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The Influence of Pets on Infants' Processing of Cat and Dog Images

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Abstract

We examined how experience at home with pets is related to infants' processing of animal stimuli in a standard laboratory procedure. We presented 6-month-old infants with photographs of cats or dogs and found that infants with pets at home (N = 40) responded differently to the pictures than infants without pets (N = 40). These results suggest that infants' experience in one context (at home) contributes to their processing of similar stimuli in a different context (the lab), and have implications for how infants' early experience shapes basic cognitive processing.

Despite the fact that experience is a factor in every theory of development, only recently have developmental psychologists set out to empirically understand *how* experience shapes development and to specify how infants' responding in the lab reflects early experiences. For example, work has examined how experience with certain types of faces (e.g. Caucasian faces, female faces) influences infants' preferences for and processing of particular types of faces (Bar-Haim, Ziv, Lamy, & Hodes, 2006; Quinn, Yahr, Kuhn, Slater, & Pascalils, 2002). It is not surprising that given the vast experience infants have with their caregiver that the gender and race of that caregiver would have a profound effect on their face processing (see Ramsey-Rennels & Langlois, 2006, for a discussion). Here we extended this previous work and examined how frequent exposure to and experience with a pet is related to infants' looking behavior toward images of animals in the lab.

Experience with pets may be an especially important aspect of infants' experience on development. About 50% of North American families have pets at home (Melson, 2003), and therefore it is a dimension of difference in experience. Thus, not only is it relatively easy to compare infants with and without pets, this is a real difference in experience among infants in North American homes. Any differences we observe in the lab as a function of pet experience therefore reflects actual differences in the experience during the daily lives of infants.

Experience and relationships with companion animals can have a profound effect on psychological functioning in older children and adults. For example, across the lifespan,

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relationships with animals have benefits for self-concept and self-esteem (Melson, Peet & Sparks, 1992; Poresky, 1997; Van Houtee & Jarvis, 2002), empathy (Vizek-Vidović Lidija, Kerestes, Kuterovac-Jagodic, & Vlahovic-Stetic, 2001), and dealing with loneliness and bereavement (Sable, 1995). School-aged children report that their pets are among their closest companions and that they receive comfort and support from them (McNicholas & Collis, 2000; see also Myers, 1998). Moreover, mere exposure to animals may influence psychological functioning. One study revealed that preschoolers were more compliant on a modeling task in the presence of a dog (Gee, Sherlock, Bennett, & Harris, 2009).

Less is known about how pet exposure contributes to cognitive development. In general, content knowledge does impact cognitive development (Chi & Ceci, 1987). Experience with animals in particular does translate to deeper understanding of animals in school-aged children. Children who have pets demonstrate more sophisticated knowledge about and conceptions of similar animals (Prokop, Prokop, & Tunnicliffe, 2008). Hatano and Inagaki (1993) found that young children who had raised goldfish showed more advanced reasoning about other animals than did children who had not raised goldfish. Therefore, experience with pets may contribute to emerging conceptions of animals even in infancy.

Here we ask how infants' pet experience contributes to visual behavior in the lab when presented with images of cats and dogs. We modeled this work after studies revealing differences in infants' visual behavior toward images of faces as a function of their experience with particular types of faces. For example, Quinn et al. (2002) found that 3- to 4-month-old infants with female caregivers both prefer and better remember female faces than male faces, while infants with male caregivers apparently prefer the more familiar male faces. Similarly, by 3 months infants prefer (i.e., look longer at) faces from their own race (Bar-Haim et al., 2006), and by 9 months demonstrate better discrimination of faces matching their own race compared to faces of a different race (Kelly, Quinn, Slater, Lee, Ge, Pascalis, 2007). One explanation for such findings is that experience with particular types of faces contributes to a developmental process of perceptual narrowing, similar to the development of phoneme discrimination in the domain of language development (Nelson, 2001). Support for this perspective comes from cross-species discrimination tasks in which 6-month-olds, but not 9-month-olds, can discriminate individual monkey faces (Pascalis, de Haan & Nelson, 2002). Importantly, experience with monkey faces can extend infants' ability to discriminate individuals (Pascalis, et al., 2005; Scott & Monesson, 2009).

Kovack-Lesh, Horst, and Oakes (2008) recently reported results suggesting that daily experience with a pet similarly influences infants' processing of images of animals. Specifically, Kovack-Lesh et al. found that 4-month-old infants with and without pet experience remembered and categorized images of cats differently (see also Kovack-Lesh et al, 2010). In the present experiment, we extend this previous finding by comparing how 6-month-old infants who do and do not have dogs or cats at home look at images of dogs or cats. The results reported by Quinn et al. (2002) described earlier would predict that infants prefer—or look longer—at images of cats and dogs if they have pets at home than if they do not. This extension is important because although Kovack-Lesh et al. (2008) examined the effect of pets on infants' categorization and memory formation, the current methods allow us to examine the effect of experience during active processing of animal images.

