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HAI AND CHILD DEVELOPMENT

4

HOW VERY YOUNG CHILDREN THINK ABOUT ANIMALS

JUDY S. DeLOACHE, MEGAN BLOOM PICKARD,
AND VANESSA LoBUE

Throughout human history, people have lived in proximity to animals. For early humans and their primate ancestors, avoiding predation by animals, scavenging or hunting animals to eat, and recognizing conspecifics constituted crucial elements of survival. Those who were more successful at meeting these challenges enjoyed a survival advantage (Barton, Briggs, Eisen, Goldstein, & Patel, 2007; Hart & Sussman, 2005; Stiner, 1994).

Archaeological excavations of prehistoric settlements have unearthed a wealth of evidence of direct human–animal interaction (HAI) and of the importance of other animals to early humans and of direct HAI (Curtis, 2006). Depictions of animals abound in some of the earliest known art, from the famous Pleistocene paintings of horses and buffaloes on the walls of European caves to ancient aboriginal rock paintings of wallabies, turtles, and fish in Australia. Egyptian effigies of animal gods date as far back as 5500 BC.

Early people made tools and weapons from animal bones, dressed in animal skins, and adorned themselves with jewelry fashioned from animal bones

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and teeth. Eventually, some types of animals were drafted to play a variety of vital roles in early human societies—such as lookout, guard, beast of burden, mode of transportation, source of power—all of which they continue to fulfill in various parts of the world today.

In addition, and more to the point of this volume, some types of animals came to serve as human companions and targets of affection: Some animals became pets. Very early evidence of the existence of pets—and of their importance to their masters—comes from ancient Egypt, where various animals were often embalmed, put in sarcophagi, and entombed with their masters.

Today, 60% of American households have at least one pet in residence. There are even more—70%—in homes with children (Weise, 2007). Children pay attention to these animals, as shown by the fact that some of the most frequently occurring words in infants' early vocabularies are "cat," "dog," and the names of family pets (Nelson, 1973; Tardif et al., 2008). Many children develop extremely important relationships with their family pets.

This chapter examines how and why infants exhibit a greater attentional and emotional attraction toward animals than toward other types of stimuli and the implications of such early preferences. The chapter begins with an overview of biophilia theory and the animate-monitoring hypothesis. Next, it describes four experiments conducted regarding infants' visual attention to animals.

BIOPHILIA

Several decades ago, E. O. Wilson (1984) introduced the concept of "biophilia," proposing that a fundamental aspect of human nature is our innate affinity for life and lifelike processes. He proposed that humans possess an affinity for nature and life as a result of our evolutionary past—the landscapes we inhabited and the animals with which we shared them. Wilson's original contention was that biophilia encompasses not only positive affiliations that humans have with nature and animals, but also negative orientations, such as the common fear of snakes. The research that has been conducted in the biophilia tradition has focused primarily on the positive bonds humans have with animals, particularly the benefits from anima interaction.

Given the history of close interaction and mutual dependence of humans and other animals, might humans have an inherent affinity for animals? According to Wilson's (1984) concept of biophilia, the answer is yes. Wilson proposed that we have an evolved tendency to pay attention to animals, arguing that such an inclination would have had adaptive value in our evolutionary history. A high degree of attention to other species would have facilitated the rapid detection of dangerous predators, delicious prey, and conspecifics—all of which are important regarding survival and passing on one's genes.

Much of the research to date in the biophilia tradition has focused on the appeal and benefits of natural landscapes for adults. For example, simply looking through a window increases subjective well-being and productivity in the workplace (Kahn et al., 2007) and promotes healing in hospitalized patients (Ulrich, 1984). Adults report a strong preference for natural landscapes over built ones (Kaplan & Kaplan, 1989). Perhaps biophilia contributes to the frequency with which people build and rebuild beach-front residences, despite the high likelihood of further danger from hurricanes and flooding.

ANIMATE-MONITORING HYPOTHESIS

Recently, the animate-monitoring hypothesis was proposed by New, Cosmides, and Tooby (2007). Their claim is that an important aspect of the human visual attention system is an evolved tendency to monitor the environment for the presence and location of animals and other humans, two categories that have always constituted both opportunities and dangers with respect to our survival. Consequently, our attention is more readily recruited by other humans and animals than by inanimate entities.

