HHS Public Access

Author manuscript

Dev Psychobiol. Author manuscript; available in PMC 2023 March 01.

Published in final edited form as:

Dev Psychobiol. 2022 March ; 64(3): e22257. doi:10.1002/dev.22257.

The Social Learning of Threat and Safety in the Family: Parent-to-Child Transmission of Social Fears via Verbal Information

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Abstract

Parental verbal threat (versus safety) information regarding the social world may impact a child's fear responses, evident in subjective, behavioral, cognitive, and physiological indices of fear. In this study, primary caregivers provided standardized verbal threat or safety information to their child (N=68, M=5.27 years; 34 girls) regarding two strangers in the lab. Following this manipulation, children reported fear beliefs for each stranger. Physiological and behavioral reactions were recorded as children engaged with the two strangers (who were blind to their characterization) in a social interaction task. Child attention to the strangers was measured in a visual search task. Parents also reported their own, and their child's, social anxiety symptoms. Children reported more fear for the stranger paired with threat information, but no significant differences were found in observed child observed fear, attention, or heart rate. Higher social anxiety symptoms on the side of the parents and the children exacerbated the effect of parental verbal threat on observed fear. Our findings reveal a causal influence of parental verbal threat information only for child-reported fear and highlight the need to further refine the conditions under which acquired fear beliefs persist and generalize to behavior/physiology or get overruled by non-aversive real-life encounters.

Keywords

social learning; instruction; verbal information pathway; parents; social fear

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Conflict of Interests
The authors declare that they have no conflict of interest.

Code availability
All codes used during data processing will be stored online within one month after publication to DataverseNL, available upon request from the corresponding author.

Social anxiety disorder (SAD) is a highly prevalent and debilitating cluster of mental illness with an early onset and often chronic course (Bijl, Ravelli, & Van Zessen, 1998; Burstein et al., 2011; Ruscio et al., 2008; Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992). SAD is defined by persistent distress and worry for social performance and interaction situations, particularly the perceived prospect of being embarrassed or negatively evaluated (American Psychiatric Association, 2013). The subjective experience of excessive anxiety or worry occurs together with greater physiological reactivity and biases in response to social cues across several steps of information processing during social situations (Beidel, Turner, & Dancu, 1985; Nikolić, 2020) and may lead to social avoidance.

There is a familial contribution to SAD: The offspring of parents with SAD are two-to-three times more at risk to develop SAD (Tillfors, Furmark, Ekselius, & Fredrikson, 2001). Genetic influences only partially explain this familiality (Hettema, Prescott, Myers, Neale, & Kendler, 2005; Hettema, Neale, & Kendler, 2001; Kessler et al., 2005), leaving room for environmental influences on the experience and consequences of social fear. Moreover, certain child characteristics seem to exacerbate the effect of environmental input (Nigg, 2006). Children with behavioral inhibition, a temperamental style characterized by fearful and withdrawn reactions to novelty, and an early precursor of SAD (Fox, Henderson, Marshall, Nichols, & Ghera, 2005; Pérez-Edgar & Guyer, 2014), seem to be especially sensitive to parental anxiety expressions (e.g., Aktar, Majdandžić, De Vente, & Bögels, 2013; de Rosnay, Cooper, Tsigaras, & Murray, 2006).

Social fears are common as well in non-clinical samples (Stewart & Mandrusiak, 2007), and typically increase between middle childhood and adolescence (Bokhorst, Westenberg, Oosterlaan, & Heyne, 2008; Westenberg et al., 2009). The environmental acquisition of social fears that contribute to the familial transmission of SAD seems to operate through the same pathways that lead to the environmental acquisition of typical and adaptive social fears among healthy children (Murray, Creswell, & Cooper, 2009). Children may acquire fears in the family (Rachman, 1977), either through modeling a parent's non-verbal anxiety signals (i.e., vicarious learning, observational learning or modeling; Askew & Field, 2008), or through their verbal communication of anxiety (i.e., information transfer or instruction learning; (Muris & Field, 2010; Percy, Creswell, Garner, O'Brien, & Murray, 2016).

In the presence of parental SAD, specific environmental influences in the family can come in the form of discrete repetitive learning experiences with parents in social situations (e.g., de Rosnay, Cooper, Tsigaras, & Murray, 2006; Murray et al., 2014). Parents with SAD not only express higher levels of anxiety in these situations (Aktar, Majdandžić, De Vente, & Bögels, 2013; Murray et al., 2008), but they are also more likely to communicate threat information to their children regarding these situations (Murray et al., 2014; Percy et al., 2016). Repeated exposure to parental non-verbal and verbal expressions of fear in these social encounters may enhance the salience and threat value of social situations, triggering physiological reactivity and anxious information processing, which leads the child to develop excessive fear of social situations. Individual measures of a fear or stress response at specific levels of analysis allow researchers to draw inferences regarding individual mechanisms contributing to a specific social encounter. However, fear responses draw on

multifaceted processes that do not work in isolation and reflect varying timescales and levels of conscious understanding. The current paper employs multiple measures which, in the aggregate, can provide a richer sense of potential cascading processes in the moment and across time (Kagan, Snidman, Mcmanis, Woodward, & Hardway, 2002; Lobue et al., 2020).

From a behavioral science perspective, fear reactions are conceptualized as action dispositions triggered by an imminent threat, aiming at maximizing survival chances (Hamm, 2020). These include increases in physiological vigilance (e.g., increased heart rate), cognition (e.g., enhanced selective attention), and behavioral tendencies (e.g., increased avoidance) co-occurring with the subjective experience of fear. These dispositions are aimed at preparing the organism for a possibly aversive encounter with the threat. For example, selective attention ensures the quick detection of, and orientation to, a threat stimulus, whereas physiological vigilance together with avoidant tendencies ensures quick escape in the face of an aversive encounter with the threat. The intensity of action dispositions in each component, as well as the synchrony between them, grow in parallel to the imminence and proximity of the threat stimulus (Hamm, 2020).

According to Lang's tripartite model (2004), fear reactions must be studied by considering the intensity and overlap of reactions at the cognitive, physiological, and behavioral levels. Thus, in the context of social fear acquisition, to gain insight into the effects of exposure to parental anxiety expressions and associated mechanisms, it is essential to study fear acquisition using multiple components of child fear reactions. This approach allows researchers to explore differences and similarities in the sensitivity of these separate fear indices to verbal information.

The importance of incorporating multiple fear outcomes has been highlighted especially in infancy (LoBue et al., 2020) where the non-verbal pathways to social fear acquisition in the family are already functional (Aktar et al., 2013; de Rosnay et al., 2006; Murray et al., 2008). Evidence relying on behavioral observations of child avoidance reveals that exposure to parents' non-verbal anxiety expressions to strangers leads to avoidance of strangers among 10-to-14-month-olds, independent of the parental SAD (Aktar et al., 2013; de Rosnay et al., 2006; Murray et al., 2008). In turn, parents' verbal expressions of anxiety may constitute a more explicit threat signal in childhood, making the verbal pathway a central environmental learning trajectory in the parent-to-child transmission of fear (Rachman, 1977). Yet, despite the presumed importance of verbal threat information in the familial transmission of fear, only a limited number of studies have prospectively investigated the verbal information pathway to fear acquisition in designs incorporating the multi-component nature of child fear responses.

The available evidence in young children has focused on the start of school as a new social situation for 4-to-6-year-olds. The findings from clinical samples suggest that mothers with SAD convey higher levels of threat surrounding this new social situation in their narratives to their children (Murray et al., 2014) and children of socially anxious mothers react with more anxious or negative responses (Pass, Arteche, Cooper, Creswell, & Murray, 2012), leading to higher levels of school anxiety subsequently. By the same token, when non-anxious mothers of typically developing children are more worried about their child

starting school, their narratives on the topic are overall more negative, and more likely to include verbal comments signaling threat and anxiety, resulting in a more negative representation of the school by their child (Pass, Mastroyannopoulou, Coker, Murray, & Dodd, 2017). Taken together, the evidence illustrates the significant role of parental verbal information in social fear acquisition at the transition to schooling, regardless of parental SAD status.

Laboratory studies of verbal fear acquisition in typically-developing children have used a paradigm in which children receive a threat, safety, or neutral message from an adult or a peer paired with unknown animals or dolls (Field, Argyris, & Knowles, 2001). Evidence from the studies using this paradigm consistently revealed that verbal threat information has a significant effect on multiple levels of fear reactions in early and middle childhood years, including cognitive (reported fear beliefs, attention biases, implicit associations), behavioral (observed avoidance), and physiological responses (heart rate (HR), Field & Lawson, 2003; Field, 2006b, 2006a; Field et al., 2001; Field, Lawson, & Banerjee, 2008; Field & Schorah, 2007; Lawson, Banerjee, & Field, 2007; Muris et al., 2009).

Muris and colleagues (Muris & Field, 2010) examined the impact of verbal threat information when conveyed by mothers, as opposed to a researcher or peer. Mothers were provided with verbal threat, safety, or ambiguous information about unknown animals. Mothers were then given vignettes that describe direct confrontations with these animals and were instructed to discuss the vignettes with their 8-to-13-year old child. Children of mothers who received verbal threat (versus positive) information about novel animals had higher fear beliefs regarding the novel animals. When the verbal information provided to parents was ambiguous in nature, maternal trait anxiety predicted transmission of fear beliefs: More anxious mothers were more likely to attribute threat to the animal paired with ambiguous information. Another study by Remmerswaal and colleagues (Remmerswaal, Muris, Mayer, & Smeets, 2010) found that threat (versus safety) information by the experimenter resulted in stronger fear beliefs and a stronger reasoning bias about the animal in mothers, which in turn translated to a higher number of verbal threat and anxiety information transmitted from the parents to the offspring. This resulted, in turn, in higher fear beliefs, and stronger reasoning bias in their 9 to 12-year-old children. Other experiments have shown effects on maternal avoidance (Remmerswaal, Muris, & Huijding, 2013) as well as on children's avoidance especially in the case of anxious attachment (Bosmans, Dujardin, Field, Salemink, & Vasey, 2015).