It its worth noting that previous studies have not revealed strong relations between experience and behavior such as overall looking duration or decreases in looking across trials (Kovack-Lesh et al., 2008; Kovack-Lesh et al., 2010; Kelly et al., 2007; Quinn et al., 2002). But, these studies did not have as a primary goal to understand how infants' experience may have contributed to visual behaviors as they inspect and learn about images. Thus, the measures used and the analytic strategies adopted in previous studies may have masked subtle influences of experience on infants' responding. Therefore, here we more extensively examined, with more and more subtle measures, infants' visual behavior during a series of trials with images of cats or dogs to establish how infants' experience over a long timescale (i.e., their experiences during extensive casual exposure to a pet at home) contributes to behavior during such trials.

We presented 6-month-old infants with and without pets a series of pictures of cats or dogs and measured their looking behavior. We measured several aspects of infants' looking: duration of looking on each trial, number of looks on each trial, number of glances between the two images presented on each trial (or *switches*), duration of individual looks, and duration of looking between switches. Each of these measures is thought to reflect some aspect of infants' processing of visual stimuli. For example, infants look longer when shown stimuli that present more information to process than when shown stimuli that present less information to process (Cohen, 1998). The number of individual looks has been argued to be related to infants' control of attention—infants who can sustain attention to a stimulus longer will have fewer, longer looks (Jankowski, Rose, & Feldman, 2001). The number of switches between two simultaneously presented stimuli is thought to reflect the level of infants' comparison of the two stimuli (Ruff, 1975; Rose, Feldman, & Jankowski, 2003).

We predicted that infants who have pets at home would exhibit different patterns of looking than would infants who do not have pets at home. For example, based on findings that infants look longer at more familiar stimuli, such as faces that are the same gender or race as their caregivers compared to faces of different genders or races (Bar-Haim et al., 2006), we predicted that infants with pets would look longer at images of cats and dogs than infants without pets. We did not have specific predictions about the other measures. On the one hand, infants may be able to sustain their attention better to more familiar images, being less distracted by the presence of another image. In this case, we may observe that infants with pets had fewer looks than infants without pets. On the other hand, infants may be able to compare images presented side-by-side more effectively when they have more knowledge related to those images. In this case, infants with pets may have more looks and more switches than would infants without pets.

We also did not know *a priori* whether such effects would have the same level of specificity as the effect of experience with human faces on infants' looking—that is, we did not have *a priori* expectations about whether infants with cats would look longer at images of cats than at images of dogs or infants with dogs would look longer at images of dogs than at images of cats. Although older children and adults report that they have close relationships with pets that are an important part of their life (Melson, 2003), it is likely that on average infants' relationships and interactions with their household pets are qualitatively different than their relationships and interactions with the people in their lives. Thus, it would not be surprising if the effects of experience with a cat or dog had a less specific influence on infants' looking behavior than their experience with a caregiver of a particular race or gender.

We tested 6-month-old infants to determine whether the effects reported for younger infants in previous studies are evident at a slightly older age. In addition, we manipulated whether infants received the items as pairs of different items (e.g., two different cats on each trial) or pairs of identical items (e.g., two identical images presented on each trial) to determine whether infants' previous experience interacts with how the stimuli are presented.

Method

Participants

The final sample was 80 healthy, full-term 6-month-old infants (*M* = 198.56 days, *SD* = 7.29 days; 42 girls and 38 boys) with no history of vision problems, recruited using standard procedures (see Kovack-Lesh & Oakes, 2007). Additional infants were excluded from the analyses due to fussiness (*n* = 7), lack of interest (*n* = 1), side bias (*n* = 1), experimenter error (*n* = 1), or maternal interference (*n* = 2). Seventy-five infants were White; 5 were multiracial. All mothers had graduated high school; 54 had earned at least a bachelor's degree.

Forty infants who were reported by parents to live with at least one indoor dog or cat or to have extensive experience elsewhere with an indoor dog or cat (i.e., at daycare) were assigned to the *Pet Group* (*M* = 198.12 days, *SD* = 7.89, 22 boys); the remaining 40 infants were assigned to the *No Pet Group* (*M* = 199.03 days, *SD* = 6.67, 16 boys). In the pet group, 19 infants had only cats, 10 had only dogs, and 11 had both dogs and cats.

