Learning Associations Involving Predators and Non-Predators in Infancy

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Abstract

Fear is one of the most universal human emotions and many common fears, such as aversions toward predatory animals, has been observed cross-culturally. Previous research has indicated that humans have an evolved predator detection mechanism (Mineka & Ohman, 2002). The present research explored this innate predator detection mechanism in infants by testing whether they are able to learn associations involving predators more quickly than associations involving non-predators. Eleven-month-old infants were shown images of snakes, spiders, flowers, and mushrooms paired with happy or scared faces. Infants' looking times were recorded to determine differences in how quickly they learned associations involving predators and non-predators. In addition, looking times were recorded to determine differences in the increase of attention to novel stimuli following habituation to predators and to non-predators. The results indicate that there was no difference in looking times between predator and non-predator stimuli during the habituation phase and did not show a differential increase in attention to predator stimuli and non-predator stimuli following habituation. Future research is needed to further investigate this mechanism in infants.

All species face adaptive problems that need to be solved in order for an organism to survive and reproduce. Some of these adaptive problems include finding food, securing a mate, and avoiding predators. The adaptations that have emerged to overcome these problems are designed by natural selection and are often specific to the environment in which they evolved. Although animal studies detailing such evolutionary adaptations are prevalent, little is known regarding similar mechanisms in humans. Humans today exist in an environment very different from the one in which they initially evolved, making evolutionary adaptations difficult to recognize. It is still apparent, however, that humans have evolved psychological mechanisms as a result of the adaptive problems faced by our early ancestors. One such mechanism is the ability to detect and respond to predators. Even though the threat of predators does not greatly effect the survival of modern humans, avoiding animals such as snakes and spiders, was critical to the survival of our ancestors. Those who failed successfully to avoid these predators risked injury or death, and would be much less likely to survive long enough to reproduce.

Research on Animals

All types of animals face the threat of predators on a regular basis. In order for these animals to survive, evolution has shaped mechanisms in animals that allows them to detect and responds to predators in ways that increase their chance of survival. A significant amount of evidence reveals innate predator detection and response behaviors in the animal kingdom. The velvet gecko has the ability to detect chemical cues from the broadheaded snake, its primary predator, and discriminate between these cues and those of non-predatory snakes living in the same environment (Downes & Shine, 1998).

Having detected these chemical cues, the velvet gecko proceeds to respond in unique ways, pressing itself flat against the ground in order to avoid detection, and if detected, raising its tail to direct the forthcoming attack away from its body and to its tail (Downes & Shine, 1998). In addition, the moustached warbler displays several distinct responses to predators. The mother warbler will give an alarm call to warn her chicks of potential danger, however, a warbler without chicks will not alarm call in response to predators. The alarm calls are specific to the type of danger present. After hearing the alarm call, the chicks will either jump in response to a terrestrial predator such as a human or snake or duck in response to an aerial predator such as a marsh harrier. These specific responses to predators are present just days after hatching, indicating that they are innate responses and not the result of learning alone (Kleindorfer, Hoi, & Fessl, 1996). The moustached warbler has evolved specific alarm calls to warn their chicks of potential danger and selective responses that are contingent on the type of predator (Kleindorfer, Hoi, & Fessl, 1996).

Primates often use alarm calls as a response to predators. In particular, the Diana monkeys have evolved two particular defense strategies to protect themselves from their two main predators, the leopard and the chimpanzee (Zuberbuhler, 2000). Diana monkeys will create several loud, conspicuous alarm calls in response to a leopard. This signal warns other monkeys of the potential threat and informs the leopard that they have been detected. At this point, the leopard usually retreats. In contrast, Diana monkeys will remain silent and flee the scene if a chimpanzee is present. Since chimpanzees are good climbers, giving an alarm call would make the Diana monkey’s location available to the chimpanzee and would most likely result in capture. The Diana monkey, therefore, remains silent and attempts to flee in order to avoid the predator. The two distinct responses to two different predators indicate that evolution has helped shape the Diana monkeys' responses to specific potential threats (Zuberbuhler, 2000).

Other types of primates also show specific responses to predators. Research by Mineka, Davidson, Cook, and Keir (1984) on rhesus monkeys indicates that a fear response to predators might not actually be present at birth; rather rhesus monkeys have a predisposition to learn fear responses to predators. When lab reared monkeys that initially did not show a fear response to snakes observed a model monkey behaving fearfully in the presence of a snake, the lab reared monkey quickly developed an intense and long-lasting fear of snakes. The lab reared monkeys did not develop this fear response for neutral stimuli, such as flowers or toy rabbits (Mineka et al., 1984). This indicates that rhesus monkeys are predisposed to learn fear responses to snakes, a natural predator, but not non-threatening stimuli, and will learn these strong fear responses quickly and with very little exposure to the modeled fear response.

