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Running head: EMERGENCE OF AFTERLIFE REASONING

The Natural Emergence of 'Afterlife' Reasoning as a Developmental Regularity

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Abstract

Participants were interviewed about the biological and psychological functioning of a dead agent. In Experiment 1, even 4- to 6-year-olds stated biological processes cease at death, although this trend was more apparent among 6- to 8-year-olds. In Experiment 2, 4- to 12-year-olds were asked about psychological functioning. The youngest children were equally likely to state both cognitive and psychobiological states continue at death, whereas the oldest children were more likely to state cognitive states continue. In Experiment 3, children and adults were asked about an array of psychological states. With the exception of preschoolers, who did not differentiate most of the psychological states, older children and adults were likely to attribute to dead agents epistemic, emotional, and desire states. These findings suggest developmental mechanisms underlie intuitive accounts of dead agents' minds.

The Natural Emergence of Afterlife Reasoning as a Developmental Regularity

When considering the near universality of afterlife beliefs (and spirituality and religious beliefs in general), it is somewhat surprising that their developmental origins have not received the serious research scrutiny that other culturally recurrent characteristics have. Given their cross-cultural preponderance, afterlife beliefs would seem to be excellent candidates for investigation from an evolutionary psychological perspective (e.g., Buss, 1995; Tooby & Cosmides, 1992), particularly one that emphasizes the role of development in the emergence of evolutionarily-significant traits (e.g., Bjorklund & Pellegrini, 2002; Geary, 1995). One way to explore the natural foundations of belief in life after death is by investigating their emergence in children. Although several researchers (e.g., Barrett, 1999; Slaughter, Jaakola, & Carey, 1999) have begun investigations on the biological bases of children's understanding of death, the prevalence of afterlife beliefs remains to be adequately explained.

Recent empirical attempts to get at children's understanding about life and death are associated with a more general line of investigation meant to determine whether implicit cognitive processes govern individuals' reasoning about the ontological regularities of the natural world. This is especially the case, it seems, among developmentalists interested in determining whether young children possess knowledge – or intuitions – of biological, physical, and social phenomena. Death is a natural phenomenon impinging upon all of these domains. From a fairly early age, children understand that death cannot be avoided, is irreversible, is caused by the breakdown of the body, and leads to complete cessation of function (e.g., Atwood, 1984; Barrett, 1999; Evans, Poling, & Mull, 2001; Lazar & Torney-Purta, 1991; Slaughter et al., 1999; Speece & Brent, 1984).

While previous, largely neo-Piagetian, approaches to revealing children's death understanding have led to scattered findings of coherence of these concepts at about 7 years of age, recent approaches to the problem have found evidence of coherence at earlier ages. Barrett (1999), for example, showed that even preschoolers understand the biology of death when it is placed in the context of predator-prey relationships – such as when a lion attacks and kills a zebra. Four-year-olds reason, for instance, that while the zebra normally grazes in the fields every day, once it is dead it will not be there tomorrow. And, arguing that children's death concepts are inextricably bound with their understanding of basic life properties (i.e., vitalism), Slaughter and her colleagues (Slaughter et al., 1999; Slaughter & Lyons, in press) showed that the majority of 4- and 5-year-olds who understand the *purpose* of food, for example, know that dead people do not need to continue eating. Thus, having knowledge of the specific role of activities in supporting life seems to provide children with an understanding that such activities will no longer continue after death.

While it is debatable whether the preschooler's understanding of death, implicit or otherwise, is really equivalent to those of older children, the fact that recent experimental techniques have elicited responses from young children that, not long ago, were thought conceptually absent, suggests that researchers might have overlooked critical mechanisms involved in children's understanding of death. Might there similarly be "hidden" processes underlying the development of afterlife beliefs, independent of, and possibly collaborative with, sociocultural immersion? The basic attribution of psychological states to deceased agents is a cross-cultural occurrence (Boyer, 2001; Hinde, 1999). It is perhaps also a defining feature of the human species. No other animal prepares the carcasses of its dead in elaborate rituals that, if nothing else, serve to testify to the species' beliefs in some form of continued existence of the decedent's mind. In both hunter-gatherer and modern societies fear of ghosts and dead people abound, rivaling such evolutionarily plausible fears as those of snakes and spiders, and is apparently even more resistant to treatment than fear of strangers (Gullone, King, Tonge, Heyne, & Ollendick, 2000). Adolescents and adults cram into movie theatres whenever the thematic content of films features ghosts and spirits. And the vast majority of adult Americans believe in some form of life after death (Greeley & Hout, 1999).

All of this is puzzling in light of previous findings concerning children's understanding of death. After all, by age 7, most research has shown that children reportedly have a clear understanding that everything stops functioning at death, something Speece and Brent (1984) have labeled the 'non-functionality' component of the mature death concept. Part of the reason that previous work has tended to report that children understand the non-functionality component at around the same age as the other components, such as 'finality' and 'irreversibility,' may be that it has tended to concentrate on functions denoting explicit actions (eating, drinking, running) and has often neglected functions denoting either epistemic (knowing, thinking, believing) or psychobiological (thirsty, hungry, sleepy) states, not to mention other psychological state categories (e.g., perceptual, emotional, desire). In the few cases where psychological state questions have been asked in relation to death (e.g., Lazar & Torney-Purta, 1991; McIntire, Angle, & Struempler, 1972; Slaughter et al., 1999; Smilansky, 1987), they have not been treated as a distinct category, and so it has been nearly impossible to parcel out the effects of, say, "Now that X has died, can he still *feel*?" from a list of primarily action-related non-functionality queries (e.g., move around, drink water, go to the toilet). The actions and thoughts of the dead have been lumped together in a hodgepodge of purported 'states' so that it has not yet been possible to understand, really, how children come to view the *minds* of dead organisms.

To our knowledge, Kane (1979) is the only researcher to have systematically distinguished between cognitive and noncognitive functions when asking children about death (labeling their cessation 'insensitivity' and 'dysfunctionality,' respectively). Interestingly, she found that children were significantly more likely to attribute to dead organisms continuity of cognitive (e.g., knowing, feeling) than they were to attribute noncognitive (e.g., heart beating, breathing) states. Kane explained her findings by suggesting that children have trouble reasoning about more subtle, non-visible aspects attributable to life. However, Kane did not mention anything about the fact that these 'subtle' functions are mental states, and may therefore be a special case altogether. Because reasoning about invisible causal forces such as beliefs and desires necessitates having a theory of mind, in the context of death reasoning such questions should be especially difficult, as any *theory* of a dead person's mind cannot be adequately validated, or disconfirmed, with behavioral feedback (cf., Gopnik & Wellman, 1992). The absence of action does not necessarily imply the absence of intentional states, as one can close his or her eyes and lie completely still yet continue to feel and think. Any theory discounting dead agents' capacity to experience these states must therefore arise through means other than those commonly employed in the social domain.

Of course, most children grow up embedded in cultures that support the belief in life after death, making it impossible to separate any purely 'evolutionarily-based mechanisms' from purely 'cultural mechanisms.' (In fact, we argue that it is impossible to separate biologic and environmental causation for *any* psychological trait, see Gottlieb, 2001.) However, if all that were influencing people's afterlife judgments were mainstream cultural beliefs, with increasing age, children should be more likely to make attributions of psychological continuation following death, because of their increasing exposure to cultural norms.

Our first hypothesis is therefore that people's judgments about the continuity of psychological processes following death should actually *decrease* with increasing age, despite the background of cultural influence to the contrary. Because younger children are more likely to have deficient biological knowledge, we predict that in reasoning about the psychological status of dead agents, they will 'default' to the same strategy they employ in the social domain – viewing dead agents as still in possession of a mind with all its psychological attributes. As children develop, they tend to acquire explicit biological knowledge, and likely apply this knowledge when reasoning about the psychological status of dead agents. This should be reflected in an overall age-related decrease in beliefs about the continuity of psychological states in dead agents. What this would show is that a general belief in the continuity of mental states in dead agents is not something that children *acquire* as a product of their social-religious upbringing, but is more likely a natural disposition that interacts with various learning channels.

Our second hypothesis is that these judgments about the continuity of psychological processes following death will also vary as a function of the nature of the mechanisms under question. For example, ontogenetically, children may begin to reason that dead agents lose the capacity to experience some types of mental states (such as psychobiological and perceptual states) before they reason that dead agents lose the capacity for other types of mental states (such as epistemic, desire, and emotional states). One reason to suspect that such age-related differences in psychological attributions to dead agents will occur is that psychobiological and perceptual states, conceptually at least, appear planted in the physical body. Psychobiological states (e.g., hunger, thirst) are associated with activities that are designed to support life (e.g., finding food, obtaining water). As Slaughter and her colleagues have shown, once children have an understanding of the vitalistic purpose of such activities, they reason that these activities no longer occur at death. To reason that the psychological states accompanying such activities also cease at death would require only one more inferential leap (e.g., "Dead agents do not need to eat. The person is dead. Therefore, the person cannot be hungry"). Similarly, perceptual states (e.g., seeing, hearing) are associated with physical parts of the body (e.g., eyes, ears). If children understand the function of these body parts (e.g., that the eyes are designed "to see," the ears are designed "to hear," and so on), then reasoning that dead agents lose the capacity for such psychological states should occur when children combine their understanding of the purpose of these body parts, around 4 years of age (O'Neill & Chong, 2001) with their knowledge that the body is rendered nonfunctional at death, around 6 or 7 years of age (Brent & Speece, 1984). Prior to this understanding that the body stops functioning at death, children may find it difficult to understand that the psychological states generated by specific body parts do not occur in dead agents.

