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Preschoolers' use of spatiotemporal history, appearance, and proper name in determining individual identity

Grant Gutheil,
Nazareth College

Susan A. Gelman,
University of Michigan

Eileen Klein,
University of California Santa Barbara

Katherine Michos, and
Widener University

Kara Kelaita
University of New Hartford

Abstract

Humans construe their environment as composed largely of discrete individuals, which are also members of kinds (e.g., trees, cars, people). On what basis do young children determine individual identity? How important are featural properties (e.g., physical appearance, name) relative to spatiotemporal history? Two studies examined the relative importance of these factors in preschoolers' and adults' identity judgments. Participants were shown pairs of individuals who looked identical but differed in their spatiotemporal history (e.g., two physically distinct but identical Winnie-the-Pooh dolls), and were asked whether both members in the pair would have access to knowledge that had been supplied to only one of the pair. The results provide clear support for spatiotemporal history as the primary basis of identity judgments in both preschoolers and adults, and further place issues of identity within the broader cognitive framework of psychological essentialism.

A fundamental aspect of human cognition is that we construe the environment as including unique *individuals* that belong to various *kinds*. An individual human, for example, could simultaneously be a mammal, woman, co-worker, and spouse. Cognitive psychologists have made an extensive study of categories but have had less to say concerning conceptions of individuals and how these concepts develop. Yet identity understanding is crucial to daily life. We need to correctly identify the unique individual book, keys, spouse, or close friend relevant to our own existence and successfully track those individuals over time.

Send all correspondence to: Grant Gutheil, Psychology Center, Nazareth College, 4245 East Ave., Rochester, NY USA 14618-3790, Phone: 585-389-2737 Fax: 585-389-2013, Email: dguthei0@naz.edu.

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How humans (especially children) accomplish this task is currently unclear, and the existing data are contradictory. One broad perspective focuses on the accessibility and importance of salient and intuitively relevant properties, such as physical appearance and proper name, in making identity judgments. We expect individuals (objects, people, and animals) in our lives to maintain more-or-less a certain appearance—at least in the short term—and we successfully use this information to recognize and track individuals over time. We may also grant these properties some real causal power to determine identity as well.

For example, 12-month-olds seem to believe that if a seemingly single object transforms from a duck to a truck, it must in fact be two separate objects, despite clear evidence to the contrary (Xu & Carey, 1996). Older children show a similar understanding: six-year-olds responded that they “would not be the same person” if their name were changed, or if they looked like their best friend (Guardo & Bohan, 1971). When asked why Scrooge remained the same individual throughout “A Christmas Carol,” preschoolers stated that he “still has the same clothes” or “still looks the same” (Chandler et al., 1987). Other experimenters have found that although 4- and 5-year-olds grasp the importance of the brain for thinking and remembering, they do not yet see a strong connection between brain and individual identity. When presented with stories of brain transplants (e.g., from one child to another, or from a child to an animal) children based their identity judgments on physical appearance or category membership rather than brain location (Gottfried, Gelman, & Schultz, 1999; Johnson, 1990).

In addition to using appearances, children seem to use proper names as an index of individual identity. The extensive literature on children’s grasp of proper names indicates that by roughly age 2 or 3 years children understand that proper names refer to unique individuals and not categories or properties of individuals (Gelman & Taylor, 1984; Hall, Bredart, & Nocolay, 2003; Hall, Lee, & Belanger, 2001; Hall, Veltkamp, & Turkel, 2004; Macnamara, 1986).

Even adults place importance on particular features as tied to identity. When faced with an individual who physically and behaviorally contradicted their mental image of John F. Kennedy (President of the United States in 1963), American adults almost unanimously (83%) refused to agree that he could be JFK, despite the assertion that this individual had, in fact, been President of the United States in 1963 (Sternberg et al., 1997). Altogether, this set of studies would suggest that young children and adults alike rely extensively on outward perceptible cues to determine individual identity.