In support of their hypothesis, New et al. (2007) reported a set of studies in which adults participated in a change–detection task. The participants were presented with a series of brief exposures of photographs of natural scenes. Their task was to respond as quickly as they could whenever they detected a change from one picture to the next. Some of the time, the pictures in a sequence were identical. Other times, there was some difference in the position of either an animal or an inanimate object.

The participants more rapidly and more reliably detected changes in the animal location than changes in the object location. For example, they were faster to detect when an elephant appeared in a new place than when a truck did. This result was interpreted by the authors as evidence for an evolved attentional priority for the detection of animate over inanimate stimuli.

In related research, LoBue and DeLoache (LoBue, 2010; LoBue & DeLoache, 2008, 2010) reported results for very young children that are consistent with the findings of New et al. (2007). LoBue and DeLoache established that preschool children detect the presence of snakes and spiders more rapidly than a variety of other stimuli. In these studies, 3-year-old children and their accompanying parents were shown a series of highly realistic color photographs, arranged in 3×3 matrices. The task is to find and touch as quickly as possible a single target stimulus among the other eight nontargets. For example, there may be one snake photo among eight frog photos. In a series of studies, 3-year-old children and adults reliably detected snakes more

rapidly than a variety of different distracters. These results offer evidence for a priority in the visual system for the detection of threat-relevant stimuli.

VISUAL ATTENTION TO ANIMALS IN INFANCY

Biological Motion Preference in Newborns

Recent evidence that humans are particularly attuned to animals right from the start comes from research conducted with newborns. Simion, Regolin, and Buff (2008) recently reported that newborns have a preference for looking at biological motion. In a series of studies, infants were shown pairs of point-light displays with both displays composed of the same number of lights. One display specified biological motion (a moving hen) and the other nonbiological (random) movement. The infants looked significantly longer at the biological than the random motion, suggesting that it was more coherent to them. (A preference for watching biological movement has also been documented in chickens.) Thus, enhanced attention to biological movement is common, both ontogenetically and phylogenetically.)

Early Attention to Animals

A primary question addressed in our research is whether infants have a preference for animals. We conducted two experiments to explore this idea. In Experiment 1, we tested whether infants in the first year of life would pay more attention to films of real animals than to films of inanimate objects. Using a standard visual attention protocol, we presented 16 infants of various ages (4–12 months) with 10 pairs of films. Each pair consisted of one film of animals and one of inanimate objects. From films of the infants' eye movements, we recorded how long they looked at the various stimuli. Figure 4.1 shows an infant participating in the research.

Fig. 1

All of the highly realistic films depicted one or more animals or objects moving in a natural landscape. For example, the scenes of animals included an elephant walking down a slope, a dolphin swimming through water, and a bird flying. The inanimate object films included automobile traffic on a highway, a sailboat, and a helicopter landing on a building. Because the infants had had little or no exposure to most of the types of animals and objects that appeared in the films, any preference they expressed could not be based on experience. Figure 4.2 shows the average looking times for the animal and object stimuli.

Fig. 2

The results were straightforward and quite dramatic: The infants responded substantially more to the animate than to the inanimate stimuli,

Figure 4.1. This 9-month-old is pointing and making excited sounds to the animal that she sees on the screen, ignoring the inanimate object beside it. (Her mother wears a blindfold to ensure that she does not influence her childís behavior.)
Wilson, E. O. (1984). *Biophilia.* Cambridge, MA: Harvard University Press.

both in terms of visual attention and affective behavior. As Figure 4.2 shows, the infants in both age groups looked substantially and significantly longer at the animals than at the inanimate stimuli. Strikingly, not a single infant preferred objects over animals; all but two showed the pattern of looking longer at the animals.

Such a high degree of similarity in the pattern of responses for an entire group of infants is extremely rare, especially for a group comprising such a range of ages. (Most studies with infants involve tightly constrained age groups.) Further evidence of the strength of the difference in responding to animate and inanimate stimuli is the fact that there were no individual differences as a function of either gender or prior experience with animals. The strong preference for animals is also evident in the infants' responses to the 20 individual stimuli. Of the 12 pictures that they looked at longest, 9 were of animals. (Interestingly, the other three—pinwheel, windmill, and lawn ornament—all involved spinning parts.)

