Cosima Anna Nimphy

LED BY EXAMPLE

Fear Transmission from Parents to Children via Social Fear Learning Pathways

Led by Example:

Fear Transmission from Parents to Children via Social Fear Learning Pathways

By Cosima Anna Nimphy

Layout & Printed by: Ridderprint | www.ridderprint.nl

Led by Example:

Fear Transmission from Parents to Children via Social Fear Learning Pathways

Proefschrift

ter verkrijging van
de graad van doctor aan de Universiteit Leiden, op gezag van rector magnificus
prof.dr.ir. H. Bijl,
volgens besluit van het college voor promoties
te verdedigen op vrijdag 24 januari 2025 klokke 10:00 uur

door
Cosima Anna Nimphy
geboren te Hamburg
in 1995

Promotores:

Prof.dr. B.M. Elzinga
Prof.dr. A.J.W. Van der Does

Co-promotor:

Dr. E. Aktar

Promotiecommissie:

Prof.dr. H.E. Hulst	(Wetenschappelijk Directeur Instituut Psychologie/Voorzitter)
Prof.dr. M.E. Kret	
Prof.dr. P.M. Westenberg	
Prof.dr. P.E.H.M. Muris	(Universiteit van Maastricht)
Prof.dr. S.M. Bögels	(Universiteit van Amsterdam (UvA))

This study was financially supported by NWO, specifically by the Veni grant awarded to Dr. Evin Aktar.

Table of Content

CHAPTER 1	General Introduction	7
CHAPTER 2	Parent to Offspring Fear Transmission via Modeling in Early Life: A Systematic Review and Meta-Analysis	15
CHAPTER 3	The Role of Parental Verbal Threat Information in Children's Fear Acquisition: A Systematic Review and Meta-Analysis	57
CHAPTER 4	"Nobody here likes her" - The Impact of Parental Verbal Threat Information on Children's Fear of Strangers	93
CHAPTER 5	"Covid-19 is dangerous": The Role of Parental Verbal Threat Information on Children's Fear of Covid-19	117
CHAPTER 6	General Discussion	137
CHAPTER 7	Nederlandstalige Samenvatting	153
	English Summary	159
	Publications	165
	About the Author (Curriculum vitae)	169
	Acknowledgements	171

“Wenn einer keine Angst hat,
hat er keine Phantasie.”

- Erich Kästner -

Chapter 1

INTRODUCTION

General Introduction

Anxiety disorders are one of the most prevalent clusters of mental illness in childhood and adolescence (Kessler et al., 2012; Bandelow & Michaelis, 2015). Children with anxiety disorders experience persistent and excessive worry and anxious feelings, which can hinder them in their daily functioning, including their social life or academic performance (Beesdo et al., 2009; Keller et al., 1992; Quilty et al., 2003). To develop successful prevention strategies or interventions, it is important to gain further insight into possible mechanisms that contribute to the development of child anxiety.

It is well established, that anxiety disorders tend to aggregate within families (Eley et al., 2015; Hudson et al., 2011). Children have a two to three-fold risk of developing an anxiety disorder if their parent has an anxiety disorder (Lawrence et al., 2019; Telman et al., 2018). To address this elevated risk of anxiety in the offspring it is important to elucidate the mechanisms through which anxiety transmission occurs in the family. Numerous studies have explored the influence of genetic and/or environmental factors in the parent-child transmission of anxiety disorders (Eley et al., 2015; Gregory & Eley, 2011; Hettema et al., 2001). Genetic transmission is responsible for about one-third of the variability in child anxiety (Hettema et al., 2001). The remaining variance can be attributed to environmental factors, either independently or in conjunction with genetic factors (Gregory & Eley, 2011). This underscores the need for research that delves into potential environmental mechanisms underlying this transmission.

Parents play a crucial role as information sources that children can learn from (Debiec & Olsson, 2017; Rachmann 1977). Every day, children get exposed to a multitude of novel or ambiguous situations, objects, or people. One way to make sense of these stimuli and to avoid possible danger is to learn from parents' reactions to these stimuli whether these are safe or threatening (known as social fear learning, Rachman, 1977; Bandura, 1977; Olsson et al., 2007). Social fear learning operates through two pathways: vicarious learning (modeling) and instructional learning (verbal threat information) (Rachman, 1977; Bandura, 1977). Vicarious learning might be especially relevant in infancy, as parent-child communication mostly depends on parents' facial expressions, followed by their gestures and body language (Feinman et al., 1992). This contrasts social fear learning in childhood. With the development of language abilities and increased salience of parental verbal statements, children can also acquire fears via the instructional pathway (Rachman, 1977). Empirical evidence suggests that parents' nonverbal and verbal anxious reactions in the face of novel stimuli or situations can influence how children feel and act toward these stimuli (Muris & Field, 2010; Percy et al., 2016; Emerson et al., 2019). By gaining more insight into the social fear learning

pathways through which parents can transmit their fears to children, we might also shed more light on the familial transmission of anxiety disorders.

Box 1. Anecdote
Anna (10 years) grew up with two parents and her younger sister (8 years) in a city that has a huge funfair with many rollercoasters every season. When Anna reached the height requirement for rollercoasters with loopings, she was allowed for the first time to enter one of them. Her mum decided to join her for her first rollercoaster ride, since Anna's mum absolutely loved rollercoasters (she has also done bungee jumping and parachuting before - so this was something she really enjoyed). She was excited to share this ride with her daughter. From that day onwards Anna could not get enough of rollercoasters and no rollercoaster was fast or high enough. Her sister Carolien however (due to her smaller height) had to stay and wait with her dad until Anna and her mum were done with their ride. Their dad is not at all a fan of rollercoasters/heights. Carolien heard and saw her dad anxiously awaiting her sister's and mum's return. For multiple years, Carolien did not enter any looping rides - even when she eventually reached the required height. On the upside, she did get quite good at the roll-a-ball camel races while waiting with her dad.
(Story of Cosima *Anna* Nimphy and Ricarda *Carolien* Nimphy)

The example of Anna and Carolien in Box 1 illustrates that parents' reactions to a novel situation (in this case a rollercoaster ride) may shape their children's reaction to it. The anecdote also exemplifies both social fear-learning pathways. Specifically, observing (vicarious learning) and listening (instructional learning) to her dad's anxious reaction about the rollercoaster may have increased Carolien's fear or increased her wish to avoid it. Taken together, two social fear-learning pathways might contribute to child acquisition of fears and play a role in family transmission of anxiety disorders.

Are some children more sensitive to parental anxiety expressions?

Most children who get exposed to their parents' anxiety may get transiently anxious or worried but few develop an anxiety disorder. One question that emerges is, whether some children are more impacted by their parents' anxiety (expressions) than others. It could be that children with specific risk factors are more sensitive to parental expressions of anxiety, which might put them at increased risk of developing an anxiety disorder.

Two crucial risk factors for child development of anxiety are parental anxiety and child temperament. While parental anxiety is one of the most extensively studied risk factors for child anxiety development, it has not been well-established whether children of anxious parents also show strengthened fear acquisition via social fear learning. Research suggests that anxious parents make negative statements about a novel stimulus to their children more frequently than non-anxious parents (Muris et al., 2010).

After repeated exposure to parental anxiety, children of anxious parents may develop heightened attention to threat signals or interpret the signals more negatively (Aktar, 2022; Creswell et al., 2010). This increased attention to parental negative comments or anxious expressions might intensify social fear learning processes, meaning children of anxious parents might become more sensitive to parental anxiety expressions. While this has been studied in the context of parental anxiety disorder (Aktar et al., 2013; Aktar et al., 2014; Murray et al., 2008), the role of typical variation in parents' anxiety levels has not been broadly investigated in the parent-to-child transmission of fears to novel stimuli.

Another important risk factor for developing anxiety later in life is child temperament, such as behavioral inhibition (BI) (see Clauss & Blackford, 2012). According to the vulnerability-stress model and the differential-susceptibility models, children with specific temperaments are more vulnerable to environmental influences, such as parental behavior (Belsky & Pluess, 2009; Ingram & Luxton, 2005; Nigg, 2006). Child temperament has been discussed as a potential characteristic that strengthens the effect of parental anxiety expressions on their children's fear acquisition (Percy et al. 2016; Muris & Field, 2010). Taken together, children who are temperamentally at risk for anxiety disorders or children from parents with more anxiety symptoms might be more sensitive to social fear learning from parents.

Methods to study social fear learning in families

This dissertation aims to capture a comprehensive overview of parent-offspring fear transmission, by using a combination of methods, including two meta-analyses, one experimental study, and one observational study. First, in the two meta-analyses, I summarize the literature on two social fear-learning pathways on child fear acquisition across childhood. Conducting meta-analyses allows us to estimate effect sizes on the impact of and relationship between parental nonverbal and verbal anxiety expressions and child fear acquisition of novel stimuli. Next, I investigate parent-offspring fear transmission utilizing a within-subject experimental study design (STARS) and one observational cross-sectional study design (FACTS). STARS is a multi-method study that examined the instructional learning pathway with early adolescents (aged 9.5 to 14) and one of their parents. In total 77 parent-child dyads participated. FACTS is a cross-sectional study, which assessed the instructional learning pathway in families via an online survey. In total 195 parent-child dyads took part in this study, including children aged between 8 and 18 years. While we can draw firmer conclusions regarding the causal effects of parental anxiety expressions with our experimental study, we might

be more likely to generalize findings from our cross-sectional study to parents' and children's reactions to novel stimuli from their daily lives (Kazdin, 2021).

To capture child fear acquisition, we have assessed multiple child fear indices with various measures. According to Lang's tripartite model (Lang, 1968), a fear response consists of three components, namely 1) cognitive (subjective) distress 2) physiological arousal, and 3) behavioral avoidance. In line with this model, we measured children's fear with cognitive, physiological, and behavioral indices (Lang, 1968). Fear responses on different indices do not always coincide (Bradley & Lang, 2000). For example, if children report high fear levels regarding novel stimuli, they do not necessarily show a physiological response or high avoidance. By assessing multiple fear indices, we have the opportunity to assess the impact of parental anxiety expressions on each of these outcomes. Furthermore, as infants are unable to express their fears verbally, assessing multiple fear indices can reduce the likelihood of misinterpreting an infant's reaction as fear (LoBue & Adolph, 2019). Taken together, we aimed to examine social fear learning pathways and children's fear reactions with a variety of designs and methods.

Outline and Objective

This dissertation is dedicated to the investigation of the parent-to-child transmission of fear of novel stimuli, via the two pathways of social fear learning. Across all chapters, child and parent anxiety dispositions were explored as potential characteristics that may strengthen child fear learning via these pathways. Specifically, we focused on child temperament, as well as parental (trait) anxiety. Figure 1 presents a graphical overview of the chapters of this dissertation.

Chapter 2 entails a systematic review and meta-analysis of the parent-to-offspring fear transmission via vicarious learning in early life (infants aged up to 30 months). First, we examined the effect of modeling parents' fearful reactions on infants' acquisition of fear and avoidance of novel stimuli. Second, we explored the moderation of this effect by child behavioral inhibition (BI) and parent trait anxiety.

Chapter 3 presents a systematic review and meta-analysis of the parent-to-offspring fear transmission via instructional learning in childhood (age 2.5 to 18). We investigated the effect of parental verbal threat information on children's acquisition of fear of novel stimuli and explored the moderation of this effect by child and parent anxiety dispositions.

Chapter 4 describes the findings of the STARS study. Within this experimental study, we assessed parent-child transmission of fear via the instructional learning pathway in children aged 9.5 to 14 years. Specifically, we investigated the impact of

parental verbal threat information about strangers on a child's fear of strangers during a social interaction task. In this chapter, we present findings on the impact of parent information on multiple child fear indices, as well as the role of parent trait anxiety and child temperament in this pathway.

Chapter 5 entails the investigation of the instructional learning pathway in the context of the COVID-19 pandemic. Within the cross-sectional FACTS study, we examined the association between parental verbal threat information about the COVID-19 virus and child fear of the virus.

Chapter 6 presents a summary and discussion of the main findings of the dissertation as well as addresses methodological challenges. We further discuss theoretical and clinical implications.

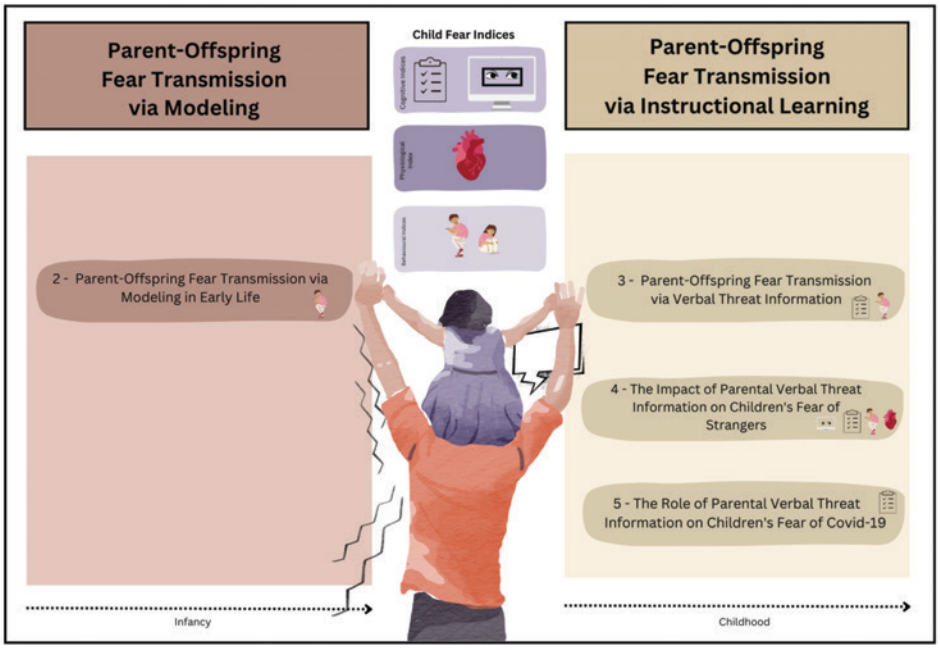

Figure 1. Graphical overview of the Chapters 2 to 5 of this dissertation.

Chapter 2

Parent to Offspring Fear Transmission via Modeling in Early Life: A Systematic Review and Meta-Analysis

Nimphy, C. A., Venetikidi, M., Elzinga, B. M., Van der Does, W., Aktar, E. (2023), Parent to Offspring Fear Transmission via Modeling in Early Life: A Systematic Review and Meta-Analysis. *Clinical Child and Family Psychology Review*, 26(3), 751-772. https://doi.org/10.1007/s10567-023-00448-1

Abstract

Objective: Infants can acquire fears vicariously by observing parents' fearful reactions to novel stimuli in everyday situations (i.e., modeling). To date, no systematic or meta-analytic review examined the role of modeling in parent-child transmission of fear and avoidance in early life. We aimed to investigate the effect of modeling parents' fearful reactions on infants' acquisition of fear and avoidance of novel stimuli and explore the moderation of this effect by child behavioral inhibition (BI) and parent trait anxiety. **Method:** Systematic review and meta-analysis. The search conducted in WebOfScience, Pubmed, Embase, and PsycINFO revealed 23 eligible studies for the systematic review and 19 for the meta-analysis. Eligible studies included published studies that measured infant fear and avoidance (infants aged up to 30 months) of novel stimuli following exposure to parental fearful expressions. **Results:** Meta-analytic findings revealed a significant causal effect of modeling of parental fear on infants' fear [g = .44] and avoidance of novel stimuli [g = .44]. The findings support moderation by child BI on infant avoidance (not fear) acquisition, with the effects being larger for infants with higher BI. However, this moderation was only found, when including both experimental and correlational studies (p >.05), but not when exclusively including experimental studies (p = .17). **Conclusions:** This meta-analysis provides support for early parent-to-offspring fear transmission: a causal small to medium effect of parents' fearful reactions was shown on infants' fear and avoidance of novel stimuli. Elucidating parent-to-offspring anxiety transmission pathways can inform us about potential fear reduction and prevention strategies.

Keywords: Modeling, Vicarious Learning, Fear, Infant, Temperament, Parental Anxiety

Introduction

Anxiety disorders run in families (Eley et al., 2015; Gregory & Eley, 2011). Children of parents with a current or lifetime anxiety disorder are up to three times more likely to develop an anxiety disorder than children of non-anxious parents (Lawrence et al., 2019; Telman et al., 2018). Studies on familial aggregation of anxiety have investigated the role of both genetic and environmental influences (Eley et al., 2015; Gregory & Eley, 2011; Hettema et al., 2001). Genetic transmission contributes significantly to family aggregation of anxiety (Hettema et al., 2001; Vasey & Dadds, 2001). Twin studies suggest heritability estimates between approximately 25 and 43% (Shimada-Sugimoto et al., 2015), which can vary depending on sex, age, and how anxiety was assessed (Gregory & Eley, 2011). Twin studies also stress the importance of shared environment in family aggregation of anxiety (Gregory & Eley, 2011). Recently, a novel children-of-twins study investigated the relative influences of genetic and environmental factors in the anxiety transmission from parent to child (Eley et al., 2015). They reported that environmental factors mainly account for the parent-child transmission of anxiety and should be focused on in subsequent research.

Environmental mechanisms can be conceptualized within the broader context of fear-acquisition frameworks and social-learning theory (Bandura & Walters, 1977; Olsson et al., 2007; Rachman, 1977). In addition to their first-hand aversive experiences with novel stimuli, children can acquire fears indirectly via others, particularly parents (so-called social fear learning, Olsson et al., 2007; Rachman, 1977). Social fear learning involves verbal communications signaling threat, (i.e. parent saying 'this is scary, right?') (Muris & Field, 2010), as well as modeling of fear expressions (also referred to as vicarious learning or observational learning (see Askew & Field, 2008). Research focusing on parent-child transmission of fear via environmental mechanisms has most frequently investigated parental modeling of fearful/avoidant expressions and behavior as a fear-learning pathway (Fisak & Grills-Taquechel, 2007). In our meta-analysis, we investigated the effect of modeling parents' fearful reactions on infants' acquisition of fear and avoidance of novel stimuli.

Parent to offspring fear transmission via modeling might be especially relevant in children's first years of life. First, the first two years have been highlighted as a sensitive/vulnerable period for exposure to parental fearful and anxious expressions and behavior (Aktar & Bögels, 2017). At this age, infants' rapid and experience-driven development of emotional brain systems, as well as enhanced face processing of caregivers might make infants particularly vulnerable to parental anxious signals (Leppänen, 2011; Leppänen & Nelson, 2009). Second, the emergence of social referencing abilities in infants between

approximately 10-14 months may be particularly relevant to the development of fear, as infants actively seek out information from parents when confronted with novelty/ambiguity (Fisak & Grills-Taquechel, 2007). Third, while infants may already understand some parental verbal cues before and in the early phases of language acquisition, parent-child communication largely depends on facial expressions, followed by gestures and body language (Feinman et al., 1992). As mentioned by Rachman (1977), with the development of language abilities, social fear learning via verbal threat information becomes a relevant fear-learning pathway. By focusing on the first years, we can also quantify the effect of vicarious learning in early life while minimizing the influence of parental verbal threat information (which would vary greatly across age). While previous literature discussed the causal role of vicarious learning in fear acquisition of infants (Aktar & Bögels, 2017, Debiec & Olsson, 2017; Fisak & Grills-Taquechel, 2007; LoBue, et al., 2019, Murray et al., 2009), this effect has not been systematically assessed or quantified for this age range.

