on the child's head. The videotape was then played back for the children 3 min later. None of the 2-year-olds and only 25% of the 3-year-olds reached up to remove the sticker when the tape revealed its being placed on their heads. In contrast, 75% of the 4-year-olds reached for the sticker. A second study replicated these age-related effects with polaroid photographs that depicted an experimenter placing a large sticker on the child's head. Although 80% of young 3-year-olds were capable of labeling their image by saying, "me," using their proper name or pointing to themselves, only 13% of them reached up to remove the sticker when they were shown the Polaroid photographs. In contrast, almost all older 4-year-olds did so. Additional evidence that 3- and 4-year-olds interpreted the image in a different manner can be derived from the fact that although children in both age groups labeled the image properly and could verbally identify the sticker in the image, 3-year-olds frequently used third-person labels to describe the image, referring to their proper name or stating that the sticker was on "his" or "her head." Four-year-olds almost exclusively used the first-person pronoun ("me") and the first-person possessive pronoun (i.e., "my head"). Both results have been interpreted as evidence for the emergence of a proper self—an autobiographical self-concept (Povinelli et al., 1996; Povinelli, 1995).

The development of the proper self allows the child to knit together historical instances of him- or herself into a unique, unduplicated self. In William James's (1890/1950) words, this is the construct that allows our consciousness to say, "*I am the same self I was yesterday*" (p. 332; italics in original). Neisser (1991) has referred to this as the development of the "extended self." Several researchers have explored the development of autobiographical memory in young children, including Nelson (1992, 1993), who has argued that the fact that few adults have memories from earlier than 3 to 4 years of age suggests that a new form of memory—autobiographical memory—emerges at about this point in the child's ontogeny. Although children as young as 2 years can verbally report specific events from the relatively distant past (e.g., Nelson, 1989), these episodic memories are not retained into adulthood. Autobiographical memory is therefore presumed to be a specific kind of episodic memory, "consisting of those memories that are retained and accessible to later recall, sometimes for a lifetime, and become part of one's life story" (Nelson, 1992, p. 174). Although the exact mechanisms of the development of this new form of memory are unclear, a number of factors have recently been proposed as playing a role, including children's developing understanding of mental representation, the joint construction of personal narratives in the context of mother–child conversations, and styles of maternal language in conversations about the past (Fivush & Hamond, 1990; Hudson, 1990; Nelson, 1992; Perner, 1991; Welch-Ross, 1995, 1997).

Povinelli (1995) has proposed a theoretical model that argues that the ability of 18- to 24-month-olds to recognize themselves in mirrors is supported by an initial, explicit self-representation that reflects the domain-general emergence of an ability to hold in mind a single representation or model of the world (for alternative views of the nature of this domain-general change at 18–24 months, see Perner, 1991; Olson & Campbell, 1993). This initial self-representation, or present self, is defined as including a single representation of the state of the self at any given instant in time. Thus, the present self can be thought of as a representation of online aspects of the self's agency, nonepistemic mental states (such as desires), and possibly default inputs concerning the self's physical appearance. Mark-directed responses in self-recognition tests with mirrors and live video are presumed to occur because the child forms an equivalence relation between his or her present self and the image in the mirror. This is believed to occur because, from the child's point of view, everything that is true of the self is also true of the image in the mirror or live video presentation. However, infants of this age are not envisioned as being able to construct a higher order concept of self that would allow them to organize past states of the self in relation to the present self. Thus, although 2- and 3-year-old children can encode, recall, and verbally report events in their memory, the model stipulates that these events are not represented in an autobiographical manner or, as Welch-Ross (1995) explained, the memories are not "tagged" with a self label.

