Vicarious learning and un-learning of fear in children via mother and stranger models

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ABSTRACT

Evidence shows that anxiety runs in families. One reason may be that children are particularly susceptible to learning fear from their parents. The current study compared children's fear beliefs and avoidance preferences for animals following positive or fearful modelling by mothers and strangers in vicarious learning and un-learning procedures. Children aged 6 to 10 years (*N* = 60) were exposed to pictures of novel animals either alone (control) or together with pictures of their mother or a stranger expressing fear or happiness. During un-learning (counterconditioning) children saw each animal again with their mother or a stranger expressing the opposite facial expression. Following vicarious learning, children's fear beliefs increased for animals seen with scared faces and this effect was the same whether fear was modelled by mothers or strangers. Fear beliefs and avoidance preferences decreased following positive counterconditioning and increased following fear counterconditioning. Again, learning was the same whether the model was the child's mother or a stranger. These findings indicate that children in this age group can vicariously learn and unlearn fear-related cognitions from both strangers and mothers. This has implications for our understanding of fear acquisition and the development of early interventions to prevent and reverse childhood fears and phobias.

Keywords: Anxiety, Fears, Vicarious Learning, Modelling, Social referencing

Studies indicate that anxiety is more common in some families (Beidel & Turner, 1997; Kendler, Neale, Kessler, Heath, & Eaves, 1992). Some of this familial transmission can be explained by genetic factors, which explain roughly a third of the variance in anxiety (Eley, 2009) and phobias (Kendler et al., 1992). But this leaves a considerable proportion of variance to be explained by environmental factors. One environmental pathway to fear development is vicarious learning (Rachman, 1977), in which a child develops fear after observing someone else's fear. There is considerable evidence suggesting that fears can be transmitted in this way (see Askew & Field, 2008, for a review), with adults (Merckelbach, De Ruiter, van den Hout, & Hoekstra, 1989; Öst, & Hugdahl, 1981) and children (Ollendick & King, 1991) typically reporting vicarious learning as a causal factor in the onset of their fear. During early childhood, opportunities for vicarious fear transmission are most likely to be from parent to child or sibling to sibling because young children spend a good proportion of their time at home. Although anxiety in childhood is associated with both maternal and paternal anxiety (Bögels & Phares, 2008; Muris, Steerneman, Merckelbach, & Meesters, 1996), the role of the mother appears particularly important for vicarious fear learning. Children's fearfulness is associated with mothers' but not fathers' fear levels, and greater fearfulness is reported by children of mothers who more often express fear in front of their child (Muris et al., 1996). Likewise, Merckelbach, Muris, and Schouten (1996) found that mothers but not fathers acted as models for 9 to 14-year-olds that endorsed a vicarious learning explanation for their fear.

Social referencing studies also highlight the importance of mothers in vicarious learning. Social referencing occurs when an individual appraises a situation using their perception of someone else's interpretation of it (Feinman, 1982). In an extension of Gibson and Walk's (1960) influential 'visual cliff' procedure, Sorce, Emde, Campos, and Klinnert (1985) found that most 12 month old infants crossed an apparent drop when their mothers appeared happy, but no infants who saw their mother expressing fear crossed the 'cliff'.

Using a related procedure, Gerull and Rapee (2002) found that infants (aged 15–20 months) showed increased fear and avoidance of a rubber snake or spider after observing their mothers responding negatively to it. This indicates that fear responses to stimuli can be learnt via negative maternal modelling. Further investigation showed that when negative modelling was by a familiar stranger (the experimenter) learning could be prevented if children (12-21 months) were first exposed to positive maternal modelling (Egliston & Rapee, 2007). Thus familial fear transmission may not merely be the result of more frequent exposure to mothers. Mothers may also be more influential models than strangers for this age group and even have the ability to inhibit ('immunise' against) future fear-related learning involving strangers. This is also supported by earlier social referencing research showing that infants use information from the responses of their mothers, but not strangers, when faced with novel and uncertain situations (Zarbatany & Lamb, 1985).