A competing body of evidence (coming at times from the same investigations) demonstrates children’s ability to ignore properties such as appearance or proper name and instead focus on spatiotemporal history as the primary basis for identity judgments. In this research, participants track individuals through time and determine individual identity by either following the spatiotemporal path of an object or using their knowledge of the events in such a path. For example, adults questioned by Sternberg et al. (1997) unanimously responded that an individual who looked and acted like JFK, but was Prime Minister of Britain (and not President of the United States) in 1963 could therefore not have been JFK.

Developmental research likewise demonstrates the importance of spatiotemporal history in judgments of identity. For example, although 12-month-olds in Xu and Carey’s (1996) work base their identity judgments on object appearance, 10-month-olds in the same study did not. They accepted the transformation of a single object from a duck to a truck as long as they could infer a clear, single, spatiotemporal path during the transformation. Preschoolers also can track the individual identity of various animals across changes in proper name and appearance (Gutheil & Rosengren, 1996). As did Xu and Carey in their work with 10-month-olds, Gutheil and Rosengren argued that these decisions were based on the spatiotemporal history of the animals involved. Similarly, in an investigation of 3-year-olds’ use of proper names, Sorrentino

(2001) found that children restricted their application of a proper name to a specific individual with a unique spatiotemporal path, despite conflicting appearance information. This study was explicitly focused on the extension of proper names and made no claims concerning children's identity understanding. The results are, however, at least consistent with children's use of spatiotemporal history in making identity judgments.

The goal of the present investigation is to provide a potential resolution to these conflicting results. We take as a starting point psychological essentialism (Gelman, 2003; Medin, 1989). From this perspective, the essence of a category or of an individual constrains object properties and property relations that are the basis of human representations. These properties vary from highly accessible features (e.g., appearance) to much less accessible, non-obvious features (e.g., internal genetic structure). Non-obvious features are thought to be more stable across category members, more closely tied to the essence, and so more indicative of category membership. Although the specific nature of the essence may be unknown (i.e., reasoners may have only an essence placeholder; Medin, 1989), and essences may not actually exist (Wilson, 1999), the belief in the existence of essences appears to drive adults' representations of living kind categories. This then is why we believe that appearances can be deceiving, that innate potential can determine how an animal will grow, and that members of a category share non-obvious similarities (see Gelman, 2003; Medin & Ortony, 1987 for further discussion of psychological essentialism).

Gutheil and Rosengren (1996) hypothesized that essentialism could be successfully applied to individual identity, but that by definition a category essence (which determines kind membership) must differ from an individual essence (which determines individual identity). They suggested that an individual's essence is tied to his or her spatiotemporal history, which is: a) stable across time, b) non-obvious, and c) unique to that individual. As such, spatiotemporal history is linked to individual identity, in contrast to the more limited predictive power of less essential properties such as name or appearance. However, prior research has not tested this possibility.

Gelman (2003) similarly proposed that spatiotemporal history is one of the components of kind essentialism. When children report that a lion wearing a tiger costume is truly a lion, not a tiger (Keil, 1989), they have decided that spatiotemporal history overrides outward appearance. When they judge that the parentage of an animal is more important than its environment in determining its behavior (e.g., a pig reared by cows will still oink; Gelman & Wellman, 1991), they have chosen to privilege spatiotemporal history. When an art dealer establishes the worth of a painting by Picasso (or the worth of a fraud; Bloom, 1996), she is making use of spatiotemporal history.

Gelman notes:

“Our cognitive systems are structured to invoke personal history—rather than observable features—as constituting identity... Tracking an individual over time requires some hefty insights: (a) that a thing can retain identity despite outward changes in appearance (the appearance-reality distinction again), (b) that personal history is central to identity. For example, the changes in an animal or plant wrought by growth are enormous, and mean that tracking identity is not a matter of tallying outward features, but rather involves learning the historical path that an individual has taken over time (see also Kripke, 1971).” (p. 318).