Although the available evidence from the limited number of experimental designs focusing on parental verbal transmission has provided valuable insights into the potential role of verbal information pathway in the parent-to-child transmission of anxiety, novel animals were the only type of fears addressed. To our knowledge, no studies have yet addressed the role of parents' verbal information in the context of social fears. Two earlier studies investigated the role of the verbal information pathway in the acquisition of social fears from unfamiliar adults or peers. First, Field and colleagues (Field, Hamilton, Knowles, & Plews, 2003) found that verbal threat (versus safety or neutral) information from peers changed 10-to-13-year old's fear beliefs regarding public speaking, but not eating in public or meeting a new group of children. Teacher-provided information had no impact on child fears.

Interestingly, the direction of the significant effect was opposite of what was predicted: verbal safety information from peers enhanced, whereas the threat information reduced, fear beliefs. To explain these inconsistent findings, Field and colleagues highlighted the potential impact of children's earlier experiences with social situations, and the relatively more complicated nature of peer relations in this age group. Second, a follow-up study by Lawson and colleagues (Lawson et al., 2007) in 6-to-8 and 12-to-13-year-olds found that manipulating the type, source, and mode of fear presentation impacted the presence and intensity of change in child fear beliefs: a significant effect of verbal threat information was found on both explicit and implicit fear beliefs of 12-to-13-year-olds, independent of the source of information, or of child trait anxiety.

There are a number of open questions in the literature with respect to the verbal transmission of social fear. First, the verbal information pathway to social fear acquisition has not yet been investigated in the context of family. Second, due to the choice of novel stimuli, a real confrontation with fear-inducing animals or social situations was not feasible in earlier studies, limiting the measurement of behavioral anxiety and avoidance. For example, avoidance has been measured in a simulated behavioral approach task, capturing children's willingness to approach and put their hands in the holes of a wooden box that supposedly contains the animals (Field & Lawson, 2003; Field, 2006a; Field et al., 2008). LoBue and colleagues (Lobue, Bloom Pickard, Sherman, Axford, & Deloache, 2013) recorded a series of encounters with live animals (e.g., fish, hamsters, snakes, and spiders) and noted that children interacted with all of the animals, if a bit more cautiously with the threatening ones. It is unclear how a simulated, as opposed to a "real-life" social encounter, would affect child fear responses after verbal instruction. Third, although the importance of incorporating cognitive, physiological, and behavioural components of fear reactions outlined in Lang's tripartite model of fear responses (Lang, 2004) is well acknowledged in this line of research, those indices are most often investigated in separate experiments. To our knowledge, all three levels of child fear reactions have not been simultaneously incorporated in a single study.

Finally, individual differences explained by child characteristics, such as child behavioral inhibition (BI) and child anxiety remain to be further explored in clinical and community samples. Child behavioral inhibition and child anxiety are proposed to strengthen or facilitate fear acquisition via social learning (Field & Price-Evans, 2009; Reynolds, Askew, & Field, 2018). In particular, children with high levels of temperamental fearfulness or response to social novelty display greater biological sensitivity to context (Hastings, Rubin, Smith, & Wagner, 2019). Thus, attunement with parents and parental information may play an outsized role in shaping acute fear responses and socioemotional trajectories (Muris, Steerneman, Merckelbach, & Meesters, 1996; Reynolds et al., 2018).

The few studies investigating the moderating role of behavioral inhibition have noted that the effects of verbal threat information regarding novel animals may trigger stronger fear reactions to those animals in some components. Field and Price-Evans (2009) reported that the effect of verbal threat information was more pronounced among high BI children for the physiological component of fear responses, but not in subjective self-reported fear (Field & Price-Evans, 2009). In another study (Field, 2006a), stronger behavioral avoidance, as well

as stronger attention biases were shown in children scoring higher in behavioral inhibition as a result of verbal threat information. In contrast, the only study investigating individual differences explained by child pre-existing levels of social anxiety in the context of social fear acquisition did not find a significant moderation of verbal information by child social anxiety (Lawson et al., 2007). It is important to note that the constructs of behavioral inhibition and anxiety have sometimes been interchangeably used in the earlier literature to refer to child anxious temperamental dispositions (e.g., Field & Price-Evans, 2009), and have so far only been addressed in separate experiments. Thus, it remains unclear whether it is possible to distinguish their contribution to child vulnerability to fear acquisition via social learning processes in this age range among generally healthy children.

In contrast to the child anxiety dispositions, the question of whether the variation in parental levels of (social) anxiety explain individual differences in child fear acquisition from parents has, to our knowledge, not been addressed in this line of research. Instead, the focus has been on comparing parents to peers and teachers as alternative sources of information (e.g., Field et al., 2003; Lawson et al., 2007). However, when the parent is the source of verbal information, parental levels of social anxiety may modulate the impact of verbal information. Building on associative and statistical learning, children come to create stable schematic expectations of their environment (e.g., threatening vs. safe) based on how people around them react to daily life experiences. Repeated exposure to anxious parental behavior may therefore shape a child's own response to potential stressors.

The Current Study

The current study aimed to investigate the effect of parental verbal threat and safety information on the acquisition of stranger anxiety in a typically developing sample of 4-to-6-year-old children. In an adaptation of the task developed by Field and colleagues (Field et al., 2001), we used strangers as the novel stimuli. This allowed us to address the effects of parental verbal threat information on child behavior during real-life social encounters, in addition to subjective measures of fear beliefs.

Moreover, we aimed to gain insight into how parental verbal threat information affects the physiological, cognitive, and behavioral components of fear reactions during direct encounters with strangers, along with the child's subjective experience. Engagement with an imminent threat is known to trigger the sympathetic nervous system, leading to the activation of the adrenergic system reflected not only in the physiological responses such as increased HR but also in the prioritised cognitive processing of threat stimulus (Hamm, 2020).

At the physiological level, we focused on heart-rate (HR) responses as an index of physiological effects triggered by the confrontation with the stranger paired with parental threat versus safety information. At the cognitive level, we focused on reported fear (fear beliefs) and attention measures. At the behavioral level, we focused on observable signs of fearful and avoidant reactions. Earlier evidence on the verbal information pathway in childhood years has revealed significant effects of verbal information at each of these levels in response to non-social stimuli, and the current study aims to extend this knowledge to

the context of social fear acquisition. Incorporating multiple indices of fear in one study makes it possible to examine the effect of parental verbal threat information on individual components as well as concordance between components.

The focus in the current experiment was on the early childhood years. This allowed us to investigate the causal role of parental verbal information on child acquisition of social fears in the period preceding normative increases in social fear levels (Bokhorst et al., 2008; Westenberg et al., 2009). We trained the primary caregiver to provide standardized verbal threat and safety information to their child paired with the pictures of two strangers that the children later encountered. After the primary caregiver provided the standardized verbal information about each of the strangers, children completed an adaptation of the fear beliefs questionnaire (Field et al., 2001; Field & Lawson, 2003) for each of the strangers with the help of an experimenter. Following this, children confronted the two strangers who were blind to their characterization. To compare child fear reactions to the stranger paired with threat versus safety information, physiological and behavioral fear reactions to each of the strangers were recorded during a social interaction task in which children were engaged in a conversation by each stranger separately. Following the social tasks, we measured child attention to the strangers in a visual search task in which the strangers' pictures appeared as stimuli. In addition, we asked both the primary caregiver and the second parent (when available) to complete questionnaires measuring their social anxiety symptoms and their child's temperament and social anxiety symptoms.

We aimed to answer the following research questions:

1. What is the effect of parental verbal threat (versus safety) information on children's acquisition of fear of strangers? Based on the earlier literature, we expected a significant effect of parental verbal threat (versus safety) information on child behavioral (observed anxiety and avoidance), cognitive (reported fear beliefs and attention), and physiological indices of fear reactions. Based on earlier evidence with non-social threat stimuli, we hypothesized that children would (1) report higher fear beliefs, (2) show stronger behavioral and physiological (higher HR) fear responses, and (3) show an attentional bias (shorter reaction times) to the stranger paired with parental threat versus safety information. We also explored the associations between these indices of child fear.

2. Is the effect of parental verbal threat (versus safety) information on fear acquisition moderated by child characteristics (behavioral inhibition and social anxiety) or by parental social anxiety? Based on preliminary evidence suggesting an influence of child BI and anxiety (Field, 2006a; Field & Price-Evans, 2009), as well as parental anxiety (Muris & Field, 2010; Murray et al., 2014), in the verbal transmission pathway, we explored the idea that the effect of parental verbal information would be exacerbated for children with greater social anxiety symptoms or with parents with higher levels social anxiety. We explored this potential moderation in the cognitive, behavioral, and physiological components of child fear reactions.

Method

Participants

A community sample of 68 American children between 4 and 6 years of age participated in this study with their primary caregiver (Age Mean=5.27, SD =.74, Range: 4.03–6.65, 34 girls, 91.18% Caucasian). Both parents of participating children (if available) were invited to complete online questionnaires, whereas only the primary caregiver joined the child in the lab visit (63 children visited with the mother). When both parents were equally involved in care, families could choose the parent that accompanied the child to the lab. Families were recruited via the Pennsylvania State University FIRSt (Families Interested in Research Studies) Database, which connects researchers with families interested in contributing to research. English-speaking parents over age 18 with 4-to-6-year-old children were included in the current sample. The exclusion criteria were premature birth, underweight (<2500 grams), severe pregnancy complications, or child health issues involving major injury, hospitalization, or developmental delays. Sociodemographic characteristics of the parents are presented in Table 1. The experiment had to be terminated in two cases before the manipulation due to high levels of child stress. Complying with the behavioral coding protocol, child observed fear and avoidance scores were coded as the maximum in these two cases, whereas the remaining data from the lab visit were not available.

