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Infants' Ability to Learn That Animates Possess 'Vital Forces'

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Running Head: SOURCE OF CAUSAL ENERGY

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Abstract

Previous studies have shown that preschoolers endorse abstract reasons as causally responsible for familiar biological events for animals (e.g., energy causes movement) but not for machines (Gottfried & Gelman, 2005). These biological phenomena are often explained by vitalistic explanations within a naïve theory of biology (Morris, Taplin, & Gelman, 2000). Understanding the distinction in the categorization of energy and motion of animates and inanimates is important in assessing the role of energy production and transfer. In this study, I examined whether infants categorize animates and inanimates by their differences in energy and motion. Infants at 11-13 and 15-17 months of age were habituated to a casual event between an agent and recipient ball, modeled after Michotte (1963).

Infants' ability to learn that animates possess ‘vital forces’

The ability to perceive the cause and the effect of an event is essential for humans to understand the world in which they live. Causality is the relationship between cause and effect, or the quality of agency. These causal phenomena occur when something that acts as an agent in the world initiates a change in the physical state of a recipient. It is important for humans to understand causal phenomena in order to predict, temporally and spatially (i.e., when and where), an event will occur.

Developmental psychologists have long debated the origins of causal perception. Michotte (1963) is well known for investigating adults’ perception of causal illusions, which he accomplished by showing individuals a set of direct launching, delayed launching, and no collision stimulus events. During the direct launching event, one simple object moved from the left side of the screen to the right until it made contact (in the middle of the screen) with a second simple object, which moved immediately after the collision along the same path (the first simple object did not continue movement after the collision). A delayed launching event followed actions similar to the direct launching event, but instead of the second simple object moving immediately after the collision, there was a temporal delay between the collision and movement. Finally, the no collision stimulus event followed actions similar to the direct launching event, but the first simple object stopped moving before making contact with the second simple object.

Infants’ ability to perceive some actions as causal – whereby one thing causes a change in state of another thing – is considered one of the cornerstones of early cognitive development (Rakison & Poulin-Dubois, 2001). As a result, infants' perception and understanding of causality has become a topic of focus and attention in recent research. However, the mechanisms that allow infants to reach this level of development are still unclear (Rakison, 2005). An understanding of cause-and-effect events is thought to be a key factor in understanding the world. More specifically, the understanding of causal events. In addition, understanding the distinction between category members of a causal event (e.g., agent versus recipient) is important for understanding and categorizing all objects in the world.

The investigation of the mechanisms that allow infants to understand causality is important to understand how infants categorize members involved in a causal event (i.e., how do infants categorize an agent and a recipient in a causal action?). It has been found that 10-month-old infants perceive the causality of simple events by associating a specific agent with a causal action (Cohen & Oakes, 1993). This evidence provides support for an information-processing view, rather than the view that infants possess a module for causality, as the basis of group member categorization. The nature for this perception and categorization may lie in the characteristics infants associate with each member (i.e. animate objects have agent qualities, inanimate objects have recipient qualities). To understand how infants do this, it is necessary to establish what we, as adults understand, and what preschoolers are able to tell us that they understand.

Adults who were shown these stimuli perceived the direct launching events as causal and both the delayed launching event and the no collision event as non-causal (Kaiser & Profitt, 1984; Michotte, 1963; Oakes, Madole, & Cohen 1991). Similar Michottean stimulus events were shown to infants 6 months of age, and it was found that they cannot detect causal relations and cannot distinguish a causal event from other stimulus events employing similar spatio-temporal properties (Leslie, 1984). However, by 6 ½ months of age the ability to perceive and distinguish these relationships becomes apparent. In addition to these findings, Leslie found that, by habituating 6½-month-old infants to a causal event and then tested with a non-causal event, infants dishabituated more often when compared to infants habituated to a non-causal event, despite each pair equally differing in physical characteristics. These results indicated that infants by 6½ months of age are sensitive to causal relations as well as perceptual changes (Leslie, 1984).

As adults, we know that we are animate and can act on inanimate (or animate) objects to cause a change in our environment. Thus, we are the agents in our environment and act upon various recipients. An understanding of causality and the roles of agents (animates) and recipients (inanimates or animates) may be directly related to experience in the world. How do infants begin to understand the intrinsic properties of agent (animate) and recipient objects?

Intrinsic properties of objects are what make them unique. Medin and Ortony (1989) found that adults and children equally believe in the essence of an object. The belief of such unique characteristics can be defined as part of a cognitive bias known as "psychological essentialism" (Medin & Ortony, 1989). The essentialist bias emerges around the time that children start preschool. Although parents do not explicitly tell their children to essentialize, children will create concepts and beliefs spontaneously to explain phenomena. This bias embraces the idea that there is a deep, underlying nature of an object that is causally responsible for its category membership and phenomenal properties (Gelman, 2003). The distinction between the nature of an object (i.e., living versus non-living) is accounted for by a concept known as vitalism.

Familiar biological phenomena may be explained by vitalistic explanations, or the notion that some life force or energy is transmitted, and may serve a causal function within a naïve theory of biology (Morris et al., 2000). Everything in the world is considered to involve the transformation of energy in a particular form (Morris et al., 2000). Thus, the recognition of life involves the production, transmission, and consumption of energy. Understanding the distinction in the categorization of energy and motion of animates and inanimates is important in assessing the role of energy production, transfer, and consumption. This, however, proves to be an obstacle to assess with young children as few studies have explored the ability of children to understand that animates possess ‘vital forces.’ Moreover, no studies have been conducted to explore the ability of infants to learn that animates possess ‘vital forces.’