Other types of mental states, such as epistemic, desire, and emotional states, are not clearly tied to vitalistic maintenance of the body (as are psychobiological states) nor to observable sensory organs (as are perceptual states), and therefore stating that dead agents have lost the capacity for such states may require more advanced biological reasoning, perhaps knowledge that the brain, which is rendered non-functional at death, is responsible for all forms of psychological states (e.g., The brain is necessary "for knowing." The brain stops working at death. Therefore, people who are dead can neither know nor not know). Such reasoning may be cognitively effortful, as evidenced by recent findings by Bering (2002). Bering found that, when reasoning about the psychological status of a person reportedly just dead in an accident, even adults who characterized themselves as 'extinctivists' (individuals who believe that personal consciousness ceases to exist, or becomes 'extinct,' at death; after Thalbourne, 1996) were less likely to say that epistemic, emotional, and desire states discontinued after death than they were psychobiological and perceptual states. In fact, 36% of extinctivists' responses to questions dealing with the epistemic status of the dead character (e.g., "does he *know* that he's dead?") reflected continuity reasoning, whereby they attributed to the dead person the continued capacity "to know." In contrast, the same group was at ceiling on discontinuity responses for questions dealing with psychobiological and perceptual states.

The current study is, we believe, the first of its kind to systematically explore the issue of how children represent the minds of dead agents. To get a baseline measure of biological knowledge and death, in Experiment 1, 4- to 8-year-old children witnessed a puppet show in which a mouse was killed and subsequently eaten by an alligator. They were then asked a series of questions concerning *biological discontinuity* of function (e.g., "Does the mouse still need to *eat food*?" "Will he *grow up* to be an old mouse?"). The age range selected represents a period that witnesses rapid changes in the core content domain of folkbiology, such that implicit knowledge about the natural world becomes increasingly explicit (Carey, 1991; Carey & Spelke, 1994; Keil, 1994; Medin & Atran, 1999). The types of questions used in Experiment 1 paralleled those used in earlier studies (e.g., Barrett, 1999; Mahon, Zagorsky-Goldberg, & Washington, 1999; Slaughter & Lyons, in press) and dealt primarily with action-related constructs (e.g., eating food) or pure biological constructs (e.g., growth) that even preschoolers have shown to understand are clearly interwoven with life (Inagaki, 1989; Inagaki & Hatano, 1996; Wellman, Hickling, & Schult, 1997; see also Medin & Atran, 1999).

Experiment 2 was similar to the first with the exception that a new group of children, this time including a third age group of 10- to 12-year-olds, was asked a series of questions concerning *psychological discontinuity* of function involving both cognitive (e.g. "Does the mouse *know* he's not alive?") and psychobiological (e.g., "Is the mouse still *sleepy*?") states. The earliest span of this developmental period – 4-5 years – coincides with the appearance of the ability to represent beliefs and desires, as evidenced by successful performance on traditional false-belief and appearance-reality tasks (for a review, see Flavell, 1999). Finally, in Experiment 3, three groups of participants (4- to 5-year-olds, 10- to 12-year-olds, and adults) were confronted with the same basic design, but this time asked whether a wide range of psychological states (i.e., psychobiological, perceptual, emotional, desire, and epistemic) continued after death.

EXPERIMENT 1: DISCONTINUITY OF BIOLOGICAL FUNCTIONING

Method

Participants

Participants were 51 children attending preschool, kindergarten, first and second grade at two university-affiliated schools in a suburban metropolitan area of south Florida. Enrollment at the elementary school (grades K-8) was based on a community lottery system, and the preschool children were enrolled by their parents. Children came from diverse backgrounds and represented a range of socioeconomic levels. Children were divided into two groups, younger and older. The younger group of children consisted of 26 participants, 12 males and 14 females, with an average age of 5 years 6 months (range = 4 years 5 months – 6 years 5 months). There were 25 older children, including 12 males and 13 females, with an average age of 7 years 4 months (range = 6 years 6 months to 8 years 9 months).

Materials and Procedure

Children were brought from their classrooms and tested individually in a small, private room in the school library or in a school administrator's private office. All children were asked at the beginning of the experiment whether they would like to watch a puppet show and help the experimenter answer some questions about the puppets. After agreeing to participate, children were instructed to sit in a chair across from the experimenter and on the opposite side of the small puppet theatre display. The puppet theatre display consisted of a green Styrofoam board (75.9 cm x 31.6 cm), wooden fencing around the perimeter of the board, a small plastic tree, artificial grass, two mouse finger puppets (one white and one brown), and an alligator hand puppet. Prior to the puppet show demonstration, participants were introduced to the three puppets (presented separately) and told, "Now we both know that these aren't real mice and this isn't a real alligator, but let's pretend that they're real, ok?" (after Barrett, 1999). They were then given the following information about the characters: (1) The alligator's favorite food is mice; and (2) The mice are baby mice. Immediately thereafter, one of the mice was put away (presentation counterbalanced) and the puppet show, involving the remaining mouse and the alligator, was presented to the child.

Enactment of the puppet show involved the following standardized story: "There's Mr. Alligator hiding behind those bushes. And here comes Brown Mouse (White Mouse). Brown Mouse doesn't see Mr. Alligator. And Mr. Alligator doesn't see Brown Mouse yet. Brown Mouse is having a very bad day. First of all, he's lost! He has no idea where he is or how to get home. And he's sick! Do you feel good when you're sick? No! Brown Mouse is very sleepy because he hasn't slept for a very long time. And he's very hungry and thirsty because he hasn't had anything to eat or drink all day. Now do you think Brown Mouse is having a good day?" (Experimenter then prompted participant to repeat Brown Mouse's problems, and reiterated them if necessary.) "Uh oh! Mr. Alligator sees Brown Mouse and is coming to get him!" (Alligator is shown eating Brown Mouse.) "Well, it looks like Brown Mouse got eaten by Mr. Alligator. Brown Mouse is not alive anymore."

Both puppets were then removed from the child's view and the child was asked whether Brown Mouse was still alive. Only after agreeing that Brown Mouse was not alive did the participant advance to testing. (There were only a few children who answered that the mouse was still alive after watching him get eaten by the alligator, and they were easily persuaded that he was, in fact, dead.) The children were then instructed that they would be asked some questions about Brown Mouse; the experimenter told the children that he or she was only interested in what they thought, and that there were no wrong or right answers.

Children were then asked a series of 10 questions pertaining to White/Brown Mouse's biological status (e.g., "Now that Brown Mouse is not alive[1] anymore, do you think that he will ever need to drink water again?"). These questions can be seen in Table 1. Following children's response to each question (usually a "yes" or a "no"), they were asked to provide a justification for their answer (e.g., "Why do you think that?" or "How come?"). Children received the questions in one of four counterbalanced orders. The experimenter's offering of confirmatory, but neutral feedback was used to encourage all answers by the children regardless of content, and there were no cases in which the children showed any signs of distress at the questions. The children's answers to the questions were recorded on audiotape for later transcription and were also coded online by the experimenters in the event of audio recorder malfunctioning or inaudible responses. There were no cases in which it was necessary to use the online data sheets.

Table 1 about here

Coding

Answers to interview questions were scored according to operational criteria establishing likely *continuity* reasoning (the *specific biological imperative* is envisioned to function despite the mouse's death) or *discontinuity* reasoning (the *specific biological imperative* is envisioned to have ceased functioning as a result of the mouse's death). Two percent (1.98) of the total responses could not be coded due to ambiguity of response or failure of the child to respond. Less than one percent (0.77) of the data could not be coded due to experimenter error.

In most cases, initial affirmative answers to the questions were unequivocal evidence of continuity reasoning. For instance, if when asked whether the dead mouse would ever need to drink water again, the child answered “yes” and his or her answer to the follow-up question (e.g., “How come?”) matched this affirmative response (e.g., “Because he will.”), then a continuity score was coded. Similarly, initial negative answers were usually evidence of discontinuity reasoning. For example, if when asked whether the dead mouse would ever need to go to the bathroom again, the child answered “no,” and his or her answer to the follow-up question (e.g., “Why not?”) matched this negative response (e.g., “Because when you’re dead you don’t have to do that.”), then a discontinuity score was coded. In those cases in which a child displayed uncertainty by changing his or her response between the target question and the follow-up questions for that item, an “unscoreable” classification was recorded. In those cases where a child answered “I don’t know” for a follow-up question, a discontinuity response was coded if the child stated “no” to the target question, and a continuity response was coded if the child stated “yes” to the target question.

Coding was based on the child’s reasoning about specific biological imperatives (e.g., need to eat food). It was therefore possible for the child to present answers that reflected general afterlife beliefs while maintaining discontinuity reasoning for the item in question (e.g., “ghosts don’t need to eat food”). In other words, individual interview questions were not an attempt to discover whether participants believed in life after death; *they were attempts to discover whether participants believed in the continuity or discontinuity of each particular biological function after death*.

The first author and a second person naïve to the purposes of the study served as independent coders for the entire data set. Initial interrater reliability was 95% and all disagreements were subsequently resolved by reviewing the episodes in question.

Results

Table 1 presents the percentage of scoreable discontinuity responses for each question used in Experiment 1, separately for the younger and older children.[2] The analyses of discontinuity responses reported below excluded those responses that could not be coded due to ambiguity or experimenter error (2.75% of all responses). Analysis of the absolute percentage of discontinuity responses, however, produced nearly identical results. In addition, there was no significant difference in the number of unscoreable responses between the two age groups. Preliminary analyses showed no significant effects of gender, color of the dead mouse (i.e., brown or white), or presentation of question order, and all subsequent analyses were collapsed across these variables.

As can be seen from Table 1, the percentage of discontinuity responses per question ranged from 54% to 96% for the younger children, and from 84% to 100% for the older children. A standard t-test produced a significant effect of age, $t(49) = 2.61$, $p <. 05$, with the older children ($M = 91\%$) being significantly more likely to give discontinuity responses than the younger children ($M = 78\%$).

To assess the degree to which children were consistent in their discontinuity reasoning, children were classified as *consistent discontinuity theorists* if they provided discontinuity responses for all questions (excluding those few that could not be scored). Significantly more older children (68%) compared to younger children (38%) provided discontinuity responses for all of the questions, χ^2 ($df = 1$, $N = 51$) = 4.53, $p < .05$, reflecting that the older children were more likely than the younger children to generalize discontinuity reasoning across the biological question set. None of the children in either age group provided continuity responses for all of the questions.