Stimuli

Stimuli were digitized photographs of 18 dogs and 18 cats, approximately 19.0 cm × 14.5 cm (subtending approximately 27° × 21° visual angle at 40 cm viewing distance), and were of different breeds, markings, and coloring. The animals were standing (7 dogs and 8 cats), sitting (5 dogs and 4 cats), or lying down (6 dogs and 6 cats) (see Figure 1). Two dogs and 2 cats were shown in profile with only partial faces visible; all other animals had fully visible faces.

Apparatus and Procedure

Infants were seated on their parents' laps 40 cm from two 17'' (43.2 cm) View Sonic monitors (center-to-center distance 52 cm). Parents wore occluding glasses. Infants were separated from the observer and computer equipment by black curtain that had openings for the monitors, a small black box located between the two monitors that had a blinking LED light and emitted beeping sound (at a rate of 3 Hz), and a small low light TV camera positioned below the blinking light. A trained observer, unaware of the experimental condition, particular stimuli being presented, or infant's pet status, sat behind the curtain and recorded looking using a Macintosh G4 computer and software developed for this purpose (Cohen, Atkinson, & Chaput, 2000) and watching the infants on a TV monitor connected to the camera.

Each of 6 15-s trials began with the blinking, beeping light. When the infant looked at this stimulus, the observer pressed a computer key that simultaneously ended the light and presented one stimulus on each monitor. Infants were free to look at the stimuli as long they wished (if no looking was recorded in the first 5 s, the trial was stopped and repeated). The observer recorded look durations by pressing one computer key when the infant looked to the left monitor and another when the infant looked to the right monitor. Three measures were recorded on each trial: 1) the *duration of looking* (total duration each key was pressed) to the left and right, 2) the *number of looks* (the number of individual key presses, regardless of whether they were to the left or right), and 3) the number of *switches* (the number of times fixation was shifted from the left monitor to the right monitor, even if it was separated by a look away, Kovack-Lesh et al., 2008). A second observer coded the looking behavior from the videotaped sessions of 19 infants. Reliability between the original on-line and the off-line coding was good. The average correlation between the two observers for how long infants looked on each trial was *r* = .97, with an average difference of the duration of looking on each trial of .42 s; agreement for the number of looks on each trial was 91.75% and for the number of switches on each trial was 94.07%.

Over the course of the 6 trials, each infant saw 6 different cats or 6 different dogs. Forty infants were tested in the *Identical Pairs* condition (20 saw cats), in which the same image was projected on both computer screens on each trial (each individual item was presented on exactly one trial), and 40 infants were tested in the *Different Pairs* condition (18 saw cats), in which different images were projected on each computer screen on each trial (20 infants with and without pets were tested in each condition). In the Different Pairs condition, each individual item was presented once in trials 1–3 and once in trials 4–6, once on the right and once on the left, never on two consecutive trials, paired with a different item each time. Importantly, the two conditions were equated for overall amount of exposure to each individual image, and the numbers of trials and different images presented.

Results

Mean values for infants' look duration, number of looks, and number of switches (averaged across the 6 trials) are presented in the top portion of Figure 2. It is immediately clear that infants with pets had higher values on each of the behaviors we measured. Each measure is thought to reflect a different aspect of infants' preferences and processing. *Look duration* is commonly assumed to reflect infants' *preferences* for some stimuli over others (Barrera & Maurer, 1981). However, in this case, infants were not given a preference task (i.e., we did not measure whether infants looked longer at some stimuli than at others). Instead, in our case, looking time reflects a difference in how compelling the stimuli were to infants with pets as compared to infants who do not have pets. This difference in looking may reflect differences in processing (e.g., infants with pets may be attending to and learning more subtle features of the images of cats and dogs) or in affective responses (e.g., infants with pets look longer because they have more positive affect when looking at images of cats and dogs). *Number of looks* can be construed as a measure of control of attention; infants who exhibit fewer looks presumably are better able to maintain their looking to a target than are infants who exhibit more looks, particularly if the individual looks differ in duration (Jankowski, et al., 2001). Thus, infants with pets were slightly better able to maintain their attention to images of cats and dogs than were infants without pets. *Number of switches* is thought to reflect infants' comparison of the pair of stimuli (Ruff, 1975). Infants who engage in more switches are looking back-and-forth between the two available stimuli more than are infants who engage in fewer switches. Infants with pets, apparently, compared the two available images more than did infants without pets.

The impressions that infants with pets had longer looking and more switches were confirmed with separate mixed-model Analyses of Variance (ANOVAs) conducted on each measure, with pet experience (pet versus no pet), condition (identical versus different pairs) and stimulus category (dogs versus cats) as the between-subjects factors and trial (1 through 6) as the within-subject factor. Somewhat unexpectedly, none of the analyses revealed significant effects of or interactions with condition. That is, none of these measures varied as a function of whether or not on each trial infants saw two identical items or two different items. This finding was unexpected because at 4 months infants show more sophisticated responding when presented with pairs of items of dogs and cats than when they are presented with dogs and cats one at a time (Oakes & Ribar, 2005). However, Oakes and Ribar observed that 6-month-old infants processed images of cats and dogs in a sophisticated way when the images were presented one at a time. Thus, the developmental differences observed by Oakes and Ribar between 4 and 6 months may have contributed to the lack of an effect of the format of the stimulus presentation on the responding of the 6-month-old infants tested here. We will return to this issue in the Discussion.