However, Povinelli (1995) has argued that changes at around 4 years of age in the child's domain-general representational system usher in an additional level of self-representation. One interpretation of a number of abilities (some related to understanding the mental states of self and other) that may emerge at around 4 years of age (e.g., passing tests of an understanding of false belief, the appearance–reality distinction, sources of knowledge, representational change, etc.) is that children become able to hold in mind multiple representations or models of the world simultaneously (see Olson & Campbell, 1993; Perner, 1991). If true, this ability would have important implications for the child's conception of self. For example, the child's representational system can begin to "temporalize" what were previously successive and unrelated states of the self into an organized, coherent autobiographical self-concept. This higher order representation of the self (the proper self) allows the child to organize previous states of the self as a temporal progression. This, in turn, provides a causal framework for the child to evaluate the relevance of previous states of the self to the present self. The self becomes not just the explicitly represented experiences of the here and now, but also the more abstract (and more ontologically questionable) entity that binds these successive states together through a causal network known as time. Previous assessments of this model have demonstrated that 4-year-olds interpret events that have happened to them in the recent past (as revealed by briefly delayed videotape) as being causally related to their present state (Povinelli et al., 1996). In contrast, although younger children can recall these past events and label their image correctly, they do not grasp the causal connection between those events and the state of their present self.

In the present study, we focused on testing two predictions that can be derived from the model just described (Povinelli, 1995). The formalism underlying the model reveals that as the delayed video feedback of themselves increases from several minutes to several hours or days, 4- and 5-year-old children ought to increasingly conclude that such images have little causal relevance to the current state of highly dynamic features of their physical appearance (i.e., whether they currently have cake on their face, are wearing their favorite shirt, or, in the context of this research, have a sticker on their head). Thus, in the context of the task used by Povinelli et al. (1996), in which a large sticker is secretly placed on the child's head, the length of the delay of the video presentation of this event is predicted to have a strong inverse effect on whether older preschoolers will reach up to their head for the sticker to explore this unexpected (but highly transient) state of the self. In direct contrast, the model predicts that younger preschoolers will fail to appreciate the temporal distinction between briefly versus extremely delayed videotape feedback of the self. Hence, after a certain threshold level of feedback delay (perhaps on the order of 1 or 2 s), changes in the length of delay are predicted to have little effect on the 3-year-olds' responses. The study reported in this article was explicitly designed to test these predictions.

Method

Participants

The participants of the study were 88 preschool children recruited from the Lafayette, Louisiana, area, whose parents gave informed, written consent for their participation. The participants were divided into 3 age groups: 32 young 3-year-olds (36–42 months), 32 young 4-year-olds (48–54 months), and 24 young 5-year-olds (60–66 months). No data were systematically collected on the children's ethnic or racial background, but the children were primarily of working and middle-class families of Caucasian, Black, Hispanic, and Asian backgrounds.

Procedure

The number of children in each age group was divided in half to create two treatment groups: briefly delayed video feedback and extremely delayed video feedback (n = 16 per group for the 3- and 4-year-olds, and n = 12 per group for the 5-year-olds). Within each age group, pairs of children were matched for age across the two treatments. Thus, both the mean and the median age of the children in each treatment group within the age groups were identical (*M*s and *Mdn*s = 38, 51, and 62 months, for the 3- and 4- and 5-year-olds, respectively).

In preparation for the study, two unusual games were created, both of which involved the child's collecting stickers and placing them on a sheet of paper. In Game 1, a Mickey Mouse puppet was used to hide stickers under two red opaque, upside-down cups that were attached to a 30- × 85-cm base. Colored pictures of Disney cartoon characters were attached to the cups by Velcro. While the child covered his or her eyes with their sticker page, the experimenter hid a sticker under one of the cups and used the Mickey Mouse doll to offer clues (graded in difficulty for the different ages) about where the sticker was hidden. In Game 2, a large game board was used that consisted of a trail of different colored steps leading to a castle. Various three-dimensional props were attached to the game as a background, including a bridge, a dragon, and a brightly decorated castle. The child was introduced to a troll doll (dressed as a wizard) and was told that the game was to walk the troll along the trail to get to the castle. A deck of cards (each of which contained a color matching the steps of the trail) was used to advance. Stickers were given to the child after each turn, as he or she landed on the steps of the trail.