Given that fear runs in families, and the likely importance of the primary caregiver to young infants, it is unsurprising that studies suggest maternal modelling is particularly influential in vicarious learning. However, there is also evidence that models and observers do not need to be related. Social referencing research has for example shown that 1-year-olds' behaviour can be influenced by the emotional facial expressions of a familiarised stranger (Klinnert, Emde, Butterfield, & Campos, 1986). There is also a substantial body of evidence from non-human primates suggesting the relatedness of a model to an observer is not important for vicarious learning. In a series of experiments offering some of the most compelling evidence for vicarious fear learning, Mineka, Cook, and colleagues showed that non-fearful rhesus monkeys rapidly acquire fear of snakes after observing other monkeys interacting fearfully with real and toy snakes (e.g., Cook & Mineka, 1989, 1990; Cook, Mineka, Wolkenstein, & Laitsch, 1985; Mineka, Davidson, Cook, & Keir, 1984). Although the first study involved adolescent monkeys and their parents (Mineka et al., 1984), subsequent studies used unrelated adults (e.g., Cook & Mineka, 1989, 1990; Cook et al., 1985). Adult monkeys were also less likely to learn fear of snakes after observing other unrelated monkeys acting non-fearfully with snakes in an immunisation procedure (Mineka & Cook, 1986). Thus in adult monkeys, both vicarious fear learning and prevention do not depend on models being related to the observers.

Experimental studies with children have also demonstrated that 7-9 year olds can vicariously acquire fear-related beliefs and avoidance behaviour via unrelated models (Askew & Field, 2007; Askew et al., 2008). In Askew and Field's vicarious learning procedure children were exposed to a series of animal-face pairing trials, each one consisting of a pair of images on a computer screen: one animal (conditioned stimulus: CS) and one emotional face image (unconditioned stimulus: US). There were three trial-types, each one involving one of three Australian marsupials (a Quoll, Quokka, or Cuscus): one animal was seen together with scared faces (scared-paired trials); one animal was seen with happy faces (happy-paired trials); and one animal with no faces (control trials). Children's self-reported fear beliefs about threat were found to have increased for animals seen with scared faces and these increases were still detected indirectly 3 months later using an affective priming task. In addition, children were also slower to approach scared-paired animals in a behavioural avoidance task. Thus vicarious learning was shown to causes changes in two of Lang's (1968) three anxiety response systems: subjective report and avoidance behaviour. Fear beliefs decreased for animals seen with happy faces suggesting vicarious learning might also be used to un-learn fear beliefs. Emotional faces were modelled by unfamiliar adults indicating that children of this age do not need to be related to the model for fear-related vicarious learning to occur. Nevertheless, the possibility that learning might have been greater if the model had been the child's mother cannot be ruled out.

To summarise then, vicarious fear-learning studies with young infants (12-21 months) suggest that mother models are more influential than stranger models (Egliston & Rapee, 2007; Zarbatany & Lamb, 1985). However, it is possible that this selectivity for maternal models diminishes as children get older: evidence from adult monkeys and older children (7-9 years) has shown that they can vicariously learn fear-related responses from strangers. But so far no research has directly compared learning via mother and stranger models in older children. The current study used Askew and Field's (2007) vicarious learning procedure to evaluate levels of fear-related learning for mother and stranger models in children aged 6 to 10 years. Children saw images of three unfamiliar animals together with images of emotional faces in three types of vicarious learning trial: scared-paired, happy-paired and unpaired (control). In addition, during a second vicarious phase, children were exposed to a series of un-learning (counterconditioning) trials of opposite emotional valence to compare the robustness of responses learnt via mothers and strangers: children saw their previously happy-paired animal together with scared faces and their previously scared-paired animal together with happy faces. During this phase the model was again either the child's mother or a stranger. Thus children were in one of four vicarious learning-counterconditioning groups: i) mother then mother; ii) mother then stranger; iii) stranger then mother; or iv) stranger then stranger. Based on previous literature with young infants it was expected that maternal fear modelling might produce larger fear-related learning effects than stranger modelling and be more robust to later stranger un-learning. Similarly, it also appeared likely that fear responses originally learnt via a stranger model would be more successfully reversed later by a mother than by a stranger model.