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These analyses did confirm our impressions of differences in infants' looking behavior as a function of pet experience. Significant main effects of pet experience were revealed both in the ANOVA on *look duration*, F (1, 72) = 7.20, p = .05, ηp^2 = .09, and in the ANOVA on the *number of switches*, F (1, 72) = 4.70, p = .05, ηp^2 = .06. The first effect is due to infants with pets looking longer, averaged across the 6 trials (M = 8.68 s, SD = 2.22), than did infants without pets (M = 7.35 s SD = 2.20). This finding is consistent with other findings that infants are more interested in stimuli relevant to their past experience (Kelly et al., 2007; Quinn, et al., 2002), and shows that this difference is evident even when comparing infants with and without a particular experience (in this case pets at home) on their looking at stimuli relevant to that experience. The second effect was due to infants with pets on average switching their glance between the two simultaneously presented images (M = 3.72, SD = 1.47) more than did infants who did not have pets (M = 3.00, SD = 1.46). Infants who had more extensive pet experience compared the images of cats and dogs more than did infants with little or no pet experience. The ANOVA on the *number of looks* did not reveal a significant effect of pet experience, F (1, 72) = 2.94, p = .09, ηp^2 = .04; although infants with pets had slightly more looks during each trial on average (M = 5.73, SD = 1.68) than did infants without pets (M = 5.08, SD = 1.73), this difference was not significant. Note that these analyses show differences between infants' with and without pets looking at images of dogs or cats. Although this study was not a traditional preference study (i.e., in which infants are given two types of stimuli and they look longer at stimuli that are closer to their past experience), these effects do tell us that infants with pets approach images of cats and dogs differently than do infants who do not have pets. We will return to this issue of how infants are processing such images as a function of their previous experience in the Discussion.

The analyses also revealed that infants' looking behavior changed over trials. The mean for each measure on each trial is presented in Table 1, and it can be seen that both the number of switches and the number of looks decreased over trials, but the duration of looking did not change systematically across the session. Indeed, the main effect of Trial was significant in both the analysis of the number of switches per trial, F (1, 72) = 9.66, p = 05, ηp^2 = .11, and the number of looks per trial, F (5, 72) = 8.86, p = .05, ηp^2 = .10. To further understand these main effects, we compared the number of switches or looks on each trial using two-tailed t-tests (to reduce the likelihood of Type I error, only comparisons with p values ≤ .01 were considered significant). For the number of switches, infants switched more in trial 1 than in trial 2, t(79) = 3.62, p < .001, d = .40, trial 3, t(79) = 4.39, p < .001, d = .49, trial 4, t(79) = 5.70, p < .001, d = .64, trial 5, t(79) = 5.05, p < .001, d = .57, and trial 6, t(79) = 5.22, p < .001, d = .58. None of the other comparisons were significant, ps ≥ .08. For the number of looks, infants exhibited significantly more looks on the trial 1 than on trial 2, t(79) = 3.80, p < .001, d = .43, trial 3, t(79) = 3.92, p < .001, d = .49, trial 4, t(79) = 5.18, p < .001, d = .58, trial 5, t(79) = 4.77, p < .001, d = .53, and trial 6, t(79) = 4.91, p < .001, d = .55. None of the other comparisons were significant, all ps > .12. For both measures, therefore, the primary decrease was from trial 1 to trial 2. The ANOVA on the duration of looking did not reveal an effect of Trial. We also compared infants' mean duration of looking (or number of looks or number of switches) on the first block of 3 trials with their mean duration of looking (or number of looks or number of switches) on the second block of 3 trials, as such data are often analyzed (e.g., Quinn et al., 2002). These analyses yielded the same results as the analyses reported examining changes across the 6 trials.

None of the ANOVAs revealed any other main effects or interactions. Thus, although infants with pets generally responded differently than did infants without pets, and infants' behavior changed over trials, these analyses did not reveal that infants with pets changed their looking behavior over trials in ways that differed from infants without pets.