Infant modeling of parents' nonverbal fear expressions has been studied in so-called social referencing paradigms (Gerull & Rapee, 2002; Murray et al., 2008). In this paradigm, infants are directly exposed to parents' fearful response to a novel stimulus (i.e. ambiguous toy or stranger), and then themselves exposed to the novel stimulus. Multiple behavioral components of infant responses to these stimuli are measured, such as infants' affective response (facial, bodily, or vocal expressions of fear, i.e., crying), as well as their avoidant response (facial or bodily avoidance of stimulus, i.e. turning or moving away from stimulus). The avoidant reaction to a novel stimulus can be seen as a regulatory response to reduce distress and escape the stimulus (Aktar & Pérez-Edgar, 2020; Klinnert, 1984). From here onwards, based on previous studies, we will refer to the affective component as "fear", whereas the regulatory avoidant response will be referred to as "avoidance" (see for example, Aktar et al., 2013; De Rosnay et al., 2006; Murray et al., 2008). Parental expressions of fear towards a novel stimulus might not necessarily increase both infant fear and avoidance towards the stimulus at the same time (Walden & Ogan, 1988), meaning infant fear and avoidance do not have to co-occur. Therefore, we decided to investigate the effect of parents' fearful reactions to novel stimuli on infants' acquisition of fear and avoidance of these stimuli separately.

Two lines of research have addressed fear transmission in infancy via vicarious learning. The first line of studies investigates typically developing infants and uses experimental designs where parental emotional displays towards novel/ambiguous stimuli are manipulated (via training) (Dubi et al., 2008; Egliston et al., 2007; Feinman, 1983; Fisak & Grills-Taquechel, 2007; Gerull & Rapee, 2002). By randomly assigning parents to

manipulation and control condition, the experimental studies control for factors such as the genetic transmission and the learning history of parental behaviors affecting the child. The second line of studies uses naturalistic observations in clinical samples of anxious parents with infants, during novel/ambiguous situations, instead of manipulating/training parental expressions (Aktar et al., 2013; Aktar et al., 2014; de Rosnay et al., 2006; Murray et al., 2008). In the correlational studies, we might get a more representative insight on the impact parents natural fear responses to novel stimuli have on infants fear and avoidance. The two lines are complementary as the first one allows causal inferences and the second aims to capture the transmission of anxiety in real life. Consequently, we will examine both lines of research in a systematic review and meta-analysis.

It is important to note that parent-to child transmission of fear is inherently an evolutionary adaptive mechanism, that helps the infant to become aware of and stay away from dangerous situations, maximizing survival (Feinman, 1985). However, if parents have an anxiety disorder, which is typically characterized by excessive fear and overestimation of danger (APA, 2015), they might expose their children to anxiety signals in the absence of actual danger. A previous study found that parents with social phobia were more likely to display threat signals when exposed to strangers interacting with their infant in an approach task, than parents without social phobia (Murray, et al. 2007). Infants may acquire fear of ambiguous situations as a result of repeatedly observing parents' anxiety signals (Aktar & Bögels, 2017; Murray et al., 2009). Furthermore, over time infants of anxious parents might learn to pay attention to threat over safety signals or interpret the signals more negatively (Aktar, 2022; Creswell et al., 2010). If the child's fear is not in proportion to the severity of the threat, persists, and interferes with daily functioning, this fear response can be regarded as maladaptive (Kiel & Kalomiris, 2019). Therefore, the effect of parental modeling of fear/ anxiety on child acquisition to novel stimuli might be stronger for infants of anxious parents than of non-anxious parents.

Infants are not only passive receivers of parents' fear and anxiety signals but their characteristics play a role in the intergenerational transmission of fear too (Reynolds et al., 2018). Behavioral inhibition (BI) is the strongest temperamental predictor of the later development of social anxiety (Clauss & Blackford, 2012). BI is defined as a fearful and avoidant style of reacting to ambiguous stimuli (Fox et al., 2005). Theoretical models indicate that infants with BI would be more susceptible to environmental stressors, including parental anxiety signals (Belsky & Pluess 2009; Ingram & Luxton 2005; Nigg 2006). Furthermore, infants' fearful temperament is consistently found to strengthen the impact of parents' anxious expressions on infants' vicarious acquisition of anxiety (Aktar et al., 2013; De Rosnay et al., 2006; Möller et al., 2014).

Although the current focus is on modeling, it is only one of the many environmental mechanisms that may alone or in interaction contribute to parent-to-child transmission of fear and anxiety (also known as equifinality, Cicchetti & Rogosch, 1996). For example, parental reinforcement of child fear and avoidance can contribute to child fear and anxiety (Fisak & Grills-Tacquechel, 2007). Furthermore, one specific risk factor may lead to multiple outcomes (also known as multifinality, Cicchetti & Rogosch, 1996). Thus, an infant exposed to parental expressions towards novel stimuli, may not necessarily acquire fear but have a different effect or it might not have any effect at all. Lastly, fears are most likely not a product of a single fear-learning pathway, but a combination of multiple pathways (Muris & Field 2011).

Previous reviews have concluded that modeling/vicarious learning is a significant contributing factor to child acquisition of fear and anxiety (Aktar & Bögels, 2017; Fisak & Grills-Taquelchel, 2007; Murray et al., 2009). However, these conclusions were based on narrative reviews, whereas, currently enough research has been done to carry out a meta-analytic review. Narrative reviews tend to lead to overly strong conclusions compared to systematic and meta-analytic reviews (Thomas-Odenthal et al., 2020). Importantly, conducting a meta-analysis allows us to quantify the size of the investigated effects. Previous reviews have also discussed the role of BI and parental anxiety (Fisak & Grills-Taquelchel, 2007; Aktar & Bögels, 2017), but their roles on infant fear and avoidance learning have not yet been systematically assessed. In the current meta-analysis, our first aim was to synthetize the evidence on the effect of infants' modeling of parents' anxiety on infants' immediate fearful or avoidant reactions to novel stimuli in early life (between six and 30 months). Second, we aim to explore whether the effect of modeling is larger for temperamentally fearful infants (based on Susceptibility models, Belsky & Pluess 2009; Ingram & Luxton 2005; Nigg 2006). Finally, we aim to explore if the effect of modeling on infants' fear and avoidance is larger for infants with anxious parents (based on Murray et al., 2009). We expect that infants' modeling of parents' fearful expressions increase their fear and avoidance toward novel stimuli. Furthermore, we expect the effect of modeling to be stronger for behaviorally-inhibited infants and infants of anxious parents.

Methods

Protocol and registration

In this systematic review and meta-analysis, PRISMA guidelines were followed (Moher et al., 2009). Moreover, this meta-analysis was preregistered at OSF (10.17605/OSF.IO/XPRUS).

Search strategy

WebOfScience, Pubmed, Embase, and PsycINFO databases were searched to identify relevant articles. The search was performed on the 21st of November 2022. The final search term was: ((postnat* OR neonat* OR newborn OR "new-born" OR infan* OR baby OR babies OR "month old" OR "month-old" OR toddler) AND (parent* OR mother* OR father* OR caregiver* OR guardian*) AND (("social referencing" OR acquisition OR "nonverbal transmission" OR "non-verbal transmission" OR "vicarious learning" OR "observational learning") AND (fear* OR avoid* OR anxi* OR threat*))). For a full overview of the development of the final search term used in this study, see the Full search term list in the Supplementary material (A). All screening steps were conducted by two independent reviewers. The interrater agreement on the inclusion of studies during the abstract screening process was high, with Cohen's kappa of .85. Inconsistencies between reviewers were discussed and resolved in coding meetings. The steps of the screening process are presented in Figure 1.

Inclusion criteria

This systematic review and meta-analysis include published studies that assessed fearful or anxious expressions in human infants (aged up to 30 months) after direct exposure to parental fear or anxious expressions in a lab setting. The included studies tested how parents' fear (in specific situations, towards an object, situation, or stranger) can shape their infants' reaction to the same ambiguous situations, object, or stranger. Within the studies, it can also be named modeling/observational or vicarious learning (the study needs to include parental *nonverbal* expression of fear). The ambiguous stimuli, i.e. stranger, object, or situation need to be novel. This means for example that the ambiguous object is an unfamiliar toy and that the infant has not played with or seen it previously. In addition, the fear/anxiety expression in front of the infant should be from the parent, not for example from an experimenter. The current meta-analysis included studies that assessed infant reactions with behavioral (i.e. crying), physiological (i.e. elevated heart rate), or cognitive (i.e. infant looks) measurements. We then categorized infant reactions into 1) infants' affective response to stimuli (facial, bodily, or vocal expressions of fear, i.e., crying), as well as 2) avoidant response to stimuli (facial or bodily avoidance of stimulus, i.e. turning away from stimulus). Furthermore, the meta-analysis only included studies that assessed parental fearful or anxious expressions. Studies with an experimental design needed to include a target group, which was defined as infants who received fearful/anxious cues from the parent about a novel object, person, or situation. The control group needed to entail infants receiving neutral

or positive cues given by the parent about a novel object, person, or situation. Studies have to be published in English. For the meta-analysis, the information provided in the results section of a given study should allow for the calculation of effect sizes for outcome measures.

Data extraction

The data that were extracted are demographic information (i.e., age of the participating parents and infants, gender, ethnicity, occupation/SES, and study location) and methodological characteristics (i.e. study design, number of outcome variables, measurement tools for predictor and outcome variables and their validity). Furthermore, we extracted means, standard deviations, effect sizes, and corresponding 95% Confidence Intervals (CI) of the variables and associations of interest. Variables of interest are infant fearful or avoidant reactions, parent anxious/fearful expressions, parent psychopathology, infant temperament, and kind of stimuli (i.e. social versus non-social). All effect sizes were converted to Hedges' *g*. In case multiple means and standard deviations were reported in a study, for instance, due to multiple outcome measures, we average the outcomes to yield a single study-wide effect size. In cases where insignificant findings were reported without providing further statistical information than the sample size and non-significance, we assumed a p-value of .5 (one-directional) to calculate the effect size, which results in an effect size of 0 with the accompanying variance (see Dusseldorp et al., 1999). This was done as excluding the insignificant finding from analyses would inflate the effect sizes. The effect sizes for the moderators were only investigated if a subset consisted of at least four studies ($k \geq 4$) (Bakermans-Kranenburg et al., 2003).

Statistical analyses

Analyses were carried out using the metafor package in R. Statistical significance of the pooled SMD was assessed using a Z-test at $p < .05$. We checked for heterogeneity using the *Q*-test. A two-tailed *p* significance test was used with statistical significance with $p < 0.05$. To enable comparisons, calculated effect sizes were transformed into standardized scores. We corrected the effect sizes to a weighted effect size (corrected for unequal *n´*s) and checked for publication bias with funnel plots. In case of publication bias, a trim and fill method was applied. Furthermore, to detect ES outliers, we checked whether the standardized residuals were between 3.29 and -3.29.

Quality and Bias assessment

The methodological quality of the retained articles was assessed using a checklist (presented in Table S1) based on the Cochrane Collaboration tool (ROB2) and adapted to our study design. Examples of these assessment criteria are the reliability of the outcome measures, as well as the transparency and selection of the reported results.

Results

Our search term yielded overall 736 hits across WebofScience, PsycInfo, Pubmed, and Embase. After the removal of 311 duplicates, we ended up with 425 studies to screen. The screening process and reasons for exclusions at each stage are presented in the flow diagram (Figure 1).

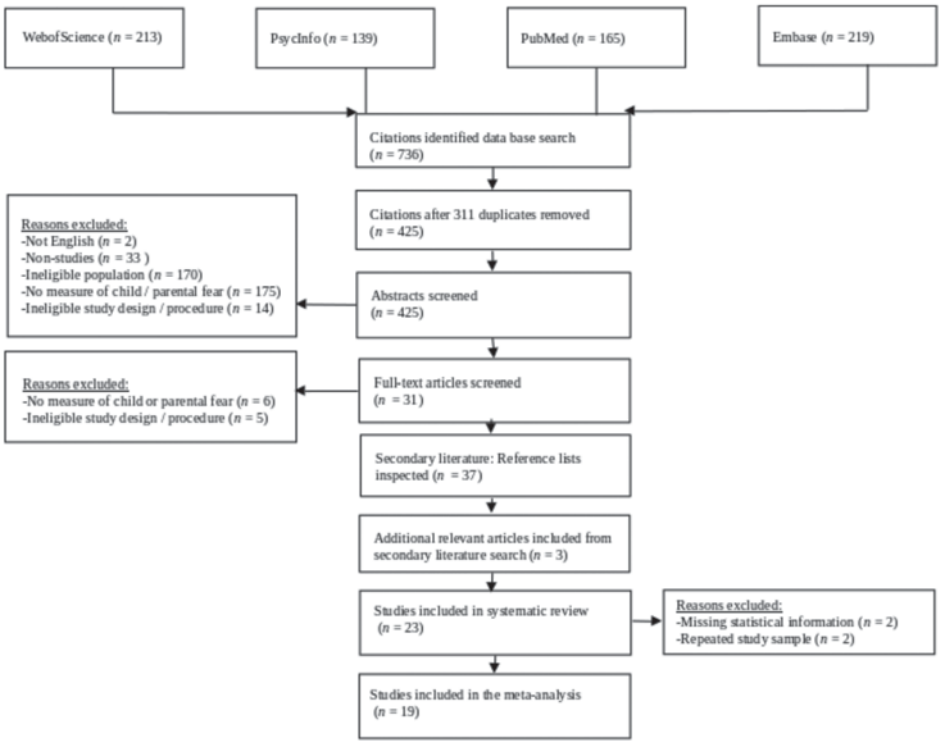

Figure 1. Flow Diagram

Overview of studies

The study characteristics of the studies included in the systematic review and meta-analysis are summarized in Table 1. The quality ratings ranged from 67% to 100%, with a mean percentage of 93% (for the quality rating per study see Table S1 in supplementary material B). Most studies randomized participants into the conditions and used reliable coding systems or measures. However, some studies did not adequately describe their hypotheses, and/or reported more analyses than planned a priori.

Systematic Review

The study and sample characteristics are presented in Table 1. The studies differed in (1) design, (2) moderators, (3) child fear index, (4) parental message type, and (5) stimulus type. Below we address each of these in detail.

First, concerning the design, from the 23 studies included in this systematic review four had a correlational design, whereas 19 had an experimental design. In the correlational designs, parental expressions of fear to novel stimuli were not manipulated/trained by the experimenter, but observed as it naturally unfolds during a social referencing paradigm with parents and their infants.

Second, of these studies, eight studies included a measure of parental anxiety symptoms or diagnosis. Four studies included clinical parent samples, consisting of 51% to 56% of parents with an anxiety disorder (Aktar et al., 2013; Aktar et al., 2014; Aktar et al., 2018; Murray et al., 2008), whereas four studies assessed anxiety (symptoms) in community samples of parents and reported no or low anxiety scores (De Rosnay et al., 2006; Dubi et al., 2008; Goodman- Wilson, 2012; Möller et al., 2014). Finally, ten studies of these 23 studies assessed infant temperament (Aktar et al., 2013; Aktar et al., 2014; Aktar et al., 2018; Blackford & Walden, 1998; Carpenter, 2004; De Rosnay et al., 2006; Dubi et al., 2008; Goodman-Wilson, 2012; Möller et al., 2014; Murray et al., 2008).

Third, there were also differences across studies, which child fear indices were assessed to test child acquisition of fear and avoidance (overview can be found in Table 2). Across all studies, infant fear was primarily assessed with a behavioral measure, specifically emotional expressions of fear and behavioral avoidance towards the stimulus during the social referencing paradigm. In one study infant reactions were assessed with just a fear measure (i.e. facial, vocal, and verbal expressions of fear), in five studies only avoidance was assessed (i.e. latency touching and reaching for the toy), and in 17 studies both fear and avoidance were assessed . Looks to the caregiver were defined as an indicator of social referencing, rather than an index of infant fear. Nearly all studies reported mean interobserver reliability (ICC or Cohen's kappa) for

coding infant fear and avoidance (22 studies), which ranged from .56 to 1, and were all classified to be sufficient to very high interrater reliability.

Fourth, parental expressions of fear towards novel stimuli can be categorized into 1) nonverbal messages only (such as fidgeting) and 2) nonverbal and verbal messages (such as "this is scary, right?"). Out of 23 studies, five studies fall in the first category, whereas 18 studies were in the second. Furthermore, in experimental designs, the threat condition was defined as fearful/anxious nonverbal messages (based on facial, bodily, or vocal expressions), whereas the control condition could either consist of parental neutral nonverbal expressions or positive nonverbal expressions (i.e. smiling). In 21 studies, the control condition in the social referencing paradigm consisted of positively-valenced nonverbal parental messages, and two studies included both a positive and neutral control condition (Klinnert, 1984; Mumme et al., 1996). Most studies reported mean interobserver reliability (ICC or Cohen's kappa) for parent variables (17 studies), which ranged from .39 to 1, and all except for one (Zarbatany & Lamb, 1985) were classified as sufficient to very high.

Fifth, the stimuli that were paired with parental messages varied across studies and can be categorized into social and non-social stimuli. Social stimuli entailed exposure to a stranger, whereas non-social stimuli entailed animals, toys, and novel situations, such as a visual cliff. The majority of studies (k = 16) included non-social stimuli, whereas two studies used only social stimuli in their social referencing paradigms, and five studies included both social and non-social stimuli.

Meta-Analysis

For the meta-analysis, we only included studies that reported the statistical information that is necessary for the computing of effect sizes. We contacted authors for missing statistical information (such as missing sample sizes or standard deviations). We only received sufficient statistical information to analyze effect sizes from one study (Möller et al., 2014). We received three responses that the statistical information was not available (Zarbatany & Lamb, 1985; Walden & Baxter, 1989; Blackford & Walden, 1998) and one author did not respond (Klinnert, 1984). Furthermore, three studies that were included in the systematic review (Aktar et al., 2013; 2014; 2018) contained analyses of the same infants at different developmental stages. For the meta-analysis, we chose to include only data from the first study (Aktar et al., 2013), as it contained the largest sample size. Möller et al. (2014) reported their findings separately on a mother and father sample, which participated independently with different infants. Therefore, we added them as separate samples in our analyses.

Overall, of the 23 studies included in the systematic review, 19 studies entailing 20 samples were also included in the meta-analysis. Two studies had a correlational design (Aktar et al., 2013; Möller et al., 2014) and the remaining seventeen studies had an experimental design. Fourteen studies entailed non-social stimuli, two had only social stimuli, and three studies included both social and nonsocial stimuli. When a study measured infant acquired fear to both social and nonsocial stimuli, we combined the effect sizes (if relevant statistical information was available). Thirteen studies assessed infant fear/ anxiety with behavioral indices of fear and avoidance separately, three studies just assessed avoidance based on infant behavior and one assessed only infant fear with a behavioral measure. Two studies assessed infant avoidance additionally with a cognitive measure. When we had multiple outcomes of fear or avoidance, we combined the effect sizes. If we could not combine indices, we chose the statistics in the following order 1) behavioral measure of infant fear or avoidance 2) cognitive measure of infant avoidance (such as frequency of looks). No study assessed physiological indices of fear.

