

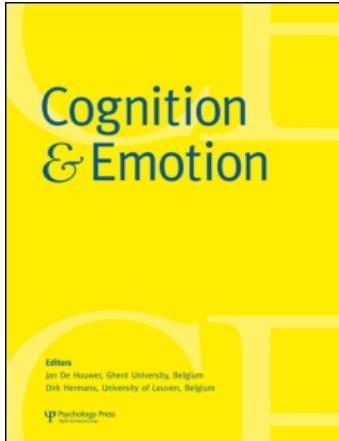
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### What's so scary about needles and knives? Examining the role of experience in threat detection

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## BRIEF REPORT

# What's so scary about needles and knives? Examining the role of experience in threat detection

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Snakes and spiders constitute a category of evolutionarily relevant stimuli that were recurrent and widespread threats to survival throughout human evolution. A large body of research has suggested that humans have an inborn bias to detect these stimuli more rapidly than non-threatening stimuli. However, recent research has demonstrated that adults also show rapid detection of modern threat-relevant stimuli, such as knives and syringes. This suggests that experience may also lead to rapid detection of threatening stimuli. The research reported here is an investigation of whether young children have an attentional bias for the detection of two types of modern threat-relevant stimuli—one with which they have experience (syringes) versus one with which they do not (knives). As predicted, the children detected the presence of syringes more quickly than pens, but did not detect knives more quickly than spoons. These results provide strong support for multiple mechanisms in threat detection.

*Keywords:* Threat; Detection; Fear; Attention; Attentional bias.

The ability to respond to threat quickly and efficiently is important for the survival of humans and other animals. Throughout the course of evolutionary history, individuals that recognised and detected threat particularly quickly would have been more likely to escape dangerous encounters and thus survive to reproduce. Because of the survival advantage of learning to identify and escape potential threat, some theorists have suggested that humans developed a biological

“preparedness” to associate evolutionarily threat-relevant stimuli with fear or aversiveness (Ohman & Mineka, 2001; Seligman, 1970, 1971). A vast body of literature supports this view in nonhuman primates and human adults (see Ohman & Mineka, 2001, for a review). In a related vein, others have theorised that humans are also biased to visually detect evolutionarily threat-relevant stimuli (Ohman, Flykt, & Esteves, 2001). This group of stimuli would only include threats that

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were recurrent and widespread throughout the course of human evolution, such as snakes and spiders.

The claim for the existence of a bias for the rapid detection of evolutionarily relevant threat has received empirical support from visual search studies showing faster detection of threat-relevant than threat-irrelevant stimuli. Ohman et al. (2001) presented participants with matrices consisting of pictures of snakes and spiders (fear-relevant) and flowers and mushrooms (fear-irrelevant). For each matrix, one of the two types of stimuli was designated as the target, and participants had to decide as quickly as possible whether or not a single target was present in each matrix. They reliably detected the presence of a snake or spider target among flowers or mushrooms more quickly than a flower or mushroom target among snakes or spiders. Further, the effect was enhanced in fearful participants; those who reported being afraid of snakes found snake targets even faster than non-fearful individuals did.

This basic finding has been replicated by several investigators (e.g., Blanchette, 2006; Brosch & Sharma, 2005; Flykt, 2005; Lipp, Derakshan, Waters, & Logies, 2004; LoBue & DeLoache, 2008; Ohman et al., 2001; Tipples, Young, Quinlan, Broks, & Ellis, 2002). However, it has been suggested that all of these studies do not necessarily point to an innate bias for the detection of evolutionarily relevant threat stimuli (Blanchette, 2006; Brosch & Sharma, 2005). Because most adults have some experience with or knowledge about snakes and spiders, it is possible that the rapid detection of these stimuli is based on experience. That is, individuals may respond particularly rapidly to these entities as a result of exposure to them.

One way to address this issue is to examine the detection of *modern* threat-relevant stimuli. Modern threats, such as guns and knives, did not exist over the course of human evolution, so an innate bias could not possibly be responsible for their rapid detection. Thus, if humans' rapid detection of snakes and spiders is based on an evolved bias, then there is no reason to expect the same attentional bias for modern threat-relevant stimuli

such as guns and knives. However, if the rapid detection of threat is based on experience, then *all* threat-relevant stimuli should be detected more rapidly than non-threatening stimuli.