Wellman and Gelman (1992) acknowledge that young children structure their knowledge in cognitive domains and within naïve theories of physics, psychology, and biology. These core principles enable children to infer causal relations about novel events. Furthermore, children are able to draw inferences among each of these knowledge domains to form an intricate, interconnected framework for knowledge acquisition. Gottfried and Gelman (2005) explored young children’s naïve theories of familiar biological events. Previous studies have shown that preschoolers endorse abstract reasons as causally responsible for familiar biological events (e.g., movement, growth) for animals (i.e., “it’s own energy”) but not machines. Furthermore, children expect animals and machines to have different internal characteristics despite not knowing specifically what those insides should look like (Simons & Keil, 1995).

According to Gelman and Wellman (1991), it is apparent that children understand the distinction between animate objects and inanimate objects, and that internal causes are more likely to determine an object’s behavior than are external ones. Moreover, these internal properties are viewed to be more prevalent in determining an object’s category membership (Gelman & Wellman, 1991). This understanding and ability to categorize objects may be credited to the essentialist bias that emerges around this age in children. However, the essentialist bias that emerges cannot overshadow the ability for preschool-age children to understand causal relations between objects.

Contemporary studies in cognitive development, particularly in the framework of “naïve theories,” suggest that 3- to 5-year-old children understand the causal relations involved in physics (Bullock, Gelman, & Baillargeon, 1982), biology (Inagaki & Hatano, 1993), and psychology (Wellman, 1990). By this age, children can also make causal predictions (Shultz, 1982) and generate causal explanations (Schult & Wellman, 1997). More specifically, children can make spatial and temporal predictions about when and where an event should take place.

Although children do not understand specific biological mechanisms, their abstract representations and expectations of causal pathways and patterns may be enough (Ingaki & Hatano, 2002). Hatano and Inagaki (1994) proposed an intermediate between psychological and biological theories of causality and contribute to what is known as “vitalistic causality.” Because children are able to distinguish between the mechanisms of intent (psychological) and biological causality (Wellman & Gelman, 1992), but may not imply mechanical principles to the phenomena, children rely on vitalistic causality. Inagaki and Hatano (1993) portray vitalistic causality as a phenomenon which is caused by “internal agency." This event involves the transfer of the "vital force" (e.g., energy or information) (Inagaki & Hatano, 1993). The information available about vitalistic explanations for the categorization of objects and perception of motion is limited.

Vitalistic explanations are rooted in biological theories, with the psychological, or intentional, explanation to create a change of physical state. Evidence suggests that infants are able to relate actions of others to their own experiences (Sommerville, Woodward, & Needham, 2005). Sommerville et al. (2005) found that 3-months-old infants who participated in a facilitated action task with Velcro mittens later interpreted an adult's reaching action toward a ball as goal-directed, and infants who did not have this experience did not. The ability to view adults as goal-directed implies that infants employ others with specific intent and the ability to cause an action on other objects in the world. From this we know that babies' experience in the world can affect their experience of other's actions.

A study conducted by Cicchino and Rakison (2008) tested the hypothesis that processing of motion ability changes when crawling begins and allows infants to encode self-propelled and caused motion. The study was conducted by employing a simple causal or non-causal launching event habituation paradigm. Results indicated the underlying mechanisms of infants' ability to identify self-propulsion, as well as the relationship between action production and perception. In an effort to clarify how motion-understanding changes when crawling begins, it is necessary to explore the mechanism by which infants learn how the phenomena of motion occurs.

Information about the mechanism with which infants learn that animates possess 'vital forces' is beneficial in providing infants with optimal situations for learning and developing. Understanding how infants develop an understanding of energy production and usage could provide information about specific mechanisms of object and motion classification. It may, then, be possible to teach infants that they are intentional beings and that their intent can lead to action being caused in the world.

The underlying principles that define and shape our understanding of animates from inanimates is the idea central to the production of energy. More often than not, objects that are agents in a causal action sequence are also animate (i.e., possessing life forces) (Saxe, Tzelnic, & Carey, 2007). However, in a causal sequence sometimes the first recipient acts like an agent on a third object (Rakison, under review). It is ultimately the definition of animacy of an object that depicts how the object is expected to function. Thus, it is important to investigate the understanding or ability to learn about energy of objects. Where animate objects should be able to produce their own energy, it should also be a replenishable supply (i.e., energy should not deplete quickly). On the other hand, inanimate objects should rely on the energy of other objects (typically animates) in order to cause a change in their environment. Thus, inanimate objects rely on the transfer of energy from one object to itself, ignoring other principles of gravity and/or wind.

The question tested in this paper is whether infants offer vitalistic explanations for the motion categorization of animate and inanimate objects (i.e., “life forces” or energy transmission). The objective of this experiment was to test empirically whether young infants develop the understanding of energy production and usage in their categorization of animate and inanimates, particularly by motion. This research could provide a more accurate depiction of how the ability to detect energy production and usage develops in infants, and whether this ability can be directly related to motor developmental stages. Because motor development has been shown to play a crucial role in how infants engage with and experience their environment, it is feasible to assume that it is also important in understanding and/or learning about ‘vital forces.’ For these reasons two groups of infants (11-13 months and 15-17 months) were chosen based upon their developmental motor skills and cognitive ability.