Note that our analyses showed different effects of pets and changes across trials for the different measures we examined. Specifically, infants with pets looked longer and had more switches between the two images, but they did not have significantly more looks than did infant without pets. This raises the possibility that infants with pets had longer individual looks than did infants without pets. Given that infants with pets did have more looks than infants without pets, although the effect was nonsignificant, it is possible that there is no difference in the duration of individual looks. In addition, infants with pets both had longer looks and switched their glance more between the two items. This raises the question of whether infants with pets accumulated more looking at the image before switching their glance than did infants without pets—if such a difference exists, it would suggest that not only did the two groups of infants engage in different levels of comparison, but the way in which they compared differed. Clearly, we can gain insight into whether or not there are subtle differences between these groups of infants by examining such differences. We therefore calculated infants' *average look length* by dividing the total looking per trial by the number of looks per trial, and their *average look duration between switches* by dividing the total looking time per trial by number of switches per trial.

The mean level of each of these scores is presented in the top portion of Figure 3. Unlike the measures just reported, infants with and without pets, as a group, were virtually identical on both of these measures. Indeed, ANOVAs on these measures did not reveal effects of pet experience or trial, suggesting that in general infants with pets did not have longer individual looks or longer periods of inspection between switches than did infants without pets. These ANOVAs did, however, reveal main effects of category, F (1, 72) = 3.67, p = 05, ηp^2 = .48, for *average look length*, and F (1, 72) = 4.48, p = 05, ηp^2 = .06, for *average time between switches.* Regardless of pet experience, infants exhibited longer individual looks on average to images of cats (M = 1.69, SD = .69) than to images of dogs (M = 1.49, SD = .56), and they looked longer durations between switching their glance between images of cats (M = 3.11, SD = 1.80) than between images of dogs (M = 2.55, SD = 1.75). These effects are interesting given that overall infants did not look longer or switch more when shown images of cats than dogs, revealing how general measures of looking and these combined measures of looking can reveal different aspects of how infants are inspecting the stimuli. Thus, although infants had similar overall interest to these two types of images, they accumulated their looking to the two categories in different ways.

Note that the analyses reported thus far compare infants with pets to infants without pets, without any consideration of the match between the infants' pet at home and the images on being presented. That is, these analyses do not reveal whether these effects are particularly robust when the images being inspected are similar to the pet infants have at home. Rather, these results show that infants who have dogs or cats at home look longer and switch more when presented with images of dogs or cats, but it is unknown how these effects are influenced by differential responding of infants with cats at home looking at cats and infants with dogs and home looking at dogs as compared to infants with cats at home looking at dogs and infants with dogs at home looking at cats. It would not be surprising if infants with any pet looked at images of dogs and cats differently than infants who have little or no experience with dogs and cats. But, it also would not be surprising if the patterns of looking differed depending on whether the images shown in the lab were from the same category as the infants' pet at home.

The results from previous studies do not lead to obvious predictions. Kovack-Lesh et al. (2010) found that 4-month-old infants' experience with *cats*, as opposed to experience with pets in general, had the most significant impact on their learning of *cat* stimuli. Kovack-Lesh et al. (2008) reported no differences on infants' learning of cats as function of experience with cats or dogs at home, perhaps due to reduced power. Thus, it is not clear whether or how the match between the infants' pet at home category of animals shown in the lab will influence infants' performance in our task.

To address this question, we conducted analyses on just the subset of infants who had pets at home, comparing infants whose stimulus condition matched their pet experience (i.e., infants who had a cat at home and saw cats in the lab or who had a dog at home and saw dogs, the *Matched* group, N = 27) with infants whose stimulus condition was different from their pet experience (i.e., infants who had only cats at home and saw dogs in the lab or who had only dogs at home and saw cats, the *Unmatched* group, N = 13). The 11 infants who had both cats and dogs at home were included in the matched group (because the images shown matched at least one of their pets at home). But, when we conducted the analyses excluding those 11 infants, the results were essentially the same. We therefore report the analyses including the full sample of infants with pets both to increase the generalizability of our results as well as to increase our power.

The average levels of each variable for the matched and unmatched groups are presented in the lower portions of Figures 2 and 3. The data in Figure 2 suggests that the effect of match on overall looking, number of looks, and switches was modest; there is some indication that infants looked longer, had fewer looks and fewer switches when looking at an animal that was similar to their pet at home, but the magnitude of the effects are small and the variability is high. The data in Figure 3, in contrast, suggests that infants had longer individual looks and longer bouts of inspection between switches when looking at animals that matched their pet at home than when looking at animals that did not match the category of their pet at home.

Comparisons between the two groups of infants confirmed these impressions. There were no significant effect of match on look durations, number of looks, or number of switches, all *p*s > .14, indicating that the apparent differences were small and not robust. There differences between infants in the matched and unmatched condition were significant for the length of individual looks, $t(38) = 2.13$, $p = .04$, $d = .72$, and the length of time inspecting the images between switches, $t(38) = 2.01$, $p = .05$, $d = .68$, however. These two results suggest that the match between the infants' pet at home and the stimulus presented in the lab related to the most subtle measures of how long infants sustained their attention to one item before they looked at the other. When the animal images matched the category of the pet infants had at home, they looked longer at the stimulus presented each time they looked, and they accumulated more looking at one image before they shifted their visual attention to the other available stimulus. Because these two groups of infants did not accumulate different amounts of looking, what these results reveal is that infants adopt different strategies when looking at images that more closely match their pet at home than when looking at images than are less closely related to their pet at home.