The applicability of essentialism to identity is further supported by a recent paper by Rips, Block, and Newman (2006). In contrast to our focus on spatiotemporal properties, Rips et al. proposed a “causal continuer” theory of adult identity judgment, which focuses on non-obvious causal factors more generally. For example, when presented with a chair that has been

disassembled, the pieces widely separated and then reassembled back into a perceptually identical chair, Rips et al. argue our intuition is that the disassembled and reassembled chairs are the same individual despite the lack of a single spatiotemporal path during the disassembly and that this intuition is based on the causal connection that exists between the original, disassembled and reassembled chairs.

The causal continuer approach is consistent with essentialism in arguing for separate, non-obvious causal factors for category membership and individual persistence/identity. Rips et al. simply take no position regarding the exact nature of an individual essence.

Developmental investigations of identity have typically focused explicitly on the importance of proper name, appearance, or some combination of the two. In virtually all cases, the spatiotemporal history of the individual(s) involved was assumed to remain stable but was never directly investigated¹. For example, Gutheil and Rosengren (1996) assumed that the source of individual identity was spatiotemporal history, but never directly assessed or manipulated this factor. Other studies with adults (e.g., Rips, Block, and Newman, 2006; Sternberg et al., 1997) manipulated spatiotemporal history with hypothetical scenarios that are too challenging for use with young children.

A theoretically grounded, empirically rigorous, and developmentally appropriate test of the psychological essentialist proposal of individual identity understanding requires directly manipulating individual spatiotemporal history in a concrete context. In order to accomplish this, we focused on familiar characters from children's literature and video (e.g., Winnie-the-Pooh from the stories of A. A. Milne).

The homes of many preschoolers in the U.S. contain multiple examples of these characters that differ only in their unique spatiotemporal histories (e.g., two identical large plush Winnie-the-Pooh dolls purchased at different times and kept in two different children's bedrooms). These characters then allow us to present children with two identical individuals who differ only in their specific spatiotemporal histories. Specifically, we presented children with two identical characters and then walked the participants through a different spatiotemporal experience with each character. We then asked participants what each character knows about each experience.

We had several reasons for assessing *knowledge state* as a measure of personal identity (see also Gutheil & Rosengren, 1996; Johnson, 1990). Knowledge state is intuitively a major part of how adults assess identity in real-world situations. Books, movies, and television, for example, are well-seasoned with plots in which the hero must prove his identity unassailably through his unique knowledge of events in his life. These include fairy tales such as the Frog Prince, classic stories such as the lost Romanoff Princess Anastasia, as well as more current fare such as *The Bourne Identity* and *The Fugitive*.

Locke (1632–1704/1959) defined human individual identity in terms of the continuity of individual memory. In this view, to possess a meaningful individual identity is to have a coherent life history expressed in memory. Although we do not equate knowledge of specific life events with identity, we argue that this property presents an effective measure of identity understanding.

If intuitions about identity are driven by name and/or appearance (e.g., Chandler et al., 1987; Johnson, 1990), then different Poohs should be considered the same individual (i.e., a single POOH). This is, in fact, exactly how toy manufacturers intend us to consider them. Virtually

¹Note A notable exception to this is Hall's (1998) innovative adaptation of the Ship of Theseus problem (Hobbes 1672/1913), in which he focused on differing aspects of history (i.e., continuity of form vs. substance) but did not address spatiotemporal information in the context of proper name and appearance.

all Winnie-the-Poohs (with the probable exception of minimal representations such as posters, key chains, etc.) are meant in some sense to *be* POOH—the unique individual who loves honey, has a best friend named Piglet, and has a very specific set of well-known adventures. These characters also then provide a uniquely strong test of children’s use of spatiotemporal history as a primary basis of individual identity judgment. When presented with two identical Poohs with differing histories, children must contend not only with shared name and appearance but also with the legitimate conceptual interpretation of both “individuals” as representations of a single POOH. If preschoolers choose to treat two identical Poohs, Blues, etc. as two unique individuals, this would be strong evidence in favor of an individual identity concept rooted in spatiotemporal history and consistent with an essentialist framework of identity understanding overall.