Method

Participants

Seventeen 11-13-month-old infants and eighteen 15-17-month-old infants were recruited for participation in this study. The data from three 11-13-month-old infants were excluded from the final analysis due to fussiness and failure to complete the testing (n=2) or having previously participated in the study (n=1), and two 15-17-month-old infants were excluded from final analyses due to prematurity (i.e., born three weeks early and weighed less than 5.5 pounds at birth) (n=1) or experimenter error (n=1). The final sample consisted of 14 healthy full term 11-13 month-olds (6 male, 8 female) (mean age 12 months 1 day; range = 11;1 to 13;3) and 16 healthy full term 15-17 month-olds (5 male, 11 female) (mean age 16 months 5 days; range = 14;29 to 17;15). The majority of infants were White and from middle class socioeconomic status. Participants were recruited through birth lists obtained from a private company. Parents were sent a letter describing the study and were later contacted by telephone and asked to participate. Participants were thanked and given a small gift for their participation. The participants were brought into the Infant Cognition Laboratory by a parent, and signed an informed consent document assuring confidentiality and voluntary participation in the study.

During the experiment, infants sat on their parent’s lap in front of a table. The parent was asked to remain neutral in the experiment by not talking or pointing to their child because it may be distracting or leading. Participants took part in the study for one session that lasted approximately 60 minutes.

Design and Procedure. The paradigm consisted of one discrete part, a visual habituation procedure. The habituation model used by Cohen and Oakes (1993) was used and was created with Macromedia Director 8.0 for PC. Infants sat on their parent's lap facing a television monitor (size: 14 in. x 24 in.; distance: 24 in.). Infants were randomly assigned to one of two groups as part of either the *Animate Test* Condition or the *Inanimate Test* Condition.

An attention-getting stimulus, in which an expanding and contracting green circle on a black background flashed with a synchronized bell sound, drew the infant's focus to the screen and the infant was presented with the habituation stimulus. The habituation stimulus was a movie of a simple Michottean causal event of direct launching in which the agent ball (red), which was initially out of sight and off screen, moved horizontally across the screen from left to right and contacted the recipient ball (green) in the center of the screen. After the agent ball had made contact with the recipient ball, the agent ball no longer moved, however, the recipient ball immediately began moving to the right and continued off screen, as shown in Figure 1. The length of time it took for each causal event to be completed was 8.0 seconds and could be repeated for a maximum of three times per habituation trial. A blue screen that descended and ascended over a period of approximately 2.0 seconds separated individual presentations of the event.

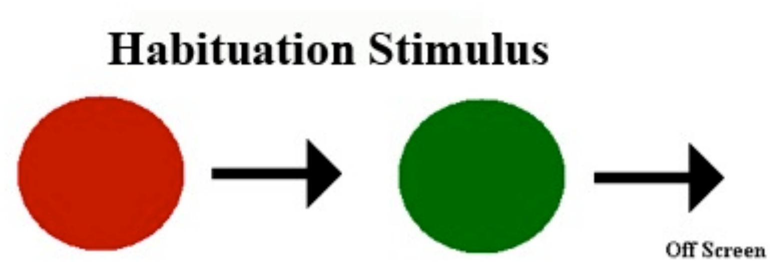

Figure 1. Example of habituation stimulus event in both conditions.

During the habituation stimulus phase of the experiment, each event was presented to the participant until the participant visually fixated away from the monitor for more than 1.0 second or until the 30.0 second time limit of uninterrupted looking had elapsed.

When the looking time for a block of three habituation trials reduced below 50% of the looking time for the first block of three habituation trials, infants were presented with two test events, unique to their condition. The attention-getting stimulus was presented between each habituation and test trial. The order of the test events was counterbalanced across infants in each condition.

During habituation the primary experimenter observed the infant via video feed from a camera placed directly behind the television monitor and each infant's looking time (in seconds) to the stimuli were coded on-line by pressing and releasing a preset keyboard key (i.e., keyboard keys specified to turn off the attention-getting stimulus and to record looking time) during the experiment. All sessions were videotaped for later reliability coding by a second experimenter. At any time, the child and/or parent could choose to terminate the study.

Animate Test Condition. In the Animate test condition, infants saw the habituation causal event of direct launching. After the habituation phase, the infant was presented with two new test items, as seen in Figure 2. One test item was the animate bouncing event in which the agent ball (red) bounced on the screen at a consistent height and distance. After the agent ball had bounced 3 times it came to an abrupt stop. This test event is considered to be the correct motion associated with the agent ball (red). The other test event was the same animate bouncing motion with the recipient ball (green). This test event is considered to be the violation of motion associated with the recipient ball (green).