Discussion

As predicted, the older children (6 years 6 months to 8 years 9 months) were significantly more likely than the younger children (4 years 5 months to 6 years 5 months) to state that the biological imperatives no longer applied once the mouse was eaten. This was shown both in the overall percentage of questions for which children gave discontinuity responses and in the percentage of children who used discontinuity reasoning for all questions posed (i.e., consistent discontinuity theorists). This is likely the result of a growing biological knowledge base at the start of middle childhood (Keil, 1994; Medin & Atran, 1999). Importantly, however, even the younger participants demonstrated a relatively firm understanding that normal biological demands associated with living did not apply after death. Half of the total number of questions elicited particularly strong discontinuity responses (i.e., > 80%) in the younger group: (1) “Will he ever be alive again?”; (2) “Will he grow up to be an old mouse?”; (3) “Will he ever need to go to the bathroom?”; (4) “Does his brain still work?” and; (5) “Do his ears still work?” Only 8% of younger children, and none of the older children, believed, for instance, that the dead mouse would grow up to be an old mouse. A typical response to this question came from a 6-year-old girl who, after being asked why she answered “no,” stated that the mouse would not grow up “because he’s already dead.”

Other studies have similarly found strong support for preschoolers’ understanding of “growth” and its extension to living organisms (Backscheider, Shatz, & Gelman, 1993; Inagaki, 1989; Keil, 1994). Yet, interestingly, the children’s discontinuity reasoning was comparatively meager for the questions related to “eating” and “sleeping” – 46% of the younger subjects, for example, informed the experimenter that the mouse would continue to need to eat food after its death. This may be at least partially due to the fact that these questions denoted action, whereas most of the other questions (e.g., “do his ears still work?”), had to do with functions. However, at least one of the other questions denoting action rather than function (i.e., “Will he ever need to go to the bathroom?”) elicited a high percentage of discontinuity responses (88%) from the younger children. Perhaps, therefore, children’s seemingly difficult reasoning about the cessation of biological functions at death has more to do with the type of actions denoted in the questions than the simple fact that they constitute overt behaviors.

For instance, the data for the “need to sleep” and “need to eat” questions are nearly identical to those obtained by Slaughter et al. (1999), who reported that 44% of their small group of 4- to 5-year-olds believed that people need food when they are dead. The authors interpreted this as evidence that “some young children conceptualize death as living on in altered circumstances, rather than as the cessation of the body machine” (p. 89). With exposure to a vitalistic teaching strategy in which children come to understand that the ultimate function of bodily processes, including nutrient intake and digestion, is to support life, children come to assimilate this knowledge into their maturing concept of death (Slaughter et al., 1999, Slaughter & Lyons, in press). Although this might account for the “need to eat” item in our study as well, it is not as apparent that this argument would apply with equal force to the “need to sleep” item. Perhaps the sleep question is a particularly difficult one for young children to grasp because they equate both death and sleep with physical stillness. Therefore, for preschoolers, stating that the dead mouse will continue to “need to sleep” might be a comment about the perceptually current state of affairs rather than a belief that sleep is required even after death.

We were, however, surprised at the number of children, even the youngest ones, who correctly reasoned that the mouse's various body parts (e.g., ears, brain, eyes) stopped working after its death. These findings suggest that preschool-aged children have some understanding of the non-functionality component of the death concept, which previous researchers have reported does not occur until age six or seven (e.g., Speece & Brent, 1984). For example, only 15% of the younger children told the experimenter that the mouse's brain continued to work after it had died. This is especially intriguing, as other research has shown that even 4-year-olds understand that the brain is "for thinking" (see Johnson & Wellman, 1982). One might therefore reasonably expect children to deny (at least) higher-order cognitive activity to dead agents. In addition, based on these findings, we would expect preschool-aged children to apply their knowledge of the non-functioning nature of these body parts (i.e., ears, brain, eyes) when reasoning about the capacity for dead agents to experience the types of mental states (i.e., hearing, thinking, seeing) directly associated with them. Experiment 2 was designed to test these and related predictions.

EXPERIMENT 2: DISCONTINUITY OF PSYCHOLOGICAL FUNCTIONING, COGNITIVE *VERSUS* PSYCHOBIOLOGICAL STATES

Method

Participants

Participants were from the same university-affiliated schools reported in the first experiment, and included 82 children ranging from 4 years 0 months to 12 years 1 month. Children were divided into three age groups. The youngest group of children, hereafter "kindergartners," consisted of 29 participants, 19 males and 10 females, with an average age of 5 years 3 months (range = 4 years 0 months to 6 years 1 month). There were 33 children from the middle age group, hereafter "early elementary," including 15 males and 18 females, with an average age of 7 years 3 months (range = 6 years 3 months to 8 years 7 months). Finally, the oldest group of children, hereafter "late elementary," consisted of 20 participants, with an average age of 11 years 0 months (range = 10 years 3 months to 12 years 1 month). This group contained 12 males and 8 females. None of the children in the present experiment participated in Experiment 1. (See footnote 2.)

Materials and Procedure

The experiment was conducted identically to the first experiment, with two exceptions. First, children in Experiment 2 were asked an entirely different series of questions from those in Experiment 1. Namely, children in the current experiment were asked not about biological functions after death, but rather about psychological functions, including both cognitive (knowing, wanting, seeing, thinking) and psychobiological (hungry, thirsty, sleepy, sick) states (see Table 2). The list of items included a total of nine questions, and consisted of five cognitive and four psychobiological questions.[3] Presentation of questions was arranged such that, of four possible order configurations, children never received more than two consecutive questions from the same category. (However, one cognitive question, i.e., "Does he know that he's not alive?" always occurred at the very end of the question set.) Seven of the items were conceptually linked to the list of biological questions from Experiment 1. For instance, the question, "Will the mouse get hungry?" from the current experiment was yoked to "Will the mouse ever need to eat food again?" from the first experiment. Second, the children from the two youngest age groups were also presented with a control condition in which a *different* mouse (either white or brown) *escaped* from the alligator and avoided death. This was done in order to assess the likelihood that the children, under conditions where death did not occur, would easily attribute mental states to a 'living' mouse puppet. Because subsequent analyses revealed ceiling performance on this control procedure for the two youngest age groups, it was deemed unnecessary for the oldest children. Presentation of the control condition was counterbalanced, so that roughly half of these children witnessed the escape scene before the death scene, and half saw the opposite puppet show order. The control questions were identical to the test questions, minus the experimenter's obligatory preface that the mouse was no longer alive and the question dealing with the mouse's knowledge of its own death.

Table 2 about here

As in the first experiment, children were asked to provide a justification for their initial "yes/no" response (e.g., "Why do you think that?" or "How come?") and the experimenter offered confirmatory, neutral feedback regardless of answer content. There were no signs of distress at the questions. The children's answers to the questions were recorded on audiotape for later transcription and were also coded online by the experimenters in the event of audio recorder malfunctioning or inaudible responses. Due to experimenter error in which interview sessions were not recorded, there were two cases in which it was necessary to use the online data sheets.

Coding

As in Experiment 1, answers to interview questions were scored according to operational criteria establishing likely *continuity* reasoning (the *specific psychological faculty* is envisioned to function despite the mouse's death) or *discontinuity* reasoning (the *specific psychological faculty* is envisioned to have ceased functioning as a result of the mouse's death). Ten percent (10.2) of the total responses could not be coded due to ambiguity of response or failure of the child to respond. There were only 3 cases (out of a total of 733 responses) that could not be coded due to experimenter error.

The criteria used to classify a response as denoting continuity reasoning or discontinuity reasoning are provided in Appendix A, along with actual examples of children's responses. As in Experiment 1, initial affirmative ("yes") responses to the test questions were usually considered unequivocal evidence of continuity reasoning. Due to the wording of the questions posed to children in Experiment 2, a "yes" response reflected a belief in the continuity of particular psychological capacities. For instance, if a child responded "yes" to the question "Now that the mouse is no longer alive, is he still hungry?" then the default assumption was that the child was using continuity reasoning. However, in all cases, children were asked follow-up questions after their initial "yes/no" response. In the event that a child's answer to a follow-up question did not match his or her initial response, an unscoreable classification was recorded for that particular item. If a child answered "yes" to the above question, for example, but for the follow-up question reported, "Because when you're dead, you don't get hungry," then the response was considered unscoreable. No such cases, however, occurred; children's answers to the follow-up questions categorically matched their initial yes/no responses along continuity/discontinuity lines. As in Experiment 1, for those cases where a child answered "I don't know" for a follow-up question, a continuity response was coded if the child stated "yes" to the target question.

Unlike Experiment 1, negative answers to the initial questions in Experiment 2 required a careful assessment of answers to follow-up questioning to determine whether the child was using continuity or discontinuity reasoning. Simply stating "no" in response to the target questions did not offer sufficient evidence of discontinuity reasoning. The participant may have said that the mouse did not know that he was dead, but may have based his or her answer on presumed knowledge of the mouse (e.g., "He's confused" or "He thinks he's still alive") rather than on permanent cessation of the dead mouse's capacity to know/not know. To be scored as discontinuity reasoning, the child was required to respond "no" to the initial target question and then provide a justification for this response indicating cessation of function for the particular faculty during follow-up questioning. Although individual children's responses were highly variable, Appendix A provides versions of two common answers that would be classified as discontinuity reasoning.

An important caveat to this coding system is that it is not infallible. One of the more frequent discontinuity responses, for instance, was "because he's dead." It is possible to make the case that such a response does not necessarily reflect discontinuity reasoning because it does not carry sufficient linguistic clarity; the child may actually be referring to the temporary suspension or occurent lack of a particular mental state rather than the dead agents' incapacity to experience that state (e.g., perhaps the dead mouse was not sleepy not because he lacked the capacity to be sleepy/not sleepy, but because he just died and was distracted by goings-on). However, one reason to suspect that this was not the case, and that children who responded in such fashion were indeed relying on discontinuity reasoning, is that when probed for further clarity, they tended to repeat their answer ("because he's dead") rather than elaborate on the reason they believed the dead mouse was not, at that moment, experiencing the state in question.

The first author and a second person naïve to the purposes of the study served as independent coders. Initial interrater reliability (for the death condition only) was 89% and all disagreements were subsequently resolved by reviewing the episodes in question.[4]

Results

For the control (escape) condition, all children (100%) from the kindergarten and early elementary groups provided clear continuity responses, demonstrating that they readily attributed mental states to the 'living' mouse puppet. Because both age groups were at ceiling, no analyses were performed on the control trials.