The parents of each child were contacted and were scheduled for two visits to the child center, with Visit 1 and Visit 2 separated by exactly 7 days. On Visit 1, the child arrived and played in a warm-up area with one experimenter, while a second experimenter explained the study to the child's parent, obtained the parent's written, informed consent, and then joined the child and other experimenter in play. After the child was comfortable with both of the experimenters, he or she was invited to play a game in one of two adjacent testing rooms.

The two rooms were visually distinct. Room 1 was twice as large as Room 2, and contained a green carpet, a single poster hung on one of the walls, and a one-way mirror. In contrast, Room 2 had a black-and-white checkered tile floor, five posters on three walls, a large chalkboard (which covered an entire wall), and did not have a one-way mirror (although a remote video camera provided a view for the parents to observe the testing sessions that occurred in Room 2).

Within each treatment group, half (n = 8, for 3- and 4-year-olds, and n = 6 for the 5-year-olds) of the children were randomly assigned to play Game 1 on Visit 1, and the other half were assigned to play Game 2 on Visit 1. All Visit 1s occurred in Room 1, and all Visit 2s occurred in Room 2. Both of the games were structured so that the main experimenter sat next to the child, and the second experimenter sat directly across the table from the child, with the game on the table between them. A video camera was positioned (to the right of the second experimenter) so that the child's head and upper torso, as well as the game itself, were clearly visible on the recording. As soon as the child sat down and was ready to play the game, the camera and a hand-held stopwatch were activated by the second experimenter.

During the first minute of the taping, the main experimenter twice patted the child on the head in the context of praising him or her for doing such a great job in playing the game. These served as sham touches to adapt the child to having the experimenter touch his or her head. After exactly 1 min had elapsed, the main experimenter again praised the child by patting him or her on the head but used this contact as a means of covertly placing a brightly colored 4.5- × 3.5-cm sticker on his or her head. The child continued to play the game for 2 min after having been so marked, during which time period the main experimenter did not again touch the child's head. After 3 min had elapsed, the game was ended. The second experimenter diverted the child's attention by assisting him or her in adding colorful ink stamps to their sticker page, during which time (in Visit 1 only) the main experimenter surreptitiously removed the sticker from the child's head.

Each child returned 7 to 9 days later for Visit 2.[1] The child again played in the warm-up area until he or she was comfortable with the experimenters. As on the first visit, the child was invited to play another game. Thus, each child was led into Room 2 to play the game that he or she had not played on Visit 1. The room contained a table with the appropriate game, a video camera that recorded them playing the game, a video monitor (42 × 32 cm)/videocassette recorder unit on a stand in one corner of the room, and a second video camera that was used to record the child as he or she observed the video monitor (see below). The child's Visit-2 game was administered in the manner explained earlier, and the child was again marked by placing a sticker on his or her head as in Visit 1. The only difference was that the main experimenter did not remove the sticker at the conclusion of the game. Instead, the experimenter continued to play with the child while the second experimenter prepared a stimulus tape for the child to view. As soon as the appropriate tape was cued, the experimenters invited the child to join

[1] Although the children were scheduled for Visit 2 1 week after Visit 1, 7 of the 88 children deviated from this protocol and were rescheduled for Visit 2 on either Day 8 or Day 9. Four of these children were in the brief delay condition, and 3 were in the extreme delay condition.

them in front of the television monitor to "watch TV," and the second video camera (that recorded the child while he or she viewed the monitor) was activated. The main experimenter accompanied the child to the television, where the two of them sat to watch the tape. Children receiving the brief delay treatment observed the 3-min tape that had just recorded them playing Game 2, whereas children receiving the extreme delay treatment observed the 3-min tape that had been recorded during their first visit. No information (other than the contextual information contained on the tape itself) was provided to the child concerning when the events they were witnessing had occurred.