Lab visit.

Strangers.—The stranger role was played by trained undergraduate students who were randomly assigned to threat and safe conditions and were blind to their condition. Blinding was broken in 6 participants because either the child or the parent disclosed the assignment in their conversation. Portrait pictures of the strangers with a neutral expression were used for the experimental manipulation, for the measurement of fear beliefs, and for the attention tasks. To facilitate the child's pairing of the parental verbal information to the two strangers, both the pictures and the instruction cards containing the verbal information were presented on a coloured frame (yellow or green, counterbalanced) that matched the judge's t-shirt color and label (yellow versus green judge). Strangers were instructed to remain neutral (except for briefly smiling at the beginning and the end of each social task), but friendly, during the social tasks. None of the participating children or parents reported having met the strangers before the lab visit.

Verbal information.—The verbal threat and safety information was adapted from Field and Lawson (2003, see Appendix 1). The order and the colour of the threat information were counterbalanced. Three trained undergraduate observers later coded the recordings to check parents' compliance with the instructions by counting the number of phrases mentioned by the parent in each of the conditions. Recordings from 15 families (22% of the total sample) were double-coded. The inter-rater reliability of the stranger in the threat condition could not be computed, due to zero variance between coders across conditions, thus 100% agreement. The intra-class correlation was .90 for the stranger in the safety condition. The total number of phrases used by the parent did not significantly differ between the threat ($M = 7.54$, $SD = 1.56$) and safe ($M = 7.47$, $SD = 1.59$) conditions, $F(1, 67) = 1.68$, $p = .200$.

Child reported fear beliefs.—Children reported fear and avoidance of strangers in a social version of the Fear Beliefs Questionnaire (FBQ) that was adapted from Field & Lawson, 2003. This version consists of two example questions, followed by six questions about child perceptions of fear (e.g., 'would you be scared if you see the Green/Yellow judge?') and avoidance (e.g., 'Would you stay away from the Yellow/Green Judge if you see him/her?) for each of the judges, scored on a 5-point scale (1: no, not at all, 2: no, not really, 3: don't know/neither, 4: yes, probably, 5: yes, definitely) (see Appendix 2).

To reduce researcher bias, recordings of the FBQ were coded by three trained bachelor students who were blind to condition. A sample of 15 recordings was double-coded to establish inter-rater reliability, with intraclass correlations for the mean FBQ scores of .99 and .97 for the first and the second stranger, respectively. For the double-coded recordings, the scores of the three coders were averaged in the final dataset.

Child heart rate.—Children's heart rate (HR) was measured continuously with the Mindware BioLab software using a 7-lead ECG, at 1000 Hz (Mindware Technologies, Gahanna, OH) starting with the baseline measurement until the end of the social tasks. Child HR data were processed using Mindware Heart Rate Variability 3.0.17 software (Mindware Technologies). A baseline and muscle noise filter were applied to remove baseline drift and high-frequency noise resulting from muscle activity. The peaks in heart rate were detected by the Hilbert transform method (Chanwimalueang, Von Rosenberg, & Mandic, 2015). First, movement or software artifacts in the interbeat interval data were flagged by statistical algorithms by the Mindware software. Next, missing or incorrectly identified beats were visually inspected and corrected by a trained researcher to correct mistakenly identified peaks, or replaced missing peaks as needed. In a small minority of cases where it was not possible to reliably detect peaks in a given interval (due to electrodes getting loose, or temporarily lost connections), the HR scores were left as missing (<1% of the observations in the final dataset).

Data were not available from 10 children who refused the electrodes. The connection with the device was lost and could not be reestablished in two children. We coded the overall quality of the HR data on a 10-point scale, with higher scores reflecting less artifact correction. The mean HR data quality for the 56 children who provided HR data was 8.53 (SD = 1.28, range 5–10). Children with missing HR data did not differ from those with HR data in gender, p = 1.00 or in their BI composite score p =.457, and in the SCARED social anxiety scores p =.115, whereas non-completers were younger in age $t(66) = 5.07$, p <.001. The data quality did not divert beyond 3 SD for any of the participants with HR data. The distribution of the HR data revealed sufficient normality (skewness & kurtosis within |2|) and there were no outlying observations (beyond 3 SD of the group or own mean). Thus, no participants were excluded during the processing of the HR data. For the current analysis, the focus was on the social interaction phase with the two judges along with the baseline measurement. Mean HR was extracted within the 5 successive 30-sec time intervals of social interaction with each of the strangers, and 10 successive 30-sec time intervals of the 5-minute baseline.

Social interaction task.—Following a social performance task with the two strangers (not used in the current study), the social interaction task was conducted with each of the strangers individually. This task was adapted from Aktar, Majdandžić, De Vente, and Bögels (2017). The stranger and the child were seated in two adjacent chairs facing the camera, turned towards each other. Each stranger engaged the child in a conversation with questions about school, family, and friends for approximately 2.5 minutes.

Child observed fear.: Child anxiety and avoidance responses to each of the strangers were observed during the social interaction task using the coding protocol from Aktar et al. (2017). The coding included the stranger's entry in the beginning (the time between the stranger entering the room and starting the conversation) and the exit (the time between the stranger ending the conversation and leaving the room) as the first and last intervals respectively. The 2.5-minute duration of the interaction was divided into five 30-second episodes. In 40% of the cases, the conversation lasted 10–15 seconds longer as the strangers took a bit more time to finalize the interaction. We added an additional interval for these cases.

The child anxiety dimension captured the frequency and duration of facial (e.g., a fearful expression or a frozen smile), bodily (e.g. a frozen, stiff posture, and fidgeting), and vocal/verbal expressions of fear (e.g., crying or saying 'I am scared', 'go away'). The child avoidance dimension captured the child's tendency to avoid the stranger, including more subtle manifestations such as gazing away and turning away, and more explicit attempts to increase the distance to the stranger, by walking away or hiding behind the parent, on a 5-point scale (1: no avoidance, 2: fleeting/ambiguous avoidance, 3: moderate avoidance, 4: intense avoidance, 5: very intense avoidance). In addition to child anxiety and avoidance, child behavior was coded into dimensions of positive engagement and positive shyness (not used in the current analyses).

In line with earlier evidence (Aktar et al., 2017), there were strong associations between child mean fear and avoidance scores in the social interaction task, $r(68) = .58$, and $r(68) = .54$, for the first and second stranger respectively, p's $< .001$. Child fear and avoidance responses were therefore averaged into an observed child fear composite while keeping the hierarchical repeated structure across the eight repeated measurements within the social interaction tasks. Recordings of social interaction were coded by four trained master's students who were blind to condition. To establish inter-rater reliability, the scores from 15 children were double-coded, the intraclass correlations for the observed child fear composite across the eight coding intervals ranged from .57 to .94, with a mean of .87 ($SD = .10$). The scores from the double-coded recordings were averaged to reach the final scores in the final dataset.

Visual search task.—Following the social tasks, child attention to the strangers was measured in the visual probe and visual search tasks. Due to the limitations on the reliability of the visual probe task, we limited the analyses of attention to the visual search task in the current study. The task was displayed on a 22-inch screen (1600*900 px, image dimension 228*279 px per picture with 100 px between the pictures). Following a 500-ms fixation image (a coloured sun drawing), pictures of neutral facial expressions of 9 models were

displayed in a 3*3 matrix. Models were the researchers who played the stranger role. The task consisted of 54 trials. Each stranger appeared twice in each of the nine locations in the matrix, for 18 trials per stranger, and an additional 18 trials that did not contain the picture of the strangers. Children were instructed to indicate the presence of a judge with a response box by pressing the left button as soon as they saw one of the judges on the screen, and the right button if no strangers appeared in the trial. Child reaction times to the strangers paired with threat and safety messages in this task were used as an index of child attention to strangers. Children also completed general visual search and dot-probe tasks with standardized affective stimuli (not used in the current analyses).

Child attention in the visual search task.—The data from 11 children were not available for the visual search task as the experiment was terminated due to child fatigue/stress or due to experimental error. Data from 4 children who selected one response more than 90% of the time, and data from one child who performed 3 *SD*s below the mean, were removed from further analysis. The trials in which none of the strangers appeared, and the trials where the RT's were 3*SD*s below or above the group mean (25 trials) or their own mean (31 trials), were removed. The mean percentage of correct responses was 88.50 % (*N* = 52, SD = 10.17, *range*: 59.26 to 100%). At the final step, RT data were averaged across trials separately per condition. Attention data were available for 52 children in the final analyses. Children with missing attention data did not differ from those with attention data in gender ($p = .570$), age ($p = .613$), BI composite score ($p = .690$) or social anxiety levels ($p = .567$). To assess the reliability of the attention task, we calculated attention bias scores by subtracting the RT to the stranger paired with safety from the RT to the stranger paired with threat information, separately for odd and even trials. Spearman-Brown corrected split-half reliability of the visual search task was .49. Child mean reaction times to the trials with each of the stranger's pictures were compared to test the effect of the manipulation on child attention.