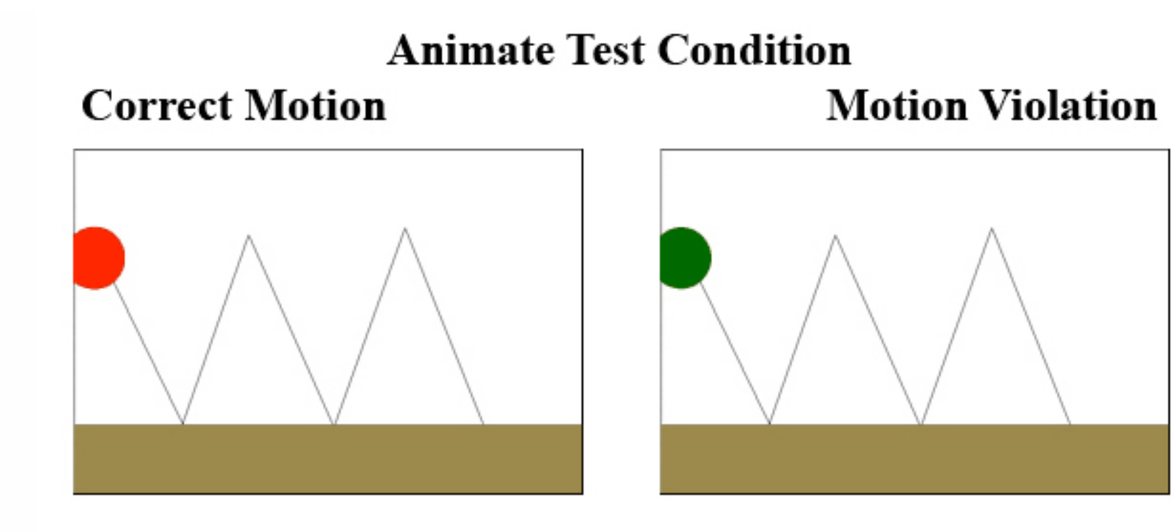

Figure 2. Examples of animate bouncing test events in Animate Test Condition.

Inanimate Test Condition. In the Inanimate test condition infants saw the habituation causal event of direct launching. After the habituation phase, the infant was presented with two new test items, as seen in Figure 3. One test item was the inanimate bouncing event in which the inanimate ball (green) bounced on the screen at a depleting height and distance, but eventually came to a stop. This test event is considered the correct motion associated with the recipient ball (green). The other test item was the same inanimate bouncing event with the animate ball (red). This test event is considered to be the violation of motion associated with the agent ball

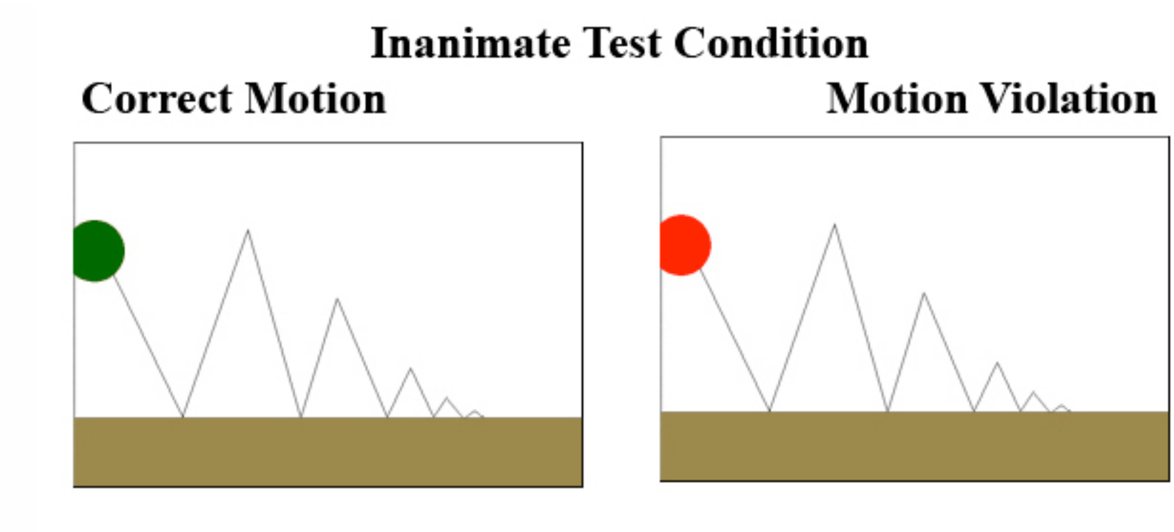

Figure 3. Examples of inanimate bouncing test events in Inanimate Test Condition.

Results

My predictions for this study were that infants in the Animate Test Condition should look longer at the motion violation (i.e., green recipient ball acting as an agent) than at the correct motion (i.e., red agent ball acting as an agent). Because this test event depicts the violation of motion of a recipient object, infants who look longer at this test event show an understanding that the recipient ball (green) should not be able to sustain its energy. However, the motion violation test event portrays the recipient ball (green) maintaining its level of energy, the way an animate object (i.e. able to produce its own energy) does in the real world.

Furthermore, infants in the Inanimate Test Condition should look longer at the motion violation (i.e., red agent ball acting as a recipient). Because this test event depicts the violation of motion of an agent object, infants who look longer at this test event show an understanding that the agent ball (red) should maintain its level energy, despite transferring energy to the recipient ball (green). However, the motion violation test event portrays the agent ball (red) losing its level of energy, the way an inanimate object (i.e., relies on energy transfer) does in the real world.

The principal analyses examined infants' looking times to the correct motion and motion violation test events in both the Animate Test Condition and Inanimate Test Condition. Sex was excluded as a factor in this analysis because no significant results were found in looking times, $F(1,15) = 2.53$, $p = .13$ and $F(1,15) = 0.14$, $p = .71$, in the Animate Test Condition, and $F(1,13) = 1.46$, $p = .25$ and $F(1,13) = 2.38$, $p = .15$, in the Inanimate Test Condition, to the correct motion and motion violation test events, respectively.