METHOD

Participants

Sixty children (29 boys, 31 girls) aged between 6.00 and 10.92 years (*M* = 8.73 years, SD = 1.28 years) took part in the study. Studies indicate that normal developmental fears often focus on animals for this age group (Field & Davey, 2001). Children were recruited via schools in south-west London, UK. Informed consent was obtained from parents prior to the study and children gave verbal assent.

Materials

Animals

Nine colour images (400 x 400 pixels) of three Australian marsupials, the quoll, quokka and cuscus were used as novel stimuli (Askew & Field, 2007; Field & Lawson, 2003): three pictures of each animal. These animals were chosen because UK children are generally unaware of them (Askew & Field, 2007). No children reported any knowledge of the animals.

Faces

Thirty-one mothers each provided three fearful and three happy colour portrait images (300 x 400 pixels), making 180 images in total. Some images were used more than once if the mother had more than one child taking part: eight mothers had two children and three mothers had three children participating. Siblings were randomly allocated across conditions. Mothers were taught how to pose using the guidelines and descriptions of Izard (1971) and Ekman and Friesen (1975); so for example for happy images, the corners of the mouth had to be raised along with the cheeks, and the eyes open and the forehead kept smooth. When conveying fear, the mouth had to be slightly open with the corners pulled straight back and lips stretched horizontally but without baring teeth. Eyes were wide open with the eyebrows raised but drawn together and the forehead was wrinkled.

Face stimuli were independently rated by 12 adults (8 female, 4 male; Aged 19-48 years: *M* = 26.67 years, *SD* = 10.61) who did not know the purpose of the study. Raters were asked to decide what emotion the person in the image was portraying from a list of options: happy, sad, angry, frightened, neutral, or disgusted. All 31 happy faces were rated as happy by all 12 raters. Similarly, 26 of the scared faces were regarded as appearing frightened by all 12 raters. Five of the faces were endorsed as frightened by only 10 (83.3%) or 11 (91.7%) of the 12 raters: two of the faces were rated as disgusted twice, another face was rated once as disgusted, one face was rated once as angry, and one once as neutral. After completing the study, children were asked to rate the three scared and happy pictures they had seen. All happy faces were rated as happy by all 60 children except for one child who rated one of their three happy pictures as neutral. All three scared faces were rated as frightened by 52 children. Seven children rated one of their three scared pictures as either sad or disgusted, and one child rated two faces as angry. Children mostly saw different pictures from each other and there was no evidence of a specific face being repeatedly endorsed as non-frightened.

Fear Beliefs Questionnaire (FBQ)

In the FBQ (Field & Lawson, 2003) children are asked how they would feel in seven hypothetical situations with each animal (e.g., “Would you be happy if you found a cuscus in your garden?”). Children respond to the total of 21 questions on a 5-point Likert scale (0 = ‘No, not at all’; 1 = ‘No, not really’; 2 = ‘Don’t know/Neither’; 3 = ‘Yes, probably’; 4 = ‘Yes, definitely’). There were 12 reverse scored questions. An average fear beliefs score from 0 to 4 was calculated for each animal, with 4 being the highest level of fear beliefs. Internal consistencies were in line with previous studies (e.g., Askew et al., 2008; Field, 2006b): before learning, Cronbach’s α = .74 (Quoll subscale), .69 (Quokka subscale) and .72 (Cuscus subscale), and after learning, .86, .84 and .88, respectively.

Nature reserve task

The nature reserve task has been successfully used in past research to measure children's avoidance preferences for animals (Field & Storksen-Coulson, 2007) and was adapted for the current study. Children were told that a green triangular board (60 cm x 60 cm x 60 cm) represented a nature reserve where the animals lived. Photos of each of the three animals were positioned at each of the three corners of the board by the experimenter. Children were asked to imagine they were visiting the reserve and to place a Playmobil figure (a boy for boys and a girl for girls) representing themselves onto the board in the location where they would most like to be. The distance from where the child placed their figure to each animal photo was measured, indicating children's approach or avoidance preference for the three animals. Increased avoidance preferences in the nature reserve task are associated with increased fear beliefs and behavioural avoidance in a behavioural avoidance task (Broeren, Lester, Muris, & Field, 2011).