Parental questionnaires.: Both parents of participating children were invited to fill in online questionnaires on sociodemographic characteristics, their child's overall functioning, anxiety symptoms, and temperament, as well as their own positive and negative emotions including anxiety, depression, and stress. For the current study, our focus was on the measures assessing social anxiety symptoms. All 68 mothers of participating children and 61 fathers (fully or partially) completed the questionnaires. For the current analyses, we used the self-reported social anxiety scores of the primary caregiver as a moderator in the analyses. In turn, for child measures of social anxiety and temperament, we used the average of the ratings from the two parents whenever available. Averaging the two parents' ratings aims to reduce potential biases in parental perceptions of child temperament and anxiety, due to their own traits and experiences with the child (Kelley et al., 2017). In additional analyses presented in the Exploratory Analyses section, we explored the same association with general anxiety scores in place of social anxiety to gain some insight into the specificity of the individual differences explained by anxiety dispositions.

Child BI.—Child BI was measured using the parental reports in the Behavioral Inhibition Questionnaire (BIQ, Bishop, Spence, & McDonald, 2003), a 30-item questionnaire

measuring child negative reactivity to novelty social and non-social stimuli (such as strangers, or novel situations) on a 7-point scale, and the very short form of Child Behavior Questionnaire (CBQ, Putnam & Rothbart, 2006), a 36-item questionnaire measuring the temperamental dimensions of child negative affect (such as fear, shyness, discomfort, and frustration) and regulation (such as reactivity, soothability, and inhibitory control) on a 7-point scale. For the purposes of the current study, we focused on the fear and shyness subscales of the CBQ and the Social Novelty Subscale of the BIQ. The five items of the fear and shyness subscales of the CBQ were coded into a single dimension (Cronbach alphas .78 for mothers and .72 for fathers). The internal consistencies of the three BIQ scales on social novelty were high for unfamiliar adults, peers, and situations (Cronbach alpha's .94, .94, and .90 for mothers, and .92, .91, and .87 for fathers, respectively).

The mean scores of parental ratings were first separately averaged across the three subscales of unfamiliar adults, peers, and situations of the BIQ to reach the maternal and paternal rating of child response to social novelty. The correlation between mothers' and fathers' ratings was $r(60) = .72$, $p < .001$. Maternal and paternal mean ratings were therefore averaged into a single score of behavioral inhibition to social novelty score. The correlation between mothers' ($N = 68$) and fathers' ($N = 60$) ratings of child temperamental fear/shyness on the CBQ was $r(60) = .67$, $p < .001$. The maternal and paternal ratings were averaged into a single score of temperamental fear/shyness. The correlation between child scores on the CBQ and BIQ was $r(68) = .65$, $p < .001$. Given this association, we computed a composite score of child behavioral inhibition by first standardizing and then averaging the scores from these two questionnaires.

Child social anxiety.—Parental report of child social anxiety was measured using the Screen for Child Anxiety Related Disorders (SCARED, Birmaher et al., 1997, 1999). The SCARED is a 41-item questionnaire measuring anxiety symptoms using a 3-point Likert scale. For the current study, our interest was the 7-item social anxiety subscale. The internal consistency of this questionnaire was high, Cronbachś alphas were .92 for the total score, and .89 for the social anxiety subscale for mothers, and .86 and .83 for fathers respectively. The averaged ratings of both parents on child anxiety scores in the total SCARED score ranged between 1 and 36.5 with a mean score of 7.79 (SD=6.57). The cut-off score for an anxiety disorder was proposed to be 25 (Wren et al., 2007), revealing that the sample, in general, had mild levels of anxiety, with only one child scoring above the cut-off.

There was a positive moderate correlation between mothers' ($N = 68$) and fathers' ($N = 61$) ratings of child social anxiety in the SCARED, $r(61) = .53$, $p < .001$. Final scores were computed as the average of maternal and paternal mean ratings. There was also a strong positive association between child BI and child social anxiety scores $r(68) = .80$, $p < .001$ that did not allow for separate investigation of their contribution in the analyses in view of multicollinearity issues. Instead, we computed a child social anxiety composite by averaging standardized scores of BI and child social anxiety into a single final score of child social anxiety.

Parent social anxiety.—Parents reported on their own social anxiety symptoms using the adult version of Screen for Child Anxiety Related Disorders SCARED-A (Bögels & Van

Melick, 2004), and the short version of the Social Phobia and Anxiety Inventory (SPAI, de Vente, Majdandžić, Voncken, Beidel, & Bögels, 2014). The SCARED-A is a 71-item questionnaire that measures anxiety symptoms on a 3-point Likert scale. Our current interest was in the 9-item subscale of parent social anxiety. The internal consistency of SCARED-A was high (Cronbachś alphas were .92 for the total score and .87 for the social anxiety subscale). The 18-item version of the Social Phobia and Anxiety Inventory measures social anxiety symptoms on a 4-point scale. Two items (item 6, and 18-e) were not correctly displayed and were therefore replaced with the mean scores of the remaining non-missing items. Cronbachś alpha was .94 in the current sample.

Scores on the SCARED-A were available from all 68 primary caregivers of participating children. There was a strong positive association between parental social anxiety symptoms as measured by the social anxiety subscale of the SCARED and the SPAI, $r(68) = .84$, $p < .001$. We standardized and averaged parents' scores in these two scales into a single measure. As the two constructs share most but not all of their variances, aggregating helped us to keep unique variance while addressing the overlap between these variables, helping to achieve greater statistical stability. The raw association between final composite scores of child and parental social anxiety scores were not significant, $r(68) = .23$, $p = .062$ (see Table 2).

Procedure

Following the intake to the lab by the Researcher (R), participating parents and children were informed about the general procedure, and written informed consent was obtained from the primary caregiver, along with the verbal assent of the child. Parents were provided written information about the real aims of the study in the informed consent form, whereas, at this phase of the experiment, children only received the information that they would be playing games first in the lab and then on the computer. Following the intake, R accompanied the parent and the child to the experimental room.

The experimental room included a clothing rack with costumes, a camera, and a table and chairs. There was also a stage consisting of a wooden step, a microphone, and lights. This part of the room was occluded with a cloth at the beginning of the experiment. Following entry to the experimental room, R invited the child to pick a costume and introduced the parent and child to the mobile physiology equipment and electrodes. After the electrodes were placed, a second researcher brought the parent to another room for the instructions on the experimental manipulation, while child baseline measurement of the physiology started in the experimental room. Children were instructed to wait for 2.5 minutes with the R and were free to sit silently or play/chat with the test leader until the parent came back.

In the meantime, parents were first reminded that the primary purpose of the study was to investigate the effect of their positive and negative verbal comments on their child's reaction to strangers and described the overall procedures. Parents received the pictures of the judges assigned to the specific visit, along with the instruction cards containing the verbal information. Next, the second researcher walked through the instructions with the parent and asked them to provide the information for one judge at a time, using the specific phrases provided in the instruction cards, in the assigned counterbalanced order. Parents

were allowed to keep the instruction cards with them during the manipulation, although they were instructed to convey the information in a naturalistic conversation, rather than reading it to their child. We asked parents to behave naturally after the manipulation phase, and encourage their child's participation when necessary. Parents were given a few more minutes to go through the information cards before going back to the experimental room.

Upon parents arriving in the experimental room, R uncovered the stage and informed the child about the social tasks and the two judges. Following this, the parent conveyed the information regarding judges to the child. R then returned to the room and completed the Fear Beliefs Questionnaire with the child, using the pictures of each stranger.

During the social performance task, the child was invited on stage to sing their favourite song in front of the two strangers. As this task did not allow us to observe child reactions to the two strangers, it was not further analyzed in the current study. Following a 2-minute recovery after the performance task, the social interaction tasks started. Each stranger separately engaged the child in a 2.5-minute conversation while child physiology and behavior were recorded. There was a 2-minute recovery period between the two interactions. After social tasks, child attention biases to the two judges were measured with a visual search task, followed by three other attention tasks (not used in the current study). At the end of the experiment, children were debriefed about the deception involved in the current study. R explained to the child that the information that their parent gave about the judges was part of the experiment and that judges were not how they were described. The visit ended after the families received the compensation for participation.

Analytic Approach

The current dataset includes multiple outcomes of child fear reactions during the stranger interaction phase of the experiment, each with its own hierarchical repeated structure. The repeated structure consists of two repeated observations (one per stranger) per child for reported fear (in the FBQ) and for attention (RT in the visual task). In turn, the observed fear composite consisted of 8 repeated observations per stranger, and the HR indices contain 5 repeated observations per stranger, in addition to 10 observations for the baseline. To decide on the analytical approach, we first computed the raw correlations between mean scores averaged over the two stranger interaction episodes during the lab visit. Interestingly, none of the interrelations between children's observed, reported fear, HR, and attention (RT) were significant (see Table 2, p's > .116). This suggests a lack of synchrony between separate indices of fear. We, therefore, decided to analyze the effect of the condition in separate models per child outcome using multi-level regressions (hierarchical linear mixed models), that allow us to keep the original repeated structure of each separate outcome variable and to accommodate all random and non-random sources of missingness in the dataset.

Following the first analyses on the effect of parental verbal comments in each of these outcomes, we incorporated the moderators of child and parent social anxiety composites to all models. The distributions of child and parent social anxiety composite scores indicated sufficient normality (skewness and kurtosis were within |2|).

Reported child fear scores were first analyzed in repeated general linear models with the condition as the independent variable. Next, the main effects of the covariates, child, and parent social anxiety, along with their two-way interactions with the condition were tested in full factorial models.