The visual fixation times from the Animate Test Condition test trials from both age groups were first investigated by submitting these data into a 2 (Age: 11-13 month-olds vs. 15-17 month-olds) x 2 (Test Event: Correct Motion vs. Incorrect Motion) two-way analysis of variance (ANOVA). The analysis revealed that across the two age groups, there was no significant difference in looking time at the correct motion test event (11-13 months: $M = 7.89$, $SD = 7.23$; 15-17 months: $M = 8.66$, $SD = 7.84$), $F(1,15) = 0.04$, $p = .84$. There was also no difference in looking times across the two age groups for the motion violation test event (11-13 months: $M = 15.30$, $SD = 8.89$; 15-17 months: $M = 11.80$, $SD = 10.06$), $F(1,15) = 0.54$, $p = .47$. Thus, infants' looking times to the two test events were not affected by age in the Animate Test Condition.

A second 2 (Age: 11-13 month-olds vs. 15-17 month-olds) x 2 (Test Event: Correct Motion vs. Incorrect Motion) two-way analysis of variance (ANOVA) was run across both age groups from the Inanimate Test Condition. The analysis revealed that across the two age groups, there was no significant difference in looking time at the correct motion test event (11-13 months: M = 17.85, SD = 10.39; 15-17 months: M = 11.71, SD = 8.71), $F(1,13) = 1.45$, $p = .25$. There was also no difference in looking times across the two age groups for the motion violation test event (11-13 months: M = 12.95 s, SD = 10.08 s; 15-17 months: M = 12.34 s, S = 5.63 s), $F(1,13) = 0.02$, $p = .89$. Thus, it can be concluded that infants' looking times to the two test events were not affected by age in the Inanimate Test Condition.

In a second set of analyses, I examined infants' looking behavior to the correct motion and motion violation test events in each age group, separately. To do this, I used a two-way repeated measures design analysis of variance (ANOVA) with test event (correct motion vs. motion violation) as the within-subjects factor and condition (Animate Test Condition vs. Inanimate Test Condition) as the between-subjects factor.

The first analysis of 11-13 month olds did not reveal a significant main effect of condition, $F(1, 12) = 3.77$, $p = .70$, but did reveal a marginally significant interaction between test event and condition, $F(1, 12) = 3.77$, $p = .076$. Since marginally significant results were found, further tests were conducted. Paired samples t-tests were conducted and revealed overall no significant effect for 11-13 month-old infants, $t(13) = -0.62$, $p = 0.27$. Because there were no overall significant effects, further investigation using paired samples t-tests were run with 11-13 month-olds in each condition, separately. It was revealed, as shown in Figure 4, that infants in the Animate Test Condition looked significantly longer at the motion violation test event that at the correct motion test event, $t(7) = -1.91$, $p = 0.05$. There was no significant effect for the Inanimate Test condition, $t(4) = 0.76$, $p = .24$.