Procedure

Vicarious learning

The vicarious learning procedure was computerised (Field, 2010) in Visual Basic.net with ExacTicks 1.1 (Ryle Design, 1997). The experiment was presented via an RM 4300 laptop computer with a 15" screen running XP.

Children were randomly allocated into one of four model groups: mother-mother (MM), mother-stranger (MS); stranger-stranger (SS); and stranger-mother (SM). There were two vicarious learning stages; so for example children in the MS group first experienced vicarious learning with their mother (M) as model, and later vicarious learning (counterconditioning) with a stranger (S) model.

Children first completed an FBQ and then the first vicarious learning stage began. Each child saw each of the three animals presented on a computer screen together with a different emotional face in 30 animal-face 'pairings': one animal was seen with a scared face 10 times ('scared-paired'), one animal with happy faces 10 times ('happy-paired') and one animal was presented alone for 10 trials ('unpaired'). The type of emotion a child saw with each particular animal was dependent on which of three counterbalancing orders they had been randomly assigned to. In addition, depending on which model group they had been assigned to, faces were either of their mother or a stranger. In the first vicarious learning stage each child in the MM and MS groups saw 20 pictures (10 scared, 10 happy) of their mother's face. Children in the SS and SM groups saw exactly the same faces, but to these children they were stranger faces. Allocation of mother images as strangers to SS and SM groups was random, but care was taken that the child did not know the mother. Each trial lasted 2 s in total, followed by a randomly determined inter-trial interval of between 2 and 4 s. One scared-paired or happy-paired trial consisted of an animal being presented on the screen for 1 s alone and a further 1 s together with a face on the opposite side of the screen. Unpaired trials consisted of just the animal being presented for 2 s. The specific animal image and side of the screen it appeared on were randomly determined for each trial.

Following vicarious learning, children completed the FBQ a second time followed by the first nature reserve tasks. Next, the second vicarious learning stage was identical to the previous one except for two important differences. First, previously happy-paired animals were now presented with scared faces and previously scared-paired animals were presented with happy faces (counterconditioning). Unpaired animals remained unpaired. Also, children in the MS and SM groups saw a different model: MS group children had seen their mothers face in the first vicarious learning stage but now saw a stranger's face; the opposite was the case for the SM group. SS and MM groups saw the same model as in the first vicarious learning phase. Following this, the third FBQ and second nature reserve task were both administered again. Finally, children were fully debriefed using games and puzzles and correct information about the animals.

RESULTS

An alpha level of .05 was used for all statistical tests and effect sizes are reported where interpretable: partial eta-squared (η^2_p) for ANOVA and *r* for planned comparison analyses.

Age

Age across conditions was compared using one-way independent ANOVA and showed a marginally significant difference in age between two of the conditions, $F(3, 56) = 2.93$, $p = .04$, $\eta^2_p = .14$. Post-hoc comparisons revealed that children in the MS group ($M = 8.03$ years, $SD = 1.40$ years) were slightly younger than children in the SS group (9.32 years, SD = 0.06 years). The age of children in these two groups did not differ from children in the MM ($M = 8.66$ years, $SD = 1.30$ years) and SM groups (8.91 years, SD = 1.29 years). This indicates that children who saw their mother in the vicarious learning phase were on average 1.3 years younger than children who saw a stranger. Children were randomly assigned to conditions and this age difference is unfortunate; however, there is no evidence as far as we are aware that developmental differences between 8-years-olds and 9-years-olds are great enough to affect vicarious learning. Nevertheless, given the possibility of developmental effects, age was included in all initial analyses.

Fear beliefs

Fig. 1 shows mean fear beliefs before and after the vicarious learning procedures for each modelling group. An initial analysis involving children's age (younger vs. older) showed no significant age interactions and hence for clarity the final fear beliefs analysis was collapsed to a three-way 4(model group: MM, MS, SS, and SM) x 3(pairing type: scared, happy and none) x 3(time: baseline, post-learning, and post-counterconditioning) mixed ANOVA with repeated measures on the last two variables. The important (Greenhouse-Geisser adjusted) time x pairing type interaction was significant, $F(3.13, 175.05) = 18.55$, $p < .001$, $\eta^2_p = .25$, showing that vicarious learning had led to changes in fear beliefs that were different depending on the type of face presented. Planned comparisons comparing baseline fear beliefs and fear beliefs after the first vicarious learning procedure showed a significant increase after scared-pairing, $F(1, 56) = 21.58$, $p < .001$, $r = .53$, and decrease after happy-pairing, $F(1, 56) = 10.12$, $p = .002$, $r = .39$. Comparisons of baseline fear beliefs with those after counterconditioning found no significant differences for happy, $F(1, 56) = 2.77$, $p = .10$, $r = .22$, or scared, $F(1, 56) = 0.11$, $p = .75$, $r = .04$, pairings, showing that fear beliefs returned to baseline levels following the vicarious counterconditioning procedure.