Blanchette (2006) and Brosch and Sharma (2005) recently examined this issue in adults. Participants were asked to detect different categories of evolutionary and modern threat-relevant versus non-threat-relevant stimuli: Snakes and spiders versus flowers and mushrooms, as well as guns, knives, and syringes versus clocks, toasters, and pens. Across studies, *all* threat-relevant stimuli were detected more quickly than non-threat-relevant stimuli, regardless of whether they were of evolutionary or modern threat relevance. Thus, these findings suggest that the rapid detection of threat is not unique to evolutionarily threat-relevant stimuli, but includes modern threat-relevant stimuli as well.

These results challenge the assertion that evolutionarily threat-relevant stimuli are detected particularly quickly because of an innate bias. Instead, these findings suggest that the mechanism for the rapid detection of *all* threat-relevant stimuli is learning: Adults rapidly detect *both* modern and evolutionarily threat-relevant stimuli. However, recent research with infants does not support this idea. Very recently, LoBue and DeLoache (in press) found that 9- to 12-month-old infants (with likely no experience with snakes) turned more quickly to look at images of snakes than at flowers. A similar result was found in DeLoache and LoBue (2008), where researchers found that even younger infants (7- to 9-month-olds) also turned to look more quickly at moving and static images of snakes than at other animals. These results suggest that even infants, with likely no experience with snakes, also detect them particularly quickly. This research presents evidence against the idea that learning is responsible for the detection of all threat-relevant stimuli. Instead, it seems that humans may in fact have a predisposition to detect evolutionarily threat-relevant stimuli particularly quickly. How, then, do we rectify these results with the findings of Blanchette (2006) and Brosch and Sharma (2005)?

One possibility is that there are multiple mechanisms responsible for threat detection in humans (Blanchette, 2006). More specifically, it is possible that humans possess an evolved bias for the detection of evolutionarily relevant threats, but that they can also *learn* to detect modern threats as a function of experience (Blanchette, 2006). Blanchette (2006) argued that it is possible that modern threats are detected particularly quickly because we have been conditioned to associate them with negative outcomes.

Research with adults has demonstrated that rapid detection of potentially threatening stimuli can in fact be learned through conditioning. Koster, Crombez, Van Damme, Verschuere, and De Houwer (2004), examined whether adults would more quickly detect a neutral stimulus when it was predictive of an aversive noise (threatening) than when it was predictive of a neutral tone. Participants were briefly presented with one of two boxes (grey or white) on a large screen, immediately followed by either a burst of noise or a neutral tone. Participants were told to indicate as quickly as possible whether each box appeared on the left or right side of the screen. They were faster at indicating where the boxes appeared when they were indicative of an aversive noise. The authors concluded that a potential threat, such as an indicator of an aversive noise, captures attention more quickly than a neutral stimulus. Of particular importance here, they also concluded that this attentional capture can be learned through experience.

It is clear from this research that the rapid detection of modern threats can be learned. However, since previous research has mostly been with adults who have experience and knowledge about threat, it is unclear what mechanism is responsible for the rapid detection of evolutionarily threat-relevant stimuli. The only way to examine this question more closely is to study the detection of both evolutionary and modern threat-relevant stimuli in participants who do not have experience with the stimuli. Thus, the most relevant research would be with children, since they have limited experience and knowledge about both modern and evolutionarily threat-relevant

stimuli. If there are multiple mechanisms responsible for the rapid detection of threat in humans—an inborn mechanism for the detection of evolutionarily threat-relevant stimuli, and a learning mechanism for the detection of modern threat-relevant stimuli—then we would expect that children would detect stimuli like snakes very rapidly, but that they would only detect modern threat-relevant stimuli very quickly if they have had some kind of negative experience with the stimuli.

LoBue and DeLoache (2008) have used a touch screen procedure to examine the detection of evolutionarily threat-relevant stimuli by 3- to 5-year-old children. They found that both preschool children and adults detect snakes faster than flowers and various other stimuli. A further experiment demonstrated that 3-year-olds also detect spiders faster than mushrooms (LoBue, 2008). This research established that young children share adults' propensity to rapidly detect evolutionarily threat-relevant stimuli.