It is possible that the differences observed for *category* described earlier (i.e., infants exhibiting longer looks to cats and accumulating more looking before switching between images of cats) were driven by the infants in the matched condition who had cats at home and who were looking at cats. However, this is unlikely given that infants with dogs looking at dogs (n = 8) did not differ from infants with cats looking at cats (n = 18) for either measure. Additionally, there were no differences between infants without pets looking at cats and infants with cats looking at cats or infants without pets looking at dogs and infants with dogs looking at dogs.

Discussion

The present results make two contributions to our understanding of development in infancy. First, these results add to a growing literature on how infants' experience outside the lab can contribute to their responding in the lab. We found here that infants with pets at home looked longer at images of dogs or cats than were infants who did not have pets at home. This finding is similar to infants looking longer at faces familiar in terms of gender (Quinn, et al., 2002) and race (Bar-Haim et al., 2006; Kelly, et al., 2007). Importantly, unlike previous studies, our results show *between-subjects* preferences—that is, we did not observe that infants given a choice between two stimuli looked longer at the stimuli that were more familiar, rather we observed that groups of infants looking at stimuli that were closer to their experience looked longer than did infants who were looking at those same stimuli but who did not have relevant experience.

Why did infants with pets look longer at the stimuli than did infants without pets? Some studies suggest that infants who look longer at stimuli are engaged in less mature processing than infants who look shorter at those same stimuli (Colombo, Mitchell, Coldren, & Freeseman, 1991; Rose et al., 2003). In this case, infants who are longer lookers are presumed to be slower processors. Although possible, it seems unlikely that our infants with pets are in general slower processers than our infants without pets. A more plausible possibility is that infants with and without pets attend to different details of the images, and as a result the infants with pets looked longer than did infants without pets. That is, a large literature has shown that infants look longer at stimuli that present more information to process (see Cohen, 1998). We proposed that infants who have more relevant experience with the stimulus under inspection will have more information to process because of their greater expertise. This proposal is based on the general finding that people attend to more detailed features of more familiar stimuli than they do of less familiar stimuli. For example, adults use finer levels of detail when categorizing stimuli that conform to their previous experience than when categorizing stimuli that do not conform to previous experience (Spalding & Murphy, 1996). Adults also encode higher resolution representations for familiar stimuli than they do unfamiliar stimuli (Scolari, Vogel, & Awh, 2008). Similarly, children who are chess experts remember more detail of chess configurations than do children or adults who are not chess experts (Chi, 1978). Thus, even infants may attend to, perceive, and encode information from relatively familiar stimuli differently than they do from relatively novel stimuli. In fact, infants make more sophisticated discriminations among faces from their own race than among faces from other races (Bar-Haim, 2006; Kelly, et al., 2005), and 9-month-old infants given extensive experience with monkey faces show superior ability to discriminate monkey faces than infants of the same age not given such experience (Pascalis, et al., 2005). Discrimination in these studies was demonstrated by infants showing a preference for a new stimulus following familiarization with one stimulus; thus, when infants had more expertise with a category they apparently attended to, perceived, and encoded finer detail about the images than did infants who had less expertise. Because infants formed a higher-resolution representation for relatively familiar items, they must have processed more information about those items. The infants with pets in the present experiment therefore may have looked longer because they were forming higher resolution representations. These data do not directly address this issue, but it is an important question for future research.

We also observed an effect of previous experience on infants' comparison of the stimuli, as least as indicated by their switching behavior. Infants with pets switched their glance back and forth between two available images more than did infants without pets. Differences in the amount of switching have been suggested to reflect differences in comparison (Ruff, 1975). Specifically, infants who look back and forth more between two simultaneously presented stimuli are presumably engaged in more comparison of the two stimuli (Kovack-Lesh et al., 2008; Ruff, 1975). This suggests that in the present case, infants with cats and dogs at home engaged in more comparison of the two stimuli than did infants without pets at home. Active comparison can lead to deeper understanding of objects and categories (Gentner & Namy, 1999). Indeed, infants with pets at home better categorize and discriminate images of animals (Kovack-Lesh et al., 2008), suggesting that when infants compare items for which they have relevant experience, that comparison results in deeper processing of those stimuli.