For the test condition, the analyses of discontinuity responses reported here excluded all unscoreable responses (10.2% of all responses). However, analysis of the absolute percentage of discontinuity responses produced nearly identical results. In addition, there was no significant difference in the number of unscoreable responses between the three age groups, nor were unscoreable responses more frequent for either question type (i.e., cognitive or psychobiological). Table 2 presents the percentage of scoreable discontinuity responses for each question posed to the children in Experiment 2, separately for each age group and question type. Preliminary analyses showed no significant effects of gender, color of the dead mouse (i.e., brown or white), or question order on children's answers, and thus all subsequent analyses were collapsed across these variables. Also, there was no significant effect of order presentation of the escape/eaten condition for the two youngest age groups ($p > .05$).

Psychobiological and Cognitive Questions by Age Group

As can be seen from Table 2, the percentage of discontinuity responses per psychological question (collapsing across question type) ranged from 21% to 50% for kindergartners, from 46% to 73% for early elementary children, and from 35% to 100% for late elementary children. A 3 (age group) x 2 (question type: psychobiological vs. cognitive) analysis of variance, with repeated measures on the question-type factor, produced significant main effects of age, $F(2,79) = 10.51$, $p < .0001$ (late elementary, $M = 77\%$ > early elementary, $M = 58\%$ > kindergartners, $M = 32\%$), question type, $F(1,79) = 9.18$, $p < .005$ (psychobiological, $M = 62\%$ > cognitive, $M = 53\%$), and a significant age group x question type interaction $F(2,79) = 6.88$, $p < .005$. (See Figure 1.) Post-hoc analyses of the significant age group x question type interaction using Bonferroni t-tests revealed that only the 11-year-old group was significantly more likely to use discontinuity reasoning for the psychobiological questions (91%) than for the cognitive questions (66%), $t(19) = 3.38$, $p < .005$. The difference between the psychobiological and cognitive questions was not significant for the early elementary (63% versus 54%) and kindergarten (33% versus 38%) groups; in fact, counter to the two older groups of children, the kindergartners made slightly more discontinuity responses for the cognitive than for the psychobiological questions. When looking at changes in the psychobiological and cognitive questions across age groups, Tukey-Kramer tests ($p < .05$) revealed that the percentage of discontinuity responses for the psychobiological questions increased significantly at each age. In contrast, only the comparison between the oldest and youngest children was significant for the cognitive category, with the late elementary group (66%) being more likely than the kindergartners (38%) to give discontinuity responses for these questions.

Figure 1 about here

Consistent Discontinuity Theorizing

To assess the degree to which children were consistent in their discontinuity reasoning overall, and also within question categories (i.e., cognitive and psychobiological), children were classified as consistent discontinuity theorists if they provided discontinuity responses for all questions (excluding those few that could not be scored). For the analysis of the overall psychological question set, the effect of age group was significant, χ^2 ($df = 2$, $N = 82$) = 8.83, $p < .05$. Additional analyses revealed that early elementary children (30%) were significantly more likely than kindergartners (3%) to generalize their discontinuity reasoning across the entire range of psychological questions presented to them, χ^2($df = 1$, $N = 62$) = 8.78, $p < .005$. The difference between the late elementary (20%) and kindergarten groups approached significance, with the oldest children being somewhat more likely to be classified as consistent discontinuity theorists than the youngest children χ^2($df = 1$, $N = 49$) = 3.58, $p = .059$.

Within question-type categories, there were more consistent discontinuity theorists at each age group for the psychobiological questions (43%) than for the cognitive questions (27%). For the psychobiological question set, there was a significant effect of age group, χ^2 ($df = 2$, $N = 82$) = 20.43, $p < .0001$. Seventy-five percent of late elementary children reasoned that all psychobiological functions ceased at death, whereas only 48% of early elementary children reasoned in this manner, a difference that approached significance, χ^2 ($df = 1$, $N = 53$) = 3.73, $p = .052$. The difference between the kindergartners (14%) and both the early elementary and late elementary groups was also significant, χ^2 (df = 1) $\geq$ 8.99, p < .005. In contrast to their answers on the psychobiological questions, the late elementary group (30%) was no more likely than the early elementary (33%) and the kindergarten (17%) groups to be classified as consistent discontinuity theorists for the cognitive question set, χ^2 (df = 2, N = 82) = 2.27, p > .05.

Conceptually Linked Biological and Psychological Factors

To determine the extent to which children answered the yoked questions from the first and second experiments differently, a multivariate analysis of variance (MANOVA) was performed comparing the overall means of these questions from Experiment 1 to those from Experiment 2 for the kindergarten and early elementary age groups. (Recall that a late elementary group was not tested in Experiment 1.) The seven yoked questions included in this analysis are presented in Table 3. Note that for each question pair, for both groups of children, the percentage of discontinuity responses was higher for the biological questions of Experiment 1 than for the corresponding psychological questions of Experiment 2. The MANOVA produced significant effects of age group, $F(1,6)$ = 56.82, p < .005 (early elementary, M = 75.3% > kindergartners, M = 54.9%) and question type $F(1,6)$ = 39.76, p < .01 (biological, M = 81% > psychological, M = 49.1%). Although the difference in discontinuity responses between the biological and psychological questions was somewhat greater for kindergartners (72.9% versus 37.9%) than for the early elementary children (89.1% versus 61.4%), the age group x question type interaction was not significant, $F(1,6)$ = 1.34, p > .05.

Table 3 about here

Discussion

As predicted, children's discontinuity responses for the psychological states increased with age, and this effect was somewhat larger for the psychobiological than for the cognitive questions. (See Figure 1.) Moreover, late elementary aged children were significantly more likely to provide discontinuity answers in response to the psychobiological questions than they were for the cognitive questions. Early elementary aged children exhibited a similar divergence between the two question-type categories, although the difference did not reach significance. For the kindergartners, the difference between the psychobiological and cognitive question types was negligible and in the opposite direction. This was surprising, given the high percentage of discontinuity responses on the biological question set among comparably aged children.

The differences in levels of discontinuity responses between the biological questions of the first experiment and the psychological questions (including both psychobiological and cognitive) of the second experiment were striking. For every biological item that had a corresponding psychological question, kindergartners and early elementary aged children made more discontinuity responses for the biological item. While the youngest children from the first experiment provided 78% discontinuity responses, in the current experiment only 33% of similarly aged children reasoned that psychobiological states ceased functioning at death. The early elementary aged children's data show a similar pattern, with 91% of children in Experiment 1 reasoning that biological functions no longer apply at death, whereas only 63% of similarly aged children in Experiment 2 reasoned that psychobiological states cease.

It seems strangely counterintuitive that similarly aged children at these ages state that dead agents do not need to drink water but answer that it is possible for dead agents to be thirsty. Although younger children may not have not yet mastered biological knowledge, even the preschoolers and kindergartners in Experiment 1 gave mostly discontinuity responses, so comparably young children's performance in Experiment 2 cannot be cast off entirely to impoverishments in the biological domain. Perhaps, ontogenetically, children come to have more control over their biological knowledge when applying it to questions about the mind. Perhaps also the youngest children's high percentage of discontinuity reasoning in the first experiment was due largely to the implicit nature of their biological knowledge – they may not, for instance, have understood why the dead mouse's ears no longer worked aside from the fact that they did not work because the mouse was dead! This would seem to provide support for Atran's (1994) view that preschoolers' folk biology is pre-theoretical. It may be that these originally implicit biological concepts become progressively elaborated over time, and only once such knowledge is made explicit can it be applied to questions about the psychological status of dead agents in a fashion reflecting discontinuity reasoning.

Some children from the second experiment (particularly among those in the early and late elementary age groups) applied discontinuity reasoning to both psychological state categories. That is, they were consistent discontinuity theorists across the entire field of questions, reasoning that not only do psychobiological experiences cease at death, but so do all higher-order cognitive activities. In effect, these children were classic extinctivists, viewing death as swiftly and sweepingly eliminating the 'beingness' of the deceased. One interpretation of these findings is that these children, unlike others, were not attempting to imagine what it 'feels like' to be dead, as in the absence of analogous *conscious* experiences to refer to for help in the matter, such attempts would have failed them and resulted in continuity reasoning, particularly for the cognitive questions (e.g., what does it 'feel like' not to think?). Koocher (1973), for instance, described how a group of children tested on death comprehension reflected upon what it might be like to be dead, "with references to sleeping, feeling 'peaceful,' or simply 'being very dizzy'" (p. 374). Consistent discontinuity theorists may have put such 'simulations' aside and employed their explicit fact-based knowledge in order to make a biologically informed decision concerning the dead agents' current cognitive states, that of nothingness. However, these children were, relatively speaking, few in number, with consistent discontinuity reasoning for the cognitive questions particularly infrequent. Only 30% of the late elementary aged children consistently reasoned that cognitive states ceased at death, compared to 75% who consistently reasoned that psychobiological states cease.

Closer inspection of Table 2, however, reveals that the oldest children's pattern of response was driven almost entirely by two questions in particular, and these both dealt with the dead mouse's epistemic access to atypical brands of information (e.g., "Does he *know* where he is now?," "Does he *know* that he's not alive?"). Perhaps, therefore, it is not that the late elementary aged children had difficulty conceptualizing the dead mouse's lack of ongoing cognitive states, in general, inasmuch as it is a difficulty in taking into account the cause of ignorance when death is to blame. To investigate this issue more fully, the third experiment had both children and adults reason about the functioning of more rigorously categorized psychological states after death, dividing psychological functions into psychobiological, perceptual, emotional, desire, and epistemic states.