There is, however, no published research on the detection of modern threat-relevant stimuli by children. This is the focus of the current investigation. In the following experiment, young children's detection of two categories of stimuli was examined—syringes and knives. While we recognise that the strongest test of the relationship between experience and threat detection in children would be a conditioning study much like Koster et al. (2004), we do not feel that it is ethical to teach children threat responses, particularly threat responses that could potentially be disruptive, such as fear of syringes or knives. Instead, a visual search paradigm similar to that of Blanchette (2006) was designed to take advantage of children's *natural* experience with various modern threat-relevant stimuli.

In the research reported here, preschool children were asked to detect (a) syringes versus pens and (b) knives versus spoons. Syringes and knives are ideal threat-relevant stimuli for studying the role of experience in speed of detection for two important reasons. First, both of these stimuli have already been shown in previous research to be rapidly detected by adults (Blanchette, 2006;

Brosch & Sharma, 2005). Second, it is likely that young children have had experience with one of these stimuli but not the other. By the age of 3, most American children have had experience with syringes as the result of childhood vaccinations. Further, it is likely that this experience was *negative*, since it involved receiving a painful shot. In contrast, it is highly unlikely that children of this age would have had any experience with knives: Since knives are dangerous for obvious reasons, it is unlikely that 3-year-old children would have been allowed to handle a knife.

## METHOD

Using the same touch screen paradigm adopted by LoBue and DeLoache (2008), both preschool children were presented with  $3 \times 3$  matrices of colour photographs of (a) syringes versus pens and (b) knives versus spoons. Pens and spoons were used as threat-irrelevant comparison stimuli because of their physical similarity to the threat-relevant stimuli used in the study—syringes and knives. These comparisons were examined by Blanchette (2006) with adults, and her exact stimuli were used in the current experiment with children. Previous research has established this touch screen procedure with adults and with children, so only children were tested here (LoBue, 2008; LoBue & DeLoache, 2008). In each task, the children were asked to find a single target among eight distracters.

Given the likelihood that children would have had unpleasant experience with syringes, it was predicted that they would detect the syringes more quickly than the pens. However, although adults have had experience with knives, it is not likely to be the case for preschool children. Hence, it was predicted that preschool children should show no difference in detection of knives versus spoons.

### Participants

The participants were 24 3-year-old children ( $M = 43.3$  months,  $range = 37.2\text{--}46.9$ ) with equal

numbers of boys and girls in the child group. The children were recruited from records of birth announcements in the local community and were predominantly Caucasian and middle class. Four additional children were excluded from the study for failure to follow the experimenter's directions.

Each child participated in 2 conditions, with the order of conditions (syringes vs. pens or knives vs. spoons) counterbalanced. They were also assigned to one of two stimulus presentation orders for each condition. Finally, within each condition, the children were randomly assigned to detect either threat-relevant targets among non-threat-relevant distracters, or non-threat-relevant targets among threat-relevant distracters. The parent was not in the room while the child was being tested.

In addition, parents were asked several questions about their children's experiences with syringes and knives. First they were asked whether their child had ever been vaccinated. Further, they were asked if their child had had any other experience with a syringe and whether each experience was positive or negative for the child. They were also asked whether their child had ever had any experience handling a knife, and whether that experience was positive or whether the child had ever had any negative experience with a knife (i.e., had ever been pierced or cut). Finally, they were asked if their child was afraid of knives or syringes. Of the 24 parents tested, 22 replied to the questions. Their responses are discussed in the results section.

### Materials

The stimuli consisted of 4 sets of photographs of syringes, pens, knives, and spoons, with 6 exemplars in each category. These were the same photographs used by Blanchette (2006). The photographs were arranged in  $3 \times 3$  matrices, with 1 target picture from one category and 8 distracter pictures from the other category. Because there were only 6 exemplars of each photograph, 2 of the distracters were repeated in each matrix. The photographs were adjusted to

325 × 245 pixel images for presentation on the touch screen.

A MultiSync LCD 2010X colour touch-screen monitor was used to present each picture matrix on a 61 cm (24 inch) screen. The overall matrix was 39.4 cm × 39.4 cm, with 1.27 cm between rows and 0.64 cm between columns. The individual projected pictures measured 11.47 cm × 8.64 cm. Each of the 6 pictures in the target category served as the target 4 times, and the target appeared in each of the 9 positions of the matrix 2 or 3 times. The 6 pictures from the distracter category appeared approximately 4 times across trials. One stimulus order was created by randomly arranging matrices, and the second order was the reverse of the first. An outline of a child's handprints was located on the table immediately in front of the monitor.