Six studies that were included in the meta-analysis assessed parental anxiety, of which the sample of two studies consisted of 51% to 54% of parents with an anxiety disorder (Aktar et al., 2013; Murray et al., 2008). Four studies assessed the absence of an anxiety disorder/ symptoms (De Rosnay et al., 2006; Dubi et al., 2008; Goodman-Wilson, 2012; Möller et al., 2014). However, only three studies that were included in the meta-analysis of main effects reported findings on parental anxiety as a moderator, and therefore we could not perform analyses on its effect size. Eight studies that were included in the meta-analysis assessed infant temperament and reported relevant statistical information (Aktar et al., 2013; Carpenter, 2004; De Rosnay et al., 2006; Dubi et al., 2008; Goodman-Wilson, 2012; Möller et al., 2014; Murray et al., 2008).

Table 1. Overview of Studies included in Systematic Review

Study	General characteristics			Infant characteristics				Parent characteristics					
	Journal	Location	Design	*N* (n after exclusion)	% Girls	Range Mean age (months)	BI	*N* (n after exclusion)	% Mothers	Mean age (years)	SES	Ethnicity % CAU	Anxiety (%)
Aktar et al. (2013)	Journal of Child Psychology and Psychiatry	Europe, The Netherlands	Correlational	122	54.92	12 (12.20)	Assessed with (LAB-TAB)	244 (242)	49.59	33.21	Moderate to High	93.03 (Parent)	31.15 (Current), 54,10 (Lifetime), Assessed with: ADIS
Aktar et al. (2014)	Journal of Child Psychology and Psychiatry	Europe, The Netherlands	Correlational	117 (subsample of Aktar et al., 2013)	54.7	30 (30)	Assessed with (LAB-TAB)	234 (232)	50.43	34	Moderate to High	92.31 (Parent)	55.56, Assessed with: ADIS
Aktar et al. (2018)	Journal of Clinical Child & Adolescent Psychology	Europe, The Netherlands	Correlational	122 (same sample as Aktar et al., 2013)	54.92	12 (12.20)	Assessed with (LAB-TAB)	244 (242)	48.18	33.21	Moderate to High	93.03 (Parent)	31.15 (Current), 54,10 (Lifetime), Assessed with: ADIS
Blackford & Walden (1998)	Infant Behavior & Development	North America, USA	Experimental	55 (42)	52.73	11-22	Assessed with IBQ and TBAQ	55 (42)	89	NA	Moderate	96 (Infant)	NA
Carpenter (2004)	Dissertation	North America, USA	Experimental	61 (58)	43.10	T1: 9 T2: 12 T3: 18	Assessed with IBQ	61 (58)	96.72	NA	Moderate to High	83.61(Infant)	NA
De Rosnay et al. (2006)	Behaviour Research and Therapy	Europe, UK	Experimental	24 (24)	50	12-14 (12.8)	Assessed with IBQ	24 (24)	100	NA	NA	100 (Infant)	Low range for social anxiety
Dubi et al. (2008)	Journal of Abnormal Child Psychology	Oceania, Australia	Experimental	80 (71)	62	15-20 (17.39)	Assessed with Short Temperament Scale	80 (71)	100	NA	"well-educated"	94 (Infant)	Normal range, assessed with DASS
Gerull & Rapee (2002)	Behaviour Research and Therapy	Oceania, Australia	Experimental	31 (30)	50	15-20 (17.16)	NA	31 (30)	100	NA	Moderate	87.5 (Infant)	NA

Table 1. Continued

Study	General characteristics			Infant characteristics				Parent characteristics					
	Journal	Location	Design	*N* (n after exclusion)	% Girls	Range Mean age (months)	BI	*N* (n after exclusion)	% Mothers	Mean age (years)	SES	Ethnicity % CAU	Anxiety (%)
Goodman-Wilson (2012)	Dissertation	North America, USA	Experimental	94 (90)	47.87	12-13.5 (12.72)	Assessed with IBQ-R	94 (90)	100	NA	Moderate	71.28 (Parent), 63.83 (Infant)	Assessed with IAS and STICSA
Hirshberg & Svedja (1990)	Child Development	North America, USA	Experimental	74 (66)	50	12	NA	148 (132)	50	31	High	"Predominantly white" (Parents)	NA
Kim et al. (2010) (Study 1)	Infant Behavior and Development	North America, USA	Experimental	41(30)	60.98	17-25 (20.6)	NA	41(30)	90.24	NA	NA	92.68 (Infant)	NA
Klinnert (1984)	Infant Behavior and Development	North America, USA	Experimental	72 (11)	50	12 - 18, (15)	NA	72 (11)	100	NA	Moderate	NA	NA
Knieps et al. (1994)	American Journal of Mental Retardation	North America, USA	Experimental	22 (11, only subsample without Down Syndrome)	36.36	10-23 (16.2)	NA	22 (11)	90.91	NA	Moderate	90.91(Infant)	NA
Möller et al. (2014)	Developmental Science	Europe, The Netherlands	Correlational	81 (81)	50.62	10-15 (11.88)	Assessed with IBQ-R	81 (81)	49.38	35.62	High education level	NA	Assessed with SCARED-A, mean = no anxiety
Mumme et al. (1996)	Child Development	North America, USA	Experimental	125 (90)	51.11	12-13 (12.43)	NA	125 (90)	100	NA	Moderate	81 (Infant)	NA
Murray et al. (2008)	Child Development	Europe, UK	Experimental	190 (156)	55.25	(T1 10.31, T2 14.04)	Assessed with behavioral coding of nonsocial tasks	190 (156)	100	30.80	Moderate to high	97.38 (Parent)	Assessed with SIAS, SPS, clinical structured interview for DSM IV, Social Phobia: 50.64%

Table 1. Continued

Study	General characteristics			Infant characteristics				Parent characteristics					
	Journal	Location	Design	*N* (n after exclusion)	% Girls	Range Mean age (months)	BI	*N* (n after exclusion)	% Mothers	Mean age (years)	SES	Ethnicity % CAU	Anxiety (%)
Rosen et al. (1992)	Developmental Psychology	North America, USA	Experimental	39 (37)	48.65	11-12 (12)	NA	39 (37)	100	NA	Moderate	NA	NA
Sorce et al. (1985) (Study 1)	Developmental Psychology	North America, USA	Experimental	61 (36)	47.22	12	NA	61 (36)	100	NA	Moderate	NA	NA
Stenberg (2003)	Infant and Child Development	Sweden, Europe	Experimental	99 (96)	50	12.15	NA	99 (96)	100	31.9	High education level	100 (Infant)	NA
Walden & Ogan (1988)	Child Development	North America, USA	Experimental	40 (40)	45	6-22 (12.79)	NA	40 (40)	80	NA	Moderate	NA	NA
Walden & Baxter (1989)	Child Development	North America, USA	Experimental	48 (32only age groups 6 to 23 months)	50	12.75	NA	48 (32 only parents of age groups 6 to 23 months)	85.42	NA	Moderate	NA	NA
Walden et al. (1991)	American Journal of Mental Retardation	North America, USA	Experimental	40 (20, only subsample without developmental delays)	45	6-27	NA	40 (20)	90	NA	Moderate	NA	NA
Zarbatany & Lamb (1985)	Infant Behavior and Development	North America, USA	Experimental	79 (18 in parent conditions)	Original Sample: 48	Original sample 13.23-15.03 (14.13)	NA	18	100	NA	NA	NA	NA

Notes: For journal: name of journal in which the article was published. For location: study location. For Infant characteristics*: N* = number of infants in the sample; *BI* = behavioral inhibition/temperament; *CAU* = Caucasian. For parent characteristics: *N* = number of parents in the sample; *SES* = socio-economic status; *CAU* = Caucasian; *Anxiety* = percentage of parents who have anxiety based on diagnostic tools or questionnaires.

Table 2. Overview of the reviewed studies' approach to measuring parental non-verbal communication

Study	Type of parental message	Type of stimulus	Specifically	Assessment method	Specifically
Aktar et al. (2013)	Non-verbal and verbal	Social and non-social	Stranger and toy	Behavioral Measure: Fear and avoidance	Fear: Intensity and frequency of facial, bodily and vocal expressions of fear on a scale from 1 to 5 Avoidance: Infant attempt to gaze away, turn away or increase distance from or ignore stimuli on a scale from 1 to 5
Aktar et al. (2014)	Non-verbal and verbal	Social and non-social	Stranger and toy	Behavioral Measure: Fear and avoidance	Fear: Intensity and frequency of facial, bodily and vocal and verbal expressions of fear on a scale from 1 to 5 Avoidance: Infant attempt to gaze away, turn away hide from stimuli on a scale from 1 to 5
Aktar et al. (2018)	Non-verbal and verbal	Social and non-social	Stranger and toy	Behavioral Measure: Fear and avoidance	Fear: Intensity and frequency of facial, bodily and vocal expressions of fear on a scale from 1 to 5 Avoidance: Infant attempt to gaze away, turn away or increase distance from or ignore stimuli on a scale from 1 to 5
Blackford & Walden (1998)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Fear and avoidance	Fear: Facial, vocal and verbal expressions of fear from 1 (very positive) to 5 (very negative) Avoidance: Approach and avoidance from stimulus 1(approach) to 7 (avoidance)
Carpenter (2004)	Non-verbal and verbal	Social and non-social	Stranger and toy	Behavioral Measure: Fear and avoidance	Fear: Facial, bodily and vocal expressions from 1 (extreme happiness) to 5 (extreme fear) Avoidance: Approach and avoidance from stimulus 1 (full approach) to 7 (full avoidance), Cognitive measure: looks at stimulus
De Rosnay et al. (2006)	Non-verbal and verbal	Social	Stranger	Behavioral Measure: Fear and avoidance	Fear: Facial, and bodily expressions of fear from 1 (absent) to 5 (very frequent) Avoidance: Attempts to increase distance from strange by i.e. Gazing away, moving away, turning away from 1 (absent) to 5 (very frequent)
Dubi et al. (2008)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Fear and avoidance	Fear: Emotional expression -2 (high negative affect) to 2 (high positive affect) Avoidance: Approach and avoidance from stimulus -2 avoidance (retreat to mother) to 2 approach (touching and exploring toy)

Table 2. Continued

Study	Type of parental message	Type of stimulus	Specifically	Assessment method	Specifically
Gerull & Rapee (2002)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Fear and avoidance	Fear: Emotional expression -2 (high negative affect) to 2 (high positive affect) Avoidance: Approach and avoidance from stimulus -2 avoidance (retreat to mother) to 2 approach (touching and exploring toy)
Goodman-Wilson (2012)	Non-verbal and verbal	Social and non-social	Stranger and toy	Behavioral Measure: Fear and avoidance	Fear: Facial and vocal expressions from 1 (very positive) to 5 (very negative) Avoidance: Approach and avoidance from stimulus 1(No avoidance) to 5 (strong avoidance)
Hirshberg & Svedja (1990)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Fear and avoidance	Fear: Facial, bodily and vocal expressions from 0 (no distress) to 2 (extreme distress) Avoidance: Approach and avoidance: mean multiple indices: number of approaches, time spent in approach, distance travelled in approach and latency to initiate approach, in seconds
Kim et al. (2010)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Avoidance (as inverse from Approach)	Avoidance: Proportion of time infant exhibited proximal toy-directed behavior
Klinnert (1984)	Non-verbal only	Non- social	Toy	Behavioral Measure: Avoidance	Avoidance: Farthest excusing toward toy, latency to approach toy
Knieps et al. (1994)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Fear	Fear: Facial expression, verbalizations and vocal tone from 1(positive expression) to 5 (negative expression), 3 is neutral
Möller et al. (2014)	Non-verbal and verbal	Non- social	Visual cliff	Behavioral Measure: Fear and avoidance	Fear: Facial, vocal and verbal expressions of fear on a 4-point scale from 0 to 3, indicating higher frequency Avoidance: Looking away, turning away, sitting still for a long time, on a 4-point scale from 0 to 3, indicating higher frequency,

Table 2. Continued

Study	Type of parental message	Type of stimulus	Specifically	Assessment method	Specifically
Mumme et al. (1996)	Non-verbal only (also voice only but not used)	Non- social	Toy	Behavioral Measure: Fear and avoidance	Fear: Facial expression from 0 (neutral) to 2 (very negative) Avoidance: Turned away from toy, not approach toy at all (0),to approach/ interaction toy (3)
Murray et al. (2008)	Non-verbal and verbal	Social	Stranger	Behavioral Measure: Fear and avoidance	Fear: Intensity and frequency of facial, bodily and verbal expressions of fear on a 5-point scale Avoidance: Infant attempt to gaze away, turn away or increase distance from stimuli on a 5-point scale
Rosen et al. (1992)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Fear and avoidance	Fear: Assessed whether infant affective display was positive, negative or unclear Avoidance: Distance from toy in meters
Sorce et al. (1985)	Non-verbal only	Non- social	Visual cliff	Behavioral Measure: Fear and avoidance	Fear: Intensity and frequency of facial, bodily and verbal expressions of fear from 1 (smile) to 5 (overt distress); Avoidance (coping behavior): Presence or absence of crossing cuff, frequency of retreat back, moving to shallow side
Stenberg (2003)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Fear and avoidance	Fear: Infant affect total number of 5s intervals during which the infant showed positive, negative and neural affect Avoidance: Amount of time averting gaze or turning away from toy, reaching for toy, time spent playing with toy
Walden & Ogan (1988)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Avoidance	Fear: Frequency of crying Avoidance: Latency and frequency touching and reaching for toy
Walden & Baxter (1989)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Avoidance	Avoidance: Latency touching and reaching for toy
Walden et al. (1991)	Non-verbal and verbal	Non- social	Toy	Behavioral Measure: Avoidance	Avoidance: Frequency, duration, and latency touching of toy
Zarbatany & Lamb (1985)	Non-verbal only	Non- social	Toy	Behavioral Measure: Avoidance	Avoidance: Latency to approach toy, distance moved towards toy

Main Results

Meta-Analysis

The effect of parental threat expression on infant *fear* was Hedges' *g* =. 39, *SE* = .13, *CI* [.14, .64], *k* = 17, $p < 0.01$), indicating that infants displayed more fear towards the novel stimulus after being exposed to parental threat expressions. There was an indication of heterogeneity ($Q = 76.50$, $p < .0001$). Egger's test did not indicate asymmetry in the funnel plot ($b = -.03$, $p = .34$), and the trim-fill method did not indicate missing studies on the left side of the funnel. In sensitivity analysis, we repeated the same analysis with only experimental studies. In experimental studies, the effect size of parental threat expression on infant *fear* was Hedges' *g* =. 44, *SE* = .15, *CI* [.14, .73], *k* = 14, $p < 0.01$), with no indication of funnel plot asymmetry ($b = -.11$, $p = .32$) or missing studies on the left side of the funnel.

The effect with infant *avoidance* as an outcome measure was Hedges' *g* = .46, *SE* = .10, *CI* [.26, .65], *k* =19, $p < .0001$), indicating that infants were more avoidant of the novel stimulus after being exposed to parental threat expressions. There was an indication of heterogeneity ($Q = 52.49$, $p < .0001$). Egger's test did not indicate asymmetry in the funnel plot ($b = .04$, $p = .18$), and the trim-fill method did not indicate missing studies on the left side of the funnel. In experimental studies, the effect size of parental threat expression on infant *avoidance* was Hedges' *g* =. 44, *SE* = .12, *CI* [.21, .68], *k* = 16, $p < 0.01$), with no indication of funnel plot asymmetry ($b = .03$, $p = .30$), or missing studies on the left side of the funnel. For both fear and avoidance outcomes, funnel and forest plots can be found in Figure 2 and Figure 3 (for plots of studies with only experimental design see Supplementary Material C). Inspection of the standardized residuals revealed no outlier (all standardized residuals between 3.29 and -3.29). Lastly, we checked whether study effect sizes for infant fear or avoidance were related to the study quality ratings, which was not the case (both *p*'s > .67).

Systematic Review

A summary of the main findings can be found in Table 3. Based on social fear learning theories (Rachman, 1977; Olsson et al., 2007), we expected that infants express more fear and anxiety towards novel stimuli when these stimuli are paired with parents' fear/anxiety expressions than non-anxious parental expressions. Of the 23 studies reviewed, infant fear was assessed in 17 studies, infant avoidance was assessed in 21 studies, and a combined fear and avoidance measure was utilized in two studies. We found that six out of 17 (44 %) studies found an effect of parental expressions of fear/ anxiety on infant fear (measured as infant fearful/negative affect/distress), and the other eleven did not. Furthermore, 11 out of 21 (52%) studies found an effect on infant avoidance (Aktar et al., 2013; De Rosnay et al., 2006; Dubi et al., 2008; Gerull & Rapee, 2002; Hirshberg & Svedja, 1990; Kim et al., 2010; Mumme et al., 1996; Sorce

et al., 1985, Walden & Ogan, 1988; Walden & Baxter, 1989; Walden et al., 1991), one study found an effect on avoidance of toys but not of the stranger (Goodman-Wilson, 2012) and another only on part of the stranger task (pick up but not approach phase) (Murray et al., 2008). Lastly, one of the two studies that included a combined fear and avoidance measure found no relationship between parental nonverbal signals of threat and infant reaction to novel stimuli (Aktar et al., 2014), whereas the other one did (Rosen et al., 1992).

Multiple studies investigated additional moderating effects of for example parental gender, infant gender and/or age in the link between parental expressed fear and infant fear/avoidance to novel stimuli. In one study, authors found an effect of parental threat on infant fear and avoidance, but only when the father conveyed the fearful signals and not the mother (Möller et al., 2014), whereas another study found only maternal, but not paternal expression being related to subsequent infant fear when the infant was 1 year old (Aktar et al., 2018). Carpenter (2004) found an effect of parental threat on infant fear and avoidance only in specific age ranges. Nine-month old's looked less to stimuli in fear vs happy condition and 18 month old's showed overall less approach in fear versus happy condition, whereas Walden and Baxter (1989) found an effect in the 13 to 23-month-olds but not in 6-12 or 24-40 years old's. Another study found mothers' messages to only affect female infants, who stayed less close to the toy in the fearful versus happy condition (Rosen et al., 1992).

Parental anxiety and child BI

Meta-Analysis

BI was not a significant moderator of infant *fear*. The effect of parent responses on infant fear did not change as a function of BI (Hedges' g = .07, SE = 0.07, CI [-0.06, 0.19], k = 8, p = .31. In sensitivity analysis, we repeated the same analysis with only experimental studies. Again, the effect size of parent responses on infant fear did not change as a function of BI, Hedges' g =. 08, SE = .09, CI [-.09, .25], k = 5, p = .36).

BI was a significant moderator on infant *avoidance*: the effect of parent responses was stronger for infants higher in BI (Hedges' g = .25, SE = .11, CI [.04, 0.46], k = 8, $p < .05$). In sensitivity analysis, we repeated the same analysis with only experimental studies. In contrast to findings including both correlational and experimental studies, the effect size of parent responses on infant fear did not change as a function of BI when solely including experimental studies, Hedges' g = .18, SE = .13, CI [-.07, .32], k = 5, p = .17).

Funnel and forest plots can be found in Figure 4 and Figure 5 (for plots of studies with only experimental design see Supplementary Material C). Inspection of the standardized residuals revealed no outliers. We could not assess whether parental

anxiety moderates the effect of parental responses on infant fear and avoidance because we did not have enough studies for the analysis ($k < 4$).