There was also a significant main effect of pairing type $F(2, 112) = 5.55$, $p = .005$, $\eta^2_p = .09$. All other main effects and interactions were non-significant, including the group x pairing type x time interaction, $F(9.38, 175.05) = 1.04$, $p = .41$, $\eta^2_p = .05$, indicating that vicariously learnt changes in fear beliefs were no different in all four model groups. The effect size for this interaction was also very small and any effect therefore negligible.

Insert Figure 1 about here

Avoidance preferences

Figure 2 shows mean distances (cm) from the animal to the figures children placed on the board. Two separate analyses were performed at each time point: after the first vicarious learning and after counterconditioning. Again, initial analyses comparing younger and older children found no effects of age, so age was not included in the final analyses. A two-way 2(model type: mother vs. stranger) x 3(pairing type: scared, happy and none) mixed ANOVA was performed on nature reserve task scores after the first vicarious learning procedure. The Greenhouse-Geisser adjusted effect of pairing type was significant, $F(1.70, 98.59) = 19.73$, $p < .001$, $\eta^2_p = .25$, indicating vicarious learning affected how far away from animals children placed themselves on the board. Planned comparisons showed no difference in avoidance preferences for animals seen with scared faces compared to the control animal, $F(1, 58) = 0.38$, $p = .54$, $r = .08$., but children avoided animals they had seen with happy faces less than the control animal, $F(1, 58) = 21.20$, $p < .001$, $r = .52$. Thus positive vicarious learning decreased children's avoidance compared to an unpaired animal but negative vicarious learning did not affect avoidance. The main effect of model type, $F(1, 58) = 0.01$, $p = .94$, $\eta^2_p < .001$, and the pairing type x model group interaction, $F(1.70, 98.59) = 0.14$, $p = .84$, $\eta^2_p = .002$, were non-significant. Effect sizes were also extremely small, indicating that type of model, mother or stranger, had no effect on avoidance preferences.

A three-way 4(model group: MM, MS, SS, and SM) x 3(pairing type: scared, happy and none) x 2(time: post-learning vs. post-counterconditioning) mixed ANOVA was performed on nature reserve task distances measured after the counterconditioning phase. The time and first model type variables were also included in this analysis because avoidance scores for each animal may already be elevated or lowered following the first vicarious learning event so avoidance after counterconditioning needs to be considered relative to the first vicarious learning event. The important time x pairing type interaction was significant, $F(1.71, 95.63) = 26.45$, $p < .001$, $\eta^2_p = .32$, indicating that avoidance preferences changed due to vicarious counterconditioning depending on the type of face seen with an animal. Planned comparisons found that avoidance increased for scared-paired (previously happy-paired) animals, $F(1, 56) = 8.45$, $p = .005$, $r = .36$, and decreased for the happy-paired (previously scared-paired) animal, $F(1, 56) = 26.44$, $p < .001$, $r = .59$, compared to the control animal. The main effects of time, $F(1, 56) = 5.52$, $p = .02$, $\eta^2_p = .09$, and pairing type were also significant, $F(2, 112) =$

10.30, p <.001, η^2_p = .16. All other effects were non-significant, including the pairing type x time x model group interaction, $F(5.12, 95.63) = 1.71$, p = .14, η^2_p = .08. The effect size for this interaction was also very small, indicating the effect was trivial and that the type of model did not influence avoidance in the nature reserve task.