EXPERIMENT 3: DISCONTINUITY OF VARIEGATED PSYCHOLOGICAL STATE CATEGORIES

Method

Participants

Sixty-six children were recruited from the same university-affiliated schools reported in the previous Method sections. Participants came from ethnically diverse backgrounds and represented a wide range of socioeconomic levels. None of the children in the current experiment had participated in either of the two previously reported experiments. Children were assigned to one of two groups based on age. The first group (hereafter “kindergartners”) consisted of the youngest participants, and included 35 preschoolers and kindergartners, 23 males and 12 females. The mean age of the children from this group was 5 years 3 months (range = 3 years 2 months to 6 years 10 months). The second group of children (hereafter “late elementary”) consisted of 31 fifth- and sixth-graders, with a mean age of 11 years 8 months (range = 10 years 6 months to 12 years 10 months). There were 11 males and 20 females in this group.

In addition to the children, 20 undergraduate students were also recruited from the psychology subject pool at Florida Atlantic University to serve as participants in the study; these participants were enrolled in a general psychology course at the time of testing. The average age of the adult participants in this study was 19 years 1 month (range = 18 years 2 months to 20 years 10 months), with 8 males and 12 females. The university is located in a suburban metropolitan area of South Florida and its student population is highly diverse.

Materials and Procedure

Children were brought from their classrooms or after-school programs and tested individually in a small, private room inside or neighboring the school library. Adults were tested in a room adjacent to the investigator’s laboratory office. As in the foregoing experiments, children were asked at the beginning of their experimental session whether they would like to watch a puppet show and help the experimenter answer some questions about the puppets. Adult participants were told that they would be participating in an experiment designed for children, and that the experimenter was interested in determining how adults answered the same types of questions asked of the children.

To minimize experimenter error during enactment of the puppet show and variability on the narration of the scripts, participants in the current experiment were shown a videotaped version of the puppet show. The video showed the same set of materials reported in the Method sections of Experiment 1 and 2. The only additions included a blue cardboard cutout that served as a small pond in the puppet show script, and also a small gathering of faux flowers aligned at the perimeter fence of the theatre display, also for inclusion in the script. Individuals (including the adults) were instructed that, although the scene was make-believe, they should pretend that the animals shown in the video were real. All participants observed the same events occurring on-screen, whereby the mouse was eaten and killed by the alligator, but heard one of two script versions (see Appendix B), appropriately matched and counterbalanced across trials, such that each participant heard either Script A or Script B, but not both. Different script versions were used in order to determine whether participants were using discontinuity reasoning similarly for specific states (e.g., *taste, see*) within the same state category (e.g., *perceptual*), or if they treated such within-category states differently. We believed that including all states in a single script may have exceeded the attentional and memory abilities of the youngest children, necessitating the use of two scripts in order to include a broader selection of psychological states. Script versions were randomly assigned to participants.

Following presentation of the video, individuals were asked a series of questions related to the continuity/discontinuity of psychological states or biological imperatives addressed in the script presented to them (Appendix B). For example, in Script B, the mouse protagonist, prior to being eaten by the alligator, was said to "love how the flowers smell." Participants who heard this version of the story were then asked in the interview whether the dead mouse could "still smell the flowers" after it had died. Each script contained information dealing with five psychological state categories: (1) psychobiological; (2) perceptual; (3) emotional; (4) desire, and; (5) epistemic states. In addition, each script contained 2 questions dealing with biological imperatives from Experiment 1 in order to get a baseline, within-subjects measure of death-related knowledge independent of reasoning about psychological states. Each interview in Experiment 3 therefore contained a total of 12 questions.

The two scripts differed with respect to the particular functions comprising each category, such that, for instance, whereas Script A included information dealing with the perceptual states "hear" and "taste," Script B substituted these with the perceptual states "smell" and "see." Both scripts, therefore, contained information dealing with perceptual states. There were two questions for each psychological state category[5], such that participants were asked a series of 10 questions dealing with the continuity/discontinuity of the psychological functioning of the dead agent. The questions used in this experiment are shown in Table 4. The ordering of presentation was varied so that questions dealing with the same psychological state categories were never asked consecutively.

As in the previous experiments, participants were asked follow-up questions after providing an initial "yes/no" response so that the experimenter could determine whether they were using continuity or discontinuity reasoning. In all cases, experimenters provided neutral, confirmatory feedback to encourage the participants' responses regardless of content, and instructed them beforehand that there were no wrong or right answers to the questions.

Table 4 about here

Coding

The coding procedure was identical to the one used in Experiment 2. The first author and a second person naïve to the purposes of the study served as independent coders. Initial interrater reliability on a random sample of twenty percent of the database was 90% and all disagreements were subsequently resolved by reviewing the episodes in question.

Results

The analyses of discontinuity responses reported here excluded all unscoreable responses (8% of all responses). However, a 3 (age group) x 6 (question type) analysis of variance including percentage of unscoreable responses as the dependent variable and question type as the repeated measure showed significant effects of age group, $F(2, 83) = 5.44$, $p < .01$ (kindergartners > late elementary children > adults) and question type, $F(5, 408) = 3.90$, $p < .005$ (desire > perceptual > emotional = epistemic > biological > psychobiological), but the interaction was not significant. Further analyses of the main effects using Tukey-Kramer post-hoc tests ($p < .05$) revealed that questions dealing with desire states (13%) produced significantly more unscoreable responses than those dealing with both biological (3%) and psychobiological (2%) states. All other comparisons between question types produced nonsignificant differences. For the main effect of age group, the youngest children (12%) made significantly more unscoreable responses than the adults (adults: $M = 3\%$) but not the older children (6%). The older children and adults produced equivalent percentages of unscoreable responses.

Preliminary Analyses

Preliminary analyses using percentage of scoreable discontinuity responses as the dependent variable found no significant effects involving gender, so all subsequent analyses were performed collapsed across this factor. Participants received one of two scripts in this experiment, and each script posed questions about the continuity/discontinuity following death of two different processes for each question type (e.g., two questions about emotions, two question about desires). The different questions posed in the two scripts produced different overall levels of discontinuity responses, $F(1, 80) = 4.14$, $p < .0001$ (Script A > Script B). The age group x script, $F(2, 80) = 17.34$, $p < .05$, and the question type x script, $F(5, 393) = 2.28$, $p < .05$, interactions were also significant. An examination of performance between the two scripts revealed higher overall discontinuity responses on Script A than Script B, but a similar pattern of discontinuity response for the various questions types in the two scripts (Script A: biological = 89%; psychobiological = 77%; perceptual = 79%; emotional = 61%; desire = 51%; epistemic = 63%; Script B: biological = 83%; psychobiological = 67%; perceptual = 65%; emotional = 33%; desire = 35%; epistemic = 29%). (Percentage of discontinuity responses for individual questions for each age group can be found in Table 4.) Because the patterns of responses among the various question-type categories were similar for the two scripts, all subsequent analyses were collapsed across scripts.

Question Type by Age Group

Figure 2 presents the percentage of scoreable discontinuity responses in Experiment 3, separately for each age group and question type. As can be seen in Figure 2, there was a general increase in discontinuity responses with age, and, for each age group, discontinuity responses were made more frequently for the biological, psychobiological and perceptual states than they were for the emotional, desire, and epistemic states. A 3 (age group: kindergartners vs. late elementary children vs. adults) x 6 (question type: biological vs. psychobiological vs. perceptual vs. emotional vs. desire vs. epistemic) analysis of variance, with repeated measures on the question-type factor, produced significant main effects of age group, $F(2, 83) = 9.40, p < .0005$ (adults [M = 78%] > late elementary children [M = 70%] > children [M = 43%]), question type, $F(5, 408) = 33.73, p < .0001$ (biological [M = 86%] = psychobiological [M = 72%] = perceptual [M = 72%] > emotional [M = 48%] = epistemic [M = 46%] = desire [M = 43%]), and a significant age group x question type interaction $F(10, 408) = 2.62, p < .005$.

Figure 2 about here

Post-hoc analyses of the significant age group x question type interaction using Tukey-Kramer (p < .05) revealed significant differences between question types in the predicted direction. For the kindergartners, biological questions elicited the highest levels of discontinuity responses, significantly greater than those of all other questions. Discontinuity responses were statistically equivalent for the psychobiological, emotional, desire, and epistemic questions. The only other significant difference was between the perceptual questions and the emotional and desire questions (i.e., perceptual > emotional = desire). Patterns of performance were similar between the late elementary children and the adults. Both showed high and equivalent levels of discontinuity responses for the biological, psychobiological, and perceptual questions, and lower and equivalent levels of performance for the emotional, desire, and epistemic questions. For the late elementary children, both the biological and psychobiological questions elicited significantly greater percentage of discontinuity responses than emotional, desire, and epistemic states. For the adults, the psychobiological questions produced significantly higher levels of discontinuity responses than did the emotional, desire, and epistemic questions; the biological questions produced higher levels of discontinuity responses than the emotional and epistemic questions, with this difference approaching significance for the desire questions.

When contrasting the means for discontinuity responses between the age groups for each question type, there were no significant differences between the adults and the late elementary children for any question type. The biological and psychobiological questions elicited significantly more discontinuity responses among both the late elementary children and adults than the kindergartners (i.e., adults = late elementary children >

kindergartners). Adults made significantly more discontinuity responses than the kindergartners for the perceptual, emotional, and desire states, but not for the epistemic states. None of the differences between the late elementary children and kindergartners were significant for these latter four categories (i.e., late elementary children = kindergartners for perceptual, emotional, desire, and epistemic).

Consistent Discontinuity Theorizing

To assess the degree to which children and adults were consistent in their discontinuity reasoning over all questions, and also within each psychological state category (e.g., psychobiological, epistemic, participants were classified as consistent discontinuity theorists if they provided discontinuity responses for all questions, excluding those few that could not be scored within a specified category (see Table 5). As can be seen from the table, differences in the percentage of participants classified as consistent discontinuity theorists were small and nonsignificant between the adults and the late elementary children for each contrast. In all cases, these two groups of older participants were more apt to be classified as consistent discontinuity theorists than the kindergartners. These latter differences were significant (i.e., both adults and late elementary children > kindergartners via chi-square tests, $p < .05$) for the biological, psychobiological, desire, and overall, but not for the perceptual ($p = .064$), emotional ($p = .085$), or epistemic ($p = .115$) questions.