In order to examine these issues, we presented children with items that posed a clear contrast between spatiotemporal history (on the one hand) and featural similarity (on the other hand). Thus, for example, children saw two identical Poohs with differing histories. These items were of focal interest, as they provided a strong test of the importance of spatiotemporal history in children’s thinking. We also included a baseline condition in which there was no predicted basis for a shared identity (e.g., Elmo vs. Blue). This baseline permits us to determine how often children treat two clearly distinct individuals as alike, on our dependent measures. Finally, we included a control condition in which appearance was identical but naming and spatiotemporal history differed (i.e., Sally vs. Jane, two identical-appearing dolls). This condition was included in order to disentangle label similarity and appearance similarity (which are confounded in the multiple-Pooh trials). Thus, to the extent that children believe that the two Poohs share a common identity, the doll condition permits us to tell whether shared appearance alone is sufficient to provoke such a belief.

Experiment 1

Method

Participants—Fifteen 4- and 5-year-olds (11 males and four females, age 4–2 to 5–9, $M = 4–11$), recruited from local daycare centers, participated. Eighteen undergraduates (5 males and 13 females, ages 17–25) also participated. All participants were recruited from a predominantly white, middle-class population.

Materials—The materials consisted of three pairs of identical fictional characters taken from children’s TV and literature (i.e., two Blues [dog character] from *Blues Clues*, two Elmos from *Sesame Street*, and two Winnie-the-Poohs). All the characters were approximately 15 inches tall. Two identical female human dolls (approximately 12 inches tall) were also used. Crayons and paper were employed for drawing pictures.

Design and procedure

Pretest trial: Participants were first introduced to two experimenters and told that they (participant) and one experimenter were going to be drawing some pictures, and that the second experimenter was going to come back later to see the pictures with some friends. Experimenter 2 then left the room. Experimenter 1 next drew a picture while obviously and successfully hiding the picture from the participant. She then asked if the participant knew what she had drawn. This was done to establish children’s understanding that (in this context) a single individual could not have knowledge of what she has not seen (see Pillow & Weed, 1997, for evidence of this understanding in preschoolers).

Test trials: The *identical condition* contrasted two identical plush characters with the same proper name (e.g., Pooh-1 vs. Pooh-2). The *different condition* contrasted two completely

different plush characters (e.g., Elmo vs. Blue). The *doll condition* compared two female human dolls of identical appearance and different proper name (i.e., Sally vs. Jane). All participants saw all conditions. The order of the three experimental conditions was random, and the plush toys used in the identical and different conditions were partially counterbalanced across participants. Within the doll condition the name given to each doll was randomized.

The experimenter then identified the character/doll in the room and asked the child to draw a picture “as fast as you can while ‘X’ (e.g., Pooh) watches.” The child was then asked to identify the drawing and show it to the character present. Experimenter 1 then took the drawing and placed it face-down behind her out of the child’s line of sight. Experimenter 2 then re-entered the room with an identical plush character (e.g., Pooh), a different plush character (e.g., Blue), or the second human doll (e.g., Jane), gave the second character/doll to Experimenter 1, and left. Experimenter 1 then asked the child if this second character knew the contents of the drawing. When asking this question she referred to the second character by proper name and gestured to clearly indicate she was referring to that specific individual. For example, in the identical condition, she would hold Pooh-2 in her lap and pat it on the head while asking, “Does Pooh know what you drew?” The second experimenter then re-entered the room, removed both characters, and the procedure was repeated for the remaining conditions. Based on participants’ pretest understanding that (in this context) a single individual could not have knowledge of what she has not seen, shared knowledge of the two events across the two characters/dolls was taken to indicate shared individual identity.