Insert Figure 2 about here

DISCUSSION

The main findings of the study were that: (1) self-reported fear beliefs for animals increased after children saw them with scared faces and decreased after they saw them with happy faces; (2) vicariously learned increases and decreases in fear beliefs for animals returned to baseline levels via a vicarious counterconditioning procedure; (3) avoidance preferences also increased for scared-paired and decreased for happy-paired animals after counterconditioning; and (4) effects were similar for mothers and strangers: the type of model did not affect changes in fear beliefs and avoidance during either initial vicarious learning or subsequent counterconditioning.

These results support previous findings showing that fear-related vicarious learning increases children's fear beliefs and avoidance preferences for animals (Askew & Field, 2007; Askew et al., 2008; Gerull & Rapee, 2002). Studies with 7 to 9-year-olds have indicated that non-relatives can act successfully as models (Askew & Field, 2007; Askew et al., 2008) and results here corroborate this. Evidence from young infants though, suggests that mother models are particularly important; for example, young infants seek and use information from their mothers, but not strangers, when faced with ambiguous situations (Zarbatany & Lamb, 1985). This was not supported by the current study, which found no difference in learning for mothers and strangers. Interpreting non-significant results can of course be problematic because non-significance can also be due to insufficient power. However, effect sizes for these interactions were extremely small. Sample size can influence accuracy of effect sizes but was large enough here (*N* = 60) to justify confidence in their precision. Therefore a power explanation of non-significance can be ruled out.

This is the first study to directly compare learning via mother and stranger models in school-age children. Children were much older (6-10 years) in the current study than is typical for social referencing (e.g., aged 13-15 months: Zarbatany & Lamb, 1985) and maternal fear-modelling studies (e.g., aged 12-21 months: Egliston & Rapee, 2007; Gerull & Rapee, 2002). Thus differences in findings to previous studies most likely reflect a greater readiness for older children to accept behavioural information from adults outside of the direct family. Children were all attending UK primary schools and likely to be more used to learning from non-family members than is the case for very young children. Taken together, the studies suggest that young infants are likely to be selective, preferentially learning about new threats from their mothers' responses; but older children are equally happy to learn from their mothers and strangers.

One implication of this and other research appears to be that fathers are less influential fear models than female strangers. In one previous study, 9 to 12-year-olds' trait anxiety was associated with both their mother's and father's trait anxiety, but fearfulness was only associated with mother's fearfulness (Muris et al., 1996). Similarly, Merckelbach et al. (1996) found far more of their spider phobic 9 to 14-year-olds reported mother modelling than father modelling. However, these reports are from children who already have fears and while they are useful to show how existing fear and anxiety developed, they do not necessarily indicate how influential father models would be during a learning event. In general, females are more likely to have fears and anxiety than males (Craske, 2003) and hence may be more likely to act as fearful models to children than fathers. There may also be more opportunity for mothers to transmit their fears to young children if they spend more time with them than the father, which is often the case (OECD, 2012). These factors could contribute to the findings from studies of children with existing fears. Non-clinical, experimental studies like the current one, on the other hand, can directly compare the relative influence of different models during vicarious fear learning. It could be useful to use a similar methodology to compare mother, father, and stranger modelling.

The study also showed that vicariously acquired fear beliefs can be reversed using a vicarious counterconditioning procedure in which children see their scared-paired animal again with happy faces, or their previously happy-paired animal with scared faces. Again, this was demonstrated for both mothers and strangers and no differences were detected. This contradicted our expectation that fear-related learning from mothers might be more resistant to modification by stranger models and is interesting because it indicates that timely positive modelling from anyone, including strangers, can be used to reverse vicariously acquired fear responses in this age group. This is the case even if the original fear learning was via the child's mother. This has important implications for parents and those working with school-age children because it suggests they can potentially prevent or reverse fear developing if they recognise a child is involved in a fear-related vicarious learning event (e.g., by responding positively towards a nonthreatening animal after a child encounters someone with a phobic response to it). The findings highlight how the experimental procedure could be used in the future to develop early intervention and fear prevention strategies. Clearly it is not desirable to create actual fears in children and so vicarious fear learning has typically been studied retrospectively in children or adults with existing fears (see Askew & Field, 2008, for a review). One of the strengths of the current procedure is that it represents a harmless laboratory model of what happens in the real world, which could be valuable for developing and assessing new fear prevention and intervention strategies in non-fearful children.