### Procedure

Each child was seated in front of the touch-screen monitor (approximately 40 cm from the base of the screen) and told to place his or her hands on the handprints. This ensured that the child's hands were in the same place at the start of each trial, making it possible to collect reliable latency data. The experimenter stood alongside to monitor and instruct the child throughout the procedure.

First, a set of 7 practice trials was given to teach the child how to use the touch screen. On the first 2 trials, a single picture appeared on the screen, and the child was asked to touch it. The first picture was from the target category and the second from the distracter category. (All pictures used in the practice trials were chosen randomly from the original sets of 24.) Next, the child was presented with 2 trials with one target and one distracter picture and asked to touch only the target picture. Three practice trials followed, each involving a different 9-picture matrix. The child was told that for each trial, his or her task was to find the "X" (target) among "Y" (distracters) as quickly as possible, touch it on the screen, and then return his or her hands to the handprints. All the children readily learned the procedure.

A series of 24 test trials followed, with different picture matrices containing one target and 8 distracters presented on each trial. In between trials, a large smiley face appeared on the screen. To ensure that the child's full attention was on the screen before each matrix appeared, the experimenter pressed the face when she judged that the child was looking at it, causing the next matrix to appear. Latency was automatically recorded from the onset of the matrix to when the child touched one of the pictures on the screen.

After the children had completed the test for one condition, they were tested in exactly the same manner in the second condition.

### RESULTS

Preliminary analyses revealed no effects for experimenter (two experimenters were involved in running the experiment), gender, or order so these variables were not included in the analyses. As standard procedure for visual search tasks, only trials in which the correct target was selected were counted. Participants rarely erred (less than 7% of the trials), and errors did not vary by target.

In a 2 (Threat-Relevance: threat-relevant vs. threat-irrelevant) × 2 (Stimulus Type: syringes and pens vs. knives and spoons) ANOVA on the latency to touch the target, there was a significant main effect for Stimulus Type,  $F(1, 44) = 12.91$ ,  $p < .01$ , with a Stimulus Type by Threat-Relevance interaction,  $F(1, 44) = 5.76$ ,  $p < .05$ . The main effect of Stimulus Type revealed that children detected the presence of targets more quickly in knives versus spoons condition than in the syringes versus pens condition. It is likely that the latencies were longer for the pens versus syringes because these two types of stimuli were more difficult to discriminate than the knives versus spoons. This is consistent with previous visual search findings (LoBue, 2008; LoBue & DeLoache, 2008).

Of most importance, the Stimulus Type by Threat-Relevance interaction indicates that the children detected the threat-relevant targets more

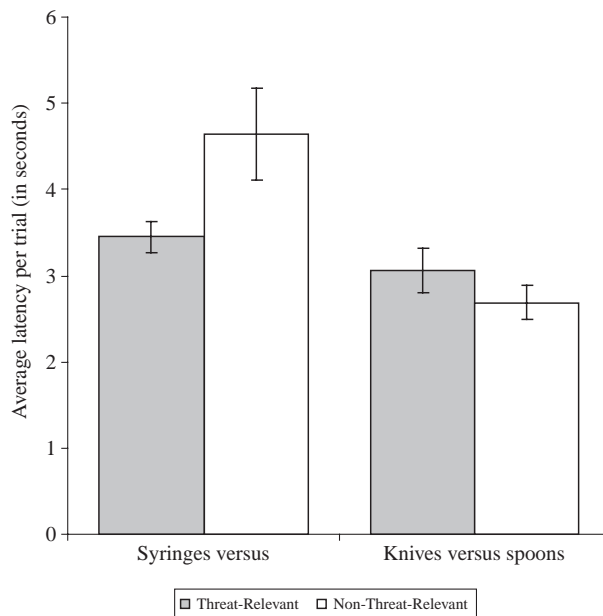
quickly than the non-threat-relevant targets only in the syringes versus pens condition. Post hoc comparisons confirm this result, demonstrating that the children detected the syringes significantly more quickly than the pens,  $t(1, 22) = 2.12$ ,  $p < .05$ , but there were no differences between the detection of the knives versus spoons,  $t(1, 22) = 1.12$ ,  $p = .56$ . These results are the first to demonstrate that superior detection of syringes is not limited to adults, but also occurs in children (see Figure 1).