Research on Humans

Similar to other animals, there is evidence that humans have evolved a psychological mechanism specific for predator detection and response. These mechanisms evolved in ancestral humans during a time when predators were a constant threat to survival. Even though most modern humans currently live in an environment in which they rarely face predators, the evolved predator detection and response mechanism is still apparent. This mechanism would allow ancestral humans to detect and avoid sources of danger with very fast activation of defensive behaviors (Mineka & Ohman, 2002). This evolved predator detection and response mechanism must have several specific characteristics in order for it to be beneficial. The mechanism must be highly selective with regard to input, principally responding to threatening stimuli in its evolutionary environment. It must be automatic in that it takes only a small amount of neural computations to identify stimuli and immediately give them priority. This mechanism must be encapsulated within itself, causing processes associated with this module to be carried out without interruption. Finally, this mechanism must be associated with specific neural circuitry shaped by evolution. In humans, and in other mammals, it is located in part of the subcortical area of the brain, known as the amygdala, and controls various fear behaviors (Ohman & Mineka, 2001). Research on physiological responses to fear, common phobias, speed of detection of predator stimuli versus non-predator stimuli, automatic responses to predator stimuli, and infants looking responses to predator stimuli has provided evidence that this mechanism exists in humans and functions according to these principles.

This psychological mechanism includes an evolved adaptation to respond to potentially threatening predators in a way that increases the chance of survival. Showing a fear response to potentially threatening stimuli is a beneficial response to predators, causing the organism to respond in an appropriate way in order to increase their chance of survival. Physiological responses associated with fear in humans include an increase in heart rate, blood pressure, and eye movement (Sinha & Parsons, 1996). These physiological responses prepare the individual to behave in certain ways, such as fighting or fleeing the situation, in order deal with the potential threat (Ohman & Mineka, 2003).

Research on phobias reveals that humans are far more likely to develop fears of objects that were potentially dangerous or harmful to early humans, and for which the ability to recognize and respond quickly to these potential dangers would have been advantageous for one’s survival and reproduction (Hofman, Moscovitch, & Heinrichs, 2002). It is those natural threats, such as predators or heights, which are strongly associated with fear in modern humans (Van den Berg & Heijne, 2005). In contrast, humans are far less likely to develop fears to dangers in the modern environment (Buss, 2004). This explains why fear of spiders and snakes are significantly more common than fear of guns or automobiles, even though the latter is currently much more dangerous to humans than the former.

Predator detection is a critical aspect of the psychological mechanism that evolved in order to protect early humans from predators. This predator detection mechanism is selectively sensitive to and automatically activated by predator stimuli, such as snakes and spiders (Ohman & Mineka, 2003). Ohman, Flykt, and Esteves (2001) investigated this module by examining whether adult participants would detect images of fear-relevant stimuli, such as snakes and spiders, against a background of fear-irrelevant stimuli, such as mushrooms and flowers, faster than fear-irrelevant stimuli hidden against a background of fear-relevant stimuli. Participants were significantly faster in detecting fear-relevant target items among fear-irrelevant distracters than vise versa (Ohman et al., 2001). Ohman et al. (2001) concluded that people automatically attended to stimuli involving some degree of threat, but do not for non-threatening stimuli.

Research by Globisch, Hamm, Esteves, and Ohman (1999) further showed the automatic nature of the predator detection and response mechanism. Subjects with high levels of fear of snakes or spiders were shown pictures of the fear-eliciting animal and pictures of neutral stimuli (such as mushrooms and flowers). Participants reliably showed a startle eye blink response while viewing the fear-eliciting pictures but not the neutral pictures. In addition, the fear-eliciting stimuli were also associated with an increase in sweat gland activity and cardiac acceleration. This shows the automatic and unconscious processing of the fear-eliciting information. Furthermore, when the picture was shown for a very brief period of time, the startle eye blink response still occurred, even after the fear-eliciting picture was no longer present. Globisch et al. (1999) argued that the startle response still occurred in this situation because once the fear module is activated, automatic processing of the information occurs, producing a fear response that cannot be terminated, even when the fear-eliciting stimuli is removed.

Research by Gerull and Rapee (2002) demonstrated how humans may be prepared to learn fear of certain stimuli by showing that toddlers can learn emotional associations to novel, fear-relevant stimuli quickly and persistently. Toddlers ranging from 15 months to 20 months were shown two novel, fear-eliciting toys: a snake and a spider. The child's mother paired either positive or negative emotions with each toy for a duration of one minute. In response, the children adopted the emotional reaction of their mother, showing strong avoidance and fear when their mother displayed negative emotions and approaching the toy when the mother displayed positive emotions. Even after a ten minute delay, the children still displayed the same response, indicating that the toddlers formed a persistent association between the fear-relevant stimuli and their mother's response (Gerull & Rapee, 2002).