In the present context, we observed that all infants with pets compared more than did infants who did not have pets. We have argued elsewhere that stimuli may induce different levels of comparison by infants as a function of their past experience (Kovack-Lesh et al., 2010). Perhaps infants' extensive experience looking at an animal in their daily lives contributed to the development of a perceptual category or expectation that facilitated the inspection of the images presented in the lab—that is, their previous experience may have provide them with a framework for actually comparing the two stimuli, which resulted in higher levels of comparison.

Why did infants engage in equivalent levels of comparison of identical and different pairs of stimuli? At this point, we can only speculate. One possibility is that due to limits on infants' working- or visual short-term memory capacity (Ross-Sheehy, Oakes, & Luck, 2003; Kaldy & Leslie, 2003), for 6-month-old infants the identical and different stimulus pairs were the same. That is, at this age, infants seem to be able to hold in working or visual short-term memory only a single item. If they are unable to hold a detailed representation of that item active in this memory system, when they move their glance from one image to the other the different items may look identical (e.g., they have the same overall shape, similar features, etc.) or the identical items may look different (e.g., infants may have encoded only a subset of features and they may attend to a different subset of features when looking at the new item). Another possibility is that for infants, comparing two complex stimuli is equally interesting, regardless of whether those two items are identical or different. Perhaps if there had been more or longer trials, differences between the two conditions may have emerged. Although infants' level of comparison (as measured by switching) has been shown to be related to the similarity of the to-be-compared items (Ruff, 1975), it is possible that the pairs of stimulus items we used were equally similar, at least in terms of how similarity relates to this aspect of comparison. Finally, although infants engaged in the same number of switches, it is possible that other aspects of their comparison differed between the two conditions (e.g., which features they looked at as they moved their glance from one feature to the other). Addressing such questions is an important goal for future research.

The present findings also showed that, although infants' general visual attentional strategies (i.e., look duration and switching) was not influenced by the match between animals seen in the lab and the pets in the infants' experience, more subtle differences in visual attention were related to the match between the infants' pet and the stimulus in the lab task. When looking at an image that matched the category of their home pet, infants exhibited longer individual looks and they inspected one image longer before switching their glance to the other available image. In particular, although infants with pets in general were more attentive and compared more than did infants who did not have pets, when the image resembled their pet at home infants seemed to process even more deeply and gather more information about one image before looking at the other image. Thus, fuller understanding emerges when considering not only overall measures of attention, but measures that reflect infants' distribution of attention and when considering how closely the on-line task matches infants' previous experience. It is likely that the overall pattern of results—that infants with pets looked longer than infants without pets—actually reflected the combined strategies adopted by infants looking at images that matched and images that did not match their pet at home. That is, infants who were looking at a matching image exhibited longer individual looks and longer bouts of inspection before switching. Infants who were looking at a nonmatching image had shorter individual looks and shorter bouts of inspection before switching. Both groups of infants, however, accumulated more looking and more switches overall than the infants without pets, revealing how the same pattern can actually reflect two different strategies. This is an important feature of the present results, and begins to address questions of *how* previous experience contributes to infants' learning of new, related items. Specifically, these results show that infants' looking reflects not just the dynamic learning occurring on-line in the context of the experimental trials, but also previous experience with similar images or objects (Furrer & Younger, 2008, made a similar point for the generalized imitation task).

The second contribution these results make is to our understanding of role of pets in human development. Specifically, just as adults and older children are affected by living with a companion animal (see Gunter & Furnham, 1999), the present results suggest that psychological function is influenced by exposure to and relationships with pets by 6 months of age. Importantly, this work extends the previous literature both in terms of the age of the subjects and in terms of the psychological processes investigated. Most past studies examining the effects of pet on development have focused on the effects on socio-emotional well-being in older children (see Myers, 1998). Here, we focus on looking time in infancy. Looking time is a key index of cognitive processing in infancy (Aslin, 2007), and the measures we used have been linked to the specific processes of attentional control and comparison (Ruff, 1975). Thus we show here that exposure to pets is related to basic cognitive processes involved in learning. In addition, we examined this effect in 6-month-old infants, showing for the first time that pet exposure in the first year of life seems to contribute to the development of psychological functioning. As has been shown with older children (Prokop et al., 2008; Hatano & Inagaki, 1993), we find that infants' processing of animals is influenced by their previous exposure to animals. This work is a first step in understanding this relation; future work will need to determine what aspects of infants' experience with pets is related to the kinds of differences observed here, and if the effects are specific to dogs and cats or if they generalize to a wide range of animal species.