These results are consistent with the parents' report of their children's experiences with knives and syringes. Based on parent report, 100% of children had had negative experiences with a syringe through vaccinations or doctor's visits, and *none* had ever had a negative experience with a knife. In fact, while all of the children in the study were readily able to identify a knife, all of their parents reported that their children were not permitted to handle knives at home, and had not had experience using a knife. None of the children were reported to be afraid of knives or dislike knives. Conversely, 59% of the children were

reported to be afraid of syringes, and 91% of parents *spontaneously* (and without prompt) reported that their children disliked syringes. These results are consistent with Blanchette (2006) and suggest that experience leads to the rapid detection of modern threat.

## DISCUSSION

The results of this experiment thus provide evidence for experience playing a role in humans' ability to detect modern threats particularly quickly. The results demonstrate that young children detect syringes (stimuli with which they had some negative experience) more quickly than pens, while demonstrating no difference in the detection of knives (stimuli with which they had little or no negative experience) versus spoons. These findings are consistent with the existence of two separate mechanisms for the rapid detection of threat—an evolved bias for ancient, evolutionarily relevant threats, such as snakes and spiders, and the ability to learn to rapidly detect modern



**Figure 1.** Average latencies to detect the target stimulus. The children detected the syringes significantly faster than the pens, but there were no significant differences for the detection of knives versus spoons.

threat-relevant stimuli, such as syringes, through experience (Blanchette, 2006).

There are two alternative explanations for the current findings. First, it is possible that varying amounts of novelty between the stimuli played a role in children's detection. For example, it is possible that spoons were more familiar to children than pens and were thus more distracting. However, the children in all conditions were easily able to identify all four categories of targets on the touch screen, making it clear that all four categories of stimuli were familiar to the children. Further, each target stimulus was presented with a different set of distracters. Future research using the same target stimuli with the same neutral distracters across conditions would be important. A second possibility is that simple stimulus characteristics were responsible for the rapid detection of the syringes. This possibility is also unlikely. First, the threat-relevant and non-threat-relevant stimuli were matched for shape and colour. Further, the stimuli used in this study were the same stimuli used by Blanchette (2006), who found that adults detect *both* syringes and knives more rapidly than non-threatening stimuli.

While these alternative explanations can be viewed as limitations, the current research also has several strengths. The current experiment examined children who have naturally had negative experience with syringes during the normal course of development. The results are particularly strong when considering that 100% of children in the sample had negative experience with syringes while none had ever had any negative experience with a knife. Further, most parents *spontaneously* reported that their children disliked syringes, adding strength to the contention that these children have had some kind of negative experience with syringes. For future research, it would be interesting to examine the development of visual search for threat longitudinally across age groups. By examining children's detection of threat from infancy through the preschool period, we could more precisely identify the experiences necessary in order to elicit faster detection of threat-relevant stimuli.

The current research also has important theoretical implications for the study of the human attentional mechanisms responsible for threat detection. The current findings suggest that humans have multiple mechanisms by which to detect threat: An evolved bias for evolutionarily relevant threats, and an ability to learn to detect more modern threats (Blanchette, 2006). The availability of multiple pathways for threat detection is quite adaptive—not only does it allow humans to quickly detect ancient threats like snakes and spiders, but it also allows humans to learn to quickly detect threats that are specific to an individual's environment. Data extending previous findings with adults (Blanchette, 2006; Brosch & Sharma, 2005) to children who have varying amounts of experience with modern threat-relevant stimuli adds important support for this multiple mechanisms view, and makes an important contribution to our understanding of the mechanisms responsible for humans' rapid detection of threat more generally.

In conclusion, the current results suggest that young children share the propensity of adults to rapidly detect modern threat-relevant stimuli with which they have had negative experience, such as syringes. This research is the first to examine the detection of modern threats by children who have little experience with most threat-relevant stimuli. Thus, the existence of this tendency in such young children lends important support for multiple mechanisms in the rapid detection of threat—an evolved bias for ancient, evolutionarily relevant threats, and a more flexible ability to learn to rapidly detect modern threat-relevant stimuli through experience (Blanchette, 2006).

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