Not only did the infants look at the animals more, but they also directed significantly more emotional responses—all positive—toward the animals

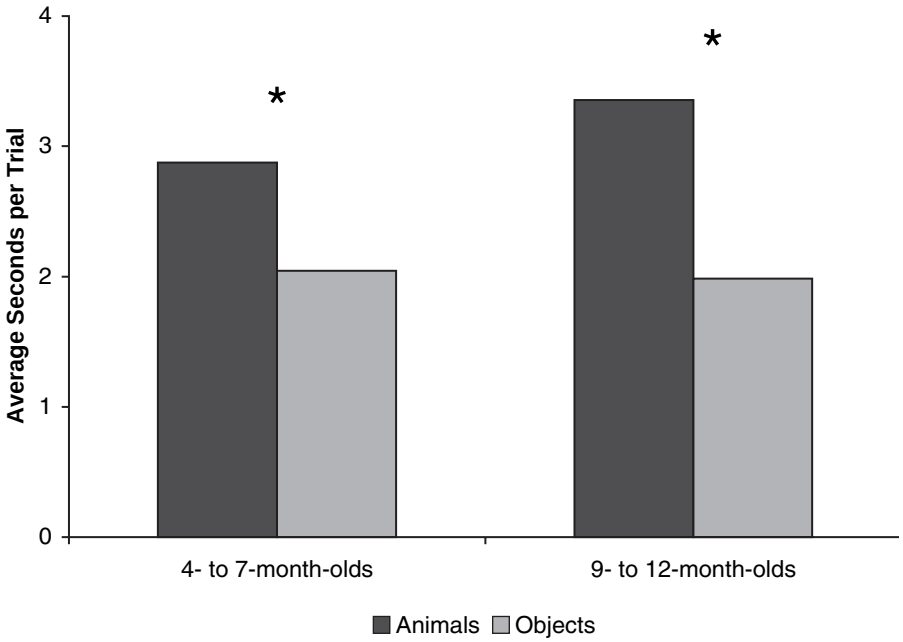

Figure 4.2. Looking times by the two age groups to the animate and inanimate stimuli.

than the objects. They frequently smiled, laughed, and waved at the animals, and one child even blew kisses at some of them. The infants virtually never directed any of these affective behaviors toward the inanimate objects. The results of this study thus document for the first time not only that humans have a preference for animate stimuli from early in life but also that the preference is remarkably robust.

In Experiment 2, we probed the basis for this strong preference for attending to animals. Specifically, we asked whether infants are attracted to animals per se or primarily to animate movement. It seemed reasonable that the basis for the early animal preference we observed could be distinctive differences in how animals and inanimate objects move. If so, the preference for viewing animate entities over inanimate ones should disappear if the stimuli were stationary.

To answer this question, we presented 10 pairs of still color photographs of animals and objects to a new group of infants ages 4 to 12 months. Each photograph depicted a single focal animal or inanimate object set against a white background. (A preliminary study, in which we presented infants with still photos taken from the films used in the earlier research suggested that the stationary animals and objects against the complex natural backgrounds were not readily discernible to them.)

Just as in Experiment 1, the infants in Experiment 2 looked significantly longer at the animals than at the inanimate objects. This difference was particularly strong among the older infants, all but one of whom paid greater attention to the animals.

Thus, the results of these two studies provide strong evidence for the existence of a preference for animate over inanimate stimuli that is evident in the first year of human life. Infants respond more, both in terms of visual attention and emotional engagement, to a range of nonhuman animals than to various inanimate entities. Although this preference is stronger when animate movement is involved, it is also present in response to stationary stimuli.