Systematic Review

A summary of the moderator effects can be found in Table 3. Of the 23 studies reviewed, only three assessed the moderating role of parental anxiety (Aktar et al., 2014; Goodman-Wilson, 2012; Murray et al., 2008). The study by Aktar et al. (2014), found that the link between parental expressions of threat at 12 months with infant fear/avoidance at 30 months was stronger for infants of parents with lifetime comorbid social and other anxiety diagnoses. However, the study did not assess the moderating role of parental anxiety in the link between parental expressions of threat at 12 months with infant fear/avoidance on the same day. Goodman-Wilson (2012) did not find a significant effect of parental anxious expression on infant fear or avoidance. Murray et al. (2008) found that infants of mothers with social phobia at 10 months were not more avoidant towards or fearful of strangers in the same social referencing paradigm. However, they did become more avoidant of strangers picking them up (but not approaching them) between 10 and 14 months. Thus, no study found that the effect of parental anxious expression on infant fear or avoidance was stronger in infants of anxious parents, when assessing the outcome in the same social referencing paradigm.

We expected that infants with a more fearful temperament express more fear and anxiety of novel stimuli than less temperamentally fearful infants when they are exposed to parental-expressed fear. Based on the 23 studies reviewed, we found some support for the hypothesis. Two out of eight studies (Aktar et al., 2013; De Rosnay et al., 2006) found a moderating effect of BI on infant *avoidance*, while five did not find such an effect (Blackford & Walden, 1998; Carpenter, 2004; 1998; Dubi et al., 2008; Möller et al., 2014) and one study (Goodman-Wilson, 2012) found an effect when the stimulus was a social but not non-social task (but in the opposite direction): Infants who were *low* in BI showed increased avoidance after parents expressed fear towards the stranger. However, Möller et al. (2014) did find a moderating role of infant BI on the impact of parental fear signals on infant avoidance of novel stimuli when fathers were conveying the fearful message and not mothers. The link between *paternal* fearful expressions and infant avoidance of the novel stimulus was stronger for infants with more fearful temperaments. In addition, while one study did find infant BI to impact the effect of parental fear signals on infant fear towards novel stimuli (Carpenter, 2004), the majority of studies (7 out of 8) assessing the moderating role on infant *fear* did not find an effect (Aktar et al., 2013; Blackford & Walden 1998; De Rosnay et al., 2006; Dubi et al., 2008; Goodman-Wilson, 2012; Möller et al., 2014; Murray et al., 2008.)

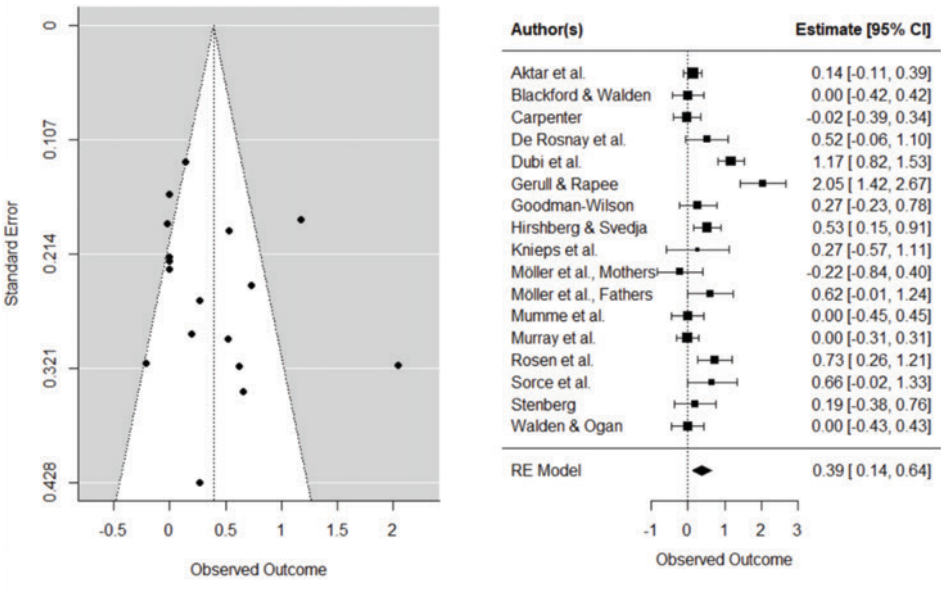

Figure 2. Funnel and forest plots of main effects on child fear

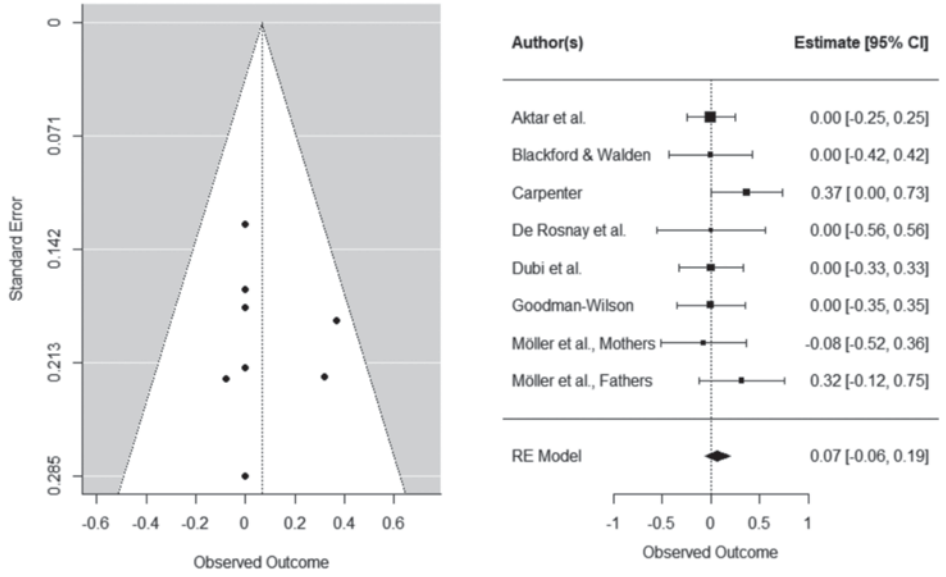

Figure 3. Funnel and forest plots of moderating BI effect on child fear

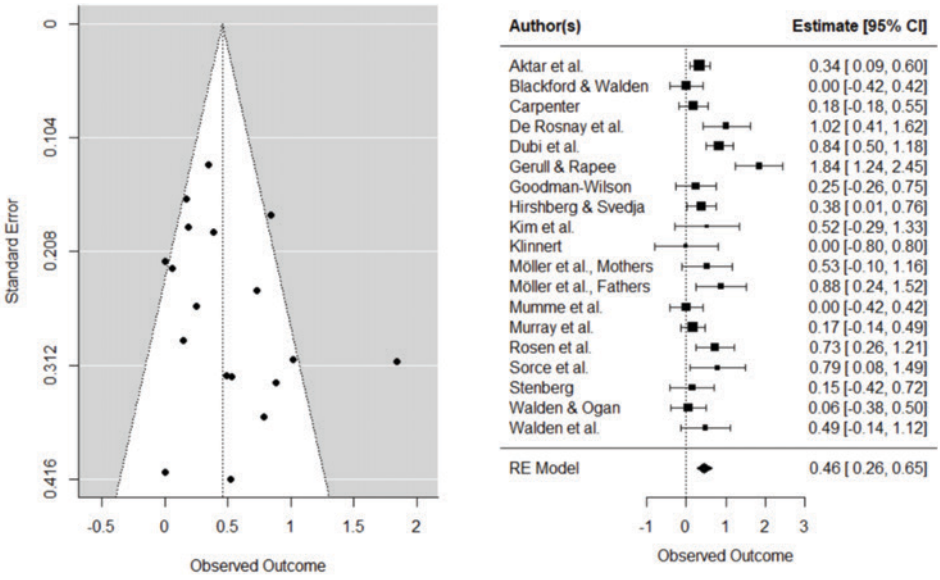

Figure 4. Funnel and forest plots of main effects on child avoidance

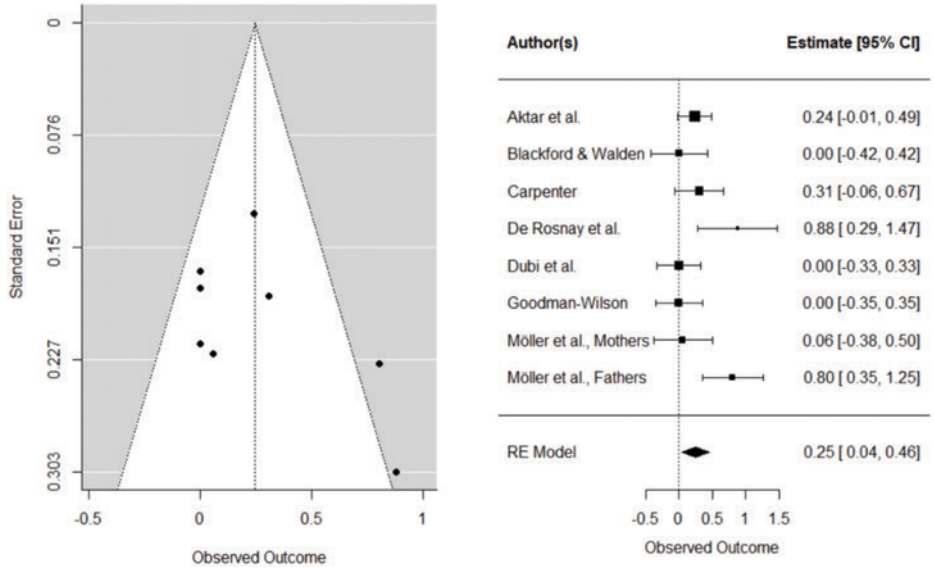

Figure 5. Funnel and forest plots of moderating BI effect on child avoidance

Table 3. Main outcomes and results of moderators on the association between parental non-verbal communication and infant fear/avoidance outcomes

Study	Main Outcomes	Moderator Outcomes
		Behavioral Inhibition
Aktar et al. (2013)	Fear: — Avoidance: ↑	Fear: — Avoidance: ↑
Aktar et al. (2014)	Fear/Avoidance: —	Fear/Avoidance: —
Aktar et al. (2018)	Fear: — Avoidance: —	NA
Blackford & Walden (1998)	Fear: — Avoidance: —	Fear: — Avoidance: —
Carpenter (2004)	Fear: — Avoidance: —	Fear: ↑ Avoidance: —
De Rosnay et al. (2006)	Fear: ↑ Avoidance: ↑	Fear: — Avoidance: ↑
Dubi et al. (2008)	Fear: ↑ Avoidance: ↑	Fear: — Avoidance: —
Gerull & Rapee (2002)	Fear: ↑ Avoidance: ↑	NA
Goodman-Wilson (2012)	Fear (Stranger and Toy): — Avoidance (Stranger and Toy): —	Fear (Stranger and Toy): — Avoidance: Stranger ↑ Toy —
Hirshberg & Svedja (1990)	Fear: ↑ Avoidance: ↑	NA
Kim et al. (2010)	Avoidance: ↑	NA
Klinnert (1984)	Avoidance: —	NA
Knieps et al. (1994)	Fear: —	NA
Möller et al. (2014) Mother Sample	Fear: — Avoidance: —	Fear: — Avoidance: —
Möller et al. (2014) Father Sample	Fear: ↑ Avoidance: ↑	Fear: — Avoidance: ↑
Mumme et al. (1996)	Fear: — Avoidance: —	NA
Murray et al. (2008)	Fear: — Avoidance: —	NA
Rosen et al. (1992)	Fear/Avoidance: ↑	NA
Sorce et al. (1985)	Fear: ↑ Avoidance: ↑	NA
Stenberg (2003)	Fear: — Avoidance: —	NA
Walden & Ogan (1988)	Fear: — Avoidance: ↑	NA
Walden & Baxter (1989)	Avoidance: ↑	NA
Walden et al. (1991)	Avoidance: ↑	NA
Zarbatany & Lamb (1985)	Avoidance: —	NA

↑: = increase in (or presence of) non-verbal communication significantly associated with increase in or higher fear/anxiety $p < .05$;
— = non-verbal communication not significantly associated with fear/anxiety $p > .05$, if main effect insignificant but 3 or 4-way interaction significant it is labeled as insignificant;
NA = interaction not assessed (i.e. only main effect and not interaction with parental fear expression, or 3-way interactions with another variable), or not assessed at relevant time point/age range.

Discussion

This systematic review and meta-analysis aimed to shed light on the role of modeling in the transmission of fear from parents to infants. The meta-analytic evidence reveals that parental fear expressions of novel stimuli increase infant fear and avoidance – after a single exposure to these stimuli (Hedges' *g* = .44 and .44 respectively). We did find that behaviorally inhibited infants had stronger avoidance (not fear) reactions towards novel stimuli after exposure to parental fear expressions when including experimental and correlational studies, but the effect did not hold in experimental studies only. Below, we address each of these findings in turn.

Infant Fear and Avoidance

In line with social fear-learning models (Olsson et al., 2007; Rachman, 1977), there was a significant effect of parental fear expressions on infant fear and avoidance, supporting the idea of parental modeling as a social fear-learning pathway with small to medium effect sizes (Hedges' *g* = .39 and .46 respectively). When investigating the causal effect of parental modeling on infant fear and avoidance using exclusively experimental studies, the effect sizes were also small to medium (Hedges' *g* = .44 and .44 respectively).

While experimental designs allow us to make stronger inferences on causality, their findings might be less generalizable to real-life interactions/ daily life (Kazdin, 2021). A previous review that summarized findings on child fear acquisition via verbal threat information has argued for assessing child fear acquisition with this social fear learning paradigm in more ecologically valid contexts (Muris & Field, 2010). This reasoning also applies to modeling pathways in early life, as both experimental as well as prospective, more naturalistic designs are necessary to gain further insight on the impact of parental fear/anxiety expressions on infant fear and avoidance acquisition towards novel stimuli.

Furthermore, there seem to be inconsistent findings regarding infant fear and avoidance. Some studies that assessed both fear and avoidance towards novel stimuli as separate constructs, found different results for fear and avoidance outcome measures in the same children (i.e. support for an effect of condition on avoidance but not infant affect) (for example, Walden & Ogan, 1988). The mixed findings suggest that infant affect and avoidance do not have to co-occur, and different behavioral indices of fear might become relevant at different developmental stages. Infants' ability to understand and judge how threatening a novel stimulus is, as well as to what extent they can regulate emotions accordingly can influence how infants express fear (LoBue & Adolph, 2019). During childhood, over time the inclination to avoid novel stimuli increases more strongly than to show distress (Sumter, et al., 2009; Rapee & Spence, 2004). As infants

get older, infants may also show fewer fearful and more avoidant strategies in response to parental expression of fear (Aktar et al., 2018). Longitudinal studies covering the periods including and extending from the toddlerhood years are needed to shed light on these developmental differences in fearful and avoidant responses.

Parental and child anxiety dispositions

Susceptibility models suggest that infants with fear-sensitive temperamental dispositions are more susceptible to exposure to environmental stressors including parental anxiety signals (Belsky and Pluess 2009; Ingram and Luxton 2005; Nigg 2006). In line with this model, our meta-analysis suggests that there is a small moderating effect of BI on infant *avoidance* (Hedges' g = .25). Also the systematic review lends some support to the idea that behaviorally inhibited infants display an increased avoidant response after exposure to parental fear expressions, but only in three out of eight studies. However, based on the experimental studies we did not find a moderation by temperament in the causal link between parental fearful expressions to novel stimuli and child avoidance (Hedges' g = .18). Possibly, infants are more likely to display their usual/learned responses in response to more naturalistic parental expressions of fear (in correlational studies), than manipulated fear expressions (in experimental studies). Given that temperamentally fearful infants have the trait tendency to withdraw and avoid novel stimuli (Stifter & Augustine, 2019), this effect might be more visible in studies with correlational designs. Possibly, a third variable that is related to both parental fear expressions and infant avoidance may have inflated the effect size of this link. The reported correlations could for example be influenced by genetic similarity or the learning history of parental behaviors. Hence, we do not know to what extent the link between parental fear expressions to novel stimuli and child fear or avoidance is due to genes, or to what extent it represents the habitual reaction of infants that has been reinforced over time. Specifically, parents may have supported children's avoidant behaviors in anxiety-inducing or novel situations, or removed the child from these situations (Reinforcement pathway described in Fisak & Grills-Tacquechel, 2007). In experimental studies, these confounds are controlled for by manipulating parental expressions/reaction. However, in experimental studies, the findings might also not be representative of the effect that parental fear expressions have on child fear and avoidance in real life, because manipulated parental expressions/reaction to novel stimuli might be different to infants' previous experiences and expectations. A previous study suggests that expectancy violations in infants might influence social learning processes (Colomer & Woodward, 2023). It is up to future research to elucidate the

role of BI in the parent-to-infant transmission of fear to novel stimuli by assessing the additional effects of genetic traits or assessing the influence of BI on the repeated exposure to parental fearful expressions.

Moreover, our meta-analysis did not find a moderating effect of BI on infant *fear* (Hedges' g = .07). This aligns with findings from our systematic review where no such effect on infant fear was observed for the majority of the studies (7 out of 8 found no significant effect). Although this finding is not in line with the susceptibility theory (Belsky & Pluess, 2009), it might be explained by the fact that BI is most relevant in fear acquisition regarding social stimuli. BI is a more prominent risk factor for social anxiety (Clauss & Blackford, 2012) than for specific phobias (Pérez-Edgar & Fox, 2018), and most studies finding an effect included social stimuli in their social referencing design. Given that the majority of the studies included in this meta-analysis assessed fear towards non-social stimuli, no firm conclusions can be drawn on the moderating role of BI in the context of fear acquisition regarding social stimuli. Future experimental studies that incorporate social stimuli in their design will help to clarify this.

Next, we investigated the moderating role of parental anxiety. In the absence of a sufficient amount of studies with statistical information regarding parental anxiety, we could only assess its influence on infant fear and avoidance of novel stimuli by means of a systematic review. While parental anxiety is one of the biggest risk factors for child anxiety, we did not find support of infants of anxious parents showing stronger fear acquisition via modeling parents' anxious expressions. This suggests that infants of anxious parents might not be more sensitive towards novel stimuli in the context of a single exposure to parental fear expressions. However, two studies, which did not find stronger fear or avoidance in the infants of anxious parents immediately after being exposed to parent's expression of fear, found these expressions to be predictive of later avoidance towards that stimulus (Aktar et al., 2014; Murray et al., 2008). Specifically, Murray et al. (2008) found that infants of mothers with social phobia did become more avoidant of strangers picking them up between 10 and 14 months. The study by Aktar et al. (2014) found that the link between parental expressions of threat at 12 months with infant fear/avoidance at 30 months was stronger for infants of parents with lifetime comorbid social and other anxiety diagnoses. Therefore, it could be that over time, the repetitive nature of infant's modeling of parental expressions of fear in families with anxious parents, entailing a higher frequency of parental anxious expressions to novel stimuli, could explain the familial aggregation of anxiety. Furthermore, anxious parents may be more likely to support infants' avoidant behaviors in anxiety-inducing or novel situations, or remove the infant from these situations/stimuli (Fisak & Grills-

Tacquechel, 2007). Anxious parents might also provide other adaptive emotion regulation strategies less frequently, such as offering a security object, or displaying alternative problem-solving behaviors (Stifter & Augustine, 2019). Moreover, they might also react unsupportive, for example dismissing or ignoring infants' emotional reactions. This in turn could decrease infants' feelings of self-efficacy for self-regulation, and increase the distress or fear response (Stifter & Augustine, 2019). Given the limited number of studies investigating the moderating role of parental anxiety in parent-infant fear transmission, we need more studies investigating its role.