Results

Positive responses were coded as “0”, negative responses were coded as “1”. Cochran’s Q statistic for within-subject comparisons of categorical data (Sheskin, 2000) was employed to compare responses across conditions within each age.

Between 93–100% of adults across all three test conditions responded that the second character/doll in each condition did not know what was drawn, regardless of the similarity of the two characters/dolls in the condition. This is significantly greater than chance in all cases ($p < .001$ binomial probability, chance = 50%), and not significantly different across conditions ($Q(2, N = 3) = 2.0, p = .37$) (see Table 1).

Children’s responses matched adults’. Between 80% (identical condition) and 87% (different and doll conditions) of children responded that the second character did not possess knowledge of the picture ($p < .02$ binomial probability, chance = 50%). There were no significant differences across conditions ($Q(2, N = 3) = 2.0, p = .37$) and no significant differences between children’s and adults’ responses ($\chi^2(5, N = 99) = 6.71, p = .24$).

The results reveal that when explicitly asked to choose between spatiotemporal history and name/appearance, both children and adults based their identity judgments on the former. This result is despite the combination of cues that are in opposition to spatiotemporal history: identical perceptual appearance, shared proper name, and a culturally sanctioned alternative interpretation based the existence of a single POOH, ELMO, or BLUE.

A second experiment was then conducted to address several issues that arose in Experiment 1. The measures were expanded beyond the exclusive use of drawing, the knowledge state of each character was explicitly established, and both positive and negative responses were required from participants to establish a spatiotemporal response pattern.

Experiment 2

Method

Participants—Nineteen 4- and 5-year-olds (9 males and 10 females, age 4–7 to 5–6, $M = 5-2$) participated. All participants were recruited from a predominantly white middle-class population. None of the children had participated in Experiment 1.

Materials—The materials were identical to those in Experiment 1 with the exception of several short games added to expand the context of the procedure (See Table 2).

Design and procedure—After completing the pretest, each child was told that “X” (e.g., Pooh-1) was going to watch while she performed a specific task (e.g., made a picture by placing plastic stickers of children in a schoolroom scene). Once finished, she was asked to show the scene to Pooh, and asked what Pooh thought it was. This established the knowledge state of Pooh-1. All children did this correctly. The experimenter then stated, “Now we’re going to put the stickers and board in a bag to keep them safe.” This placed the task materials explicitly out of view. She then continued, “I have another game that I brought with me in a different room. Pooh is going to stay here and watch the bag for us while we go see the other game.” This explicitly established the spatiotemporal location of Pooh-1 and reinforced his connection to the first task.

The child and experimenter then walked out into the hall and into a separate room containing Pooh-2 and a second game (involving a cup and two cars). The experimenter stated, “Now I have another game. First, can you tell me who this is? OK, Pooh is going to watch while you hide the car under one of these cups.” Once the child had done so, she was asked: (a) where she hid the car, (b) to show Pooh where she hid it, and finally (c) where Pooh thought the car was. This established the knowledge state of Pooh-2. The experimenter finally said, “Let’s put the cups and car in this bag so we can’t see them,” and placed the bag out of the child’s line of sight.

At this point the second experimenter entered the room carrying Pooh-1 and said, “Hi guys, I saw Pooh sitting in the other room with a bag, so I decided to bring him in here.” Experimenter 1 responded, “That’s great. You’re just in time for a new game.” Experimenter 2 then sat down still holding Pooh-1, and Experimenter 1 told the child, “I need you to help me remember some things.” She then proceeded to ask four questions.