Attention to Biological Motion

For Experiment 3, we investigated whether infants' animal preference holds when only dynamic information is available to specify animals and objects. Specifically, we used point-light displays—schematic representations of motion made up of moving dots of light[1]—to determine the extent to which entities are recognizable solely by their patterns of movement. Ftn. 1

Adults are highly skilled at recognizing the content of point-light displays of humans, accurately identifying type of movement (Walk & Homan, 1984), emotional state (Atkinson, Dittrich, & Gemmell, 2004), gender, age, and even the identity of individuals (Cutting & Kozlowski, 1977; Troje, Westhoff, & Lavriv, 2005). Evidence that these displays are perceived holistically—as coherent biological motion—comes from the fact that inversion disrupts identification. If a point-light display of a person walking that is readily recognizable when shown upright is presented upside-down, adults no longer perceive human movement.

Infants also perceive coherent movement in point-light displays of human walking. This conclusion is supported by the fact that inversion destroys the illusion of coherent locomotion for infants just as it does for adults. Several species of nonhuman animals, including cats (Blake, 1993), pigeons (Dittrich, Lea, Barrett, & Gurr, 1998), dolphins (Herman, Morrel-Samuels, & Pack, 1990), and even visually inexperienced 1-day-old chicks (Vallortigara, Regolin, & Marconata, 2005) perceive biological motion from point-light displays and are subject to inversion effects just as are humans.

To date, there has been little research exploring humans' reactions to point-light displays depicting nonhuman animals or inanimate objects. Recent

[1]Point-light displays of human movement are typically created by attaching lights to the joints of a person and then filming in complete darkness as the person moves. Point-light displays can also be made from digital videos: In each frame of the film, lights are digitally applied to the joints of the target stimulus. When the background in the film is eliminated, the resulting image is a standard point-light display.

evidence suggests that adults, young children, and even infants discriminate between upright point-light films of animals and inanimate objects such as vehicles. However, it is quite difficult for infants or even adults to identify the particular exemplar of a category (for example, dog vs. cow or car vs. truck) being depicted in the point-light display (Arterberry & Bornstein, 2001; Pavlova, Krageloh-Mann, Sokolov, & Birbaumer, 2001).

Some evidence from research using point-light stimuli suggests that infants prefer biological motion per se to other patterns of motion. For example, when presented with upright and inverted human point-light walkers, infants looked longer at the coherent upright human movement (Fox & McDaniel, 1982). As mentioned, even newborns visually prefer point-light displays specifying biological motion (a moving hen) over nonbiological motion (inverted hen or random movement; Simion et al., 2008).

For Experiment 3, we constructed and presented point-light displays of various moving animals and objects. Eliminating all other cues makes it possible to assess the extent to which movement alone affects behavior. The animal point-light displays each consisted of pairs of point-light representations of numerous different animals walking.

The 16 infants participated in two within-subjects conditions. In the first, they saw a pair of upright displays, one of an animal(s) and the other of an inanimate object(s). Assuming that the infants would perceive biological movement in the displays, the prediction was that the infants would look longer at the animals than the objects, as in the earlier studies with realistic films. That is just what they did, suggesting that they perceived animate movement in these abstract displays. In a second condition, the pairs of point-light stimuli were inverted. Because adults and infants alike generally fail to recognize the content of inverted point-light displays (Bertenthal, Proffitt, & Cutting, 1984; Bertenthal, Proffitt, & Kramer, 1987), we expected that the infants would show no preference in this condition. As predicted, the infants looked equally long at the two types of upside-down stimuli.

Attention to 'Super' Stimuli

In a further effort to identify what types of information contribute to infants' perception of and preference for animals, we have recently used commercially produced animated cartoons. Animations can give the illusion of life to normally inanimate objects, as exemplified by highly popular movies such as *Beauty and the Beast* and *Cars* (Wargo, 2005). In cartoons, inanimate objects can have features that mimic animates, and they can display biological motion, as well as intentional action and emotion. They also can illustrate any of these characteristics either one at a time or in combination. As a result, any given feature or element can be manipulated independent of the

others. By exaggerating particular animate features in isolation, we should be able to get a better idea of which ones are most effective for specifying animals and eliciting the attention of an infant.