Table 5 about here

Discussion

The findings show that older children and adults were, overall, more likely to state that both biological imperatives and psychological states cease at death, and were more likely to report that *particular* categories of psychological states (i.e., psychobiological and perceptual states) ended at death than others (i.e., emotional, desire, and epistemic states). In contrast, the youngest children in the sample, while acknowledging that biological imperatives no longer applied to the dead agent, failed to distinguish between the different categories of psychological states and were just as likely to report that the capacity to have one type of state (e.g., psychobiological) continued after death as the next (e.g., epistemic). This may be explained by the implicit nature of the youngest children's knowledge about the biology of death; only after this knowledge has become conceptually enriched and made explicit can it be applied when reasoning about the psychological status of dead agents. However, even when explicit knowledge is in place, reasoning that certain types of psychological states (i.e., emotional, desire, and epistemic states) become extinguished at death appears difficult. Discontinuity reasoning for these types of mental states encounters resistance. The present studies do not address the question of where, precisely, this resistance comes from, but it seems likely that it is the product of both the 'ephemeral' nature of these states (i.e., they are neither clearly tied to vitalistic demands nor directly associated with sensory organs) and an underlying sociocultural endorsement of folk dualism, phenomena that are probably causally linked among themselves.

As the findings strongly suggest, this pattern of response (among the children especially) is sensitive to independent factors, such as the specific psychological states (as opposed to the general state category) used in the interview tasks. This is especially apparent for the emotional and epistemic categories. For the emotional questions, for instance, participants more readily attributed positive emotional states (e.g., love) than negative ones (e.g., anger) to the dead mouse. Eighty percent of the older children in Experiment 3 reasoned that the dead mouse had the capacity to love, whereas only 20% of children from the same age group reasoned that it maintained the capacity to experience anger. Similarly, for the question, "Now that the mouse is not alive anymore, does he still believe his mom is the nicest grownup?" only 33% of the older children applied discontinuity reasoning, whereas another question dealing with the capacity for belief, "Does he still believe he's smarter than his brother?" evoked 77% of discontinuity responses. Together, these data suggest that the emotional valence included in such questions may play an important role in children's answers, with participants being more likely to attribute the capacity to experience positive feelings to dead agents than negative feelings. However, although inherent differences between specific psychological states within the same state category (e.g., the perceptual states "taste" vs. "see") can either exacerbate or attenuate the general pattern of discontinuity responses seen here, the overall pattern between state categories remained consistent among older children and adults.

When compared with the findings from the previous two experiments, Experiment 3 closely approximated the earlier results. For example, the younger children from Experiment 1 produced, on average, 78% discontinuity responses, whereas a sample from that same biological question set in the current experiment elicited 74% discontinuity responses from similarly aged children. Likewise, the performance of children in the second experiment for the psychobiological questions was very similar to that observed for the kindergartners and late elementary aged children in the current experiment for a sample from the same question set. (Indeed, for the oldest children it was nearly identical.)

In addition, contrary to the findings from Experiment 2 in which the pattern of responses for questions dealing with epistemic access to atypical information (e.g., "does he know that he's not alive?") was seemingly disparate from the rest of the "cognitive" questions, the current findings indicate that older children and adult's discrimination between psychological state types is driven by factors other than problems in representing the knowledge of dead agents. That is, it is not only the case that children and adults are challenged by reasoning about what a dead agent does or does not know, but they face real challenges when thinking about dead agents' capacity for emotional, epistemic, and desire states more generally. Finally, the pattern of adult discontinuity reasoning for the different question types was similar to that reported by Bering (2002), in which adults were tested on a modified design with a human protagonist as the dead story character, adding support for the general testing paradigm.

GENERAL DISCUSSION

The results from this series of experiments lend support to the initial hypotheses that belief in the continuity of psychological states in dead agents generally decreases over time, and also that these default "afterlife" beliefs are pruned in a systematic fashion during development so that, in older children and adults, discontinuity reasoning is more likely to be applied to some mental state categories (i.e., perceptual and psychobiological) than others (i.e., epistemic, emotional, and desire). Although even preschool-aged children seemed to possess knowledge that parts of the body (e.g., ears, eyes) no longer work at death, and many understood that biological imperatives (e.g., the need to eat, the need to drink) no longer applied at death, they tended to reason that the psychological states associated with these body parts (e.g., hearing, seeing) and these biological activities (e.g., hunger, thirst) continued at death. This may suggest that young children's biological knowledge about death is implicit in this regard, and that only when such knowledge becomes explicit and declarative can it be logically applied to reasoning about the psychological status of dead agents. Nevertheless, by preschool, most children appear fully appreciative of the fact that, once death is certain, those activities and physical processes essential to the physical maintenance of all organisms cease. Seventy-eight percent of all responses made by the 4- to 6-year-olds in Experiment 1 were classified as reflecting discontinuity reasoning, and a nearly identical percentage (74%) of such responses was reported by the youngest children in the final experiment (even though this sample included several 3-year-olds).

Surprisingly little has been reported in the literature specifically addressing children's understanding of biological imperatives and death, but our findings largely support those of Barrett (1999; Barrett & Behne, 2001), who found that even 3-year-olds possess accurate death-related knowledge when the study design is sensitive enough to extract implicit knowledge. Jointly, these findings of such early understanding of death contradict previous work derived from Piagetian-type methodologies suggesting that preschoolers are bound to view death as a form of 'deep sleep' or a literal physical absence from the scene of the living (e.g., Koocher, 1973; Nagy, 1948). Children understand that, unlike sleep, biological processes no longer apply at death.

Deep sleep is, of course, closely related to a monistic view of death, and in terms of children's attributions of the psychological processes accompanying sleep and death, there may indeed be a common inductive mechanism at work. For example, Flavell, Green, and Flavell (1995; see also Flavell & O'Donnell, 1999) found that 5-year-olds were more likely than 8-year-olds to attribute decision-making abilities and self-awareness to a person "sound asleep and not dreaming." Flavell et al. (1995) interpreted their findings as evidence of young children's tendency to wrongly attribute mental states when explaining the absence of behavior during unconscious periods, and older children's better understanding of unconsciousness. Because Flavell et al.'s study only dealt with children's reasoning about higher-order cognitive activity during sleep, however, it is currently unknown whether children of different ages are more likely to attribute certain types of psychological states (e.g., thinking, knowing) to sleeping agents than others (e.g., being thirsty, hearing).

It is also worth noting that both Barrett's work and the current study placed the death scenario in the context of a predator-prey relationship, something Barrett proposes is critical to experimentally getting at discontinuity death reasoning at such early ages. Whether this evolutionarily based explanation continues to hold awaits to be seen, but nevertheless it is apparent from the results reported for Experiment 1 that, at least when it comes to strictly biological matters, preschoolers confronted with concrete, visually salient death events apprehend the subject far more clearly than most professionals have been willing to give children their age credit for. And by age 7, nearly all children view death as a collapsing of the biological system in individual organisms and all associated vitalistic demands.

Interestingly, however, only slight deviations from the original biological questions resulted in drastic changes in children's reasoning. Comparisons between the strictly biological questions in Experiment 1 (e.g., "Will he ever need to drink water again?") and the psychological questions from Experiment 2 conceptually linked to them (e.g., "Is he still thirsty?") showed that both the youngest children ($M = 5$ years) and those in the middle age group ($M = 7$ years) produced far fewer discontinuity responses for the psychological questions. Similarly, in Experiment 3, which included questions about the continuity of both biological imperatives and psychobiological states in the same design, the youngest children clearly distinguished between these two categories, readily reporting that biological imperatives ceased at death while psychobiological states still occurred. Clearly, the youngest children had some biological knowledge about death, but ran into trouble when applying this biological knowledge to related psychological matters.

Perhaps only after biological knowledge has become elaborated and made increasingly declarative, can children apply this knowledge of the non-functionality of body parts and the role of vitalistic activities to related psychological states, as evidenced by the performance of the oldest children in Experiments 2 and 3 and the adults in the final experiment. However, participants in these age groups were more likely to report that psychobiological and perceptual states ceased at death than they were emotional, desire, and epistemic states, showing an underlying cognitive bias that predisposes individuals to entertain certain phenomenological characteristics of dead agents over others.

The current study was not an attempt to explain why individuals believe in life after death, per se, but rather why, when individuals do harbor such accounts of the afterlife, these beliefs are characterized by a highly typical complexion: that of a knowing, believing, *mindful* spirit that has shed its biology proper. We wish not to pit cognitive biases for ‘afterlife’ beliefs against culture in attempting to explain this nearly universal phenomenon. Narrow scientific philosophizing of this sort rarely proves to be anything but futile (Cosmides & Tooby, 1992). As is the case with any complex psychological trait found across cultures, genders, religions, and a host of other dispositional variables, the tendency for people to believe in the continued existence of specific psychological states after death while discounting others cannot be reduced to some instinctive mechanism in isolation from experiential input. Neither, as these data show, can afterlife beliefs be effectively reduced to a product of sheer learning, independent of the organized structure that receives information regarding such beliefs (Bering, 2002). If afterlife beliefs were solely a function of social learning, then we should be compelled to ask why early elementary aged children would provide, in general, more *discontinuity* responses than, say, kindergartners? Likewise, the late elementary aged children in the current study provided more epistemic discontinuity responses than the early elementary aged children (Experiment 2). The vast majority of adults believe in some form of personal consciousness after death, and one would suppose, after all, that the more time children spend in a given socioreligious milieu, the more they should show signs of indoctrination (see also Brent, Speece, Lin, & Dong, 1996). From a strictly cultural perspective, there is simply no *a priori* reason to assume that preschoolers, no matter what religious instruction they have thus far received, would be more likely to reason that a dead agent will no longer need to eat food than they would to reason that a dead agent cannot be hungry.

It is also interesting to note that only a very small percentage of children used any eschatological terms (e.g., heaven, God, spirit, and so on) during the course of the study. If children’s answers were guided in any significant fashion by what they had learned from religious pedagogy, then one might expect such material to have been more salient in the children’s responses. In contrast, it was conspicuously lacking. This is not compelling evidence of the unimportance of indoctrination in its own right, but only suggestive when viewed in light of the patterns of divergence between children’s responses to the various questions posed to them.