Of course, the reported effects are correlational, and therefore it is possible that infants (and families) with and without pets differ in other important ways, and the differences in looking patterns we observed would have been seen regardless of what stimuli we presented infants. Importantly, Kovack-Lesh and her colleagues (Kovack-Lesh et al., 2008; Kovack-Lesh et al., 2010) reported that no effect of pet experience for infants' looking at abstract shapes. Thus, although we think it unlikely that the effects we observed here would be found for any stimuli presented, the possibility that these effects are not specific to infants' looking at animals images should be addressed in future research.

The effects reported also here have implications for how we interpret infants' looking behavior in studies using habituation of looking time or familiarization tasks. Researchers need to carefully consider all the factors that might contribute to how infants behave in a task, and conclusions about infant cognition from such tasks should take into consideration both what infants have learned in the moment and what knowledge they have acquired over time that is tapped by the task. When the task is related to experiences common to all infants —for example, the fact that unsupported objects fall, round objects roll, animate objects move unassisted—differences in experience will not contaminate the findings. However, when using stimuli that may be more familiar to some infants than to others—for example, animal images, faces of a particular gender or race—then it is critically important to measure in some way and/or control for past experience.

Note that although Kovack-Lesh et al. (2008) found that 4-month-old infants' responding to *test* items was related to their experience with pets, they did not observe differences during familiarization—6 trials with pairs of images of cats like those, much like the trials used here. Why did our findings differ from those previously reported findings? One possibility is that the effect of pet experience on infants' looking may change with age, and the effects of pet exposure on infants' looking duration may not yet be present by 4 months. Given that by 4 months infants look longer at familiar types of faces than at novel types of faces (Quinn, et al., 2002, Bar-Haim et al., 2006), however, we think this possibility is unlikely. A second possibility is that in the present study we more systematically examined visual behavior than in the previous study. Measures other than overall looking provided deeper understanding of the relation between infants' pet experience and their visual behavior as they inspected images of animals. Moreover, these measures revealed relations between pet experience and different aspects of visual behavior that may reflect different cognitive processes. Infants look longer at stimuli when they are more familiar (Barrera & Maurer, 1981) and when they are learning more details about the stimuli (Jankowski et al., 2001). Infants switch their gaze more between two simultaneously presented images because they are engaged in more comparison of those images (Ruff, 1975). By examining a variety of measures that reflect different aspects of processing may be the most sensitive way of revealing the relation between infants' previous experience and existing knowledge.

In summary, laboratory procedures that utilize looking procedures to understand memory, categorization, face processing, and other developing cognitive skills must take into consideration how looking behavior is influenced both by the on-line processing of stimuli and by infants' previous experience with similar objects. The present research suggests that experience in the first few months of life influences basic cognitive processing.

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Figure 1.
Examples of the stimuli.

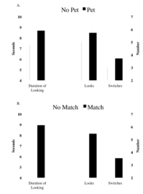

Figure 2.
Mean look durations, number of looks, and number of switches by Pet Group (A) and by Match with Pet at Home (B). Error bars represent +1 SE.

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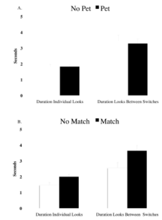

Figure 3.

Mean duration of individual looks and duration of looking between switches by Pet Group (A) and by Match with Pet at Home (B). Error bars represent +1 SE.

Table 1

The mean for each of the looking measures by trial (*SD* are in the parentheses).

Measure	Group	*N*	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Number of looks	Overall	80	6.59 (2.80)	5.46 (2.57)	5.36 (2.18)	5.09 (2.07)	4.99 (2.32)	4.95 (2.41)
	Pets	40	6.70 (2.33)	5.72 (2.70)	5.90 (2.10)	5.50 (1.89)	5.35 (2.28)	5.22 (2.26)
	No Pets	40	6.48 (3.24)	5.20 (2.43)	4.82 (2.16)	4.68 (2.18)	4.63 2.33)	4.68 (2.11)
Duration of looking	Overall		8.62 (2.95)	7.99 (3.23)	7.63 (3.19)	8.07 (3.35)	8.05 (3.35)	7.76 (3.40)
	Pets	40	8.93 (2.71)	8.99 (2.95)	8.34 (3.21)	9.08 (2.99)	8.56 (3.21)	8.13 (2.99)
	No Pets	40	8.30 (3.18)	6.99 (3.36)	6.87 (3.01)	7.05 (3.46)	7.51 (3.44)	7.39 (3.75)
Number of Switches	Overall		4.46 (2.39)	3.51 (2.29)	3.3 (2.06)	2.99 (1.77)	2.95 (2.07)	2.98 (2.20)
	Pets	40	4.78 (2.20)	3.75 (2.45)	3.90 2.05)	3.35 (1.76)	3.33 (2.08)	3.23 (2.29)
	No Pets	40	4.15 (2.26)	3.28 (2.14)	2.70 (1.91)	2.63 (1.72)	2.58 (2.02)	2.73 (2.11)