At the end of the 3-min presentation, the main experimenter paused the tape so that the child's image with the sticker on his or her head remained on the screen. The main experimenter then pointed to the child's image and asked the child, "Who is that?" If the child did not respond, the experimenter then asked, "Can you tell me who that is?" Next, the main experimenter pointed to the image of the sticker on the child's head and asked, "What is that?" If the child did not reply, the question was repeated. If the child still did not respond to this question, or if he or she answered incorrectly, the experimenter said, "I think it's a sticker," and then immediately asked, "Can you get that sticker for me?", again while pointing to the image of the sticker on the monitor. The child's response to this third question concluded the session, at which time the child was praised for his or her efforts and was escorted back to their parents in the waiting room.

Data Analysis

A main rater was administered a set of written instructions requesting that he view the tapes of the children as they observed themselves on the stimulus tape in Visit 2. A second rater was administered the same instructional set and was instructed to view a sample of 28% of the children (n = 25) to assess the reliability of the coding scheme. The instructions requested that the raters first note on a standardized scoring sheet whether at any point during the stimulus presentation or the questioning period, the child "appear[ed] to reach up to touch the sticker on his or her head." The reliability rater agreed with the main rater on 21/25 cases in the initial presentation period and 16/16 cases in the questioning period (overall agreement = 90%). Instances of disagreement were resolved by discussion while having the main rater observe the cases again. The instructions also directed the raters to record a verbatim transcript of the children's responses to the experimenter's questions. The raters agreed on the category of the children's replies for 25/25 (100%) of the cases for both Question 1 ("Who is that?"/ "Can you tell me who that is?") and Question 2 ("What is that?").

Finally, to assess whether the children noticed that the main experimenter had removed something (the sticker) from their heads at the end of Visit 1, two raters were each administered an instructional set that requested them to view a predetermined random sample of 7 children from each age–treatment group (total n = 42). (The sample was random within the pool of children for whom the act of removing the sticker from their heads at the end of Visit 1 was available on videotape.) The raters viewed the recordings of these children for 10 s prior to the experimenter's removing the sticker from their heads, and for 10 s after, and recorded the total number of times each child touched his or her head during each of these 10-s periods. For 41/42 (98%) of the children observed, the raters agreed that no touches to the head occurred in the 10-s period prior to the removal of the sticker. Both raters also agreed that 1 child did touch his head during this time (although he did not touch the sticker itself). In addition, the raters agreed that none of the 42 children touched his or her head during the 10-s period following the removal of the sticker. Thus, there was no evidence that the children knew either that a sticker had been placed on their heads or that it had been removed.

Results

In addition to the final 88 participants who completed the study, an additional 19 children began but did not complete the study (seven 3-year-olds, six 4-year-olds, and six 5-year-olds). Three of the children did not show up for their second visit, 3 refused to cooperate during their second visit, 5 found the sticker while playing the game during Visit 1, and 8 found the sticker before seeing themselves on video during Visit 2. Most of the cases in which the children discovered the sticker while playing the game appeared to be accidental, as the result of brushing their hair or scratching their heads.

To examine the main results, the main rater's judgments were used to determine whether each child reached up ("yes" or "no") at some point during the initial 3-min presentation period or whether he or she reached up ("yes" or "no") at any point during the presentation and questioning periods combined. These results were examined to determine whether there were gender effects, by placing the children into separate 2 (gender) × 2 (test result) tables for the initial presentation period and the presentation and questioning periods combined. The results revealed no effect of gender in either case, $\chi^2(1, N = 88) = 0.006$, $p = .94$, and, $\chi^2(1, N = 88) = 0.026$, $p = .87$, respectively.