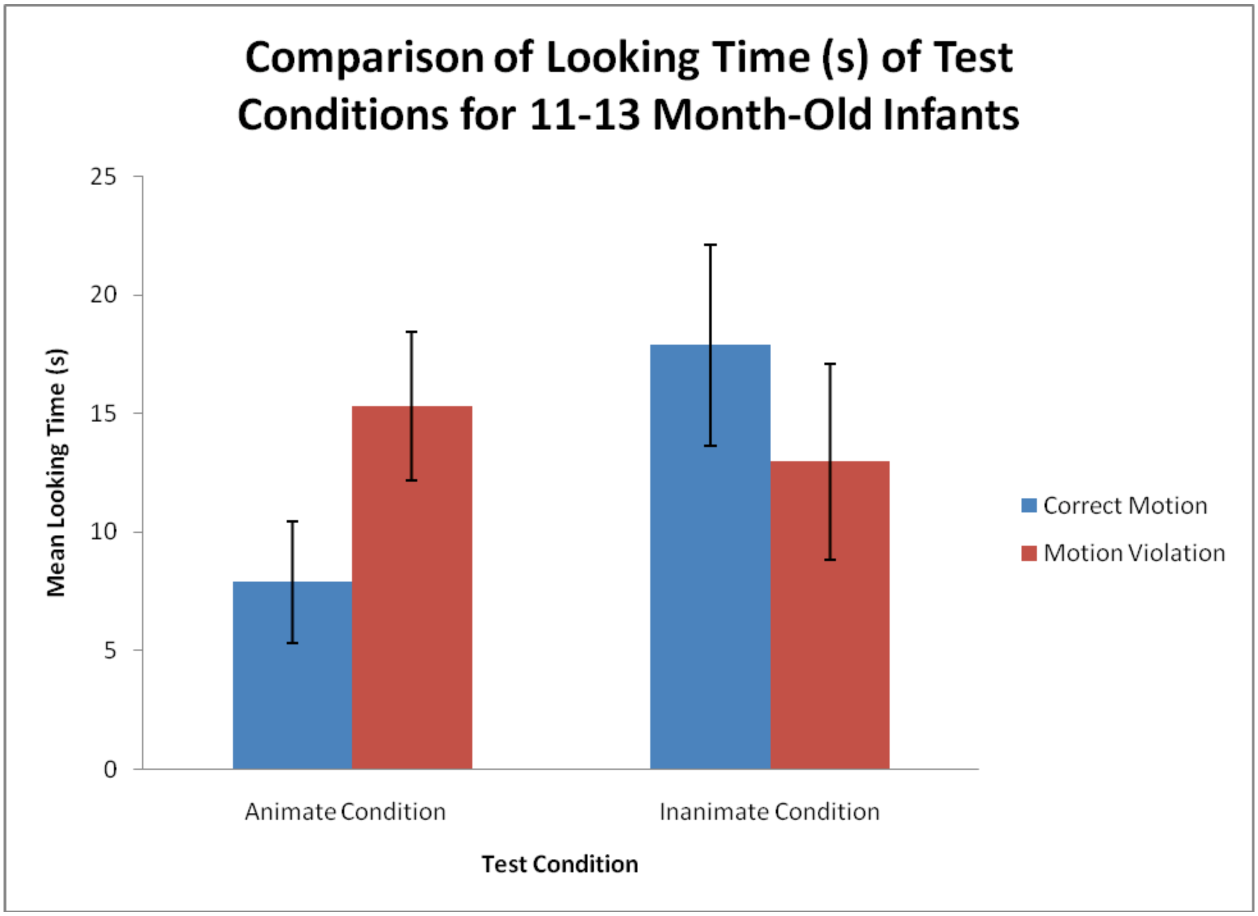

Figure 4. Mean looking times and standard errors (depicted by vertical lines) during the correct motion and motion violation test trials for 11-13-month-old infants.

Similarly, the first analysis of 15-17 month olds did not reveal a significant main effect of condition, $F(1, 14) = 1.04$, $p = .33$, and no significant interaction between test event and condition, $F(1, 14) = 0.47$, $p = .51$. Since no significant results were found, no further tests were conducted. The analysis of both age groups did not reveal a significant main effect of condition, $F(1, 28) = 1.00$, $p = .33$, however the interaction between test event and condition revealed to be approaching significance, $F(1, 28) = 3.96$, $p = .056$.

A second one-way repeated measures design analysis of variance (ANOVA) with Animate Test Condition test events (correct motion vs. motion violation) as the within-subjects factor for 11-13 month olds revealed a marginally significant main effect of condition, $F(1, 7) = 3.63$, $p = .099$. However, no significant results were found for 15-17 month olds in the Animate Test Condition. Interestingly, for both age groups in the Animate Test Condition, this analysis revealed a significant main effect for test events (Correct Motion: $M = 8.23$, $SD = 7.30$; Motion Violation: $M = 13.55$, $SD = 9.33$), $F(1, 15) = 5.06$, $p = .04$. These results revealed that infants in the Animate Test Condition looked longer at the motion violation test event than at the correct motion test event.

Finally, a third one-way repeated measures design analysis of variance (ANOVA) with Inanimate Test Condition test events (correct motion vs. motion violation) as the within-subjects factor for 11-13 month olds revealed no significant results. Similarly, no significant results were found for 15-17 month olds. Furthermore, no significant results were found for the analysis of both age groups in the Inanimate Test Condition.

According to these analyses no significant results were revealed for 15-17 month old infants. Thus, my prediction was incorrect for both Test Conditions and infants at this age look equally long at the test trials, as shown in Figure 5.