Previous research has demonstrated fear-related vicarious learning leads to increased avoidance preferences (Askew, Dunne, Özdil, Reynolds & Field, in press) and behavioural avoidance for animals (Askew & Field, 2007). Similarly, avoidance preferences increased here for scared-paired animals during vicarious counterconditioning and decreased for animals seen with happy faces. However, elevated avoidance preferences were not detected for scared-paired animals following the first vicarious learning phase. One reason for this could be that baseline measures of avoidance preferences were not taken before vicarious learning. Increases in avoidance were detected post-counterconditioning compared to pre-counterconditioning learning levels, but similar comparisons could not be made between pre- and post-vicarious learning. This is important because avoidance preferences for scared-paired and unpaired animals were compared, and were similar following vicarious learning. Without a baseline measure though, we cannot be absolutely certain whether avoidance changed or remained the same. For example, avoidance preferences for scared-paired animals could theoretically have been lower at baseline than for unpaired animals and only subsequently increased to similar levels following learning. This would mean that avoidance of scared-paired animals had increased due to vicarious learning but was not detected due to the absence of a baseline measure. This explanation seems unlikely given that comparisons were made to an unpaired control animal and stimuli were counterbalanced across conditions. Nevertheless, future studies might consider taking pre-learning measures of avoidance preferences.

One final limitation of the current methodology is that we cannot rule out unequivocally the possibility that fear beliefs would have returned to baseline levels even without the counterconditioning procedure. To establish this we would have had to use four additional 'no-counterconditioning' conditions, which would have doubled the number of groups and substantially increased the complexity of the design. However, given that self-reported fear beliefs have previously been found to remain elevated at least 1 week following vicarious learning, and have even been indirectly detected 3 months later using affective priming (Askew & Field, 2007), it appears very unlikely that they would have returned to baseline so rapidly here without the counterconditioning procedure.

To summarise, the current study showed that, unlike young infants, 6 to 10-year-olds vicariously learn fear-related responses to novel stimuli from both mothers and strangers; the type of model does not appear to affect the size or robustness of the learnt fear response. Vicariously acquired fear responses can also be reversed using vicarious learning and again it does not make a difference whether this counterconditioning is modelled by the child's mother or by a stranger. These findings seem to reflect children's increasing willingness to learn from the responses of strangers as they get older.

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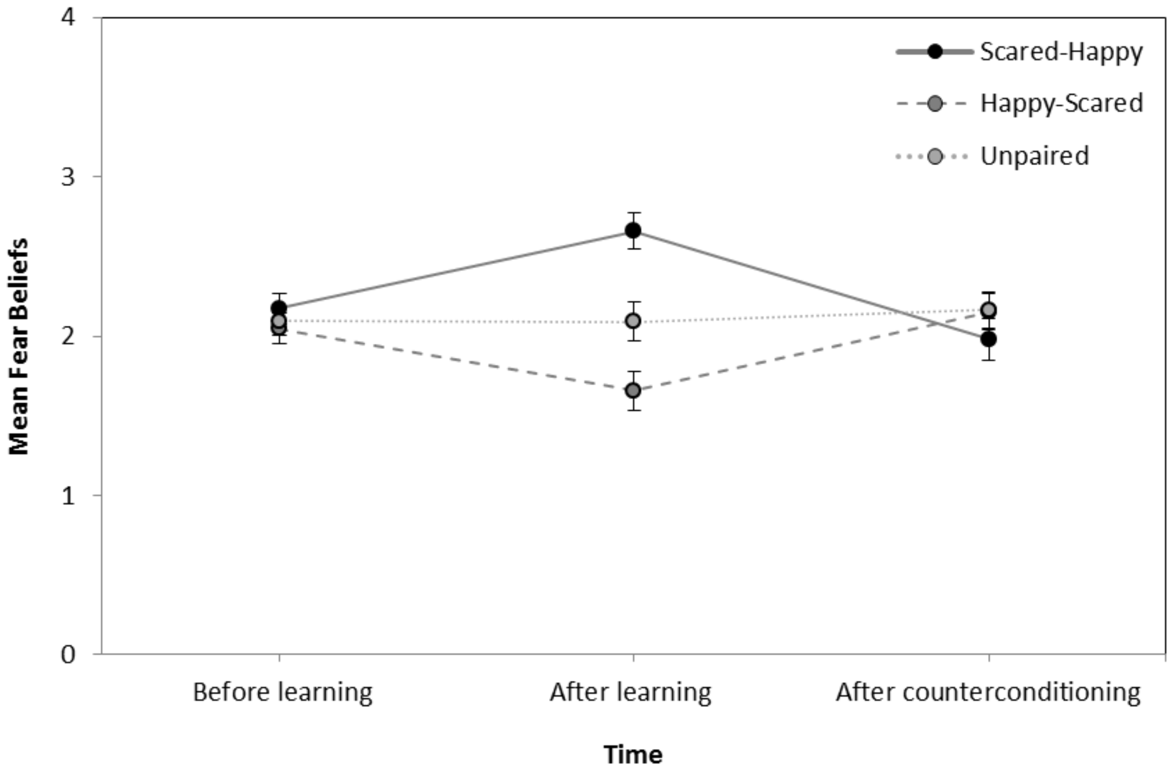