The study by Gerull and Rapee (2002) also revealed in interesting sex difference; while both males and females showed an equal amount of approaching behavior in response to their mother's positive response, females showed greater fear than males following the mother’s negative response to the toy. This result is consistent with evidence on the prevalence of phobias in adults. Women are almost four times more likely to have phobias of snakes or spiders than men (Fredrikson, Annas, Fischer, & Wik, 1996). This can be explained by the behavior of ancestral humans. Ancestral women spent a significant amount of time gathering food while men spent their time hunting (Buss, 2004). Unlike hunting, gathering involved close contact with vegetation in the forests and grasslands. This presented ancestral women with substantial risks, including bites from poisonous creatures, such as snake and spiders, which live in this vegetation (Buss, 2004). It would have been more beneficial for ancestral women to fear snakes and spiders than men because they were more likely to come in contact with these threats.

Ancestral women also spent a significant amount of time caring for their children. Women would bring their infants and children with them as they gathered food (Buss, 2004). Because infants and children would have also been in close contact with threats such as snakes and spiders on a regular basis, evolution shaped an innate predator detection and response mechanism designed to help protect children and infants from these threats. Research conducted by Rakison and Derringer (under review) supported a predator detection mechanism that is present in infancy. Infants were shown images of a geometric spider, a spider with reconfigured features, and a completely scrambled, linear image of a spider that moved back and forth across a screen. The results revealed that infants at 5 months of age would track the image of a schematic spider significantly longer than the images of a spider with reconfigured features or a completely scrambled, linear image of a spider. These results suggest that infants may possess an innate perceptual template for spiders, causing them to pay attention to images of spiders. In addition, research conducted by Rakison (2005) further supports an innate predator detection mechanism. Ten month old infants were familiarized with predatory animals (e.g. snakes) and then shown a familiar predator (e.g. another snake), a novel predator (e.g. a spider), and a non-predator (e.g. a rabbit). Infants looked at the novel predator and the familiar predator for the same amount of time, but looked significantly longer at the non-predatory animals than at novel predatory animals. This further indicates that infants may have an innate template for predators, causing them group different predators (e.g. snakes and spiders) into the same category and treat them similarly.

The Current Study

Although the results of previous research are promising, research on an evolved predator detection and response mechanism in humans is limited. The current study was designed to expand upon previous research by investigating the innate predator detection mechanisms in infants. If infants possess an evolved predator detection mechanism, they will be more likely to learn associations involving predators than associations involving non-predators and will learn associations involving predators more quickly than associations involving non-predators. More specifically, it was predicted that infants will require fewer trials to habituate to predator stimuli than to non-predator stimuli and infants will overall spend less time looking at predator stimuli than non-predator stimuli during the habituation phase.

The habituation paradigm is a commonly used assessment of infant learning; infants respond less to previously experienced stimuli and relatively more to novel stimuli (Siegler, Deloache, & Eisenberg, 2003). Thomas and Gilmore (2004) explain the habituation behavior in terms of the comparator theory. This theory explains that infants attend to a stimulus in order to form an internal representation of that stimulus. With repeated presentations of the same stimulus, the internal representation of that stimulus becomes more accurate and resembles the external stimulus more closely. Habituation occurs when then infant reduces visual attention to the stimulus, showing that the internal representation of that stimulus matches that of the external image of the stimulus. If infants have an innate template for predators, they already possess an internal representation of predators to some extent. Infants do not possess this internal representation of non-predators, however. In the present study, infants were expected to habituate in less trials and in less time to predator stimuli because there is a smaller difference between their internal representation of predator stimuli and the actual external predator stimuli than there is for non-predator stimuli.

An alternative explanation to differences in the number of trials to habituate and the total looking time during habituation between predator and non-predator stimuli relates to individual differences in the general fearfulness of infants. Rieser-Danner (2003) tested 12-month-old infants in a basic-level categorization task using the habituation paradigm. Infants' fear level was determined by a fear scale completed by the mother. The results revealed that highly fearful infants were less likely to meet the habituation criterion than were less fearful infants. In addition, highly fearful infants required more trials to habituate than less fearful infants (Rieser-Danner, 2003). Moehler, Kagan, Parzer, Wiebel, Brunner, and Resch (2006) also showed a relationship between rate of habituation and fear. Infants were tested at two weeks of age and again at 14 months. They found that infants who had a lower speed of habituation at two weeks were more fearful at 14 months. The researchers proposed that infants who habituate faster towards a novel stimulus shortly after birth seem to be less disturbed by novel stimuli later in life (Moehler, Kagan, Parzer, Wiebel, Brunner, & Resch, 2006). This research suggests that infants will look longer and take more trials to habituate to predator stimuli than to non-predator stimuli, a suggestion in opposition to the proposed hypothesis.