Clinical implications

Heightened offspring fear or fear learning in response to (potentially) threatening stimuli represents an evolutionary-adaptive and normative process (Kiel & Kalomiris, 2019). Nevertheless, by understanding how social fear learning processes unfold and differ between healthy and at-risk families, we might eventually shed more light on the specific processes and factors to target in prevention and treatment efforts. In our study, we found a small to medium effect of parents displaying fearful reactions to novel stimuli on infant fear and avoidance towards these stimuli, independent of parental anxiety levels. While this fear acquisition pathway in itself can be seen as an adaptive response to threatening/novel situation, it does not exclude the possibility that in at-risk families, where exposure to parental anxious expressions in daily life can be more frequent or intense, the impact of this fear acquisition pathway can be amplified. Incorporating psychoeducation targeting the potential pathways of social fear transmission in parents and children might be helpful in the prevention of anxiety risk in the offspring. Given that the effect of parental fearful reactions to novel stimuli on infant avoidance was stronger for children with more fearful temperaments- psychoeducation might be valuable for parents with children who are behaviorally inhibited.

In real life, infants might not only get exposed to a fearful reaction of one (anxious) parent in isolation, but another parent or significant other may display the same or conflicting emotional responses. As fear modeling seems to lead to an infant's fear acquisition towards novel stimuli, modeling of parents' positive emotions or confident reactions may reduce or prevent fear acquisition, even when one parent displays anxious responses. This was recently summarized in a systematic review investigating whether infants and children's positive modeling (of parents, strangers, and peers) in experimental, non-clinical contexts can reduce/prevent acquired fears (Krause & Askew, 2022). Although their conclusions rely on a limited amount of studies, positive modeling seems to be a promising technique to prevent fear acquisition and reduce fear responses

in infants and children. Understanding how fears are acquired in developmentally sensitive designs can inform us of potential strategies to reduce or prevent parent-to-child fear transmission in at-risk families.

Limitations and Future directions

This is the first systematic review and meta-analysis on the effect of parental fear expressions on infant fear and avoidance of novel stimuli. Although this work provides a relatively less biased synthesis of available evidence on parent-infant fear transmission via modeling, this study is not without shortcomings and echoes the limitations of the singular empirical work. First, in our systematic review and meta-analysis we heavily relied on studies with WEIRD (Western, educated, industrialized, rich, and democratic) samples. It is important to acknowledge the role of cultural differences in the emotional development of infants since parents' emotional expressions during daily interactions are part of commonly shared socialization practices (Halberstadt & Lozada, 2011). For example, infant's attention to (parental) emotional expressions in daily life can vary depending on their socioeconomic status (SES) (Clearfield & Jedd, 2013). Regarding our meta-analysis, this means we cannot generalize our findings to non-WEIRD samples. Future research that replicates previous studies in new or more heterogenous samples, or compare the fear acquisition pathway across different cultural environments, can give us more insight on the generalizability of our findings (Nielsen et al., 2017).

Second, studying fear modeling in strict experimental lab designs allows stronger conclusions, but it restricts the ecological validity of the findings. In daily life, infants are usually exposed to ambiguous stimuli such as novel toys in their own home or daycare, surrounded by familiar people, instead of in a new and ambiguous place with strangers (i.e. a lab, which does not characterize their common experience). Also training the parents to show specific emotional expressions in lab settings may not capture the intensity that the parent in real life displays to novel stimuli. Furthermore, infants might not only get exposed to a fearful reaction of one parent in isolation, but often the two parents or significant others display similar or conflicting emotional responses, either simultaneously or successively. More research is needed to investigate fear modeling in multiple contexts, as well as naturalistic observations in clinical samples. Future studies might also investigate repeated exposure to parental fearful expressions (either via experimental manipulation or by inclusion of anxious parents) to examine whether repeated exposure predicts fear or avoidance to novelty over time, and whether the relationship becomes stronger. This might also represent real life more accurately, as infants most likely will not only get exposed to parental expression to a novel stimulus just once.

Another limitation concerns the fact that multiple studies measured fear as a behavioral response to novel stimuli by exclusively focusing on either fear *or* avoidance. Studies focusing on singular indices of fear may not be sufficient to capture the entirety of infant fear reactions and do not allow us to investigate relationships between different fear indices. Measuring fear with singular indices can increase the likelihood of falsely identifying an infant's reaction as fear (LoBue & Adolph 2019). Therefore, to decrease the chances of misattribution, measuring fear in infants should contain multiple complementary methods such as multiple behavioral (infant distress and avoidance) and physiological indices of fear (LoBue & Adolph, 2019). This would also allow us to investigate whether parental fear expressions influence various behavioral but also physiological reactions in infants. Moreover, in a longitudinal design, one could also assess which indices of infant fear can predict later development of fear or anxiety to novel stimuli.

Conclusion

To conclude, we found a small to medium effect of parental fear signals towards novel stimuli on infant fear and avoidance of the stimuli – after a single exposure to that stimulus. Parents' nonverbal reactions to novel stimuli matter and contribute to infant fear and avoidance learning. The infants' levels of behavioral inhibition might increase avoidance to novel stimuli after exposure to parental expressions of fear, but more research is needed to conclude whether infant behavioral inhibition strengthens early environmental acquisition of fears and avoidance via parental modeling.

References

Aktar, E. (2022). Intergenerational transmission of anxious information processing biases: an updated conceptual model. *Clinical Child and Family Psychology Review*, 25(1), 1–22.

Aktar, E., & Bögels, S. M. (2017). Exposure to Parents' Negative Emotions as a Developmental Pathway to the Family Aggregation of Depression and Anxiety in the First Year of Life. *Clinical Child and Family Psychology Review*, 20(4), 369–390. https://doi.org/10.1007/s10567-017-0240-7

Aktar, E., Majdandžić, M., de Vente, W., & Bögels, S. M. (2014). Parental social anxiety disorder prospectively predicts toddlers' fear/avoidance in a social referencing paradigm. *Journal of Child Psychology and Psychiatry*, *55*(1), 77–87. https://doi.org/10.1111/jcpp.12121

Aktar, E., Majdandžić, M., De Vente, W., & Bögels, S. M. (2018). Parental Expressions of Anxiety and Child Temperament in Toddlerhood Jointly Predict Preschoolers' Avoidance of Novelty. *Journal of Clinical Child and Adolescent Psychology*, S421–S434. https://doi.org/10.1080/15374416.2017.1371029

Aktar, E., Majdandžić, M., de Vente, W., & Bögels, S. M. (2013). The interplay between expressed parental anxiety and infant behavioural inhibition predicts infant avoidance in a social referencing paradigm. *Journal of Child Psychology and Psychiatry*, 54(2), 144–156. https://doi.org/10.1111/j.1469-7610.2012.02601.x

Aktar, E.; Pérez-Edgar, K. Infant Emotion Development and Temperament. In *The Cambridge Handbook of Infant Development: Brain, Behavior, and Cultural Context*; Lockman, J., Tamis-LeMonda, C., Eds.; Cambridge University Press: Cambridge, UK, 2020; pp. 715–741. https://doi.org/10.1017/9781108351959.026

American Psychiatric Association. (2015). *Anxiety Disorders* (1st ed.). Washington, D.C: American Psychiatric Publishing.

Bakermans-Kranenburg, M. J., van IJzendoorn, M. H., & Juffer, F. (2003). Less Is More. *Psychological Bulletin*, 129(2), 195–215. https://doi.org/10.1037/0033-2909.129.2.195

Bandura, A., & Walters, R. H. (1977). *Social learning theory* (Vol. 1). Prentice Hall: Englewood cliffs.

Belsky, J., & Pluess, M. (2009). Beyond Diathesis Stress. *Psychological Bulletin*, 135(6), 885–908. https://doi.org/10.1037/a0017376

Blackford, J. U., & Walden, T. A. (1998). Individual differences in social referencing. *Infant Behavior & Development*, 21(1), 89–102. https://doi.org/10.1016/S0163-6383(98)90056-X

Bögels, S., & Perotti, E. (2011). Does father know best? A formal model of the paternal influence on childhood social anxiety. *Journal of Child and Family Studies*, 20(2), 171–181. https://doi.org/10.1007/s10826-010-9441-0

Carpenter, K. L. (2004). Relations between dyadic contingency, joint attention, infant distress, gender, and behavior and emotion regulation in 9- to 18-month-old infants. ProQuest Dissertations Publishing.

Cicchetti, D., & Rogosch, F. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology*, 8(4), 597-600. doi:10.1017/S0954579400007318

Clauss, J. A., & Blackford, J. U. (2012). Behavioral Inhibition and Risk for Developing Social Anxiety Disorder: A Meta-Analytic Study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 51(10), 1066–1075.e1. https://doi.org/10.1016/j.jaac.2012.08.002

Clearfield, M. W., & Jedd, K. E. (2013). The Effects of Socio-Economic Status on Infant Attention. *Infant and Child Development,* 22(1), 53–67. https://doi.org/10.1002/icd.1770

Colomer, M., & Woodward, A. (2023). Should I learn from you? Seeing expectancy violations about action efficiency hinders social learning in infancy. *Cognition,* 230, 105293–105293. https://doi.org/10.1016/j.cognition.2022.105293

Creswell, C., & Waite, P. (2015). The dynamic influence of genes and environment in the intergenerational transmission of anxiety. *American Journal of Psychiatry*, *172*(7), 597-598. https://doi.org/10.1176/appi.ajp.2015.15040509

Creswell, C., Cooper, P., & Murray, L. (2010). Intergenerational transmission of anxious information processing biases. In J. A. Hadwin & A. P. Field (Eds.), *Information processing biases and anxiety: A developmental perspective* (pp. 279–295). Wiley Blackwell. https://doi.org/10.1002/9780470661468.ch12

De Rosnay, M., Cooper, P. J., Tsigaras, N., & Murray, L. (2006). Transmission of social anxiety from mother to infant: An experimental study using a social referencing paradigm. *Behaviour Research and Therapy*, 44(8), 1165–1175. https://doi.org/10.1016/j.brat.2005.09.003

Debiec, J., & Olsson, A. (2017). Social Fear Learning: from Animal Models to Human Function. *Trends in Cognitive Sciences,* 21(7), 546–555. https://doi.org/10.1016/j.tics.2017.04.010

Degnan, K. A., Almas, A. N., & Fox, N. A. (2010). Temperament and the environment in the etiology of childhood anxiety. *Journal of Child Psychology and Psychiatry*, *51*(4), 497–517. https://doi.org/10.1111/j.1469-7610.2010.02228.x

Dubi, K., Rapee, R. M., Emerton, J. L., & Schniering, C. A. (2008). Maternal Modeling and the Acquisition of Fear and Avoidance in Toddlers: Influence of Stimulus Preparedness and Child Temperament. *Journal of Abnormal Child Psychology*, *36*(4), 499–512. https://doi.org/10.1007/s10802-007-9195-3

Dusseldorp, E., Elderen, T. van, Maes, S., Meulman, J., & Kraaij, V. (1999). A Meta-Analysis of Psychoeducational Programs for Coronary Heart Disease Patients. *Health Psychology*, *18*(5), 506–519. https://doi.org/10.1037/0278-6133.18.5.506

Egliston, K.-A., & Rapee, R. M. (2007). Inhibition of fear acquisition in toddlers following positive modelling by their mothers. *Behaviour Research and Therapy*, *45*(8), 1871–1882. https://doi.org/10.1016/j.brat.2007.02.007

Eley, T. C., McAdams, T. A., Rijsdijk, F. V., Lichtenstein, P., Narusyte, J., Reiss, D., … Neiderhiser, J. M. (2015). The Intergenerational Transmission of Anxiety: A Children-of-Twins Study. *The American Journal of Psychiatry*, *172*(7), 630–637. https://doi.org/10.1176/appi.ajp.2015.14070818

Feinman, S., Roberts, D., Hsieh, KF., Sawyer, D., Swanson, D. (1992). A Critical Review of Social Referencing in Infancy. In: Feinman, S. (eds) Social Referencing and the Social Construction of Reality in Infancy. Springer, Boston, MA. https://doi.org/10.1007/978-1-4899-2462-9_2

Feinman, S. (1982). Social referencing in infancy. *Merrill-Palmer Quarterly (1982-)*, 445-470.Feinman, S. (1985). Emotional expression, social referencing and preparedness for learning in infancy. *The development of expressive behavior: Biology-Environment Interactions*, 291-318. Orlando, FL: Academic Press.

Feinman, S., & Lewis, M. (1983). Social Referencing at Ten Months: A Second-Order Effect on Infants' Responses to Strangers. *Child Development*, *54*(4), 878–887. https://doi.org/10.2307/1129892

Fisak, B., & Grills-Taquechel, A. E. (2007). Parental modeling, reinforcement, and information transfer: Risk factors in the development of child anxiety? *Clinical Child and Family Psychology Review*, *10*(3), 213–231. https://doi.org/10.1007/s10567-007-0020-x

Fox, N. A., Henderson, H. A., Marshall, P. J., Nichols, K. E., & Ghera, M. M. (2005). Behavioral inhibition: Linking biology and behavior within a developmental framework. *Annual Review of Psychology*, *56*(1), 235–262. https://doi.org/10.1146/annurev.psych.55.090902.141532

Gerull, F. C., & Rapee, R. M. (2002). Mother knows best: effects of maternal modelling on the acquisition of fear and avoidance behaviour in toddlers. *Behaviour Research and Therapy*, *40*(3), 279–287. https://doi.org/10.1016/S0005-7967(01)00013-4

Gregory, A., & Eley, T. (2011). The genetic basis of child and adolescent anxiety. In W. Silverman & A. Field (Eds.), Anxiety Disorders in Children and Adolescents (Cambridge Child and Adolescent Psychiatry, pp. 161-178). *Cambridge: Cambridge University Press*. doi:10.1017/CBO9780511994920.009

Goodman-Wilson, M. (2012). Social Referencing: *Sources of Variability in Infant and Maternal Behavior*. ProQuest Dissertations Publishing.

Halberstadt, A. G., & Lozada, F. T. (2011). Emotion Development in Infancy through the Lens of Culture. *Emotion Review*, 3(2), 158–168. https://doi.org/10.1177/1754073910387946

Hettema, J. M., Neale, M. C., & Kendler, K. S. (2001). A Review and Meta-Analysis of the Genetic Epidemiology of Anxiety Disorders. *The American Journal of Psychiatry*, 158(10), 1568–1578. https://doi.org/10.1176/appi.ajp.158.10.1568

Hirshberg, L. M., & Svejda, M. (1990). When Infants Look to Their Parents: I. Infants' Social Referencing of Mothers Compared to Fathers. *Child Development*, *61*(4), 1175–1186. https://doi.org/10.2307/1130885

Ingram, R. E., & Luxton, D. D. (2005). Vulnerability-stress models. *Development of psychopathology: A vulnerability-stress perspective*, *46*. https://doi.org/10.4135/9781452231655.n2

Kazdin, A. E. (2021). *Research design in clinical psychology*. Cambridge University Press.Kiel, E. J., & Kalomiris, A. E. (2019). Emotional development and anxiety. *Handbook of emotional development*, 665-693. Springer International Publishing.

Kim, G., Walden, T. A., & Knieps, L. J. (2010). Impact and characteristics of positive and fearful emotional messages during infant social referencing. *Infant Behavior & Development*, *33*(2), 189–195. https://doi.org/10.1016/j.infbeh.2009.12.009

Klinnert, M. D. (1984). The regulation of infant behavior by maternal facial expression. *Infant Behavior & Development*, *7*(4), 447–465. https://doi.org/10.1016/S0163-6383(84)80005-3

Knieps, L. J., Walden, T. A., & Baxter, A. (1994). Affective expressions of toddlers with and without Down syndrome in a social referencing context. *American Journal on Mental Retardation*.

Krause, L., & Askew, C. (2022). Preventing and reducing fear using positive modelling: A systematic review of experimental research with children. *Behaviour Research and Therapy,* 148, 103992–103992. https://doi.org/10.1016/j.brat.2021.103992

Lawrence, P. J., Murayama, K., & Creswell, C. (2019). Systematic Review and Meta-Analysis: Anxiety and Depressive Disorders in Offspring of Parents With Anxiety Disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, *58*(1), 46–60. https://doi.org/10.1016/j.jaac.2018.07.898

Leppänen, J. M. (2011). Neural and developmental bases of the ability to recognize social signals of emotions. *Emotion Review, 3*(2), 179–188. https://doi.org/10.1177/1754073910387942

Leppänen, J. M., & Nelson, C. A. (2009). Tuning the developing brain to social signals of emotions. *Nature Reviews Neuroscience*, 10, 37–47. https://doi.org/ 10.1038/nrn2554

LoBue, V., & Adolph, K. E. (2019). Fear in Infancy: Lessons From Snakes, Spiders, Heights, and Strangers. *Developmental Psychology,* 55(9), 1889–1907. https://doi.org/10.1037/dev0000675

LoBue, V., Kim, E., & Delgado, M. (2019). Fear in development. In *Handbook of emotional development* (pp. 257-282). Cham: Springer International Publishing.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*, 339(7716), 332–336. https://doi.org/10.1136/bmj.b2535

Möller, E., Majdandžić, M., Vriends, N., & Bögels, S. . (2014). Social referencing and child anxiety: the evolutionary based role of fathers' versus mothers' signals. *Journal of Child and Family Studies,* 23(7), 1268–1277. https://doi.org/10.1007/s10826-013-9787-1

Mumme, D. L., Fernald, A., & Herrera, C. (1996). Infants' Responses to Facial and Vocal Emotional Signals in a Social Referencing Paradigm. *Child Development*, 67(6), 3219–3237. https://doi.org/10.1111/j.1467-8624.1996.tb01910.x

Muris, P. (2006). The pathogenesis of childhood anxiety disorders: Considerations from a developmental psychopathology perspective. *International Journal of BehavioralDevelopment*,*30*(1),5–11.https://doi.org/10.1177/0165025406059967

Muris, P., & Field, A. P. (2010). Role of Verbal Threat Information in the Development of Childhood Fear. "Beware the Jabberwock!" *Clinical Child and Family Psychology Review,* 13(2), 129–150. https://doi.org/10.1007/s10567-010-0064-1

Muris, P., & P. Field, A. (2011). The"normal" development of fear. In Anxiety Disorders in Children and Adolescents (pp. 76–89). Cambridge University Press. https://doi.org/10.1017/CBO9780511994920.005

Murray, L., Creswell, C., & Cooper, P. J. (2009). The development of anxiety disorders in childhood: an integrative review. *Psychological Medicine*, 39(9), 1413–1423. https://doi.org/10.1017/S0033291709005157

Murray, L., de Rosnay, M., Pearson, J., Bergeron, C., Schofield, E., Royal-Lawson, M., & Cooper, P. J. (2008). Intergenerational Transmission of Social Anxiety: The Role of Social Referencing Processes in Infancy. *Child Development*, *79*(4), 1049–1064. https://doi.org/10.1111/j.1467-8624.2008.01175.x

Nielsen, M., Haun, D., Kärtner, J., & Legare, C. H. (2017). The persistent sampling bias in developmental psychology: A call to action. *Journal of Experimental Child Psychology*, 162, 31–38. https://doi.org/10.1016/j.jecp.2017.04.017

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *47*(3-4), 395-422.https://doi.org/10.1111/j.1469-7610.2006.01612.x

Ollendick, T. H., & Hirshfeld-Becker, D. R. (2002). The developmental psychopathology of social anxiety disorder. *Biological Psychiatry (1969)*, *51*(1), 44–58. https://doi.org/10.1016/S0006-3223(01)01305-1

Olsson, A., Nearing, K. I., & Phelps, E. A. (2007). Learning fears by observing others: the neural systems of social fear transmission. *Social cognitive and affective neuroscience*, *2*(1), 3-11. https://doi.org/10.1093/scan/nsm005

Pérez-Edgar, K., & Fox, N. A. (Eds.). (2018). *Behavioral inhibition: Integrating theory, research, and clinical perspectives*. Cham: Springer International Publishing AG. https://doi.org/10.1007/978-3-319-98077-5

Rachman, S. (1977). The conditioning theory of fear-acquisition: a critical examination. *Behaviour Research and Therapy*, *15*(5), 375–387. https://doi.org/10.1016/0005-7967(77)90041-9

Rapee, R. M., & Spence, S. H. (2004). The etiology of social phobia: empirical evidence and an initial model. *Clinical Psychology Review*, 24(7), 737–767. https://doi.org/10.1016/j.cpr.2004.06.004

Reynolds, G., Askew, C., & Field, A. P. (2018). Behavioral inhibition and the associative learning of fear. In *Behavioral inhibition* (pp. 263-282). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-98077-5_12

Rosen, W. D., Adamson, L. B., & Bakeman, R. (1992). An Experimental Investigation of Infant Social Referencing. *Developmental Psychology*, 28(6), 1172–1178. https://doi.org/10.1037/0012-1649.28.6.1172

Shimada-Sugimoto, M., Otowa, T., & Hettema, J. M. (2015). Genetics of anxiety disorders: Genetic epidemiological and molecular studies in humans. *Psychiatry and Clinical Neurosciences,* 69(7), 388–401. https://doi.org/10.1111/pcn.12291

Sorce, J. F., Emde, R. N., Campos, J., & Klinnert, M. D. (1985). Maternal emotional signaling: its effect on the visual cliff behavior of 1-year-olds. *Developmental Psychology*, *21*(1), 195–200. https://doi.org/10.1037//0012-1649.21.1.195

Stenberg, G. (2003). Effects of maternal inattentiveness on infant social referencing. *Infant and Child Development*, *12*(5), 399–419. https://doi.org/10.1002/icd.321

Stifter, C., & Augustine, M. (2019). Emotion Regulation. *Handbook of Emotional Development*, 405-430. Springer International Publishing.