In Experiment 4—the first of what will probably become a long series of studies—we showed infants (ages 4–12 months) cartoons of animals, cartoons of inanimate objects, and cartoons in which animate features were applied to inanimate objects. One example of the last category is a car that behaved as if it were a wild animal, using its tires as paws, displaying a ferocious facial expression on its grill, producing screeching calls with its front bumper, and so on. This stimulus was a particular favorite. An interesting result that emerged from this preliminary study was that the infants' highest level of preference was for "super stimuli"—cartoons that imposed greatly exaggerated features and movement patterns onto inanimate objects. (This approach may prove useful in investigating various different topics.)

As predicted, there was an overall preference for animals, with infants looking longer at both cartoon animals and animated objects than at inanimate objects. A particularly interesting result was that, overall, the infants looked longer at the animated animals than at the real animals. This result indicates that animate features, such as having a face and moving in an animate manner, are sufficient to elicit a preference in infants, regardless of the specific identity of the entity in question.

GENERAL DISCUSSION

The goal of the experiments described here was to explore the nature of humans' attention to animals. Of specific interest was the extent to which infants' attention is recruited by animals over inanimate stimuli. In two preliminary experiments, this question was examined by presenting infants with pairs of images of animals and objects, and visual attention was assessed. Experiment 1 established that infants strongly prefer moving animals to moving objects. In Experiment 2, in which infants were shown still photographs, older infants showed a strong preference for animals over objects. Overall, the results of the preliminary studies showed that infants prefer animals to objects on the basis of both static and dynamic features. However, the strongest preference was toward moving animals.

Two subsequent experiments further explored the nature of infants' attention to animate movement. In Experiment 3, girls but not boys preferred biological motion (depicted in point-light displays) to the motion of inanimate objects. This result suggests that, at least for girls, animate movement, apart from all other cues to identity, is sufficient to elicit an animal preference. In Experiment 4, infants overall preferred cartoons of both animals and

animated objects (objects made to move and behave like animals) to cartoons of objects moving as they normally would. This result suggests that features of animals, such as having a face and moving like an animal, are sufficient to elicit an animal preference in infants, regardless of the identity of the object in question.

Overall, the results of the four studies described here suggest that in the first year of life infants possess a preference for animate over inanimate stimuli in numerous different forms. This research supports an intrinsic tendency for humans to orient preferentially toward animals. This basic result is consistent with the recently published animate-monitoring hypothesis, that humans have an evolved tendency to preferentially allocate attention to animals (New et al., 2007). In addition, it is consistent with the life-detector hypothesis, the idea that the human visual system readily detects and recognizes patterns of biological motion (Johnson, 2006; Simion et al., 2008). Such tendencies would have likely had adaptive value during mammalian evolution, as a high degree of attention to other animals would have facilitated survival through the rapid detection and identification of predator, prey, and conspecifics.

The results of this research have also established that particular animal features draw infants' attention. First, infants prefer animals to objects on the basis of both dynamic (as demonstrated in Experiments 1, 3, and 4) and static (as demonstrated in Experiment 2) features, even when the entity being depicted with those features is not actually an animal but rather an object made to look like an animal (as in Experiment 4).

Future work is needed to determine to a higher level of precision which dynamic and static elements of animals draw infants' attention. For example, static features of animals include (but are not limited to) facial features, eyes, legs, tails, and a particular body shape (e.g., animal bodies never possess right angles or perfectly straight lines). We know infants discriminate animals from objects on the basis of these features (e.g., Jones, Smith, & Landau, 1991; Rakison & Butterworth, 1998; Rakison & Poulin-Dubois, 2001) and, in the case of faces, actually show a preference (Cassia, Turati, & Simion, 2004; Fantz, 1961). However, more work is needed to determine precisely which of these features attracts infants' attention and to what extent.

In terms of dynamic features of animals, the results of the research described here suggest that the pattern of animal movement (as depicted in point-light displays) is sufficient to elicit an animal preference in infants, at least for girls. However, there are numerous other dynamic elements of living creatures that infants recognize as distinctly animate, such as patterns of movement with smooth trajectories (Arterberry & Bornstein, 2001; Bertenthal, 1993; Fox & McDaniel, 1982), self-initiation (Spelke, Phillips, & Woodward, 1995), and apparent agency and intentionality (Gergely, Nadasdy, Csibra, &

Bíró, 1995; Johnson, 2003; Poulin-Dubois & Shultz, 1990; Rakison & Poulin-Dubois, 2001). Although quite a bit is known of infants' developing understanding of these concepts, future work is needed to examine which of these features of animals actually draw infants' attention. Do dynamic patterns that encompass these features draw attention to a greater extent than other types of movement?