Although this research shows that infants who take longer to habituate are more fearful, these studies focus on individual differences between infants' rate of habituation to the same non-fearful stimuli. Infants that were more fearful in general took longer to habituate than non-fearful infants (Rieser-Danner, 2003; Moehler, Kagan, Parzer, Wiebel, Brunner, & Resch, 2006). In the present study, infants were shown two different types of stimuli, predator and non-predator. Although predator stimuli may be fear-eliciting, infants were expected to habituate more quickly to these stimuli because of their innate template for predators. This template allows infants to attend to predator stimuli for less time than non-predator stimuli because they already possess an internal representation of predators, but do not possess this representation for non-predators. Therefore, it was predicted that infants would take fewer trials to habituate and would take less time overall to habituate to predator stimuli than to non-predator stimuli.

It was also predicted that infants would increase looking time to an association involving a non-predator and a face after habituating to a different non-predator associated with a different face to a greater extent than they would for an association involving a predator and a face after habituating to a different predator associated with a different face. This differential increase in looking time is a result of the infants' ability to group predators into the same category but not non-predators. The increase in looking time for associations involving predators is only a result of the different face the predator is paired with and not because of the different predator. For non-predators, however, the increase in looking time is a result of a different face and a different non-predator. Because there are two novel stimuli in the non-predator condition but only one novel stimulus in the predator condition, it is predicted that infants will look longer at the non-predator associations than the predator associations during dishabituation.

Method

Participants

Participants were 14 healthy full-term infants at 11 months of age (*M* age = 10.9 months, *SD* = 0.6 months). There were seven males and seven females. Participants were randomly assigned to habituation condition, with seven participants in the predator condition and seven participants in the non-predator condition. Four participants were dropped from further analysis because they became too fussy to complete the experiment, because of experimenter error, or because they failed to meet the habituation criterion level. The participants were primarily Caucasian and of middle socioeconomic status. Infants were recruited through birth lists obtained from a private company and were given a small gift for participating.

Design

The experiment utilized a 2 (pretest condition) x 2 (habituation condition) x 2 (test condition) mixed design, with pretest condition and test condition as the within-subjects factors and habituation condition as the between-subjects factor. The factor, pretest condition, had two levels, predator and non-predator. The factor, habituation condition, had two levels: predator and non-predator. The test condition had two levels, predator and non-predator. The predator condition for all factors included images of spiders and snakes while the non-predator condition for all factors included images of mushrooms and flowers. The experiment measured looking times in seconds for each participant.

Stimuli

The stimuli were created with Macromedia Director 8.0 for PCs. The pretest stimuli began with a blue screen lifting up to reveal the target stimuli in the center of the screen. The image remained motionless for ten seconds and concluded with the blue screen lowering over the image. The habituation and test stimuli paired the target stimuli with a drawing of a face. In each event, a blue screen lifted up, revealing the target stimulus on the left side of the screen. After two seconds, a drawing of a face faded in on the right side of the screen over a period of one second. Both images remained motionless on the screen for the remainder of the event. Each event lasted for a total of ten seconds and concluded with the blue screen lowering to occlude the images.

The target stimuli included four images of spiders, four images of snakes, four images of mushrooms, and four images of flowers (see figure 1). All images were square, color photographs. There were also two different drawings of faces, one depicting a happy emotion and one depicting a scared emotion (see Figure 1). All target stimuli were paired with both faces, for a total of 32 combinations.

Insert Figure 1 Here

Each participant was presented with two pretest stimuli, one predator and one non-predator. The pretest phase was used to determine if the infant had an initial preference for one type of stimuli over the other (i.e. predator over non-predator or vice versa). If the participant was in the predator condition, they saw the same predator in the habituation phase as they did in the pretest phase, paired with either a happy face or a scared face. If the participant was in the non-predator condition, they saw the same non-predator in the habituation phase as they did in the pretest phase, paired with either a happy or a scared face.

The test phase included two trials. For the predator condition, the participant was shown a different predator image than in the habituation phase, but of the same type (i.e., two different spiders, one in the habituation phase and one in the test phase), paired with the other face. They also saw the same non-predator as in the pretest phase, paired with the same face used during the habituation phase. For example, if the participant saw a flower and a snake in the pretest phase, they saw the same snake during the habituation phase and the same flower but a different snake during the test phase. In the test trials for the non-predator condition, the participant was shown a different non-predator image than in the habituation phase, but of the same type (i.e., two different flowers, one in the habituation phase and one in the test phase), paired with the other face. They were also shown the same predator as in the pretest phase, paired with the same face used during the habituation phase.