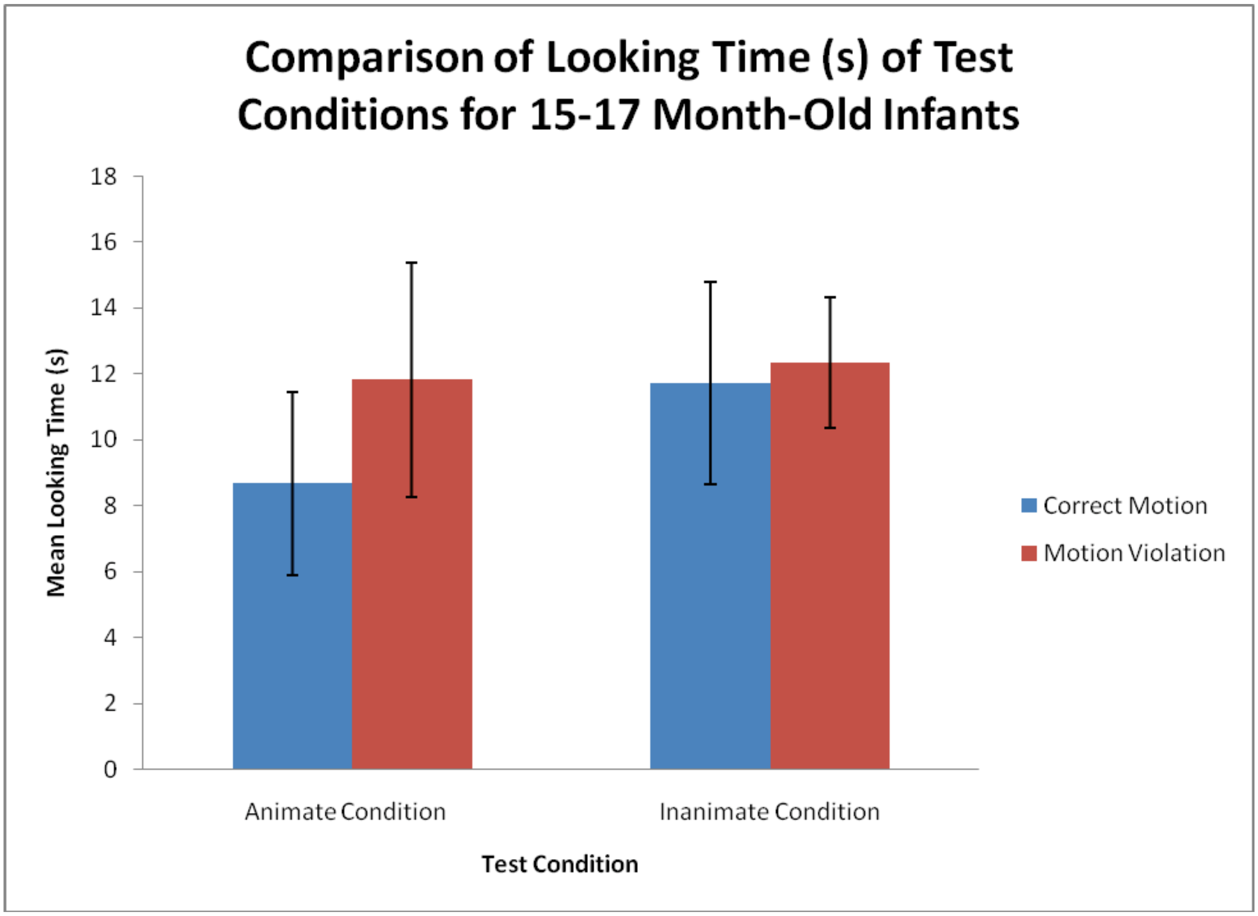

Figure 5. Mean looking times and standard errors (depicted by vertical lines) during the correct motion and motion violation test trials for 15-17-month-old infants.

However, further evidence from the analyses indicate that my prediction that infants will look longer at the motion violation test trial in the Animate Test Condition was supported by significant results of both age groups, as shown in Figure 6.

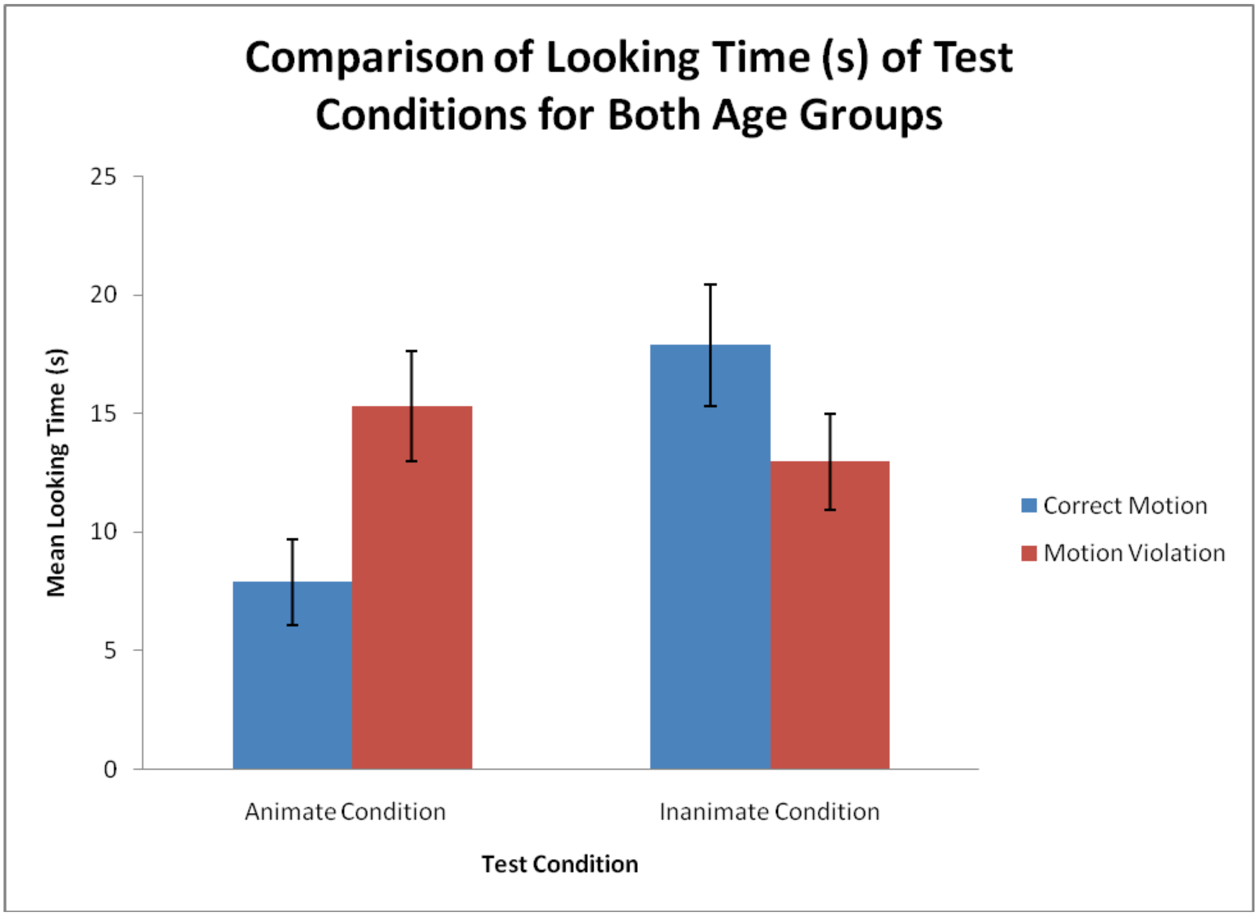

Figure 6. Mean looking times and standard errors (depicted by vertical lines) during the correct motion and motion violation test trials for both age groups.