Figure 1. Graph showing mean (and SE) fear beliefs before and after the two vicarious learning phases.

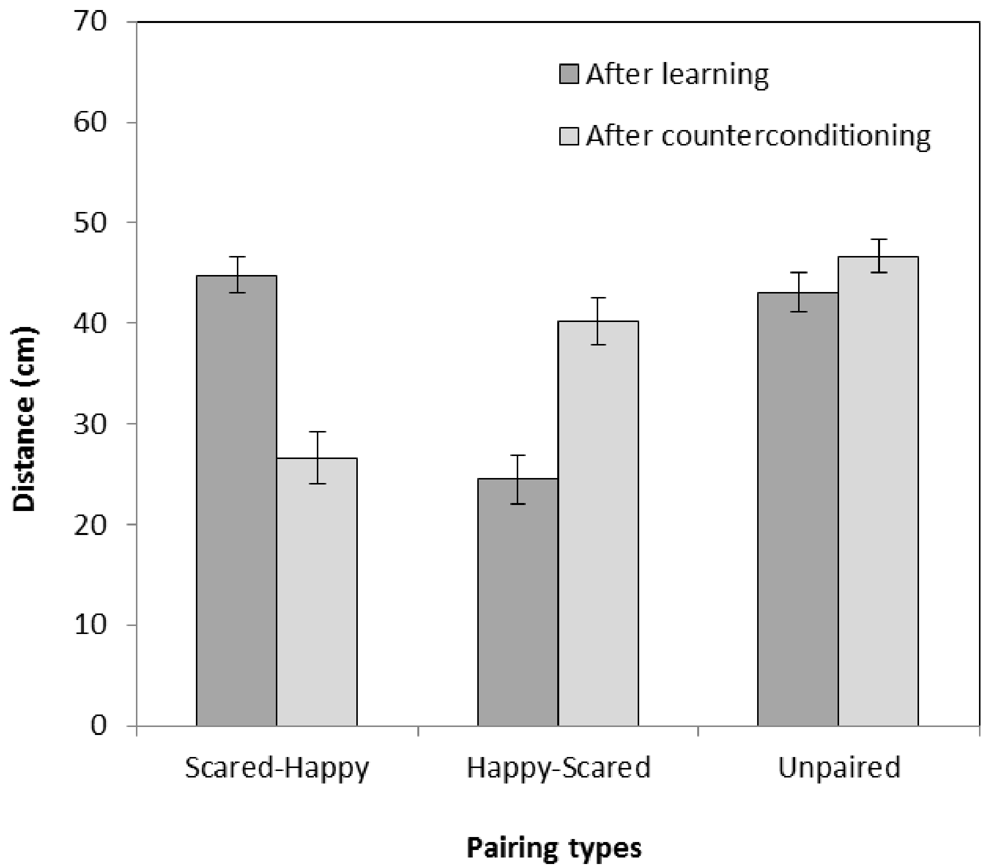

Figure 2. Graph showing mean (and SE) distance (cm) between animals and children's figures in the nature reserve tasks