Procedure

Informed consent was first obtained from the parent. Participants were then taken to a dark, quiet room. Infants sat on their parent’s lap approximately five feet away from a wide-screened monitor. A video camera was placed behind the monitor and focused on the infant’s face. A black curtain blocked the participant’s view of the experimenter and the rest of the room. The video camera was connected to a television and recorder so the experimenter could monitor the infant’s looking time for each trial. Parents were instructed not to direct their infant’s attention to the screen or to interact with the infant in any way that may influence their behavior.

For each trial, stimuli appeared on the monitor for a maximum of 20 seconds or until the infant looked away for a minimum of one second. In between trials, a green, blinking circle accompanied by a binging noise appeared on the screen until the infant’s visual attention was drawn back to the monitor. The experimenter monitored the infant’s looking time for each trial by holding down a computer key when the infant was looking at the monitor and releasing the key when the infant looked away. The computer program, Habit X, was used to present the stimuli and record looking times.

The participants were first shown two pretest trials, one involving a predator stimulus and one involving a non-predator stimulus. Each trial was shown for a maximum of 20 seconds or until the infant looked away from the monitor for a minimum of one second. The pretest trials were used to determine if infants have an initial preference for looking at one type of stimuli over the other (i.e. predator over non-predator or vice versa).

The habituation phase followed the pretest trials and continued until the infant’s looking time decreased to a set criterion level of 50% or until 16 trials were presented. Each trial lasted for a maximum of 20 seconds or until the infant looked away from the monitor for a minimum of one second. It is predicted that infants will take fewer trials to habituate to associations involving predators than to associations involving non-predators and total looking time during the habituation phase will be less for the predator condition than for the non-predator condition. Once the criterion level was met or all 16 trials were presented, the test trials were automatically presented. Infants who failed to reach the criterion level after 16 trials were determined to be non-habituators and excluded from further analysis.

There were two test trials: one test trial included a predator stimulus and one included a non-predator stimulus. Each test trial lasted for a maximum of 20 seconds or until the infant looked away from the monitor for a minimum of one second. The test trials for the predator condition included a different predator than in the habituation phase, paired with the other face and a non-predator paired with the same face used during the habituation phase. The test trials for the non-predator condition included a different non-predator than in the habituation phase, paired with the other face and a predator paired with the same face used during the habituation phase.

The test trials were used to determine if infants actually learned the association presented during the habituation phase. It was predicted that infants' looking time will increase for the test trial containing the same type of stimuli as in the habituation phase but the other face. If infants learned that a spider is associated with a happy face during the habituation phase, they should dishabituate to the test trial involving a different spider and the scared face because it is a novel association. In addition, it was predicted that infants' will show a differential increase in looking time between the two conditions when dishabituation occurs. More specifically, infants were expected to show a larger increase in looking time in the non-predator condition than in the predator condition.

This differential increase in looking time is a result of the infants' ability to group predators in the same category but not non-predators. In the predator condition, the increase in looking time is only a result of the different face and not because of the different predator. In the non-predator condition, however, the increase in looking time is a result of a different face and a different non-predator. Because there are two novel stimuli in the non-predator condition but only one novel stimulus in the predator condition, infants will look longer at this test trial in the non-predator condition than in the predator condition.

The other test trial contained the same face as seen in the habituation phase but the other type of stimuli. This test trial was also used to determine if the infants' learned the association presented during the habituation phase. Because the same face was used during this test trial as in the habituation phase, dishabituation occurs as a result of the different type of target stimuli. If infants learned that a certain face was always associated with a certain target stimuli during the habituation phase, infants were expected to look longer at the same face with a different target stimuli, a pairing that violates this learned association.

The order of presentation for all stimuli was counterbalanced across participants. Once the test trials were completed, the parents were debriefed regarding the purpose of the experiment and giving a small gift for their participation.

Reliability

A second experimenter recoded 25% of the videotaped sessions to determine inter-rater reliability. Reliability was determined by a Pearson's correlation between the original looking times and reliability video-coded looking times, with an average difference of 0.10 seconds ($r = 0.99$, $p < .001$).

Results

The main analysis focused on the differences in mean looking times between the predator stimuli and the non-predator stimuli during the pretest phase, habituation phase, and test phase. The results also considered any possible sex differences in all analyses, however, it was predicted that sex would not be a significant effect. A significance level of alpha = 0.05 was used for all analyses.