Observed child fear scores had a nested structure with 8 repeated observations during the social interaction with each of the strangers, giving rise to 16 observations per child. Child observed fear was analyzed in repeated mixed hierarchical models with the time and condition as fixed variables. The inspection of the distribution for observed fear revealed sufficient normality (skewness and kurtosis values within |2|). The scores on observed fear and the covariates were standardized in the current models. The intercept was first randomized, but was redundant and caused convergence problems, and was therefore removed from the models. An autoregressive covariance structure was used for the repeated observations. The reference for the time variable was the first phase (i.e., stranger entry) and the reference for the condition was safety information. Maximum likelihood estimation was used. The scores on the observed fear as well as the covariates were standardized in the models. In the initial multi-level regression models we tested the effect of time, in addition to condition and time*condition. Next, the two-way interactions of the child and parent social anxiety covariates with time and with condition, in addition to the three-way interactions between time, condition, and child/parent social anxiety were included in this first model. To reach the most concise multi-level models for the analyses, the non-significant effects were removed one-by-one starting with the higher-order interactions and higher *p*-values.

Child HR had a nested structure with 20 repeated observations during the three phases (10 during the 5-minute baseline, and 5 during the social interaction with each of the strangers). HR responses were analyzed in repeated mixed hierarchical models with time and condition as fixed variables. The inspection of the distributions for HR revealed sufficient normality, skewness, and kurtosis values were within |2|. The scores on HR and the covariates were standardized in the current multi-level models. The intercept was first randomized, but was redundant and caused convergence problems, and was therefore removed from the models. An autoregressive covariance structure was used for the repeated observations. The reference for the time variable was the first time point, and the reference for the condition was safety information. Maximum likelihood was the estimation method. Similar to the repeated mixed hierarchical models with HR as the outcome, the two-way interactions of the covariates with time and with condition, and the three-way interactions between time, condition, and each of the covariates were included in the initial first model. The final model was reached using the same strategy.

Child attention to strangers was first analyzed in repeated general linear models with the condition as the independent variable, and child reaction time to stranger trials as the dependent variable. Next, the main effects of the covariates (child and parent social anxiety), and their two-way interaction with condition were tested in full factorial models.

Results

Reported child fear.

Child reported fear beliefs for the strangers significantly differed between the strangers paired with threat versus safety message $N = 66$, $F(1, 65) = 113.95$, $p < .001$. Children reported significantly stronger fear beliefs to the stranger paired with threat ($M = 3.88$, $SD = .84$) as compared to safety ($M = 2.23$, $SD = 1.00$). In the model with social anxiety scores included as covariates, no significant two-way interactions were noted between condition and child social anxiety, and between condition and parent social anxiety, ($p = .201$ and .566 respectively. The main effects of the child or parent social anxiety were also not significant ($p = .581$, and .669, respectively). As such, while parental verbal information influenced child-reported fear in the FBQ, and we found no evidence for the idea that individual differences in pre-existing levels of social anxiety in parents or children further exacerbated the effect of verbal threat information in the current sample.

Observed child fear.

The multi-level models on the effect of parental verbal information did not reveal a significant interaction between condition and time $F(1, 698.83) = .547$, $p = .460$, reducing the final model to the main effects. The final model did not reveal a significant difference between child observed fear reactions to the strangers paired with the threat versus safety information, $N = 68$, $F(1, 332.13) = .18$, $\beta = -.04$, $SE = .01$, $p = .675$. There was a significant main effect of time, $F(1, 519.28) = 4.35$, $p = .038$, revealing higher levels of fear observed in later intervals as compared to the first interval of this task.

In the model including the parent and child social anxiety as additional predictors, the two-way interactions between condition and child social anxiety $F(1, 951.51) = 5.89$, $p = .015$, and between condition and parent social anxiety $F(1, 953.63) = 6.12$, $p = .014$, were significant and retained in the final model presented in Table 3. Inspection of the plots with the mean predicted scores of observed fear (see Figure 1) revealed a positive association between child social anxiety and observed fear that was stronger for the safe, as compared to the threat, condition. In turn, there was a cross-over interaction between condition and parents' social anxiety: the link between parental social anxiety and child observed fear was negative in the safety condition, but positive in the threat condition (see Figure 2).

Taken together, we conclude that parental verbal threat versus safety information alone did not significantly alter children's observed fear of strangers. However, once individual differences in parent and child social anxiety were included, we found that the effect was moderated by social anxiety levels of the children and the parent. The positive associations of child and parent social anxiety with child observed fear in the threat condition suggests that parental and child characteristics can further exacerbate the effect of parental threat messages on observed child fear.

Child Heart Rate.

The multi-level models on the effect of parental verbal information on child HR ($N = 56$) did not reveal a significant interaction between condition and time, $p = .618$ reducing this model

to main effects. The main effect of condition was significant, $F(2, 468.88) = 9.67$, $p < .001$, while the main effect of time was not significant $p = .298$. Children showed a higher mean HR during the baseline $\beta = .40$, $SE = .15$, $p = .007$ as compared to the social interaction with the stranger paired with safety information, whereas HR responses to strangers paired with threat versus safety did not significantly differ, $\beta = -.06$, $SE = .09$, $p = .530$.

The HR model including the covariates (presented in Table 4) revealed a significant two-way interaction between child social anxiety and time, $F(1, 937.97) = 8.97$, $p = .003$, whereas none of the remaining tested interactions were significant in the first model. Inspection of the plots with mean predicted HR values from the final model revealed a negative association between child social anxiety and child HR that was stronger in the last half 2.5 minutes of the baseline than during the first 2.5 minutes of the interaction or the baseline. The main effect of parental social anxiety on child HR was not significant $p = .433$ in the final model. Taken together, findings on child HR responses revealed no significant effect of parental verbal threat versus safety information, and no significant moderation of the parental verbal information by social anxiety of the child or parent. In turn, findings revealed a moderation effect of time by child social anxiety: Children with higher levels of social anxiety showed higher levels of habituation in HR in the second half of the baseline.

Child attention.

Child attention to the strangers in the visual search task was compared using a repeated general linear model. Child reaction times did not significantly differ between the threat ($M = 3.42$, $SD = 1.44$) and safe ($M = 3.72$, $SD = 1.87$) conditions, $N = 52$, $F(1, 51) = 2.33$, $p = .133$. In the model with child and parental social anxiety scores as covariates, no significant moderation by child ($p = .271$) or parent ($p = .550$) social anxiety was observed. The main effects of child ($p = .512$) and parental anxiety ($p = .516$) were also not significant, leading us to conclude that parental verbal information does not influence child attention to the strangers, neither alone nor as a function of child or parent social anxiety.

Exploratory analyses on unaggregated child physiological and behavioral indices.

The raw associations between separate indices of mean child fear reactions aggregated to a mean value over threat and safe conditions were not significant (presented in Table 2). In additional exploratory analyses, we used the hierarchical structure of the child observed fear and mean heart rate during the social interaction phase to explore a potential temporal overlap between child HR and observed fear responses. The HR responses at 5 time points during the 2.5 minutes of the interaction task (following stranger entry) were tested as a predictor of observed fear in mixed hierarchical models that included the effects of time and condition. The two-way interactions between child HR and time, and between child HR and condition, as well as the three-way interaction between child HR, time, and condition were included in the initial model. None of these interactions were significant in this model ($p > .338$), reducing the final model (presented in Table 5) to the main effects of condition, time, and child HR. The model revealed a significant main effect of heart-rate, $N = 51$, $F(1, 277.02) = 4.97$, $\beta = .10$, $SE = .05$, $p = .027$. Thus, higher levels of fear were observed in children who had higher HR during the interaction with the two strangers.

Exploratory analyses on the specificity of individual differences.

To gain insight on the specificity of the links between pre-existing levels of social anxiety and child fear outcomes, we repeated the analysis of individual differences with child and parent general anxiety (mean anxiety scores in the SCARED) in place of social anxiety.

For reported child fear, the findings were consistent with those described in the main analyses with social anxiety. In the model with the child and parent general anxiety scores included as covariates, no significant two-way interactions were observed between condition and child general anxiety, and between condition and parental general anxiety, $p = .749$ and .238, respectively. The main effects of child or parent social anxiety were also not significant ($p = .155$ and .760, respectively). Thus, differences in general and social anxiety for parents or children did not predict child-reported fear of strangers in the current sample.

For observed child fear, none of the interactions between condition, time, and child anxiety were significant in the initial model (p's < .182), reducing the final model to the main effects model. In this final model, only the main effects of time, $N = 68$, $F(1, 539.44) = 4.66$, $\beta = .03$, $SE = .01$, $p = .031$, and child anxiety were significant, $F(1, 108.88) = 22.12$, $\beta = .36$, $SE = .08$, $p = <.001$. Thus, the moderation effects observed in the main analyses were specific to social anxiety and did not hold with the general anxiety scores. Instead, we observed that children with higher levels of general anxiety show, in general, stronger signs of observable fear over time, irrespective of condition.

For child HR, the findings with general anxiety were similar to those with social anxiety (presented in the main analyses above): there was a significant two-way interaction between child anxiety and time, $F(1, 937.11) = 8.90$, $p = .003$, whereas none of the remaining interactions were significant. Differently from the main analyses that revealed no significant link between parental social anxiety and child HR during social interaction, this model revealed a significant main effect of parental general anxiety on child HR responses, irrespective of condition, $N = 56$, $F(1, 78.13) = 5.62$, $\beta = .23$, $SE = .10$, $p = .020$. Children of parents who reported higher levels of general anxiety showed higher HR reactions to strangers.

For child attention, the findings were similar to the main analyses: In the model with child and parent general anxiety scores as covariates, no significant moderation by child ($p = .593$) or parent ($p = .315$) anxiety was observed. The main effects of child ($p = .346$) and parent ($p = .566$) anxiety were also not significant. We conclude that individual differences in child attention to the strangers paired with threat versus safety information cannot be accounted for by child or parent social or general anxiety.