Rather, it seems more likely that popular and ecumenical accounts of the afterlife contribute throughout development to the general pattern of reasoning about dead agents' minds, with cultural immersion and religious indoctrination effectively exploiting innate cognitive biases. It may be a simple matter of fact that spirits and ghosts are typified by the possession of certain psychological states, but it is precisely because the disposition of these beliefs about dead agents are so uniform that developmental psychologists must attempt to explain them. Future research should examine the exact role of sociocultural influences on children's intuitive reasoning about the psychological status of dead agents.

References

Atran, S. (1994). Core domains versus scientific theories: evidence from systematics and Itzaj-Maya folk biology. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Domain specificity in cognition and culture* (pp. 316-340). New York: Cambridge University Press.

Atwood, V. A. (1984). Children's concepts of death: A descriptive study. *Child Study Journal, 1*, 11-29.

Backscheider, A., Shatz, M., & Gelman, S. (1993). Preschoolers' ability to distinguish living kinds as a function of regrowth. *Child Development, 64*, 1242-1257.

Barrett, C. (1999). *Human cognitive adaptations to predators and prey*. Unpublished doctoral dissertation, University of California, Santa Barbara.

Barrett, H. C., & Behne, T. (2001, August). *Understanding death as the cessation of intentional action: A cross-cultural developmental study.* Poster presented at the 2001 Meeting of the Cognitive Science Society, Edinburgh.

Bering, J. M. (2002). Intuitive conceptions of dead agents' minds: The natural foundations of afterlife beliefs as phenomenological boundary. *Journal of Cognition and Culture, 2*, 263-308.

Bjorklund, D. F., & Pellegrini., A. D. (2002). *The origins of human nature: Evolutionary developmental psychology.* Washington, D.C.: American Psychological Association Press.

Boyer, P. (2001). *Religion explained: The evolutionary origins of religious thought.* New York: Basic Books.

Brent, M. W., Speece, S. B., Lin, C., & Dong, Q. (1996). The development of the concept of death among Chinese and U.S. children 3-17 years of age: From binary to "fuzzy" concepts? *Omega: Journal of Death & Dying, 33,* 67-83.

Buss, D. M. (1995). The future of evolutionary psychology. *Psychological Inquiry, 6*, 81-87.

Carey, S. (1991). Knowledge acquisition: enrichment or conceptual change? In S. Carey & R. Gelman (Eds.), *The epigenesis of the mind: Essays on biology and cognition* (pp. 257-291).

Hillsdale, NJ: Lawrence Erlbaum.

Carey, S., & Spelke, E. (1994). Domain-specific knowledge and conceptual change. In L. Hirschfeld & S. Gelman (Eds.), *Mapping the mind: Domain-specificity in cognition and culture* (pp. 169-200). New York: Cambridge University Press.

Cosmides, L., & Tooby, J. (1992). The psychological foundations of culture. In J. Barker, L. Cosmides, & J. Tooby (Eds.), *The adapted mind* (pp. 19-136). New York: Oxford University Press.

Evans, M., Poling, D. A., & Mull, M. S. (2001, April). *Confronting the existential questions: Children's understanding of origins and death.* Paper presented at the biennial meeting of the Society for Research in Child Development, Minneapolis.

Flavell, J. H. (1999). Cognitive development: Children's knowledge about the mind. *Annual Review of Psychology, 50*, 21-45.

Flavell, J. H., Green, F. L., & Flavell, E. R. (1995). Young children's knowledge about thinking. *Monographs of the Society for Research in Child Development, 60*, 1.

Flavell, J. H., & O'Donnell, A. K. (1999). Development of intuitions about mental experiences. *Enfance, 3*, 267-276.

Geary, D. C. (1995). Reflections of evolution and culture in children's *cognition: Implications for mathematical development and instruction. American Psychologist, 50*, 24-37.

Gopnik, A., & Wellman, H. M. (1992). Why the child's theory of mind really is a theory. *Mind & Language, 7*, 145-171.

Gottlieb, G. (2001). A developmental psychobiological systems view: Early formulation and current status. In S. Oyama & P. E. Griffiths (Eds.), *Cycles of contingency: Developmental systems and evolution* (pp. 41-54). Cambridge, MA: MIT Press.

Greeley, A. M., & Hout, M. (1999). Americans' increasing belief in life after death: Religious competition and acculturation. *American Sociological Review, 64*, 813-835.

Gullone, E., King, N. J., Tonge, B., Heyne, D., & Ollendick, T. H. (2000). The fear survey schedule in children – II (FSSC-II): Validity data as a treatment outcomemeasure. *Australian Psychologist, 35*, 238-243.

Hinde, R. A. (1999). *Why gods persist: A scientific approach to religion*. London: Routledge.

Inagaki, K. (1989). Developmental shift in biological inference processes: From similarity-based to category-based attribution. *Human Development, 32*, 79-87.

Inagaki, K., & Hatano, G. (1996). Young children's recognition of commonalities between animals and plants. *Child Development, 67*, 2823-2840.

Johnson, C. N., & Wellman, H. M. (1982). Children's developing conceptions of the mind and brain. *Child Development, 53*, 222-234.

Kane, B. (1979). Children's concepts of death. *The Journal of Genetic Psychology, 134*, 141-153.

Keil, F. (1994). The birth and nurturance of concepts by domains: The origins of concepts of living things. In L. Hirschfeld & S. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 234-254). New York: Cambridge University Press.

Koocher, G. (1973). Childhood, death, and cognitive development. *Developmental Psychology, 9*, 369-375.

Lazar, A., & Torney-Purta, J. (1991). The development of the sub-concepts of death in young children: A short term longitudinal study. *Child Development, 62*, 1321-1333.

Mahon, M. M., Zagorsky-Goldberg, E., & Washington, S. K. (1999). Concept of death in a sample of Israeli kibbutz children. *Death Studies, 23*, 43-59.

McIntire, M. S., Angle, C. R., & Struempler, L. J. (1972). The concept of death in Midwestern children and youth. *American Journal of Diseases in Children, 123*, 527-532.

Medin, D., & Atran, S. (1999). *Folkbiology*. Cambridge, MA: MIT Press.

Nagy, M. (1948). The child's theories concerning death. *Journal of Genetic Psychology, 83*, 199-216.

O'Neill, D. K., & Chong, S. C. F. (2001). Preschool children's difficulty understanding the types of information obtained through the five senses. *Child Development, 72*, 803-815.

Slaughter, V., & Lyons, M. (in press). Learning about life and death in early childhood. *Cognitive Psychology.*

Slaughter, V. Jaakola, K., & Carey, S. (1999). Constructing a coherent theory: Children's biological understanding of life and death. In M. Siegal & C. Peterson (Eds.), *Children's understanding of biology, health, and ethics* (pp. 71-96). Cambridge: Cambridge University Press.

Smilansky, S. N. (1987). *On death: Helping children understand and cope*. New York: Peter Lang.

Speece, M. W., & Brent, S. B. (1984). Children's understanding of death: A review of three components of a death concept. *Child Development, 55*, 1671-1686.

Thalbourne, M. A. (1996). Belief in life after death: Psychological origins and influences. *Personality and Individual Differences, 21*, 1043-1045.

Wellman, H. M., Hickling, A. K., & Schult, C. A. (1997). Young children's psychological, physical, and biological explanations. In H.M. Wellman & K. Inagaki, K. (Eds.), *The emergence of core domains: Children's reasoning about physical, psychological, and biological phenomena. New directions for child development* (pp. 7-25), No. 75. San Francisco: Jossey-Bass.

Appendix A

Coding Guidelines for Interview Sessions, Experiment 2

Continuity (C) – Child responds “yes” to initial, target question and does not contradict this answer in his or her response to the follow-up question(s) (see Example 1a). If child does not provide answer at follow-up questioning for initial “yes” response (e.g., shrugs shoulder, states “I don’t know, etc.), then a continuity score is recorded (see Example 1b). Also, a continuity score is recorded when child responds “no” to initial, target question, but his or her answer to subsequent follow-up questioning indicates continuity reasoning (see Example 1c).

Example 1a

E: “Now that the mouse is not alive anymore, is he thinking about the alligator?”

C: “Yes.”

E: “Why?”

C: “Because he scared him.”

Example 1b

E: “Now that the mouse is not alive anymore, does he know where he is now?”

C: “Yes.”

E: “How come?”

C: “I don’t know.”

Example 1c

E: “Now that the mouse is not alive anymore, can he see this tree?”

C: “No.”

E: “Why not?”

C: “He’s inside of an alligator’s body and can’t see anything but his mouth.”

Discontinuity (D) – Child responds “no” to initial, target question and provides a justification for this response indicating cessation of function for particular faculty during follow-up questioning (see Examples 2a and 2b below).

Example 2a

E: “Now that the mouse is not alive anymore, is he thinking about alligator?”

C: “No.”

E: “How come?”

C: “Because he doesn’t have a brain that’s attached and working.”

Example 2b

E: “ Now that the mouse is not alive anymore, is he still sleepy?”

C: “No.”

E: “And why not?”

C: “Because he’s dead.”

Appendix B

Afterlife Vignettes and Interview Questions for Experiment 3

Script A.

Hi, I'm going to do a puppet show for you today, and the first thing I'm going to do is introduce you to the two characters. Do you know what kind of animal this is? That's right! It's a mouse. And this mouse is a baby mouse. One day he's going to grow up to become an old mouse. Do you know what kind of animal this is? Right again! It's an alligator. And this alligator's favorite food is baby mice. Now, we both know that these animals aren't real, they're just puppets, but for today let's just pretend that they are real.

One day, Baby Mouse decides to go for a walk in the woods. While he's walking he's thinking about a lot of things. He's thinking about how angry he is with his brother, because is brother is always fighting with him. Sometimes Baby Mouse wishes he was an only child and didn't have a brother to worry about. Baby Mouse's mom always tells Baby Mouse how smart he is, so Baby Mouse thinks he is smarter than his brother. He's also wondering what his brother is doing right now and what he's thinking.