Differences in mean looking times for the pretest stimuli were first analyzed to determine if there was an initial preference for one type of stimuli over the other. Looking times were entered into a 2 (Pre-test Condition: predator vs. non-predator) x 2 (Sex: male vs. female) mixed-design analysis of variance (ANOVA). The results revealed that there was no difference between looking times for predator stimuli and non-predator stimuli during the pretest phase, $F(1,12) = 1.65$, $p = 0.55$, indicating that infants looked at each type of stimulus to the same extent. In addition, there was not a significant effect for sex of the infant, $F(1,12) = 0.48$, $p = 0.50$, and there was no significant interaction between stimulus type and sex, $F(1,12) = 0.38$, $p = 0.55$.

A 2 (Habituation Condition: predator vs. non-predator) x 2 (Sex: male vs. female) x 2 (Face Type: happy vs. scared) univariate-design ANOVA was used to determine differences in the mean number of trials it took for infants to habituate to predator stimuli and non-predator stimuli. The analysis revealed that there was no significant difference between the number of trials it took to habituate in each condition, $F(1,13) = 0.65$, $p = 0.45$. In addition, the sex of the infant was not found to be significant, $F(1,13) = 0.65$, p

= 0.45. There was a significant main effect for face type, $F(1,13) = 5.52$, $p < 0.05$, indicating that infants took more trials to habituate to happy faces than to scared faces. Furthermore, there were no significant interactions between condition and sex, $F(1,13) = 0.93$, $p = 0.37$, or condition and face type, $F(1,13) = 1.62$, $p = 0.25$. There was a significant interaction between sex and face type on the number of trials to habituate, $F(1,13) = 9.73$, $p < 0.02$, indicating that males took significantly more trials to habituate to happy faces than sad faces, but females only took slightly more trials to habituate to happy faces than to sad faces. See Figure 2 for the mean trials to habituate to happy and sad faces for males and females. There was also a significant interaction between condition, sex, and face type on the number of trials to habituate, $F(1,13) = 6.66$, $p < 0.05$.

Insert Figure 2 Here

A 2 (Habituation Condition: predator vs. non-predator) x 2 (Sex: male vs. female) x 2 (Face Type: happy vs. scared) univariate-design ANOVA was also used to determine differences in the total looking time between the predator condition and the non-predator condition during the habituation phase. The analysis revealed that there was no significant difference in total looking times during the habituation phase between the two conditions, $F(1,13) = 0.001$, $p = 0.99$. In addition, sex, $F(1,13) = 0.24$, $p = 0.64$, and face type, $F(1,13) = 2.40$, $p = 0.17$, were both not found to be significant. There were also no significant interactions between condition and sex, $F(1,13) = 0.07$, $p = 0.80$, condition and face type, $F(1,13) = 0.11$, $p = 0.75$, sex and face type, $F(1,13) = 3.52$, $p = 0.11$, or condition, sex, and face type, $F(1,13) = 4.45$, $p = 0.08$. These results are contrary to the proposed hypothesis that infants would learn about predator stimuli faster than non-predator stimuli as reflected in the number of trials to habituate and the total looking time during habituation. Instead, the results revealed that infants were able to learn associations involving predators and non-predators in an equal number of trials and looked at each type of association for an equal amount of time during the habituation phase.

The final analysis focused on the increase in looking times during the test trials. Paired t-tests were used to determine if infants actually dishabituated during the test trials. The results revealed that a significant increase in looking time between the final habituation trial and the face-switch (i.e., happy vs. scared) test trial, $t(13) = 4.69$, $p < 0.001$, and a significant increase in looking time between the final habituation trial and the target-switch (i.e., predator vs. non-predator) test trial, $t(13) = 3.64$, $p < 0.003$. This indicates that infants found the stimuli in both test trials to be different from the stimuli in the habituation trials, indicated by their increase in attention.

Differences in the increase in looking times during each test trial between the predator and non-predator condition was analyzed using a 2 (Habituation Condition: predator vs. non-predator) x 2 (Sex: male vs. female) univariate-design ANOVA. The results showed that infants increased their attention to the face-switch test trial equally in the non-predator condition and in the predator condition, $F(1,13) = 0.84$, $p = 0.38$. This result goes against the proposed hypothesis that infants who habituated to an association with a non-predator stimulus and a face would increase their attention to a different non-predator stimulus and a different face to a greater extent than the increase in attention by infants who experienced the same test trial in the predator condition. The analysis also revealed that sex was not significant, $F(1,13) = 0.81$, $p = 0.39$, and there was no significant interaction between habituation condition and sex, $F(1,13) = 0.25$, $p = 0.63$.