Two of these questions concerned Pooh-1’s knowledge of the two tasks and two concerned Pooh-2’s knowledge of the two tasks (see Table 2). These four questions were asked in random order for each participant. For example, “Now, remember the hiding game we played with the cups and the car? Does Pooh [2] know where you hid the car? Remember the sticker picture you made? Does Pooh [1] know what’s in the sticker picture?” Experimenter 1 explicitly touched the appropriate character as she asked each question. This procedure produced 4 responses within each of the three conditions, for a total of 12 responses per child overall. If children based their responses on the differing spatiotemporal histories of each character, they should have responded that each character knows the task it saw and does not know the task it did not see. A spatiotemporal response pattern therefore requires both “yes” and “no” responses.

The child was then told that Experimenter 1 had a new game to play in the other room, and the procedure was repeated for the two remaining conditions.

Results

Responses were coded as “1” for yes and “0” for no. Responses of a given type (spatiotemporal history *supports* task-specific knowledge vs. spatiotemporal history *conflicts with* task-specific knowledge) were summed, yielding scores ranging from 0–2 of each type. Specifically, the supportive questions concerned Pooh-1 with activity 1, and Pooh-2 with activity 2; the conflicting questions concerned Pooh-1 with activity 2, and Pooh-2 with activity 1. We predicted higher scores on the supportive questions than on the conflicting questions (i.e., use of spatiotemporal history as a basis of identity judgments). In contrast, use of name and/or perceptual appearance would yield high scores on both types of items.

We then conducted a 3 (condition: identical, different, doll) by 2 (question type: supportive, conflicting) repeated measures ANOVA which indicated a significant main effect of question type, $F(1, 18) = 24.24, p < .001$, and no other main effects or interactions. Across all three conditions (identical, different, and doll) the mean score for supportive questions was 1.81, and the mean score for conflicting questions was 0.90 (see Table 3).

We next examined the consistency of individual responses across all three conditions. Collapsing across conditions yielded responses ranging from 0–6 for each child and item type. Eleven children had higher scores on the supportive items, 1 child showed the opposite pattern, and the remaining 7 showed no difference. The difference between the number of children showing spatiotemporally consistent and inconsistent response patterns is statistically significant with a sign test ($p < .01$).

The results of Experiment 2 support and extend those of Experiment 1. The combined results demonstrate preschoolers’ use of spatiotemporal history (not name or appearance) as the basis of their individual identity judgments.

General Discussion

Questions of individual identity and persistence have been central to both formal philosophy and popular culture for thousands of years. These issues seem to be a foundational component of how we perceive not only our environment but ourselves as well. In ordinary life, individual identity guides every aspect of our interactions with others. When notions of individual identity go awry, they are correspondingly devastating—and revealing. For example, adolescents at risk for suicide demonstrate an inability to perceive their identity as psychologically stable over time (Chandler, Lalonde, Sokol, & Hallett, 2003). Consider, too the neurological disorder Capgras syndrome, in which individuals believe that significant people in their lives have been replaced with strangers who are perceptually identical imposters. This disorder is of interest not only because it is profoundly debilitating, but also because it suggests that a concept of individual identity can be dissociated from all relevant properties associated with an individual (appearances, behaviors, or proper name) (Edelstyn & Oyebode, 1999). Despite the importance of identity, cognitive psychologists have turned to scientific studies of identity only relatively recently and with inconsistent and conflicting results. This inconsistency is especially true of developmental research on identity understanding.

We presented children with a particularly strong contrast between spatiotemporal information and perceptual features through the use of multiply instantiated fictional characters. With these characters children have direct experience with multiple, discontinuous instances that *are meant* to represent the same individual. Children’s overwhelming reliance on spatiotemporal information with respect to these characters provides strong support for the importance of spatiotemporal information, and by inference, an essentialist approach to individual identity.