General Discussion

The present experiment is the first of its kind to determine whether 11-13 month-old infants or 15-17 month-old infants offer vitalistic explanations for the motion categorization of animate and inanimate objects. The objective of this experiment was to test empirically whether young infants understand and use energy production in their categorization of animate and inanimate objects, particularly by motion. This was done by presenting infants with correct motion and motion violation test events of either animate bouncing events or inanimate bouncing events.

Infants at 11-13 months who were in the Animate Test Condition increased visual fixation, following a habituation paradigm with a direct launching causal event, to a test event in which the recipient ball followed an animate bouncing pathway (i.e., motion violation of the recipient object). However, infants 15-17 months-old did not increase visual fixation to either correct motion or motion violation event in the test phase.

In contrast, infants 11-13 months-old as well as 15-17 months old in the Inanimate Test Condition did not increase visual fixation to either correct motion or motion violation event in the test phase. There was also a marked difference in looking time for both age groups of infants in the Animate Test Condition: the visual fixation was significantly longer for the motion violation event relative to the correct motion event. In conjunction, these patterns of looking behavior during the test trials provide strong evidence that infants in the Animate Test Condition responded to the simple animated motion violation test event in terms of specific energy and motion attributed to agent (i.e., animate) objects. In fact, infants responded in a way that they are constrained to the pathway of motion for the appropriate category member (see Rakison, 2005). Infants in the Inanimate Test Condition, however, did not respond to the test events in terms of energy and motion differences of the agent and recipient objects.

Infants 11-13 months-old looked markedly longer at the motion violation in the Animate Test Condition, however, infants in the Inanimate Test Condition looked equally long at both test events. The specific pattern of motion infants in each condition saw correlated to either the object's ability to sustain energy, or an object's loss of energy over a brief time period. The fact that 11-13 month-old infants did not look longer at the motion violation in the Inanimate Test Condition (i.e., infants saw the agent object losing energy) reveals that infants perceive animate objects as unconstrained to particular pathways of motion. Thus, this pattern of motion by animate objects did not violate their expectation of an animate's pathway. These results are also seen among both age groups due to more power and less variance within the sample.

The obvious difference is seen with infants in the Animate Test Condition. These infants looked much longer at the motion violation (i.e., infants saw a recipient objects sustaining energy) reveals that infants perceive inanimate objects as constrained to particular pathways of motion. Thus, the ability for an inanimate object to sustain energy along it's pathway of motion, in fact, violates infants' expectation of inanimate objects. These results are also seen among both age groups due to more power and less variance within the sample.

The results of the present study have potential theoretical implications in regard to infants' development in the distinction and categorization of animate and inanimate objects, as assessed by the role of energy and motion. Rakison (2005) has proposed that infants' animate-inanimate distinction is based on the knowledge of causally relevant object parts in children as young as 18 months-old, whereas no empirical experiments have been conducted to investigate what infants know about 'vital forces.' The most relevant research on what children know about 'vital forces' was conducted with pre-school age children, not infants. Gelman (2003) has suggested that young children categorize group membership by distinguishing the nature of an object (i.e., living versus non-living).

The present experiment results reported are more consistent with the first of these views. In contrast to Gelman's claim, infants 15-17 months-of-age do not offer vitalistic inferences to distinguish member categorization. At the same time, these results suggest that infants at 11-13 months-of-age perceive the motion of an inanimate object as constrained to a specific pathway. Furthermore, infants 11-13 months-of-age do not constrain animate objects to specific pathways. These results may indicate the presence of vitalistic-like inferences specific to animate objects.

The present experiment reveals that infants do not necessarily attribute vitalistic qualities in their animate-inanimate distinction and categorization. However, this experiment does show that infants 11-13 months-old expect inanimate objects to be constrained to specific patterns of motion. This finding is the first to literature on the relationship between vitalistic inferences (e.g., Gelman, 2003; Gelman & Welman, 1991; Morris et al., 2000) and categorization of energy and motion in the animate-inanimate distinction (e.g., Gelman, 2003). The works have in common the notion that animate-inanimate categorization can only be understood completely by taking into account an object's pathway and the role of energy in an object's motion.

However, at this moment in time there is not enough empirical work or evidence to suggest that infants understand the source of causal energy for this relationship, and so it remains unidentified if infants offer viatlistic inferences for animate objects. Unfortunately, we cannot begin to truly understand the mechanism infants employ to learn this relationship. Further investigation on infants' understanding or ability to learn about vitalism is needed before it will be possible to verify how they learn about specific pathways and how they categorize group members. Further research could provide a more accurate depiction of how the ability to detect energy production and usage develops in infants, and whether this ability can be directly related to motor developmental stages. Because motor development has been shown to play a crucial role in how infants engage with and experience their environment, it is feasible to assume that it is also important in understanding and/or learning about 'vital forces.'

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