Differences in the increase in looking times during the target-switch (i.e. predator vs. non-predator) test trial between the predator and non-predator condition was analyzed using a 2 (Habituation Condition: predator vs. non-predator) x 2 (Sex: male vs. female) univariate-design ANOVA. As expected, the analysis revealed that there was no significant difference in the increase in looking times between the predator and non-predator condition during this test trial, $F(1,13) = 0.27$, $p = 0.61$. This indicates that infants find the association involving the same face but a different target stimulus as equally novel associations, regardless of whether they habituated to a predator association or a non-predator association. The analysis also revealed that sex was not significant, $F(1,13) = 0.15$, $p = 0.71$, and there was no significant interaction between habituation condition and sex, $F(1,13) = 0.48$, $p = 0.51$.

Discussion

The focus of this was on the differences in infants' looking times for predator stimuli and non-predator stimuli. The initial analysis of the pretest phase showed that infants do not prefer to look at predators more than non-predators or vice versa. This is important in that any differences between looking times during the habituation or test phases cannot be attributed to an initial preference to look at one type of stimuli over the other.

It was predicted that infants would take fewer trials to habituate to associations involving predators than to associations involving non-predators and would spend less time looking at associations involving predators than associations involving non-predators during the habituation phase. The results did not support this hypothesis; infants took the same amount of trials to habituate in the predator condition and the non-predator condition and looked equally as long during the habituation phase for both conditions. According to evolutionary theory, infants possess an innate template for predators (Rakison & Derringer, under review). This template provides infants with a basic internal representation of predator stimuli, but does not provide this internal representation for non-predator stimuli. According to this view, infants were expected to habituate faster to predator stimuli than non-predator stimuli because there is a smaller difference between their internal representation of predator stimuli and the actual external predator stimuli than there is for non-predator stimuli. In contrast, research involving fear and infants showed that infants that were more fearful in general took longer to habituate than non-fearful infants (Rieser-Danner, 2003; Moehler, Kagan, Parzer, Wiebel, Brunner, & Resch, 2006). According to this view, predators are fear-eliciting stimuli and therefore infants should take longer to habituate to predators than to non-predators, which are non-fear-eliciting stimuli.

The results in the present study revealed no difference between total looking time during habituation and the number of trials to habituate in the predator condition and the non-predator condition. These results may be due to the opposing effects of the innate predator detection mechanism and the fear-eliciting nature of predator stimuli. Both of these effects work in opposing directions and in the end cancel each other out. In order to determine if either of these forces is influencing looking time during habituation, further research should be conducted in order to isolate each type of effect. For instance, additional research should investigate differences between habituation to predator stimuli and other fear-eliciting stimuli to see whether predators are actually considered to be fear-eliciting stimuli by infants.

It was also predicted that there would be a differential increase in looking time during the test trials; infants were expected to look longer at novel non-predators associated with face after being habituated to a different non-predator and a different face than they would at novel predators associated with a face after being habituated to a different predator and a face. The results did not provide significant support for this hypothesis.

An innate predator detection mechanism allows infants to group predators into the same category and treat them similarly (Rakison, 2005). When presented with a novel association involving a predator and another stimulus (in this case, a face) following habituation to an association involving a predator, infants will not view the predator as novel, only the other stimulus. Infants should place both predators into the same category and treat them similarly. When presented with a novel non-predator association following habituation to an association involving a non-predator, both stimuli are now considered to be novel. The infant has more to attend to in the later condition (two novel stimuli instead of one), and therefore should spend more time looking at these stimuli than in the former condition. The results of the present study did not show this effect, however. This could be because the face stimuli used in the experiment are extremely interesting for infants to look at and therefore override any potential differences in looking time during the test trial. In order to reduce this effect, simpler images, such as geometric figures, should be used instead of faces. Although these images would still be considered novel during the test trial, they are not as visually appealing. Infants will therefore attend more to the target stimuli rather than the face stimuli, allowing any differences in attention to the predator and non-predator conditions to become apparent.

The results also indicated an unexpected main effect for face type; infants habituated more quickly to scared faces than to happy faces. Infants may find the happy face more pleasing to look than the scared face and therefore spend more time looking at the happy face during habituation than the scared face. In addition, the results revealed an interaction between sex and face type; males looked at happy faces significantly longer than females and males looked at scared faces significantly less than females. Because females are much more likely to develop phobias than males as adults, females pay more attention to the scared face than males (Fredrikson, Annas, Fischer, & Wik, 1996). Although these results are interesting, they were unexpected and unplanned. The effect the face type has on visual attention may be masking any effects of the predator and non-predator stimuli on attention. Once again, future research should include another type of stimuli, such as geometric figures, that will not produce this effect.

The main limitation of the current study was the lack of participants. Due to time constraints, it was not possible to obtain the desired quantity of participants in this experiment. With more participants, the results may yield significant main effects for the hypothesized results. The present study is being continued in order to obtain more participants and therefore increase statistical power.