Discussion

The present study investigated the effect of parental verbal information regarding strangers on child behavioral, cognitive, and physiological indices of fear responses to those strangers. In the light of theoretical models on the etiology of SAD (Ollendick & Hirshfeld-Becker, 2002), and earlier evidence suggesting an influence of both child and parent social anxiety (Field & Price-Evans, 2009; Murray et al., 2014) in the verbal transmission pathway, we

also investigated the potential impact of child and parent social anxiety symptoms on this pathway. More specifically, we tested whether the effect of parental verbal information would be especially pronounced for fear indices among children with higher levels of social anxiety symptoms or with parents with higher levels of social anxiety symptoms.

An initial review of the findings suggests that parental threat versus safety information about strangers did not significantly influence child behavior, heart rate, or attention, but did influence reported fear: Children reported stronger fear beliefs for the stranger paired with verbal threat as compared to safety information. Thus, although children said they would be more scared and avoidant of the stranger in a real-life encounter when asked in a questionnaire format, their observed behavioral and physiological responses to two strangers paired with threat versus safety information did not significantly differ. Regarding the moderation by child and parent trait social anxiety, the effect of parental verbal threat information on child fear was exacerbated by higher social anxiety among the parent and the child, but this moderating influence was only detected in the behavioral (observed fear) measures. In turn, there were no effects on the cognitive or physiological indices of fear.

The main effect of parental verbal threat information on child reported fear beliefs of the strangers is in line with earlier literature consistently revealing a significant effect of verbal information in the acquisition of fear beliefs of novel animals (Field & Lawson, 2003; Field et al., 2001; Field et al., 2008; Lawson, et al., 2007). Thus, the causal influence of verbal threat information on reported fear beliefs seems to be not limited to specific fears of unknown animals, but also extends to unknown humans in a social context. However, we found no significant effects of verbal information alone on observed fear, HR responses, or attention biases. This finding is at odds with earlier evidence suggesting that verbal information affects all three components of Lang's tripartite model (Lang, 2004), with threat information causing higher levels of observed avoidance, heart rate, and attention biases (e.g., Field & Lawson, 2003; Field, 2006a; Field et al., 2008; Field & Lawson, 2003; Field & Schorah, 2007). Here, verbal threat information solely altered the subjective index of fear.

It is important to note the parallels between the nature of our experimental manipulation (parents' subjective verbal report of threat versus safety information) and the nature of the observed effects (in children's subjective verbal report of fear cognitions). In other words, children passed on the verbally acquired information from parents only verbally, in their self-report of fear beliefs. However, the verbally transmitted threat information does not seem to get under the skin of the children, leaving their implicit (physiological and attention) responses and objective behavioral fear reactions unaffected. In view of these findings, it would be interesting to study whether such parallels exist in the case of fear acquisition via non-verbal channels. For example, a child may learn from exposure to a parent who shows visible signs of physiological reactivity (such as blushing) or observably vigilant attention to a novel stimulus.

The specificity of the current findings must be considered in the light of the overall lack of associations between child mean responses across fear indices in the current sample. Whether the separate indices covary as a result of verbal information was not directly tested in earlier studies (e.g., Field & Lawson, 2003; Field, 2006a; Field et al., 2008; Rifkin,

Schofield, Beard, & Armstrong, 2016). Instead, the effects of verbal information were often reported in each of the three components in isolation. To our knowledge, the only study that included the associations in the child heart rate and reported fear found a moderation of the verbal information effects on heart rate by fear beliefs, rather than a direct positive association between higher fear beliefs and higher heart rate (Field & Price-Evans, 2009). In the current sample, we found no support for the idea that the link between HR and observed behavior is moderated by condition.

The lack of significant associations between the physiological, behavioral, and cognitive indices of fear in the current experiment is in line with the broader literature that reveals a lack of synchrony or concordance across these three components of the Lang model in youth (Ollendick, Allen, Benoit, & Cowart, 2011). The lack of correlations between fear indices in the current study may be related to the developmental processes that are still shaping the fear network in early childhood. Lang's (2004) original argument that synchrony is more likely in cases where the initial activation and the experience of fear are strong. Behavioral science approaches propose that the intensity and synchrony of action dispositions in each fear component grow in parallel to the imminence and the proximity of the threat stimulus (Hamm, 2020). Thus, our pattern of findings could suggest that the social tasks investigated in the current experiment did not trigger a strong experience of fear in this community sample of preschoolers. Indeed, other work has proposed that that verbal threat information only becomes highly arousing in cases where children have very high levels of trait anxiety (Field & Price-Evans, 2009; Hodgson & Rachman, 1974). However, finding concordance across levels may be more the exception than the norm. For example, Nesse et al. (1985) examined measures of distress during in vivo exposure therapy in phobic individuals. Although they noted increases in subjective anxiety, pulse, blood pressure, plasma norepinephrine, epinephrine, insulin, cortisol, and growth hormone, there was only modest convergence in the "magnitude, consistency, timing, and concordance" (p. 320) of their measures.

It is also clear that the content of the verbal threat messages regarding the strangers in this adaptation were less intensely negative as compared to earlier studies using the same paradigm with novel animals. The animals in the studies by Field and colleagues (e.g., Field & Lawson, 2003; Field et al., 2008) were depicted as more life-threatening (e.g., their favourite food is raw meat and they drink blood), whereas the aversive value of the threat information here was less pronounced for the strangers in our study. Our information reflected social-evaluative concerns rather than literal fears of safety and survival. This difference in the nature and relative intensity of the threat message could explain why the social situations may not have been perceived as equally arousing and did not lead to a diffusion of activation to other cognitive, behavioral, and physiological indices.

In addition to the intensity of the verbal threat messages, it is important to note that children's responses to the two strangers were only measured after children had a neutral encounter with the strangers (who were blind to condition) in the social performance task. Considering that performance situations are often perceived as more anxiety triggering than a one-to-one interaction and that the strangers kept a neutral but friendly attitude during the task, the lack of an actual negative experience during this first encounter with the

strangers may have reduced the impact of the parental verbal information. Earlier evidence comparing observed avoidance of novel animals as a result of (1) verbal information with no encounters, (2) a direct negative encounter without verbal information, or (3) a direct negative encounter following verbal information provides some insight on the effect of actual encounters (Field & Storksen-Coulson, 2007). Although verbal threat information, or a negative encounter alone, was sufficient to trigger avoidance of novel animals in the absence of a negative real-life encounter in 6-to-8-year-olds, the fear response was intensified when a direct negative encounter followed the verbal threat information.

In the current study, we chose to keep the real-life encounters with the strangers neutral to be able to investigate the effect of verbal information in isolation from the effects of positive or negative direct encounters. Given the current findings, it would be interesting to follow up with a design that incorporates parental verbal information with an aversive, positive, and neutral encounter versus no encounters in a mixed design to delineate the effects of experience from verbal instructions. The findings highlight the need for future studies that refine the set of conditions under which the acquired fear beliefs persist and generalize to behavior or get overruled by non-aversive experiences during direct confrontations with novelty. The findings also suggest that we should be cautious when using hypothetical reports to infer actual behavior, particularly in the case of young children.

Alternatively, the lack of direct associations between fear indices in the current study may be related to the measurement levels chosen, as the attention and fear beliefs components were aggregated to mean scores per stranger to preserve a reliable unit of measurement. In fact, when the repeated hierarchical structure was accounted for in unaggregated models, a direct link appeared between child heart rate and observed fear behavior. This finding highlights the importance of capturing cognitive and physiological indices of child fear simultaneously using refined measures sensitive to temporal patterns (see MacNeill, Fu, Buss, & Pérez-Edgar, 2021). For example, mobile eye-tracking during social tasks could have helped to better capture attention, together with repeated measurement of reported and observed fear. It may be that the lack of findings for the attention component is related to using a computerized task with the pictures of the strangers after the real-life encounters, rather than capturing attention as it unfolds during the actual encounters with the strangers.

Likewise, adding a more temporally refined measure of arousal (such as pupil responses) in addition to heart rate during the social situation could help gain perspective on the unexpected absence of differences in heart rate in response to the two strangers, as well as the elevated heart rate during the baseline relative to the social interactions. Considering that the experimental set-up for the performance tasks was hidden during the baseline measurement, and children were not yet informed about what was to come next, higher heart rate responses in the baseline phase may be related to an anticipation effect previously reported for social performance situations in older children (e.g., Westenberg et al., 2009). It is important to keep in mind that the parents were in the room during the social interaction tasks, but not during the baseline measurement. Thus, our findings may be explained by a dampening of the heart rate response in the presence of the primary caregiver during the social interaction tasks, reducing the impact of the experimental manipulation (Gee et al., 2014; Hostinar, Sullivan, & Gunnar, 2014; Moriceau & Sullivan, 2006). Due to the stressful

nature of these encounters with strangers in the lab, and the young age of our participants, it was not feasible to conduct the social tasks without the parent in the testing room. It remains to be further investigated whether such dampening response disappears in the presence of a safety figure in the room during social tasks.

Earlier findings suggest that higher anxiety in the child may exacerbate or facilitate the differential effect of verbal threat on child behavioral avoidance, attention biases, and heart rate (Field, 2006a; Field & Schorah, 2007). Current findings only partially replicate these findings noting a moderation by child social anxiety, but only in the behavioral fear indices: Children who were rated as more socially anxious by their parents displayed overall more behavioral fear during the social interaction with the stranger. The strength of this association was further qualified by stranger condition, suggesting that the exacerbating effect of pre-existing levels of child social anxiety was especially apparent for the stranger paired with the safety information, thus in the absence of any verbal threat signal. We conclude that the effect of verbal information on child fear is intensified for children with higher levels of pre-existing social anxiety symptoms particularly for the safe stranger in this community sample where most children had mild anxiety symptoms. The findings showing a positive link between child social anxiety and child fearful reactions to the strangers paired with threat information is in line with the earlier proposal regarding stronger activation of the fear response in anxious children (Field & Price-Evans, 2009; Hodgson & Rachman, 1974).