Sumter, S. ., Bokhorst, C. ., & Westenberg, P. . (2009). Social fears during adolescence: Is there an increase in distress and avoidance? *Journal of Anxiety Disorders,* 23(7), 897–903. https://doi.org/10.1016/j.janxdis.2009.05.004

Telman, L. G. ., van Steensel, F. J. ., Maric, M., & Bögels, S. . (2018). What are the odds of anxiety disorders running in families?: A family study of anxiety disorders in mothers, fathers, and siblings of children with anxiety disorders. *European Child & Adolescent Psychiatry*, *27*(5), 615–624. https://doi.org/10.1007/s00787-017-1076-x

Thomas-Odenthal, F., Molero, P., van der Does, W., & Molendijk, M. (2020). Impact of review method on the conclusions of clinical reviews: A systematic review on dietary interventions in depression as a case in point. *PloS one*, *15*(9). https://doi.org/10.1371/journal.pone.0238131

Vasey, M. W., & Dadds, M. R. (2001). The Developmental Psychopathology of Anxiety. Cary: Oxford University Press. https://doi.org/10.1093/med:psych/9780195123630.001.0001

Walden, T. A., & Baxter, A. (1989). The Effect of Context and Age on Social Referencing. *Child Development*, *60*(6), 1511–1518. https://doi.org/10.2307/1130939

Walden, T. A., & Ogan,T. A. (1988). The development of social referencing. *Child development*, 1230-1240.

Walden, T. A., Knieps, L. J., & Baxter, A. (1991). Contingent provision of social referential information by parents of children with and without developmental delays. *American Journal of Mental Retardation*, *96*(2), 177-187.

Zarbatany, L., & Lamb, M. E. (1985). Social referencing as a function of information source: Mothers versus strangers. *Infant Behavior & Development*, *8*(1), 25–33. https://doi.org/10.1016/S0163-6383(85)80014-X

Supplementary Material

Material A.

Search strategy

To identify relevant articles, WebOfScience, PUBMED, Embase, and PsycINFO databases were searched. The search will include studies up to 21-11-2022 in English. The search term was created after searching for synonyms in dictionaries and in previous literature for the key components: "infant", "parent", "fear" and "vicarious learning". The resulting terms were combined, and the search term was adjusted. The initial proposed search term was: (("postnat*" OR "neonat*" OR "newborn" OR "new-born" OR "infan*" OR "baby" OR "babies" OR "month* old" OR toddler*) AND (parent* OR mother* OR father* OR caregiver* OR guardian*) AND ("social referenc*" OR acquisit* OR learn*) AND (fear* OR avoid* OR anxi* OR threat*)). We decided to shorten this for the following reasons: 1) we wanted to combine the vicarious learning and fear terms in order to find results more specific and relevant to our field of study, and exclude medical studies about viral/ bacterial transmission, and 2) this search term provided a large number of results, many of which were medical or animal studies, which are not relevant to our study. The final search term was: ((postnat* OR neonat* OR newborn OR "new-born" OR infan* OR baby OR babies OR "month old" OR "month-old" OR toddler) AND (parent* OR mother* OR father* OR caregiver* OR guardian*) AND (("social referencing" OR acquisition OR "nonverbal transmission" OR "non-verbal transmission" OR "vicarious learning" OR "observational learning") AND (fear* OR avoid* OR anxi* OR threat*))).

Material B.

Quality assessment

<u>Domain 1 - Randomization process</u>

In case of one condition: Were all subjects selected or recruited from the same or similar population? (e.g. same age range and healthy sample)

In case of control vs experimental condition: Were participants randomized into conditions/ or were groups matched based on age and sex? (if not randomized).

No (0): Not a similar population or not matched or unclear

Yes (1): Participants were randomized into conditions, they matched the groups before the group allocation *or* they checked if groups did not differ and they were similar *or* they checked if groups did not differ and they controlled for the variables that were not similar

Domain 2 - due to deviations from intended interventions

a. Did the stimuli remain novel for the participants?

   No (0): if participants already had some interaction with the stimulus beforehand

   Yes (1): if stimulus remained novel (e.g.: making sure stranger is not seen before experiment)

b. For social stimuli: Did the experimenter(s) make sure that stranger(s) were not aware of conditions?

   No (0): the randomized allocation was not concealed; thus it is likely that strangers (who deliver the intervention) were aware of participants' assigned intervention during the trial (e.g. if stranger sees infants allocation into experimental and control group beforehand)

   Yes (1): the experimenters made sure that strangers were not able to see any part of the randomized allocation of the infants (= they remained blind)

Domain 3 -Missing Data

Was there less than 20 % of dropout? (or if there is none mentioned but no way of checking it - to answer this question check if they mention the sample size in the descriptives and check if this number of participants is the same in the analyses and check if they have a paragraph about missing data and check if there was less attrition than 20%)

No (0): there was more than 20% attrition, *or* they have not mentioned how much attrition they specifically had

Yes (1): there was less than 20% of attrition

Domain 4 – Measurement of outcome

a. For observed infant anxiety/fear/avoidance: was the measurement of this outcome variable reliable?

   - No (0): the ICC (inter-coder reliability) was <.60 *or* in the text there was something like 'low reliability' *or* they do not mention something about reliability at all
   - Yes (1) = the reliability for the outcome measure is higher than >.60

b. For child temperament (e.g. behavioral inhibition, general fearfulness, fearful temperament)/ parental anxiety only: In case there was behavioral inhibition or parental anxiety measured, was the alpha bigger than 0.60?

- No (0): the alpha reported for these measures was below 0.60
- Yes (1): the measures obtained have an alpha of 0.60 or higher

Domain 5 – Selection of the reported results

a. Are there missing analyses in the results section, which have been mentioned in the introduction/methods section (check hypotheses, data analyses or preregistration)?

- No (0): there are some analyses which have been left out in the results section, although they have been planned and named beforehand
- Yes (1): all measurements planned (mentioned in the introduction/methods section) are also reported in the results

b. Did they refrain from applying more analyses which have not been planned beforehand (check hypotheses, data analyses or preregistration)

- No (0): here is evidence that measurements were analyzed in multiple ways despite not planning them apriori
- Yes (1): all analyses planned match all the data

Calculation of Quality score:

- Add all points for yes together and weigh score (since domain 2.2 and domain 4.1 are only applicable for specific studies/situations).

Table S1. Quality Assessment of Individual Studies

Background	Randomization		Deviations		Dropout	Outcome Measurement		Reported Results		Quality
Author	**1.a**	**1.b**	**2.a**	**2.b**	**3.a**	**4.a**	**4.b**	**5.a**	**5.b**	
Aktar et al. (2013)	1/1	NA	1/1	NA	1/1	1/1	2/2	1/1	1/1	100%
Aktar et al. (2014)	1/1	NA	1/1	NA	1/1	1/1	2/2	1/1	1/1	100%
Aktar et al. (2018)	1/1	NA	1/1	NA	1/1	1/1	2/2	1/1	1/1	100%
Blackford & Walden (1998)	1/1	NA	1/1	NA	1/1	1/1	1/1	1/1	1/1	100%
Carpenter (2004)	1/1	NA	1/1	1/1	1/1	1/1	1/1	1/1	1/1	100%
De Rosnay et al. (2006)	1/1	NA	1/1	1/1	1/1	1/1	1/1	1/1	1/1	100%
Dubi et al. (2008)	1/1	NA	1/1	NA	1/1	1/1	2/2	1/1	1/1	100%
Gerull & Rapee (2002)	1/1	NA	1/1	NA	1/1	1/1	1/1	1/1	1/1	100%
Goodman-Wilson (2012)	NA	1/1	1/1	1/1	1/1	1/1	2/2	1/1	1/1	100%
Hirshberg & Svedja (1990)	1/1	NA	0/1	NA	1/1	1/1	NA	1/1	1/1	83%
Kim et al. (2010)	NA	1/1	0/1	NA	0/1	1/1	NA	1/1	1/1	67%
Klinnert (1984)	1/1	NA	0/1	NA	1/1	1/1	NA	1/1	0/1	67%
Knieps et al. (1994)	1/1	NA	1/1	NA	1/1	1/1	NA	1/1	1/1	100%
Möller et al. (2014)	1/1	NA	1/1	NA	1/1	1/1	2/2	1/1	1/1	100%
Mumme et al. (1996)	NA	1/1	1/1	NA	1/1	1/1	NA	1/1	0/1	83%
Murray et al. (2008)	1/1	NA	NA	1/1	1/1	1/1	2/2	1/1	1/1	100%
Rosen et al. (1992)	1/1	NA	1/1	NA	1/1	1/1	NA	1/1	0/1	83%
Sorce et al. (1985)	NA	1/1	1/1	NA	0/1	1/1	NA	1/1	0/1	67%
Stenberg (2003)	NA	1/1	1/1	NA	1/1	1/1	1/1	1/1	1/1	100%
Walden & Ogan (1988)	1/1	NA	1/1	NA	1/1	1/1	NA	1/1	1/1	100%
Walden & Baxter (1989)	NA	1/1	1/1	NA	1/1	1/1	NA	1/1	1/1	100%
Walden et al. (1991)	1/1	NA	1/1	NA	1/1	1/1	NA	1/1	1/1	100%
Zarbatany & Lamb (1985)	NA	1/1	1/1	NA	0/1	1/1	NA	1/1	1/1	83%

Note: NA = Not applicable.

Material C.

Supplementary Figures

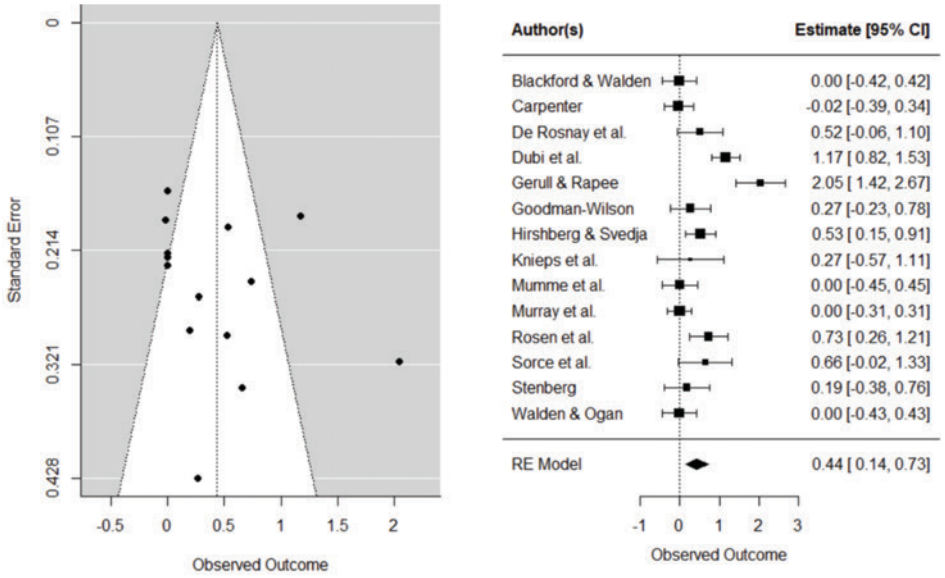

Figure C1. Funnel and forest plots of main effects on child fear in experimental studies

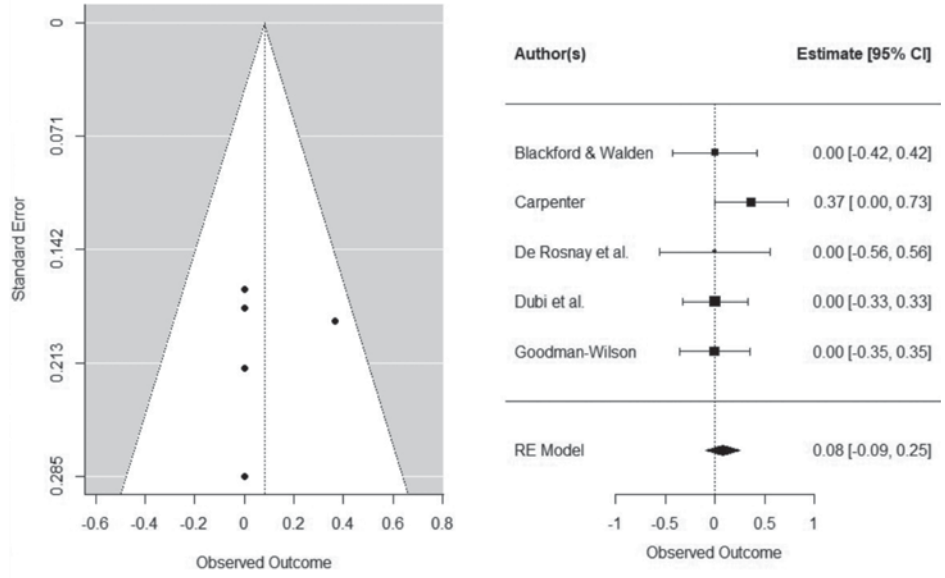

Figure C2. Funnel and forest plots of BI effect on child fear in experimental studies

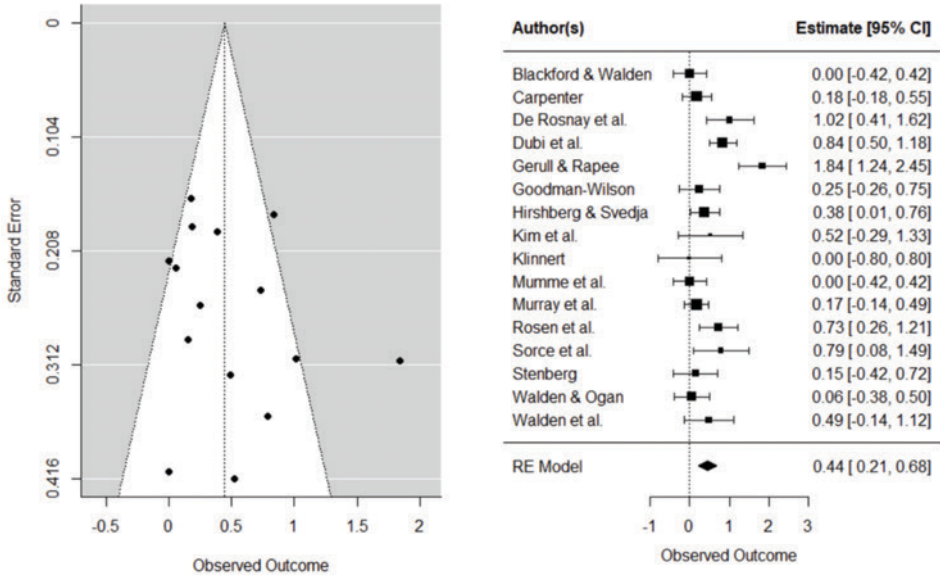

Figure C3. Funnel and forest plots of main effects on child avoidance in experimental studies

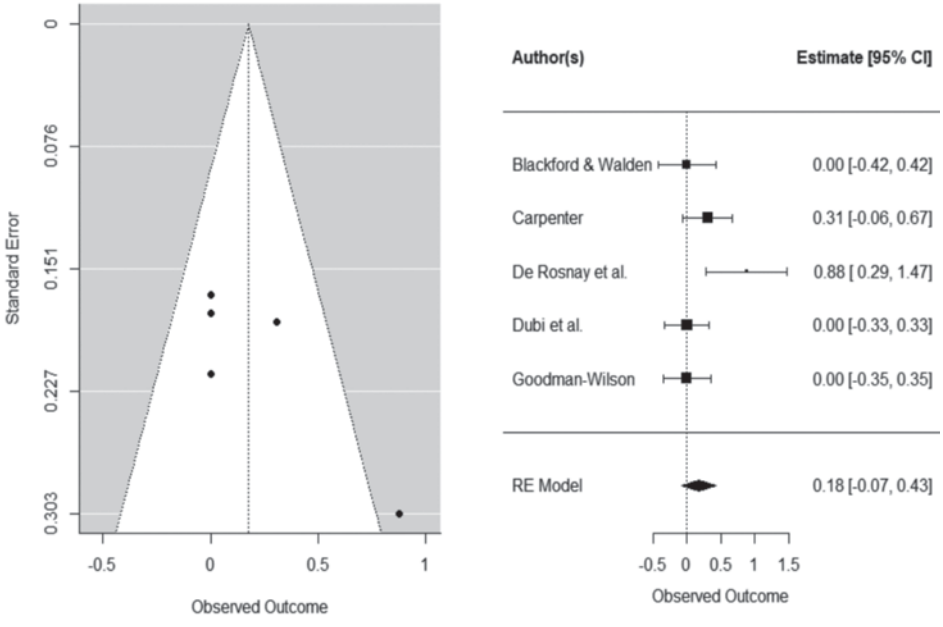

Figure C4. Funnel and forest plots of BI effect on child avoidance in experimental studies

Chapter 3

The Role of Parental Verbal Threat Information in Children's Fear Acquisition: A Systematic Review and Meta-Analysis

Nimphy, C.A., Mitrou, V., Elzinga, B.M. Van der Does, W., Aktar, E. (2024). The Role of Parental Verbal Threat Information in Children's Fear Acquisition: A Systematic Review and Meta-analysis. *Clinical Child Family Psychology Review*, 1-18. https://doi.org/10.1007/s10567-024-00485-4

Abstract

Background: Children can acquire fears of novel stimuli as a result of listening to parental verbal threat information about these stimuli (i.e., instructional learning). While empirical studies have shown that learning via parental information occurs, the effect size of parental verbal threat information on child fear of a novel stimulus has not yet been measured in a meta-analysis. **Objective**: To assess the effect of parents' verbal statements on their children's fear acquisition. Additionally, to explore potential moderators of this effect, namely, parent and child anxiety levels, as well as child age. **Method:** Systematic review and meta-analysis. WebOfScience, Pubmed, Medline, and PsycINFO were used to identify eligible studies that assessed children's (30 months to 18 years old) fear of novel stimuli after being exposed to parental verbal threat information. **Results:** We selected 17 studies for the meta-analysis and 18 for the systematic review. The meta-analysis revealed a significant causal effect of parental verbal threat information on children's fear reaction towards novel stimuli [g = 1.26]. No evidence was found for a moderation of verbal learning effects, neither by child or parent anxiety levels nor by child age. **Conclusion:** The effect of parents' verbal threat information on children's fear of novel stimuli is large and not dependent on anxiety levels or child age.