One striking element of the studies described here is that experience with animals seems to have no effect on whether infants express an animal preference. In combination with the fact that the observed patterns of preference were relatively consistent across children, this suggests that the results of these studies reflect an intrinsic, low-level attentional bias that is immune to effects of experience (at least beyond the normative changes related to age). There are reasons to suspect that experience with animals might have had an effect on infants' preference for animals. The most likely reason is that infants with more experience with animals might find animals to be generally more familiar and thus might attend to them to a greater extent than do infants with less experience with animals. Alternatively, infants with a high degree of experience with animals might have found the novelty of the inanimate objects to be highly appealing and thus show the opposite pattern of results, a preference for inanimate objects. However, both of these cases can be ruled out because no effects of experience on patterns of preference were observed.

It is possible that the measure of experience with animals employed in these studies was not precise enough to detect subtle effects of experience. One possible reason is that the questions asked were not specific. A second possibility is that the population tested was too homogenous in terms of individuals' experiences with animals to detect any effects of experience. Testing populations with extreme degrees of animal experience, such as urban versus rural children, might yield a more heterogeneous sample, and more subtle effects of experience may thus be observable.

The question remains whether particular types of animals may draw attention more than others. There is some evidence that particular types of animals elicit specific types of responses. For example, snakes and spiders, two animals that have posed a significant threat throughout evolution, are detected more quickly than other nonthreatening entities by both adult and infant humans (DeLoache & LoBue, 2009; LoBue, 2008; LoBue & DeLoache, 2008; Ohman, Flykt, & Esteves, 2001; Ohman, Lundqvist, & Esteves, 2001) and by nonhuman primates (Shibasaki & Nobuyuki, 2008). The ability to respond quickly and efficiently to threat is highly adaptive and serves as an important survival mechanism for humans and other animals (Ohman, 1993; Ohman, Lundqvist, & Esteves, 2001). Still unresolved is the extent to which particular animals attract infants' attention over other types of animals. For example, would

infants attend differentially to animals that have posed a significant threat throughout evolution versus nonthreatening animals, humans versus nonhuman animals, prototypical versus nontypical or unusual animals, or specific classes of animals, such as mammals versus birds versus fish versus reptiles.

A related question is whether humans' attention to different types of animals changes with age. According to one theory, for example, a wariness of large mammals is likely to emerge in toddlerhood, at the point in development when children begin to explore their surroundings somewhat independently, often a distance from the safety and protection of parents or other adults (Heerwagen & Orians, 2001). A question for future research is whether children's attention to particular types of animals changes over the course of development as a result of these types of developmental changes.

Finally, the question remains, how does an intrinsic attentional bias toward animals benefit humans? One possibility, according to the animate-monitoring hypothesis, is that humans are quicker and more accurate to allocate attention to animals, thus facilitating survival through the rapid detection and identification of predator, prey, and conspecifics. Evidence for such a tendency comes from the fact that adults are quicker and more accurate in identifying changes to an animal in a scene than in an object (New et al., 2007). Does a similar monitoring bias exist in infants? Future work will examine this question.

A second possibility is that an attentional bias toward animals in infancy scaffolds conceptual development. If attention is drawn so strongly to animals over other elements of the environment, what is the impact on early learning? Might a high degree of attention to animals facilitate learning in this domain, drawing infants' attention early on to the structure and function of animals over other sorts of stimuli. Finally, perhaps the preference for animals observed in these studies among infants represents an early manifestation of biophilia, an interest and affiliation with life. Thus, future research will explore the extent to which an emotional tie to animals develops in children.

Overall, the research described here provides the first comprehensive evidence of an intrinsic attentional bias that leads even infants to preferentially attend to animate stimuli. Future work will continue to explore the nature of this bias and how it changes throughout development.

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