The crucial results of our study concern whether the children reached up to their heads to search for the sticker, after seeing the videotape of the experimenter placing it there, and whether this response was dependent on the type of feedback they received (brief vs. extreme delay). The results of the main rater's assessment are presented in Table 1, which indicates the percentage of children who were judged to reach up to search for the sticker at any point during the presentation period. As predicted by the autobiographical stance model, less than half of the 3-year-olds in both the brief and the extreme treatment groups responded by reaching up to their heads (see Table 1), and a Fisher's exact test indicated no significant association between the treatment group and the number of children who searched for the sticker (p = 1.00). In contrast, in the brief delay group, 87.5% and 83% of 4- and 5-year-olds, respectively, searched for the sticker, whereas only 25% and 8% did so in the extreme delay group (see Table 1), and Fisher's exact tests indicated significant associations for both age groups between the treatment they received and the number of children who searched for the sticker (4-year-olds, $p < .001$; 5-year-olds, $p < .0006$).

Table 1
Percentage of Children Reaching Up for the Sticker in Brief Versus Extreme Delay Conditions

	Presentation				Presentation + questioning			
	Brief delay		Extreme delay		Brief delay		Extreme delay	
Age (months)	%	n	%	n	%	n	%	n
36–42	43.8	16	37.5	16	56.2	16	37.5	16
48–54	87.5	16	25.0	16	93.8	16	43.8	16
60–66	83.3	12	8.3	12	83.3	12	33.3	12

Several of the children who had not reached up during the 3-min stimulus presentation period did reach up during the questioning period. The combined number (and percentage) of children who were judged to reach up during either the presentation period, the questioning period, or both are also presented in Table 1. Although, in general, more children reached up to their heads, the overall pattern of results did not change. For the 3-year-olds, a Fisher's exact test indicated no significant association between whether they reached up and the type of feedback they received (p = 1.00). However, as before, there were significant associations between these variables for both the 4- and the 5-year-olds (Fisher's exact tests, ps = .006 and .036, respectively).

Next, the main data were also analyzed to examine age-related trends within each of the conditions. Replicating the basic findings of Povinelli et al. (1996), chi-square tests for trend revealed significant or near-significant age-related trends for the brief delay condition, presentation period only, χ^2 (1, N = 44) = 5.884, p = .02, presentation and questioning periods combined, χ^2 (1, N = 44) = 3.448, p = .06. Thus, as age increased, so too did the number of children who reached up to their heads. In contrast, and as the model we were testing predicted, chi-square tests for trend indicated near-significant age-related effects for the presentation period results of the extreme delay condition as well but in the opposite direction, presentation period only, χ^2 (1, N = 44) = 3.088, p = .08. That is, as age increased, the number of children who reached up tended to decrease. No age effects were detected for the data from the presentation and questioning periods combined, χ^2 (1, N = 44) = 0.032, p = .86.

Finally, we analyzed the children's responses to the questions that they were asked after viewing the delayed videotape of themselves. The children's responses to the question, "Who is that?" were examined in several ways. First, we examined these data to determine if the younger children had a more difficult time than did older children in identifying their image. However, as can be seen by collapsing all the children in each age group across the two response categories ("me" and proper name) in Table 2, none of the age groups had difficulty in responding by saying "me" or by using their proper name (28/32 = 87.5%, 28/32 = 87.5%, and 22/24 = 91.7% of the 3-, 4- and 5-year-olds, respectively, responded in one of these two ways). Second, we examined whether there were age-related trends in terms of the children's tendencies to use the first-person pronoun ("me") versus their proper name. As discussed earlier, previous research indicated that younger children tended to use these labels indiscriminately, whereas older children almost exclusively used the personal pronoun. To explore this effect, we collapsed the treatment conditions within each age group and then placed the children who responded by using either the first-person pronoun or their proper name into a 3 (age) × 2 (response type) contingency table. (Children who did not respond or responded in irrelevant ways were not included in this analysis.) A chi-square test for trend revealed a significant effect of age, χ^2 (1, N = 78) = 4.977, p = .026. This effect is the result of the fact that the number of 3-year-olds who responded by using the first-person pronoun (17/28, 60.7%) was comparable to the number who responded by using the more dissociative response of their proper name (11/28, 39.3%), whereas older children responded by using the first-person pronoun far more frequently (4-year-olds: first-person pronoun = 24/28, 85.7%, proper name = 4/28, 14.3%; 5-year-olds: first-person pronoun = 19/22, 86.4%, proper name = 3/22, 13.6%). Finally, to examine whether the treatment (brief vs. extreme delay) had an effect on the type of response, these same children were placed into a 2 (treatment) × 2 (response type: first-person pronoun vs. proper name) contingency table. A Fisher's exact test revealed no effect of treatment (p = .282).