Keywords: Verbal Threat, Fear, Instructional Learning, Children, Parental Anxiety, Child Anxiety

Introduction

Anxiety disorders are among the most prevalent clusters of mental disorders in children and adolescents (Bandelow & Michaelis, 2015, Kessler et al., 2012; Remes et al., 2016). Individuals with anxiety disorders suffer from excessive worry and anxiety, which impairs their daily functioning, including their social life or academic performance (Quilty et al., 2003). The disorder often takes a chronic course, meaning that, without successful intervention, it tends to prevail (Beesdo, et al., 2009; Keller et al., 1992). In order to develop successful interventions, it is important to gain insight into the mechanisms that play a significant role in how anxiety disorders develop.

Anxiety runs in families (Eley et al., 2015; Hudson, Dodd, & Bovopoulos, 2011; Beidel & Turner, 1997). Children with parents who had or have an anxiety disorder have a two to three-fold risk for developing an anxiety disorder, compared to children of parents without anxiety (Telman et al., 2018; Lawrence et al., 2019). To reduce this increased risk of anxiety in the offspring it is crucial to understand how the anxiety transmission unfolds in the family. Many studies have assessed the impact of both genetic and/or environmental influences in the familial aggregation of anxiety disorders (Eley et al, 2015; Gregory & Eley, 2011; Hettema et al., 2001). Genetic transmission explains approximately one third of the variance in child anxiety (Hettema et al., 2001). This leaves the majority of variance unexplained and attributed to environmental factors, alone and in interaction with genetic factors (Gregory & Eley, 2011). This is in line with a children-of-twins design study, where the relative influence of genetic and environmental factors was investigated and showed that environmental factors predominantly accounted for the parent-child transmission of anxiety (Eley et al, 2015). This calls for research that elucidates the mechanisms involved in this transmission.

Children can acquire fears via others, including parents (also known as social fear learning, Rachman, 1977; Olsson et al., 2007) in two ways. Firstly, children can acquire fear of a novel stimulus via modeling: observing others being fearful towards that novel stimulus (also known as vicarious fear learning). Within the family context, children can for example learn to fear a novel animal as a result of being exposed to parents' anxious responses to that animal (Murray et al., 2008). This vicarious fear transmission starts as early as in infancy, as children start seeking out information about novel stimuli from parents between 10 and 14 months of age (so called social referencing, Feinman, 1982; Nimphy et al., 2023). Secondly, children can learn to be fearful of a novel stimulus when they receive verbal information from others about the threatening/anxiety-provoking properties of this stimulus (also known as verbal (threat) information learning or instructional learning, Olsson et al., 2007; Muris &

Field, 2008). During early childhood, when children learn to speak, verbal information about novel stimuli from parents becomes especially salient (Berman, 2004). Rachman suggests that verbal information from parents and peers during childhood is the origin of most fears in daily life (Rachman, 1977). Findings of cross-sectional and longitudinal studies that assessed origins and potential mechanisms underlying childhood anxiety suggest a role of parental verbal threat information (Fliek et al, 2017; Fliek et al., 2019; Ollendick & King, 1991). Moreover, in a review, Muris and Field (2010) argued that there is "clear support for the notion that the verbal provision of threat information may have fear-enhancing effects in children". Therefore, in this meta-analysis, we focus on this verbal information-learning pathway by summarizing the empirical evidence on child acquisition of fear and anxiety via parental verbal threat information.

Besides the line of research investigating whether parental verbal threat information is related to child anxiety (symptoms), biased cognition, or general fearfulness, two distinct lines of research have studied child fear acquisition of *specific* novel stimuli via parental verbal threat information. The first line of studies focuses on typically developing children and employs experimental designs, where parents are instructed/trained to express specific verbal information towards novel stimuli (i.e., Aktar et al., 2022; Bell et al. 2022, Remmerswaal et al., 2013). The second line of studies relies on naturalistic observations of anxious and non-anxious parents with their children, that investigate the relationship between parental verbal threat information about a novel stimulus and child fear responses to the stimulus in daily life (i.e., Nimphy et al., 2023; Radanović et al., 2021; Remmerswaal & Muris, 2011; Setiawan et al., 2018; Uy et al., 2022). While the first line may enable us to draw causal inferences, the second line aims to capture anxiety transmission in daily life. Our meta-analysis will examine both complementary lines.

Importantly, parent-to child transmission of fear serves an evolutionary adaptive purpose, namely helping children in recognizing and avoiding dangerous situations, to enhance their chances of survival (Feinman, 1985). However, parents with an anxiety disorder, who experience excessive fear and have a tendency to overestimate threat (APA, 2013), may inadvertently express anxiety – even in the absence of a threat. Parents with higher trait anxiety make more negative statements about a novel stimulus to their children than parents with lower levels of trait anxiety (Muris et al., 2010). Over time, children of anxious parents may develop heightened attention to threat signals or interpret the signals in a more negative manner (Aktar, 2022; Creswell et al., 2010). Consequently, the influence of parental fear expressions on a child's acquisition of novel stimuli might be more pronounced in children of anxious parents than in those with non-anxious parents.

Besides the role of parental anxiety, previous studies also investigated child characteristics such as temperament, general fearfulness, or anxiety symptoms as a potential moderator in the parent-to-child transmission of fear, possibly strengthening the effect that parent verbal anxiety expressions have on their children's fear acquisition (Percy et al. 2016; Muris & Field, 2010). For example, child behavioral inhibition (BI) is an important risk factor for developing social anxiety (see Clauss and Blackford, 2012). Moreover, BI was proposed to be a marker of enhanced vulnerability to environmental stressors, including parental anxiety expressions (Belsky & Pluess, 2009; Ingram & Luxton, 2005; Nigg, 2006). Nevertheless, findings regarding the moderating role of child anxiety dispositions in parent-to-child fear transmission are mixed, allowing no firm conclusion about a potential moderating role (Muris & Field, 2010).

The impact of the parental verbal threat information on child fear acquisition of novel stimuli might also depend on the child's developmental stage, with children being more affected by parental anxiety expressions in earlier stages. As children develop increasingly advanced cognitive and emotional abilities, they gradually become more emotionally independent from their parents as they age (Morris et al., 2007). In line with this idea, one study that investigated the relationship between parental verbal threat information on children's fear of COVID-19, suggests that younger children might be more sensitive to parental verbal threat information (Uy et al., 2022). They argue that older children may have greater emotion regulation capacity, which might dampen the impact of parental verbal threat information, compared to younger children. Younger children might also depend more heavily on their parents as sources of information than adolescents. However, this empirical finding still has to be replicated.

Currently, knowledge on the parent-child transmission of fear through parental verbal threat information and the moderating roles of child temperament and parental anxiety is based on narrative and systematic reviews (Muris & Field, 2010; Emerson et al., 2019, Percy et al., 2016). These reviews have concluded that parent-child transmission of fear via verbal threat information is a significant factor contributing to child acquisition of fear and anxiety. More specifically, the reviews argue that fear acquisition as a result of verbal threat information can manifest in children's fearful and anxious cognitions (Muris & Field, 2010; Emerson et al., 2019), heart rate (Muris & Field, 2010) and avoidant behavior to novel stimuli (Percy et al. 2016; Muris & Field, 2010). Taken together, the findings summarized in these reviews also suggest the effect of verbal threat information on children's cognitions, implicit associations, and behavior is noticeable for up to 6 months (Muris & Field, 2010).

This *meta-analysis* aims to combine the available evidence from empirical studies to calculate the effect size of the relationship between verbal threat information and child fear and avoidance of a novel stimulus. In line with previous studies (Muris & Field, 2010), we included studies that assessed child fear or anxiety with behavioral (i.e. avoidance), physiological (i.e. elevated heart rate), or cognitive (i.e. fear belief) measures. We expected that verbal threat information from parents is positively correlated with childrens' fear or avoidance towards a novel stimulus. Furthermore, we explored whether the relationship between parental verbal threat information and child fear of novel stimuli is stronger for children of parents with higher anxiety levels/ an anxiety disorder, children with higher levels of anxiety dispositions, and younger children. By gaining more specific insights into the verbal threat information pathway, we aim to improve our theoretical understanding on fear learning mechanisms in childhood and possible practical applications in prevention efforts.

Methods

Protocol and Registration

We followed the PRISMA guidelines, proposed by Moher and colleagues (2009) (see supplementary material for the PRISMA Checklist). Furthermore, this study was preregistered on the Open Science Framework (OSF) (https://doi.org/10.17605/OSF.IO/7THK5).

Search Strategy

WebOfScience, PsycINFO, Embase (Medline) and PUBMED databases were searched to identify relevant studies. The database search included studies up to the 10th of November 2023 (date of search). The final search term was: (child* OR adolescent* OR toddler* OR teenager*) AND (parent* OR mother* OR father* OR caregiver* OR guardian*) AND ((transmission OR acquisition* OR ("observation* learning") OR ("verbal threat*") OR conditioning) AND (fear* OR avoid* OR anxi*)) AND (verbal OR instruction OR information). For an overview on the construction of the search term, see Supplementary Material A. Twenty percent of the screening process for inclusion was double-coded by an independent reviewer to establish interrater reliability of identifying relevant studies. The interrater agreement on the inclusion of studies was high, with Cohen's kappa of .85. Inconsistencies were resolved through consensus. After the identification of relevant articles, all duplicates were removed. Next, in a secondary screening step, additional articles identified through the reference lists were added (n = 49). These articles were then also screened.

Inclusion and Exclusion Criteria

This meta-analysis included published studies that measured fearful or anxious responses in human children (between 30 months and 17 years) after exposure to parental verbal responses of fear or anxiety. These studies had to assess child fear or anxiety with behavioral (i.e., avoidance), physiological (i.e., elevated heart rate), or cognitive (i.e., fear belief) measures. We included studies, which investigated how parent's verbal fear or anxiety information/instruction towards a stranger, novel object, or situation can shape their children´s reaction to the same ambiguous stranger, object, or situation. Studies that investigate only the non-verbal transmission of anxiety or fear were excluded (i.e., vicarious learning, also known as modeling). We excluded studies, which only investigated children who are hearing impaired, or have neurodevelopmental delays, as it could interfere with verbal fear transmission. The meta-analysis only included studies published in English. To be included in the meta-analysis, the extracted statistical information in a study's result section should allow for calculation of effect sizes for at least one outcome measure.

Data Extraction

Two reviewers independently extracted relevant information from identified studies. Inconsistencies were resolved through consensus. The data that was extracted are demographic information (i.e., age of the participating parents and children, occupation/ socio-economic status (SES), ethnicity, gender, and study location) and methodological characteristics (i.e., study design, number of outcome variables, measurement tools for predictor and outcome variable number of outcome variables, and reliability estimates). Additionally, we extracted means, standard deviations, correlation coefficients, effect sizes, and corresponding 95% Confidence Intervals (CI) of the variables and associations of interest. Variables of interest are child anxious/fearful expressions, parent anxious/ fearful verbal (and nonverbal) expressions, parent psychopathology, child temperament or anxiety disposition, and type of stimulus (i.e., social versus non-social). All effect sizes were converted to Hedges' *g*, as most studies provided relevant statistical information about the experimental and control condition. For studies that reported insignificant findings without providing relevant statistical information beyond the sample size and non-significance, we assumed a p-value of .5 (one-directional) to calculate the effect size. This results in an effect size of 0 with the accompanying variance (see Dusseldorp et al., 1999). This method was used as excluding the insignificant finding from analyses would inflate the effect sizes. We only assessed the effect sizes for the moderators if a subset consisted of at least four studies ($k \geq 4$) (Bakermans-Kranenburg et al., 2003).

Statistical analyses

We carried our analyses with the metafor package in R. Statistical significance of the pooled Hedges' *g* was assessed using a Z-test at $p < .05$. Heterogeneity between the studies was theoretically anticipated and thus we chose the random effects model. However, we still checked for heterogeneity using the *Q*-test. A two-tailed *p* significance test was used with statistical significance, if $p < 0.05$. We corrected the effect sizes to a weighted effect size (corrected for unequal *n*´s) and checked for publication bias with a funnel plot. In case of publication bias, a trim and fill method was applied. To detect effect size outliers, we checked whether the standardized residual $z > 3$.

Quality and Bias Assessment

The methodological quality of the included articles was checked using a checklist (results presented in Table S1) based on the Cochrane Collaboration tool (ROB2) and adapted to our study design (for details on Quality assessment, see Nimphy et al., 2023). Examples of these assessment criteria are the reliability of the predictors and outcome measures, as well as how transparent the results are reported.

Results

Our search term yielded overall 2286 hits across WebofScience, PsycInfo, Pubmed, and Medline. After the removal of 620 duplicates, we screened 1666 studies and included 15 articles. During the secondary screening process, we screened the abstracts of 49 and the full text of 25 studies and included two more studies. The screening process and reasons for exclusions at each stage are presented in the flow diagram (Figure 1).

Overview of studies

The study characteristics of the studies included in the systematic review and meta-analysis can be found in Table 1. We included 18 studies (from 17 articles) in the systematic review and 17 studies (from 16 articles) in the meta-analysis. The study of Reider et al. (2022) included two experiments with two independent samples. Therefore, we added them as separate samples in our analyses. Furthermore, two studies that were included in the systematic review (Aktar et al., 2014, 2018) contained analyses of the same children at different developmental stages. For the meta-analysis, we chose to include only data from the first study (Aktar et al., 2014), as it contained the data from a larger sample size. The quality ratings of all studies included in the systematic review and meta-analysis ranged from 71.4% to 100%, with a mean percentage of 92.97% (for the quality rating per study see Table S1 in supplementary material B).

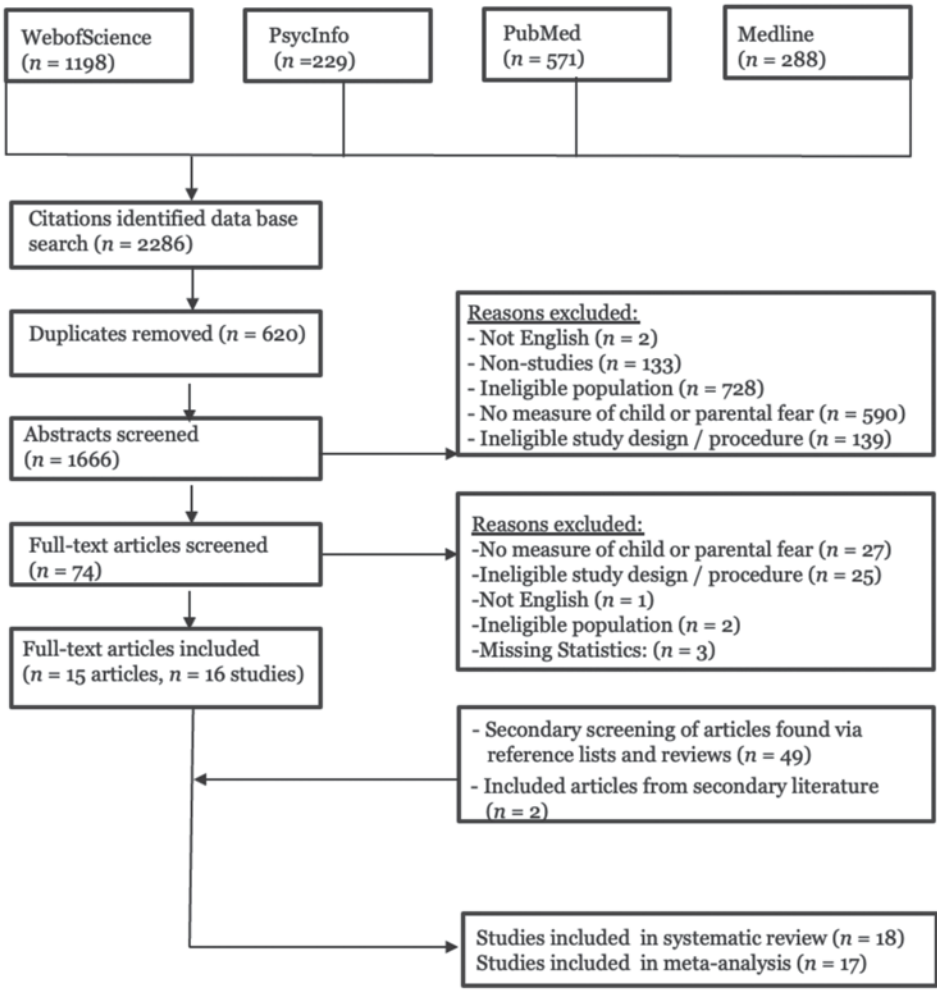

Figure 1. Flow Diagram

Systematic Review

The study and sample characteristics are presented in Table 1. The studies differed in (1) design, (2) child fear index, (3) parental message type, and (4) stimulus type. Below we address each of these in detail.

First, concerning the study design, from the 18 studies included in this systematic review, eight had a correlational design, whereas ten had an experimental design. In the correlational designs, parental verbal threat information regarding novel stimuli were not manipulated/trained by the experimenter, but observed during a social referencing paradigm with parents and their children or assessed in their daily life. Of

the 18 studies, 12 included a measure of parental anxiety symptoms or diagnosis, three studies included clinical parent samples, consisting of 16.67% to 55.56% of parents with an anxiety disorder (Aktar et al., 2014, 2018; Becker & Ginsburg, 2011), whereas nine studies assessed anxiety (symptoms) in community samples of parents, reporting no or low anxiety scores (Aktar et al., 2022; Bell et al., 2015; Burstein & Ginsburg, 2010; Muris et al., 2010; Nimphy et al., 2023; Radanović et al., 2021; Remmerswaal et al., 2010, 2013; Remmerswaal & Muris, 2011). Finally, 13 studies of these 18 studies assessed child anxiety dispositions (Aktar et al., 2014, 2022; Bell et al., 2015; Bosmans et al., 2015; Burstein & Ginsburg, 2010; Muris et al., 2010, 2013; Nimphy et al., 2023; Radanović et al., 2021; Remmerswaal et al., 2010, 2013; Remmerswaal & Muris, 2011; Setiawan et al., 2018).