However, given the use of these characters, it is important to consider the potential generality and limits of these results. That our findings were equivalent in the doll and identical conditions suggests that the findings are general across both cases, and so broadly applicable beyond the fictional characters emphasized. In addition, we recognize that this procedure clearly emphasized the existence of the separate spatiotemporal histories of each character (e.g., presenting both Poohs side-by-side). It was in part for this reason that we chose to use the identical fictional characters. The nature of these characters provides a clear counterweight to the overt physical presence of the two identical figures during questioning of the participants. Nonetheless, we recognize the potential impact of the spatiotemporal information presented in this manner, and believe that it would be interesting in future research to vary this factor. One could, for example, have each toy come out of a separate box, one at a time. In this way, children would know that the toys are spatiotemporally distinct, yet not be faced with seeing both present at the same time.

Although we argue that the current identical condition presents the strongest test of spatiotemporal vs. perceptual and name features, it would also be interesting to examine children's responses in other conditions that systematically vary the factors under investigation. For example, in order to isolate the effect of sharing a proper name on judgments of individual identity, one could present children with two different-appearing dolls that share a proper name. Or, in order to isolate the effects of having a "famous" character under investigation, one could present children with two perceptually identical, unknown dolls that share the same name. Based on the present results, we would expect that even in these cases, children would continue to maintain that spatiotemporal history overrides featural similarity. Finally, although beyond the scope of the current investigation, it would be worthwhile to examine the effects of different framing contexts on the nature of children's understanding. For example, children may display greater sensitivity to featural cues if they hear information that is provided within the character's fictional world (e.g., information that Christopher Robin tells about one Pooh might generalize to another Pooh).

Given the contrast between reliance on spatiotemporal information in the current studies, and the inconsistent use of this information elsewhere in the identity literature, it seems useful to ask under what circumstances children might override spatiotemporal information and in what ways those circumstances may inform a broader developmental theory of identity understanding.

In several cases we would argue that preschoolers' reliance on non-spatiotemporal properties, such as proper name and appearance, represents limitations imposed by task demands, rather than limitations on children's understanding. For example, an open-ended interview technique asking children how individuals are the same or different over time poses difficult verbal demands that may encourage preschool children to use readily available properties, such as names or appearances (Chandler et al., 1987; Guardo & Bohan, 1971).

In other cases, however, use of non-spatiotemporal cues may represent a true measure of identity understanding. There are two possible interpretations of the results with the familiar characters (e.g., Pooh). One possibility (the one we endorse) is that children recognize that the different "Poohs" are representations of the same individual, but nonetheless treat spatiotemporal properties as more compelling for the sorts of identity judgments they were asked to make on this task. If, however, we had asked participants which Pooh knew Piglet, or which Pooh lived in the Hundred-Acre Wood, we would expect even adults to select both instances (i.e., both Poohs). This is despite the clear violation of a single continuous spatiotemporal path.

An alternative interpretation is that children failed to recognize the different “Poohs” as representing the same individual. Under either interpretation, the data still clearly provide evidence of the importance of spatiotemporal cues versus appearance and name in children’s identity judgments. However, the demonstration would be even stronger if one were to show that children recognize that the different instances represent the same individual. In order to test this possibility, it would be valuable in future research to pose questions that should be true of all instances, because they are true of the original (authentic) Pooh (e.g., knowing Piglet, liking honey, or living in the Hundred Acre Wood). We suspect that children would be successful on such a task, given the substantial cultural support for the notion that different instantiations of Pooh (for example) represent the same individual.

There are other cases as well where adults seem willing to suspend spatiotemporal cues in assigning identity. Rips et al. (2006) adapted a long-standing “possible worlds” scenario from the Western philosophical identity literature (see for example, Nozick, 1981; Parfit, 1984). In their procedure, one hypothetical machine destroyed the matter of an individual (e.g., Fred the lion), and then a second machine created an identical copy from new material. Researchers then asked participants whether or not the second individual was still Fred. Despite the lack of spatiotemporal continuity between Fred and the second object, adults were quite willing to accept that this second individual was Fred, as long as it was made from material *copied* from the original Fred. According to Rips et al., the basis for individual continuity in this case is the causal connection between Fred-1 and Fred-2, established by the copying procedure. It is this causal connection, which can be exemplified in a variety and combination of ways (e.g., similarity, spatiotemporal continuity, material persistence, etc.) that then determines identity—rather than any one specific property such as spatiotemporal continuity alone. Rips et al. refer to this model as the causal continuer theory of identity.