Because the theory of an evolved predator detection and response mechanism in humans is a relatively new concept, there is still a great need for further research. Future research should include infants at even younger ages. Even though 11-month-old infants are still very young and have limited experience with predators such as snake in spiders in real life situations, it is still possible that the environment has influenced their treatment of predator stimuli. In order to show that the predator detection and response mechanism is truly innate, research should be conducted on infants immediately after birth. In addition, there are several beneficial modifications to this study that would help rule out alternative explanations for the results. Future research should involve using a wider range of stimuli. Because both of the predator stimuli used were animals and the non-predator stimuli were plants, further research should include examples of non-predator stimuli that are also animals, such as hamsters or rabbits. In addition, future research should include threatening, but non-evolutionarily relevant stimuli such as guns and knives. This would be useful to see if infants were simply responding to threatening stimuli, rather than predators specifically. Even though snakes, spiders, guns, and knives are all threatening and potentially dangerous, the evolved predator detection mechanism should be specific to threats in the ancestral environment. Since guns and knives were not present in this environment, infants should treat them differently than predator stimuli.

Although the results found in this study did not support the proposed hypotheses, it is still important to further investigate a predator detection and response mechanism in humans. Research that reveals that infants treat stimuli involving predators differently than stimuli involving non-predators is important because it shows that this predator detection and response mechanism is present at a very young age. This indicates that any differences in the treatment or predator stimuli by adults is most likely not a result of learning alone; instead, there is an innate mechanism also influencing behavior in adults. Understanding the predator detection and response mechanism sheds light on the evolution of humans and what was important for the survival of ancestral humans. In addition, it is also essential for understanding why humans develop phobias of evolutionarily relevant threats, such as snakes and spiders.

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Figure Captions

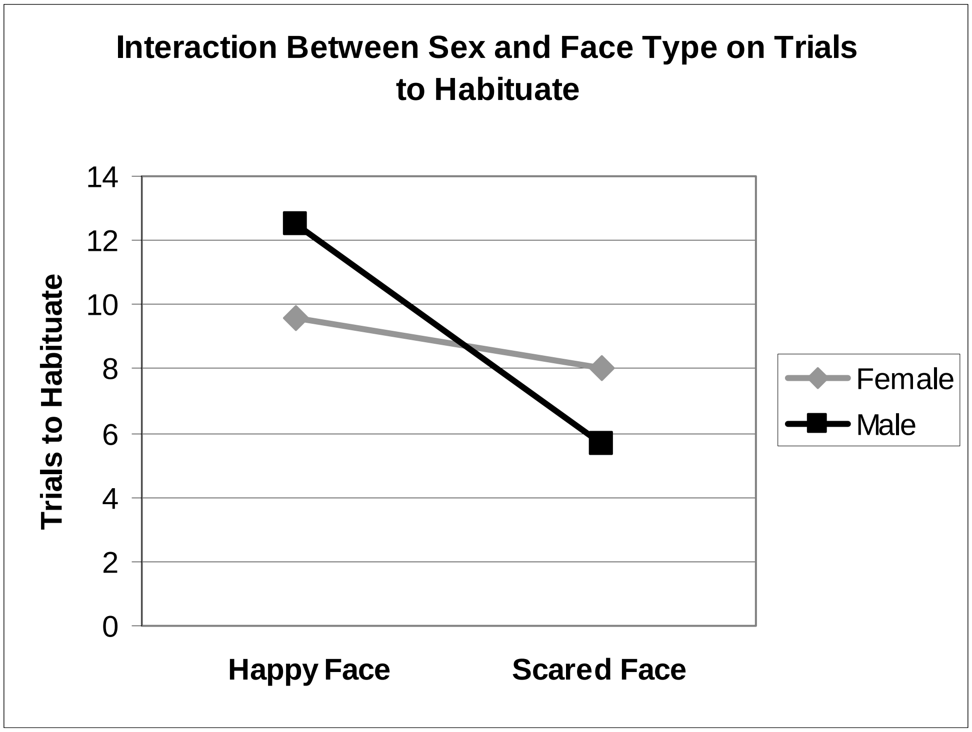
Figure 1. Predator, non-predator, and face stimuli used in the experiment.

Figure 2. Mean trials to habituate to associations involving happy faces and associations involving scared faces in males and females.

Figure 1

Predator Stimuli	Spiders	
	Snakes	
Non-Predator Stimuli	Mushrooms	
	Flowers	
Face Stimuli		

Figure 2


Interaction Between Sex and Face Type on Trials to Habituate
Trials to Habituate
14
12
10
8
6
4
2
0
Happy Face
Scared Face
Female
Male