It is important to note that the measure of child social anxiety in the current analyses incorporated the measure of social anxiety symptoms together with a temperament (behavioral inhibition) measure. The strong correlations between social anxiety symptoms and temperament scores did not allow the separate analyses of these as moderators, suggesting that these two constructs are highly overlapping in this developmental time window. The high level of concordance may also reflect the shared source of information. Finally, rather than purely reflecting biological predispositions, temperament scores in early childhood include the accumulated effects of the environment, including (social) learning experiences. Longitudinal designs incorporating an earlier measurement of temperament in toddlerhood may help to shed further light on the separate contributions of early predispositions from later anxiety symptoms in early childhood.

The current findings also reveal that pre-existing social anxiety levels of the primary caregiver may exacerbate the differential effect of verbal threat as compared to safety information. The effects of verbal information on child observed fear only became apparent after taking into account the moderation by parent (and child) social anxiety, whereas no significant moderation was observed for the other indices of child fear. The relation supports the idea that the primary caregiver’s social anxiety may titrate the child’s response in a complex manner, such that children were more likely to react with less fear to the stranger paired with the safety information and more fear to the stranger paired with threat. It is likely that the exacerbating effect of parental social anxiety on the relation between verbal information and child observed fear also genetic influences supporting the intergenerational transmission of fear and anxiety.

Taken together, the positive association between pre-existing social anxiety levels in parents and children, and child behavioral fear reactions to the strangers paired with verbal threat information in this community sample reveal the sensitizing impact of higher social anxiety load in the family to social verbal threat signals in the developmental period preceding SAD onset. This implies that the salience and impact of the verbal threat information may be further enhanced in the presence of clinical levels of social anxiety on the side of the parent or the offspring, making the verbal information pathway a potentially malleable causal mechanism behind maladaptive social learning patterns leading to parent-to-child transmission of social anxiety. This increased salience and impact, together with a higher frequency of verbal threat information from socially anxious parents (e.g., Pass et al., 2012; 2017), may potentially interact with the socially anxious children's susceptibility to threat information. The current study was underpowered to test the complex three-way interaction between verbal information manipulation and social anxiety levels of parents and children. However, the findings are in line with SAD development models pointing to the dynamic influence of parent and child anxiety dispositions in the intergenerational anxiety transmission (Murray et al., 2009; Ollendick & Benoit, 2012).

Studying the acquisition of early childhood social fears in community samples contributes to our understanding of the causal influences of social learning processes that precede the onset of childhood SAD. As the next step, it would be especially interesting to incorporate a subgroup of children and/or parents with SAD to further clarify any exacerbating effects of clinical impairment. In particular, the acquisition of social fears is a promising target for early prevention, since it presents a tangible target for intervention. Interestingly, when the verbal information conveys safety, the findings reveal a sensitizing influence of child social anxiety, but a desensitizing influence of parental social anxiety. Thus, an intervention that can help the socially anxious parent provide more safety and less threat information verbally may be potentially effective in counteracting the effects of a child's own dispositions.

The moderation of the verbal information effects by pre-existing levels of anxiety in the parent and the child only held when pre-existing social anxiety, but not general anxiety, was considered. Thus, the positive association between pre-existing anxiety levels among family members and child observed fear reactions in the threat condition did not hold when considering general anxiety scores. We conclude that the exacerbating effect of pre-existing anxiety dispositions is specific to social anxiety in the current social context.

When general anxiety scores of parents and children were considered, children with higher general anxiety showed stronger signs of observed fear, and children of parents with higher general anxiety showed stronger HR responses. None of these links were further qualified by an interaction with condition, thus these findings reflect individual differences in child social fear acquisition explained by anxiety dispositions in the family. We conclude that general anxiety dispositions of children may render them more reactive to social situations at the behavioral level, whereas general anxiety dispositions of parents may create a susceptibility to heightened physiological reactivity in these situations.

Furthermore, the current findings reveal a significant non-specific moderation of the effects of time on heart rate by social as well as general anxiety levels of the child. Greater (social)

anxiety in children was related to lower heart rate responses, especially in the last 2.5 minutes of the baseline as compared to the first 2.5 minutes of the baseline and to the 2.5-minute duration of the interaction. This finding is not in line with the earlier literature that consistently revealed a moderation by child anxiety, such that the differential impact of threat (versus safety) verbal information was reflected in faster heart rate, along with higher responses in the behavioral and attention components the fear responses (e.g., Field & Price-Evans, 2009). At this point, we have no viable explanation for the unexpected direction of this association. Furthermore, because the context has changed from the baseline to the social interaction tasks (the parent was in the room in the latter), the current comparison cannot differentiate time effects from the effect of parental presence, and it would need to be replicated in order to prove its robustness.

Limitations

The findings of the current study should be interpreted in the light of a number of limitations. First, parents' and children's social anxiety levels relied on parental reports. Questionnaire measures are known to induce measurement error due to biases in how parents perceive their child's anxiety levels due to their own anxiety (Kelley et al., 2017). However, recent work does suggest that the effect is not overwhelming (Olino, Guerra-Guzman, Hayden, & Klein, 2020). To reduce this potential measurement error, we used the ratings from both parents in calculating final scores of child social anxiety, whereas primary caregiver's ratings of their own social anxiety were used in the analyses. There was no significant correlation between the final scores on primary caregiver's reports of their own and their child's self-reported anxiety in the current sample. Nevertheless, a more objective measurement of child and parent anxiety levels (for example with lab observations or clinical interviews) would be an important addition in the future assessment of social anxiety.

A second, related, limitation concerns the fact that the effect of parental verbal information was only visible in the fears reported in a questionnaire measure, as it may be prone to task demands (see Mertens et al., 2018; Muris & Field, 2010). Third, we did not include observations of the primary caregiver's non-verbal signals of anxiety during the social situation, which may partially explain the exacerbating effects of parents' pre-existing social anxiety levels on the effect of verbal threat information. Fourth, certain aspects of the protocol were adapted to the young age of the sample. For example, children were free to decide what to do while waiting for the parent during the baseline HR measurement and the parents were in the room during the social tasks. In this sense, the effects reported for HR responses may be confounded by the presence of a safety figure or by the different activities of children during the baseline. Fifth, although we aimed to analyze the moderating role of child behavioral inhibition separately from child social anxiety, the high correlations between these scores did not allow the study of separate contributions of temperament and social anxiety symptoms. Sixth, in the exploratory analyses on unaggreggated physiological and behavioral indices, the data were matched on pre-defined time intervals in each of these separate outcomes, the videos and the physiology data were not recorded in a synchronized way. Despite this limitation, the current findings revealed a link between higher HR and higher observed fear in children. Finally, as the participants of the current study were

predominantly Caucasian and from medium to high SES backgrounds, thus it remains to be investigated in future studies whether the findings generalize to the general population.

Conclusion

The current study is among the first to directly assess the potential cascading effects of verbal threat information on the subjective, behavioral, physiological, and cognitive responses of young children to social encounters. We found that parental information influenced the child's perception of the upcoming encounter, but did not translate to variation in other fear indices. This may reflect either a general trend noting little to no concordance across levels of analysis or the in-the-moment updating of situational awareness based on initial experiences in the task. Verbal threat information appears to have a stronger influence on observed child behavior in case of higher social anxiety symptoms on the side of the parents and the children. Overall, the current study reflects the complexity of incorporating multiple levels of analysis during active social behavior to capture potential conduits of intergenerational transmission of social anxiety. We provide a broad foundation on which to build future research examining the processes by which parental risk for anxiety becomes the biological and environmental inheritance of risk by the child.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

The authors are grateful to the parents and children who participated in this study, and to the members of Cognition Affect and Temperament Lab for their support during the realization of this project.

Funding

This research was funded by a Rubicon Grant #446-16-021 to Evin Aktar from the Dutch Research Council (NWO). The contribution of Evin Aktar during manuscript preparation was supported with an NWO VENI grant #016.Veni.195.285. The contributions of Koraly Pérez-Edgar were supported by the National Institute of Mental Health (NIMH) NIMH, R01 MH109692 to Koraly Pérez-Edgar.

Availability of data and material

All raw data and materials will be stored online within one month after publication to DataverseNL, available upon request from the corresponding author.

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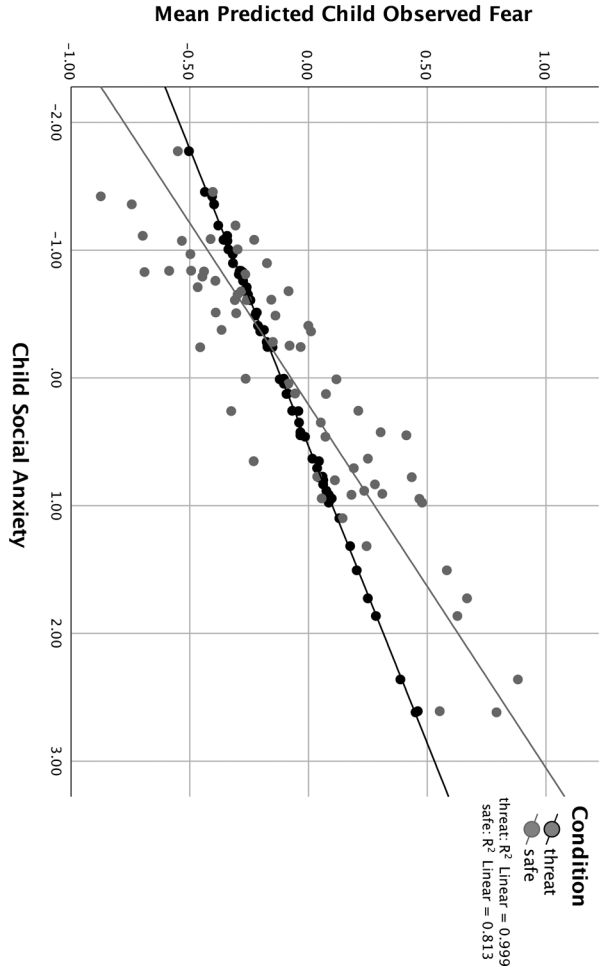

Figure 1.