Interestingly, when young children were given an analogous task (asked if they would prefer the original or an exact copy, when one of their attachment objects was placed in a “copying machine”), children preferred the original, indicating once again the importance of spatiotemporal properties (Hood & Bloom, in press).

We find the causal continuer model persuasive, and Rips et al. argue that their model could be consistent with an essentialist approach to identity as well. We therefore propose the following reconciliation of both approaches into a broad developmental model of identity understanding. Rips et al. clearly demonstrate adults’ willingness to look beyond spatiotemporal history when making identity judgments. However, in order to remove spatiotemporal history from consideration in their participants’ identity judgments, Rips et al. were forced to employ an impossible hypothetical scenario. We argue that removing spatiotemporal information from identity judgments is difficult precisely *because* of its centrality to these judgments more generally. Even in the Rips et al. procedure, the machine copying process functioned essentially as an artificial proxy for spatiotemporal continuity. The copied lion possessed all the properties that we would argue normally arise from spatiotemporal continuity in the daily environment. Given the identical substance and appearance in the machine copying procedure, for example, it is quite likely that adults believed the second lion possessed Frank’s memory and behavior as well. These would have been transferred along with the exactly copied substance of the original brain, just as would normally occur if both lions simply occupied different points on the spatiotemporal path of a single individual.

The fact that adults and not children accepted a duplicate (see Hood & Bloom, in press) argues for developmental change in identity understanding during childhood. The difficulty in even posing an identity question that effectively removes spatiotemporal information from consideration argues for the continued centrality of such information across development.

Based on this interpretation, we propose a developmental progression in which spatiotemporal history forms the core of children's identity understanding from at least preschool onward. That core spatiotemporal approach to identity is then broadened with development to become the causal continuer model found with adults. This seems reasonable to us because none of the more specific theories proposed to this point, *including* spatiotemporal history, can likely account for the variability of conditions under which adults are asked to make identity decisions, or the variability of their responses. Sternberg et al.'s results concerning concepts of JFK are a clear case in point. Even in the current task, it would be reasonable to violate spatiotemporal continuity if participants were asked which Pooh lived in the Hundred Acre Wood. The idiosyncratic nature of these examples highlights both the broad applicability of spatiotemporal information, as well as the flexibility required of a mature model of identity understanding. The nature and mechanisms of the transition from a strict spatiotemporal model to this broader model are an important topic for future research.

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Table 1
Percent of Responses Consistent with Use of Spatiotemporal History in Experiment 1

Age	condition		
	Two Identical Plush Dolls	Two Different Plush Dolls	Two Identical Human Dolls
Adult	93	100	100
Preschool	80	87	87

Table 2

Items/tasks and questions used in Experiment 2

Items/Tasks	Questions
Puzzle to complete showing Mickey et al. sleigh riding	Does (x) know what the puzzle is?
Stickers of children to place in a classroom scene	Does (x) know what's in the sticker picture?
Two paper cups and a small toy car to hide under one of the two cups	Does (x) know where you hid the car?
Connect the dots picture of a flower to complete	Does (x) know what's in the dot-to-dot picture?
Portion of a storybook of an alligator playing a saxophone to read	Does (x) know what the alligator plays music with?
Color picture of a dog. A yo-yo and toy plane to pick as the dog's favorite toy	Does (x) know what the puppy's favorite toy is?

Table 3
Mean Score Across Item type and Condition in Experiment 2

Condition	Item Type *	
	Supportive	Conflicting
Identical	1.79	1.0
Different	1.79	0.74
Doll	1.84	0.95
Overall Mean	1.81	0.90

* Range = 0–2