Baby Mouse is also thinking about food. He hasn't had anything to eat all day and he's getting very hungry. He decides to eat some grass. But he takes one bite and spits it out because it tastes very gross. Yuck! He's also very thirsty, but he doesn't want to drink out of the pond because the water is dirty. The birds are singing very loud, and Baby Mouse is listening to their songs. Baby Mouse really wants to go home now because he's lost. This makes him very sad. He doesn't know where he is. Just then, he notices something strange. The bushes are moving! An alligator jumps out of the bushes and gobbles him all up. Baby Mouse is not alive anymore.

Script A. Interview Questions

Biological

1. Do you think that Baby Mouse will ever need to *eat* food again?*
2. Do you think that Baby Mouse's *brain* still works?

Psychobiological

1. Do you think that Baby Mouse is still *thirsty*?

2. Do you think that Baby Mouse is still *hungry*?

Perceptual

1. Do you think that Baby Mouse can still *hear* the birds singing?

2. Do you think that Baby Mouse can still *taste* the yucky grass he ate?

Emotional

1. Do you think that Baby Mouse is still *sad* that he can't find his way home?

2. Do you think that Baby Mouse is still *angry* at his brother?

Desire

1. Do you think that Baby Mouse still *wishes* he had no brother?

2. Do you think that Baby Mouse still *wants* to go home?

Epistemic

1. Do you think that Baby Mouse is still *thinking* about his brother?

2. Do you think that Baby Mouse still *believes* he's smarter than his brother?

* Each question was prefaced with the conditional, "Now that Baby Mouse is not alive anymore. . ."

Script B

Hi, I'm going to do a puppet show for you today, and the first thing I'm going to do is introduce you to the two characters. Do you know what kind of animal this is? That's right! It's a mouse. And this mouse is a baby mouse. One day he's going to grow up to become an old mouse. Do you know what kind of animal this is? Right again! It's an alligator. And this alligator's favorite food is baby mice. Now, we both know that these animals aren't real, they're just puppets, but for today let's just pretend that they are real.

One day, Baby Mouse decides to take a walk in the woods. There are flowers, and Baby Mouse loves how the flowers smell. The flowers smell very nice. While he's walking, he's thinking about a lot of things. He's thinking about his mom, and how much he loves her. He believes his mom is the nicest grownup mouse in the whole world. Baby Mouse wonders where his mom is right now. Baby Mouse is also thinking about numbers. He likes numbers, but he's not very good at using them. He doesn't even understand how to add numbers together. He hopes that one day he'll be better at using numbers. Baby Mouse's feet are very tired, and he wants to go home now. But he realizes that he's lost and he doesn't know how to get back to his house. He's very sleepy and really wants to go to bed.

Baby Mouse has a sore throat and he feels sick. Maybe if he drinks some water he'll feel better. He goes to drink some water from the pond but before he gets there he notices something funny. The bushes are moving! An alligator jumps out of the bushes and gobbles him all up. Baby Mouse is not alive anymore.

Script B. Interview Questions

Biological

1. Do you think that Baby Mouse will *grow* up to be a grownup mouse?*
2. Do you think that Baby Mouse will ever need to *drink* water again?

Psychobiological

1. Do you think that Baby Mouse still feels *sleepy*?
2. Do you think that Baby Mouse still feels *sick*?

Perceptual

1. Do you think that Baby Mouse can still *smell* the flowers?
2. Do you think that Baby Mouse can *see* where he is now?

Emotional

1. Do you think that Baby Mouse still *loves* his mom?
2. Do you think that Baby Mouse is still *scared* of the alligator?

Desire

1. Do you think that Baby Mouse still *hopes* he gets better at math?
2. Do you think that Baby Mouse still *wants* to go home?

Epistemic

1. Do you think that Baby Mouse *knows* he's not alive?

2. Do you think that Baby Mouse still *believes* his mom is the nicest grownup?

* Each question was prefaced with the conditional, “Now that Baby Mouse is not alive anymore. . .”

Footnotes

[1] Due to the timing of the research and worldly events, we used the term “not alive” whenever possible rather than “dead.” Parents and teachers expressed greater satisfaction with this terminology and it likely contributed to the level of parental compliance. It is important to take this into account, however, in interpreting the present findings. It may be that use of more straightforward terms such as “dead,” “death,” and “kill” could influence children’s responses.

[2] For Experiments 1 and 2, age group classifications were based on the relative age distribution of the sample, such that there was approximately a two-year age range within each age category. For both experiments, preliminary analyses revealed no significant differences between the youngest half and the oldest half of children within each age group, indicating that, for the questions posed here, children in each age group were relatively homogenous in their reasoning.

[3] Initial testing included a sixth cognitive question (i.e., “Now that the mouse is not alive anymore, does he like Mr. Alligator?”). However, this question was dropped early during the course of the study because responses from the two youngest groups of children were highly ambiguous, suggesting that the children did not understand the nature of the question (e.g., that it referenced the mouse’s state *after* being eaten rather than before or during). The decision to drop this question was also motivated by comments from several of the older children, in which they asked whether the experimenter was referring to the mouse’s feelings toward the alligator before or after it had been killed.

[4] This does not include responses from the control condition. All control responses were coded without error.

[5] This was true for all categories except questions dealing with desire states. Both scripts included the question “Does he still want to go home?” because other potential desire state terms (such as desire, long for, etc.) were judged to be too sophisticated for the youngest children.

Table 1

Percentage of Children, Younger and Older, Providing Discontinuity Responses, Experiment 1

"Now that the mouse is no longer alive. . .

	Younger	Older
1. Will he ever *be alive* again?"	96	100
2. Will he ever *grow up* to be an old mouse?"	92	96
3. Will he ever need to go to the *bathroom*?"	88	96
4. Do his *ears* still work?"	85	96
5. Will he ever *get sick* again?"	79	91
6. Does his *brain* still work?"	85	81
7. Will he ever need to *drink water* again?"	68	92
8. Do his *eyes* still work?"	68	88
9. Will he ever need to *sleep* again?"	60	84
10. Will he ever need to *eat food* again?"	54	88

Table 2

Percentage of Children, by Age Group, Providing Discontinuity Responses, Experiment 2

"Now that the mouse is no longer alive. . .

	Age Group		
	Kind	Early Elem	Late Elem
	Psychobiological		
1. Is he still *hungry*?"	39	67	100
2. Is he still *thirsty*?"	33	63	100
3. Is he still *sleepy*?"	39	66	89
4. Does he still *feel sick*?"	21	55	75
	Cognitive		
1. Is he *thinking* about the alligator?"	43	73	85
2. Can he *see* this tree?"*	50	54	78
3. Does he still *want* to go home?"	28	47	80
4. Does he *know* where he is now?"	36	46	53
5. Does he *know* that he's not alive?"	33	52	35

* Refers to the plastic tree placed on the theatre display.

Table 3

Means for Discontinuity Responses for Yoked Factors Experiment 1 and Experiment 2

"Now that the mouse is no longer alive. . .

		Kind	Early Elem
1.	Will he ever need to *eat food* again?"	54	88
	Is he still *hungry*?"	39	67
2.	Will he ever need to *drink water* again?"	68	92
	Is he still *thirsty*?"	33	63
3.	Will he ever need to *sleep* again?"	60	84
	Is he still *sleepy*?"	39	66
4.	Will he ever *get sick* again?"	79	91
	Does he still *feel sick*?"	21	55
5.	Does his *brain* still work?"	85	81
	Is he still *thinking* about Mr. Alligator?"	43	73
6.	Do his *eyes* still work?"	68	88
	Can he *see* this tree?"	50	54
7.	Will he ever *be alive* again?"	96	100
	Does he *know he's not alive*?"	33	52

Table 4

Percentage of Children, by Age Group, Providing Discontinuity Responses, Experiment 3

"Now that the mouse is no longer alive. . .

	Age Group		
	Kind	Late Elem	Adults
		Biological	
1. Will he ever need to *eat food* again?"*	76	100	100
2. Does his *brain* still work?"*	88	81	82
3. Will he ever *grow up* to be an old mouse?"	59	100	100
4. Will he ever need to *drink water* again?"	63	93	100
		Psychobiological	
1. Is he still *thirsty*?"*	44	94	100
2. Is he still *hungry*?"*	47	100	100
3. Is he still *sleepy*?"	44	86	93
4. Does he still *feel sick*?"	29	87	100
		Perceptual	
1. Can he still *hear* the birds singing?"*	67	81	82
2. Can he still *taste* the yucky grass he ate?"*	83	87	100
3. Can he still *smell* the flowers?"	47	62	89
4. Can he *see* where he is?"	53	77	87
		Desire	
1. Does he still *wish* he didn't have a brother?"*	60	60	50
2. Does he still *want* to go home?"*	24	46	74
3. Does he still *hope* he gets better at math?"	23	45	88
		Emotional	

(*table continues*)

	Age Group		
	Kind	Late Elem	Adults
		Emotional	
1. Is still *sad* because he can't find his way home?"*	38	69	60
2. Is still *angry* at his brother?"*	60	81	70
3. Still *loves* his mom?"	6	20	36
4. Is still *scared* of the alligator?"	27	62	100
		Epistemic	
1. Is still *thinking* about his brother?"*	64	69	64
2. Still *believes* he's smarter than his brother?"*	53	77	40
3. *Knows* that he's not alive?"	21	23	60
4. Still *believes* his mom is the nicest grownup?"	11	33	56

* The first two questions for each question category reported above were from Script A. The remaining questions for each category were from Script B. The exception to this was the Desire question category, in which the question "Does he still want to go home?" was included in both scripts.

Table 5

Percentage of Consistent Discontinuity Theorists by age for all questions and separately for each question type, Experiment 3*

	Kind	Late Elem	Adult
All questions	14	35	40
Biological	65	87	90
Psychobiological	34	90	95
Perceptual	55	71	85
Emotional	24	45	50
Desire	21	47	60
Epistemic	26	48	50

*defined as providing 100% scoreable discontinuity responses within a question type

Figure Captions

Figure 1. Percentage of participants providing discontinuity responses for psychobiological and cognitive questions, by age group, Experiment 2

Figure 2. Percentage of participants providing discontinuity responses, by age group and question type, Experiment 3 (Note: Bio = biological; Psybio = psychobiological; Per = perceptual; Emo = emotional; Des = desire; Epi = epistemic)