The Scatter Plot of Mean Predicted Scores of Child Observed Fear (z-score) to Strangers in the Threat and Safety Conditions by Child Social Anxiety (z-score)

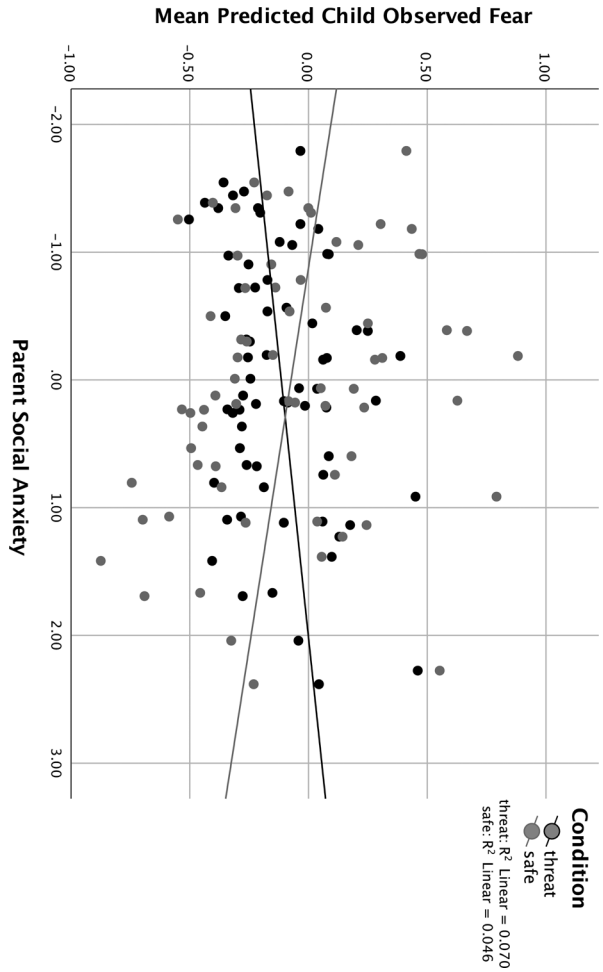

Figure 2.

The Scatter Plot of Mean Predicted Scores of Child Observed Fear to Strangers (z-score) in the Threat and Safety Conditions by Parental Social Anxiety (z-score)

Table 1

Sociodemographic Characteristics of Parents

	Mother	Father
Age *M* (*SD*, range)	36.76	38.30
	(4.17, 28.61–48.68)	(5.08, 30.87–52.27)
Caucasian ethnicity	94.1 %	79.4 %
Highest completed Educational level % (Frequency)		
Lower than High School degree	0 (0)	2.9 (2)
High School graduate	2.9 (2)	7.4 (5)
Degree in college	45.6 (31)	44.1 (30)
Master's degree	42.6 (29)	25 (17)
Doctoral degree	7.4 (5)	10.3 (7)
Missing	1.5 (1)	10.3 (7)
Employment % (Frequency)		
Working	75 (51)	85.3 (58)
Not working	23.5 (16)	2.9 (2)
Missing	1.5 (1)	11.8 (8)
Working Status % (Frequency)		
Full-time	45.6 (31)	82.4 (56)
Part-time	27.9 (19)	2.9 (2)
Unemployed/Other	25 (17)	4.4 (3)
Missing	1.5 (1)	10.3 (7)

Notes. *SD*= standard deviation, *M* =Mean

Table 2.

Descriptives, and Intercorrelations between Separate Indices of Child Fear Responses to Strangers, and Child/Parent Social Anxiety

	M	*SD*	*N*	2	3	4	5	6
1. Reported Child Fear	3.05	0.67	66	.20	−.04	−.02	.09	.07
2. Observed Child Fear	3.36	0.48	68		−.06	−.07	.34**	−.02
3. Child Heart Rate	104.10	9.03	51			−.20	−.19	.08
4. Child Attention (RT)	3.57	1.52	52				−.11	−.11
5. Child Social Anxiety	0.00	0.95	68					.23
6. Parent Social Anxiety	0.00	0.96	68					

Notes: *M* = mean, *SD* = standard deviation, *N* = sample size, *r* = Pearson Correlation Coefficient, 1 = Reported Child Fear, 2 = Observed Child Fear, 3 = Child Heart Rate, 4 = Child Attention, 5 = Child Social Anxiety Composite, 6= Parent Social Anxiety Composite,

* = $p \leq 0.01$.

Table 3

Multi-level regression of child observed fear on condition, time, child and parental social anxiety

Fixed Effects

	Numerator df	*Denominator df*	*F*	*p*
Intercept	1	182.84	5.86	.016
Condition (Threat vs Safety)	1	325.48	0.20	.653
Time	1	535.43	4.70	.031
Child social anxiety	1	107.63	18.18	<.001
Parent social anxiety	1	107.80	1.35	.249
Condition * Child social anxiety	1	951.51	5.89	.015
Condition * Parent social anxiety	1	953.63	6.12	.014

Estimates of Fixed Effects

Parameter	***ß***	***SE***	***df***	***t***	***p***	**95% Confidence Intervals**	
						Lower Bound	**Upper Bound**
Intercept	−.19	.08	216.18	−2.36	.019	−.36	−.03
Threat	−.04	.09	325.48	−0.45	.653	−.22	.14
Time	.03	.01	535.43	2.17	.031	.00	.05
Child social anxiety	.39	.08	155.55	4.90	<.001	.23	.55
Parent social anxiety	−.17	.08	155.18	−2.17	.032	−.33	−.02
Threat * Child social anxiety	−.18	.07	951.51	−2.43	.015	−.32	−.03
Threat * Parent social anxiety	.18	.07	953.63	2.47	.014	.04	.33
		Estimate	**SE**	**Wald Z**	**P**	**Lower Bound**	**Upper Bound**
Repeated Measures	AR1 diagonal	.93	.07	12.39	<.001	.79	1.09
	AR1 rho	.78	.02	41.60	<.001	.74	.81

Notes. df= degrees of freedom, *F* = F-value, *p* = significance level, *ß* = Beta, *SE* = Standard Error, *t* = t-value.

Table 4

Multi-level regression of child HR on condition, time, child and parent social anxiety

Fixed Effects							
	Numerator df	***Denominator df***	***F***	***p***			
Intercept	1	84.92	0.36	.552			
Condition (Baseline, Threat vs Safety)	2	463.91	10.21	< .001			
Time	1	560.11	1.35	.245			
Child social anxiety	1	86.52	2.77	.099			
Parent social anxiety	1	77.42	0.62	.433			
Time * Child social anxiety	1	937.97	8.97	.003			
Estimates of Fixed Effects							
Parameter	***ß***	***SE***	***df***	***t***	***p***	**95% Confidence Intervals**	
						Lower Bound	**Upper Bound**
Intercept	−.17	.11	130.17	−1.54	.127	−.39	.05
Baseline	.40	.14	269.81	2.81	.005	.12	.68
Threat	−.06	.09	799.65	−0.64	.519	−.23	.11
Time	−.01	.01	560.11	−1.16	.245	−.03	.01
Child social anxiety	−.15	.09	86.52	−1.67	.099	−.33	.03
Parent social anxiety	.07	.09	77.42	0.79	.433	−.11	.24
Time * Child social anxiety	−.02	.01	937.97	−3.00	.003	−.03	−.01
		Estimate	**SE**	**Wald Z**	**P**	**Lower Bound**	**Upper Bound**
Repeated Measures	AR1 diagonal	.92	.10	9.64	<.001	.75	1.13
	AR1 rho	.88	.01	70.21	<.001	.86	.90

Notes. df= degrees of freedom, *F* = F-value, *p* = significance level, *ß* = Beta, *SE* = Standard Error, *t* = t-value.

Table 5

Multi-level regression of child observed fear on condition, time, and child HR

Fixed Effects							
	Numerator df	***Denominator df***	***F***	***p***			
Intercept	1	271.81	40.79	< .001			
Condition (Threat vs Safety)	1	228.53	.22	.644			
Time	1	484.88	38.70	< .001			
Child HR	1	277.02	4.97	.027			
Estimates of Fixed Effects							
Parameter	***ß***	***SE***	***df***	***t***	***p***	**95% Confidence Intervals**	
						Lower Bound	**Upper Bound**
Intercept	−.67	.10	367.67	−6.63	<.001	−.87	−.47
Threat	.04	.09	228.53	0.46	.644	−.14	.23
Time	.13	.02	484.88	6.22	<.001	.09	.17
Child HR	.10	.05	277.02	2.23	.027	.01	.19
		Estimate	**SE**	**Wald Z**	**P**	**Lower Bound**	**Upper Bound**
Repeated Measures	AR1 diagonal	.53	.05	10.69	<.001	.44	.64
	AR1 rho	.68	.03	20.86	<.001	.61	.73

Notes. df= degrees of freedom, *F* = F-value, *p* = significance level, *ß* = Beta, *SE* = Standard Error, *t* = t-value.