The children's responses to the question, "What is that?", while the experimenter pointed to the image of the sticker on their head on the paused videotape, are presented in Table 3. In general, the majority of children in all age–treatment groups were able to correctly identify what was on their heads (before the experimenter told them). However, a 3 (age) × 2 (response: correct vs. incorrect/don't know/no response) chi-square test for trend indicated a near-significant linear trend for more correct responses as age increased, χ^2 (1, N = 78) = 3.694, p = .055. In contrast, a 2 (treatment) × 2 (response: correct vs. incorrect/don't know/no response) Fisher's exact test detected no effect of treatment (p = .617). To summarize, the key finding with respect to the children's responses to this question is that the older children's differential responses to the brief and the extreme delay treatments cannot be attributed to some peculiar

Table 2
Percentage of Children Using First-Person Pronoun Versus Proper Name in Describing Themselves From Briefly Versus Extremely Delayed Videotape

Age (months)/ treatment	Me		Proper name		Don't know/ no response	
	%	*n*	%	*n*	%	*n*
36–42						
Brief delay	62.5	16	31.3	16	6.3	16
Extreme delay	43.8	16	37.5	16	18.8	16
48–54						
Brief delay	87.5	16	12.5	16	0.0	16
Extreme delay	62.5	16	12.5	16	24.6	16
60–66						
Brief delay	83.3	12	0.0	12	16.7	12
Extreme delay	75.0	12	25.0	12	0.0	12

Table 3
Percentage of Children Able to Identify Sticker on Their Head From Briefly Versus Extremely Delayed Videotape

Age (months)	Sticker identification			
	Brief delay		Extreme delay	
	%	*n*	%	*n*
36–42	75.0	16	56.3	16
48–54	81.3	16	75.0	16
60–66	83.3	12	92.0	12

difficulty in identifying what was on their heads, as children in both treatments answered this question equally well.

Discussion

The results reported here are consistent with both of the predictions of the autobiographical stance model outlined earlier. First, young 3-year-olds exhibited little ability to understand the different causal implications of briefly versus extremely delayed video presentations of the self with respect to highly transient aspects of the self. In contrast, 4-, and especially 5-year-olds, displayed a clear understanding that although briefly delayed visual feedback is causally relevant to transient aspects of the present self, extremely delayed feedback is not. Both of these predictions were generated by a model that accounts for the developmental trends uncovered in previous tests of delayed visual self-recognition in terms of the emergence of an autobiographical stance toward those images. The 3- to 5-year-old age transition detected with the nonverbal test used here is consistent with previous estimates concerning the age of the emergence of autobiographical memory. For example, both Perner (1991) and Nelson (1992) have noted that the phenomenon of infant amnesia suggests that autobiographical memory may emerge at about 4 years of age. This represents the typical age at which most individuals possess their earliest memories.

Given that we were able to replicate the finding of Povinelli et al. (1996) that young 3-year-olds were as likely as older children to label their image properly, our results further emphasize the point that the ability to pass mark tests involving delayed visual feedback is not strictly related to the presence or absence of featural recognition of the self. However, given that we also replicated the finding of Povinelli et al. that 3-year-olds do not tend to prefer labeling the image using the first-person pronoun "me" (as an adult would), as opposed to using the also correct but more distant or dissociative label of their proper name, their ability for featural recognition may obscure an underlying difference in the manner in which they interpret the image. Indeed, we believe that the younger children's proclivity for using their proper name in this context complements our main findings that these children exhibit low rates of searching for the sticker and exhibit comparable rates in both the brief and the extreme delay conditions. Both results seem to reflect the younger children's difficulty in understanding that the self's past and present states refer to the same person (albeit at different points in time), possibly because they have not yet developed the representational capacities to construct a notion of the proper self (Povinelli, 1995).

However, the issue of featural recognition is not unrelated to the response we have chosen as our dependent measure (i.e., reaching up to the head to search for a sticker). If infants' detection of equivalence, in general, is what allows them to pass the mark test of self-recognition in cases of live feedback, then it seems likely that their recognizing the featural equivalence between the image observed in live or delayed feedback, on the one hand, and the default memory of one's physical appearance on the other, may contribute to passing both live and delayed mark tests. To fully understand why this is the case, recall that our model postulates that 18- to 24-month-olds pass mark tests in situations of live feedback because they map an equivalence relation between their representation of their present kinesthetic state and the actions of the image that they are observing. However, at some point in development, this representation may also incorporate default inputs concerning their featural appearance (as the 3-year-olds' correct answers to the "Who is that?" question clearly demonstrate). Thus, with respect to the child's enduring set of physical features, the delayed image of the self and the child's representation of the present self are, in fact, equivalent, despite the nonequivalence of their present kinesthetic state and the actions of the delayed image. Indeed, if their attentional resources were focused exclusively on the physical features of the image, then younger children might assume that the image in the delayed video is, in fact, equivalent to the present self. Although the mapping of an equivalence between their mental representation of what they look like and the appearance of the image on the screen may thus lead 3-year-olds to reach up to search for a sticker on their head, this is, in principle, a very different process than their understanding the temporal-causal distinction between briefly versus extremely delayed images of themselves.

In attempting to tease apart the influence of kinesthetic, featural, and temporal-causal information on our central dependent measure (reaching up to the sticker), it is important to note that our model stipulates that kinesthetic (or agency) information is the most salient cue for younger children. Thus, passing the delayed mark test solely by mapping an equivalence relation on the basis of featural information may occur relatively infrequently (see Povinelli, 1995). In contrast, older children clearly identify the kinesthetic nonequivalence between the delayed image and the present self (as do the majority of the 3-year-olds) but differ in that they also understand the causal connections between their present state and their previous states (which collectively comprise the proper self). In effect, we propose that the majority of the 80% to 90% of older children who reach up to search for the sticker in the brief delay condition do so because they grasp the temporal-causal connection of successive states of the self, whereas the majority of the 40% to 50% of the 3-year-olds who search for the sticker do so because they map the equivalence between a mental representation of their physical appearance and the appearance of the image. Indeed, the differing abilities of 3-year-olds versus older children to discriminate between briefly versus extremely delayed images can be thought of as direct evidence that different cognitive processes do, in fact, support what superficially seems to be an identical response on the part of some of the younger versus the older children (i.e., reaching up to search for a sticker on the head).

So far, we have postulated that young 3-year-olds do not interpret a briefly (or extremely) delayed video image of themselves from an autobiographical stance because they have not constructed a higher order representation of the self. However, it is logically possible that, prior to the 4th year of life, children do, in fact, develop a less sophisticated form of the proper self that may emerge before they grasp the temporal and causal implications of higher order representations of the self. For example, it may be that young 3-year-olds have already begun to develop a meta-representational system through which they can hold in mind past as well as imagined future states but, unlike the 4- and 5-year-olds, are unable to link such states in a temporal or

causal manner. This, in turn, could preclude an understanding of the inherent interdependence between successive instances of the self. Indeed, in practical methodological terms, it is worth noting that if young 3-year-olds possess this kind of proper self (a meta-concept of self, in which previous states of the self are understood as previous states but are not related to one another in a causal manner), we would not expect to obtain results significantly different from those reported here. Thus, future tests should seek to manipulate the causal structure of events, while holding constant the absolute time elapsed, in an effort to determine whether young 3-year-olds have a particular problem in understanding the causal connections that bind together previously experienced states of the self.

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