Second, there were also differences across studies, in how child fear was operationalized (overview can be found in Table 2). From the 18 included studies, 12 studies primarily assessed child fear with a cognitive measure, specifically self-reported fear beliefs towards the novel stimulus. In two studies child reactions were assessed with just a behavioral measure of fear and avoidance (i.e., facial, vocal, and verbal expressions of fear). Four studies investigated child fear with both cognitive and behavioral measures. Three studies reported mean interobserver reliability (ICC or Cohen's kappa) for the behavioral coding of observed child fear and avoidance (Aktar et al., 2014, 2018, 2022), which ranged from .87 to .93, and were classified to be of high interrater reliability. Twelve studies reported reliability for child cognitive fear indices, ranging from .49 to .97.

Third, the variation in the delivery form of parental verbal expressions of fear towards novel stimuli in these studies can be categorized into 1) verbal messages only (such as "this is scary, right?") and 2) combined nonverbal and verbal messages (also including nonverbal expressions of anxiety such as fidgeting). Regarding the correlational studies, we can only categorize how parental expressions of fear/threat were assessed but not delivered, whereas we can categorize how parental fear expressions were delivered in the experimental studies into 1) only verbal or 2) combination of verbal and nonverbal expressions. Out of 18 studies, 13 studies fall in the first category, whereas five studies were in the second. Furthermore, in experimental designs, the threat condition was defined as fearful/anxious verbal messages, whereas the control condition could either consist of parental neutral verbal expressions or positive verbal expressions. Three studies reported mean interobserver reliability (ICC or Cohen's kappa) for coded parent variables (Aktar et al., 2014, 2018; Becker & Ginsburg, 2011) which ranged from .68 to .88. One study reported 100% agreement for coded parent variables (Aktar et al., 2022).

Fourth, the stimuli that were paired with parental verbal information differed across studies and can be categorized into social and non-social stimuli. Social stimuli entailed exposure to a stranger, whereas non-social stimuli entailed exposure to animals, toys, and novel situations. The majority of studies (k = 13) included non-social stimuli, whereas three studies used only social stimuli in their social referencing paradigms (Aktar et al., 2022; Becker & Ginsburg, 2011, Burstein & Ginsburg, 2010), and two studies included both social and non-social stimuli (Aktar et al., 2014, 2018).

Meta-Analysis

Overall, of the 18 studies included in the systematic review, 16 studies entailing 17 samples were also included in the meta-analysis. Seven studies had a correlational design (Aktar et al., 2014; Becker & Ginsburg, 2011; Nimphy et al., 2023; Radanović et al., 2021; Remmerswaal & Muris, 2011; Setiawan et al., 2018; Uy et al., 2022) and the remaining ten studies had an experimental design. Thirteen studies entailed non-social stimuli, three had only social stimuli, and one study included both social and nonsocial stimuli (Aktar et al., 2014). Not every study reported multiple child fear indices. Hence we could not perform a *multi-level* meta-analysis. If a study did report multiple child fear outcomes, we chose the statistics in the following order 1) cognitive measure of child fear or avoidance (self-reported fear) and 2) behavioral measure of child avoidance. Only one study assessed child fear with a physiological index (Aktar et al., 2022).

Eleven studies that were included in the meta-analysis assessed parental anxiety. However, only four studies that were included in the meta-analysis reported findings on parental anxiety as a moderator (Aktar et al., 2014, 2018; Bell et al. 2015; Nimphy et al., 2023). Twelve studies that were included in the meta-analysis assessed child temperament. Five studies that were included in the meta-analysis reported findings on child anxiety disposition as a moderator (Aktar et al., 2014, 2018; Bell et al. 2015; Nimphy et al., 2023; Remmerswaal et al., 2013).

Table 1. Overview of Studies included in Systematic Review

Study	General characteristics			Child characteristics				Parent characteristics					
	Journal	Location	Design	*N* (*n* after exclusion)	% Girls	Range in years (Mean age)	Child Anxiety Disposition/ BI	*N* (*n* after exclusion)	% Mothers	Mean age (years)	SES	Ethnicity % CAU	Anxiety
Aktar et al. (2014)	Journal of Child Psychology and Psychiatry	Europe, The Netherlands	Correlational	117 (subsample of Aktar et al., 2013)	55	(2.5)	Assessed with *LAB-TAB*	234 (232)	50.43	34	Moderate to High	92.31 (Parent)	Assessed with *ADIS*: 55.56%
Aktar et al. (2018)	Journal of Clinical Child & Adolescent Psychology	Europe, The Netherlands	Correlational	111 (106) (subsample of Aktar et al., 2013)	52	(4.5) *data of 2.5 year-olds' not included	Assessed with *LAB-TAB*	222 (212) 212	50	37.58	Moderate to High	93.23 (Parent)	Assessed with *ADIS*: 7.66 % (Current), 9.01 % (Lifetime),
Aktar et al. (2022)	Developmental Psychobiology	Europe, The Netherlands	Experimental	68	50	4.03 -6.65 (5.27)	Assessed with *BIQ*,*CBQ* and *SCARED*	136 online survey and 68 for lab visit	50	37.5	Moderate to High	86.75 (Parent) 91% (Child)	Assessed with *SCARED-A* (subscale social anxiety)
Becker & Ginsburg (2011)	Child Psychiatry and Human Development	North America, USA	Correlational	75	52	6 – 14 (9.03)	NA	75	100	39.91	High	78.7 (Child)	Assessed with *ADIS*: 50.67% (Current Anxiety)
Bell et al. (2015)	Australian Journal of Psychology	Oceania, Australia	Experimental	122	54	7 - 12	Diagnosis assessed with: ADIS-C/P-IV, Severity with: *SCAS-C:* 44.23 (anxious) 26.67 (non-anxious)	121	100	NA	NA	NA	Assessed with *STAI-T*: 55.37% High Trait Anxiety, Overall *M* = 35.23

Table 1. Continued

Study	General characteristics			Child characteristics				Parent characteristics						
	Journal	Location	Design	*N* (*n* after exclusion)	% Girls	Range in years (Mean age)	Child Anxiety Disposition/ BI	*N* (*n* after exclusion)		% Mothers	Mean age (years)	SES	Ethnicity % CAU	Anxiety
Bosmans et al. (2015)	Parenting	Europe, Belgium	Experimental	60	67	9 - 12 (10.47)	Assessed with *STAI-C*: 32.32	60		100	NA	NA	"All mothers were European"	NA
Burstein & Ginsburg (2010)	Behaviour Research and Therapy	North America, USA	Experimental	25	44	8 - 12 (9.24)	Assessed with *SCARED:* 10.12 *CBCL:* 46.32 (Internalizing)	25 (24)		52	41.8	Moderate to High	76 (Child)	Assessed with *ASR*: *M*=42.88 (Internalizing)
Muris et al. (2010)	Behaviour Research and Therapy	Europe, The Netherlands	Experimental	88	48	8 - 13 (10.28)	Assessed with *FSSC-R:* 39.49	88	81.82		40.4	NA	84.1 (Parent)	Assessed with *STAI:* *M* = 34.92
Muris et al. (2013)	Behavior Therapy	Europe, The Netherlands/ Germany	Experimental	60	50	8 - 12 (10.65)	Assessed with *FSSC-R:* 40.85	60		100	NA	NA	88.33 (Child)	NA
Nimphy et al. (2023)	Journal of Adolescence	Europe, The Netherlands	Correlational	195	58	8 - 18 (14.23)	Assessed with *BIS:* 2.26	193		76	47.82	Moderate to High Education	100 "Dutch parent-child dyads"	Assessed with *SCARED-A:* *M* = 0.32
Radanovic et al. (2021)	Frontiers in Psychology	Europe, Serbia	Correlational	376	60	7 - 19, (12.77)	Assessed with *FSSC-R:* 2.46	376		NA	42.9	NA	NA	Assessed with *STICSA:* *M*= 1.70 (cognitive) *M*= 1.40 (somatic)

Table 1. Continued

Study	General characteristics			Child characteristics				Parent characteristics					
	Journal	Location	Design	*N* (*n* after exclusion)	% Girls	Range in years (Mean age)	Child Anxiety Disposition/ BI	*N* (*n* after exclusion)	% Mothers	Mean age (years)	SES	Ethnicity % CAU	Anxiety
Reider et al. (2022) Study 1	Developmental Psychology	North America, USA	Experimental	27	44.4	4.05 -6.83 (5.33)	NA	27	81.48	NA	Moderate to High	74.1 (Parent)	NA
Reider et al. (2022) Study 2	Developmental Psychology	North America, USA	Experimental	54	50	3.67-7.07 (5.52)	NA	54	81.48	NA	Moderate to High	61.1 (Parent)	NA
Remmerswaal et al. (2010)	Journal of Anxiety Disorders	Europe, The Netherlands	Experimental	52	52	9 - 12 (10.6)	Assessed with *FSSC-R:* 40.83	52 (50)	100	42.9	NA	95.74 (Parent and children)	Assessed with *STAI:* *M*= 33.60
Remmerswaal & Muris (2011)	Journal of Anxiety Disorders	Europe, The Netherlands	Correlational	223 (220)	53	7 - 12 (9.97)	Assessed with *FSSC-R:* 7.63	347 (342)	58.21	43.1	NA	NA	Assessed with *FSSC-R* (medical fear): *M*= 6.70
Remmerswaal et al. (2013)	Behavior Therapy	Europe, The Netherlands	Experimental	47	66	8 - 12 (10.55)	Assessed with *FSSC-R:* 31.95	47	100	41.8	NA	70.2 Dutch (Parents and Children)	Assessed with *STAI-Y2:* *M*= 47.77
Setiawan et al. (2018)	European Journal of Dentistry	Southeast Asia, Indonesia	Correlational	550	NA	3 - 6	NA	NA	NA	NA	NA	NA	NA
Uy et al. (2022)	Developmental Psychobiology	North America, USA	Correlational	283	44.2	5.5 - 17 (10.17)	NA	283	97.9	NA	Moderate to High	66.7	NA

Notes: For journal: name of journal in which the article was published. For location: study location. For child characteristics*: N* = number of children in the sample; BI = behavioral inhibition/ temperament; *CAU* = Caucasian. For parent characteristics: *N* = number of parents in the sample; *SES* = socio-economic status; *CAU* = Caucasian; *Anxiety* = percentage of parents who have anxiety based on diagnostic tools or questionnaires or mean anxiety symptoms.

Table 2. Overview of the reviewed studies' approach to measuring parental verbal communication

Study	Type of parental message manipulated/ assessed	Type of stimulus	Specifically:	Assessment method	Specifically:
Aktar et al. (2014)	Non-verbal and verbal	Social and non-social	Stranger and toy	Behavioral Measure: Fear and avoidance	Fear: Intensity and frequency of facial, bodily, and vocal/verbal expressions of fear on a scale from 1 to 5 Avoidance: Child attempt to gaze away, turn away or hide from stimuli on a scale from 1 to 5 Fear and Avoidance were combined into one measure.
Aktar et al. (2018)	Non-verbal and verbal	Social and non-social	Stranger and toy	Behavioral Measure: Fear and avoidance	Fear: Intensity and frequency of facial, bodily, and vocal/verbal expressions of fear on a scale from 1 to 5 Avoidance: Child attempt to gaze away, turn away or increase distance from/ignore stimuli on a scale from 1 to 5
Aktar et al. (2022)	Verbal only	Social	Stranger	Behavioral Measure: Fear and avoidance Cognitive Measure: Fear and Avoidance Physiological Measure: Fear	Fear: Frequency and duration of facial, bodily, and vocal/verbal expressions of fear on a scale from 1 to 5 Avoidance: Child attempt to gaze away, turn away, or increase distance from stranger, by walking away or hiding behind the parent on a scale from 1 to 5. Fear and Avoidance were combined into one measure. Fear: Attention Bias (Visual Search Task) Fear/Avoidance: Self-report Fear Beliefs Questionnaire (FBQ) from 1 (no, not at all) to 5 (yes, definitely) Fear: Heart rate, beats per minute
Becker & Ginsburg (2011)	Non-verbal and verbal	Social	Videotaped Speech	Cognitive Measure: Distress	Distress: Self-evaluation of distress on a scale from 1 to 5
Bell et al. (2015)	Verbal only	Non-social	Animal	Behavioral Measure: Avoidance Cognitive Measure: Fear	Avoidance: Distance in cm between Lego figure (representing child or child's family) and animal Fear: Self-report on a scale from 0 (no fear) to 10 (extreme fear)

Table 2. Continued

Study	Type of parental message manipulated/ assessed	Type of stimulus	Specifically:	Assessment method	Specifically:
Bosmans et al. (2015)	Verbal only	Non-social	Animal	Behavioral Measure: Avoidance Cognitive Measure: Fear and Avoidance	Avoidance: Latency time putting the hand in box with animal (Touch Box Task) Fear/Avoidance: Self-report FBQ from 1 (no, not at all) to 5 (yes, definitely)
Burstein & Ginsburg (2010)	Non-verbal and verbal	Non-social	Spelling test	Cognitive Measure: Anxiety and Avoidance	Anxiety: Self-report C-FAT anxiety about the test from 0 (not at all) to 4 (extremely) Avoidance: Self-report C-FAT on desired avoidance from 0 (not at all) to 4 (very much)
Muris et al. (2010)	Verbal only	Non-social	Animal	Cognitive Measure: Fear and Avoidance	Fear/Avoidance: Self-report FBQ from 1 (no, not at all) to 5 (yes, definitely)
Muris et al. (2013)	Non-verbal and verbal	Non-social	Animal	Cognitive Measure: Fear	Fear: Self-report on a scale from 1 (no, not at all) to 5 (yes, absolutely)
Nimphy et al. (2023)	Verbal only	Non-social	Virus	Cognitive Measure: Fear	Fear: Self-report Fear of COVID-19 (FCQ) on a scale from 1 (not true) to 4 (very true)
Radanovic et al. (2021)	Verbal only (for analysis)	Non-social	Virus	Cognitive Measure: Fear	Fear: Self-report Fear of COVID-19 for Children (FC19Q-C) from 1 (strongly disagree) to 5 (strongly agree)
Reider et al. (2022) Study 1	Verbal only	Non-social	Animal	Cognitive Measure: Fear and Avoidance	Fear/Avoidance: Self-report FBQ from 1 (no, not at all) to 5 (yes, definitely)
Reider et al. (2022) Study 2	Verbal only	Non-social	Animal	Cognitive Measure: Fear and Avoidance	Fear/Avoidance: Self-report FBQ from 1 (no, not at all) to 5 (yes, definitely)

Table 2. Continued

Study	Type of parental message manipulated/ assessed	Type of stimulus	Specifically:	Assessment method	Specifically:
Remmerswaal et al. (2010)	Verbal only	Non-social	Animal	Cognitive Measure: Fear and Avoidance	Fear: Wason Selection Task Fear/Avoidance: Self-report FBQ from 1 (no, not at all) to 5 (yes, definitely)
Remmerswaal & Muris (2011)	Verbal only	Non-social	Virus	Cognitive Measure: Fear	Fear: Self-report Fear of the Swine Flu (FSFQ) from 1 (not true) to 4 (very true)
Remmerswaal et al. (2013)	Verbal only	Non-social	Animal	Behavioral Measure: Avoidance Cognitive Measure: Fear and Avoidance	Avoidance: Latency time putting the hand in box with animal (Touch Box Task) Fear/Avoidance: Self-report FBQ from 1 (no, not at all) to 5 (yes, definitely)
Setiawan et al. (2018)	Non-verbal and verbal	Non-social	Dental fear	Cognitive Measure: Fear and Avoidance	Fear/Avoidance: Children Fear Survey Schedule-Dental Subscale (CFSS-DS)
Uy et al. (2022)	Verbal only	Non-social	Virus	Cognitive Measure: Fear and Avoidance	Fear/Avoidance: Self-report Fear of Illness and Virus Evaluation (FIVE) from 0 (not afraid at all) to 3 (afraid all the time)

Main Results

Meta-Analysis

The effect of parental verbal threat expression on child fear reaction was Hedges' g = 1.01 (*SE* = .17, *CI* [.67, 1.34], k = 17, $p < .0001$), indicating that children did display more fear towards the novel stimulus after being exposed to parental threat expressions. There was an indication of heterogeneity (Q = 151.82, $p < .0001$). The visual inspection of the funnel and forest plots shows some asymmetry and suggest that there might be a small-study effect, since two studies with relatively small samples have the largest effect sizes (Burstein & Ginsburg, 2010; Remmerswaal et al., 2010). However, the two large effect sizes might be explained by the fact that these two studies utilized an experimental design (possibly leading to less noise in the data) and had, according to our quality assessment, higher quality than the mean of the other studies (see Table S1 in supplementary material). Furthermore, the trim-fill method did not indicate missing studies on the left side of the funnel. In sensitivity analysis, we repeated the same analysis with only experimental studies, and only correlational studies. In experimental studies, the effect size of parental verbal threat expression on child fear and avoidance was Hedges' g = 1.26 (*SE* = .25, *CI* [.77, 1.75], k = 10, $p < .0001$), with no indication of missing studies on the left side of the funnel according to the trim-fill method. In correlational studies, the effect size of parental verbal threat expression on child fear and avoidance was Hedges' g = 0.70 (*SE* = .17, *CI* [.35, 1.04], k = 7, $p < .0001$).

Funnel and forest plots can be found in Figure 2, Figure 3, and Figure 4. Inspection of the standardized residuals revealed no outlier (all standardized residuals between 3.29 and -3.29).

Systematic Review

A summary of the main findings can be found in Table 3. Based on social fear learning theories (Rachman, 1977; Olsson et al., 2007), we expected that children express more fear and anxiety towards novel stimuli when these stimuli are paired with parents' fear/anxiety verbal expressions than non-anxious parental verbal expressions. Of the 18 studies reviewed, 13 studies did find an effect on child fear (72%) on at least one of the child fear indices in the expected direction, four studies (22 %) did not, and one study (6%) found an effect in the opposite direction. For four studies (22%), findings on different fear indices were mixed. Specifically, they found significant findings on one of the child fear indices (i.e., self-report child fear beliefs) but not on another child fear index (i.e., observed child anxiety).

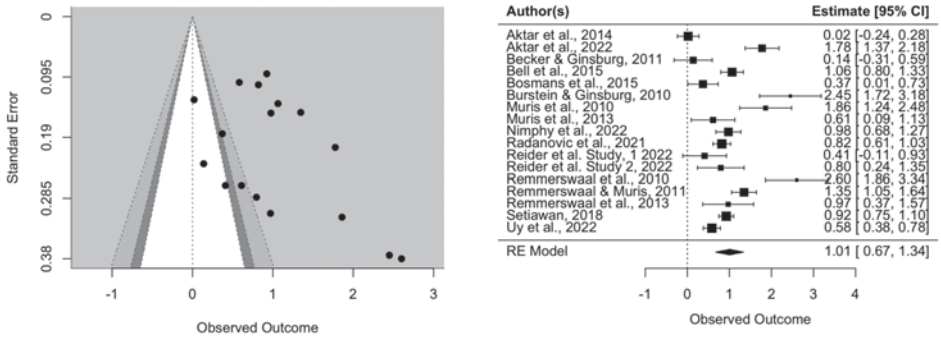

Figure 2. Funnel and forest plots of main effect on child fear

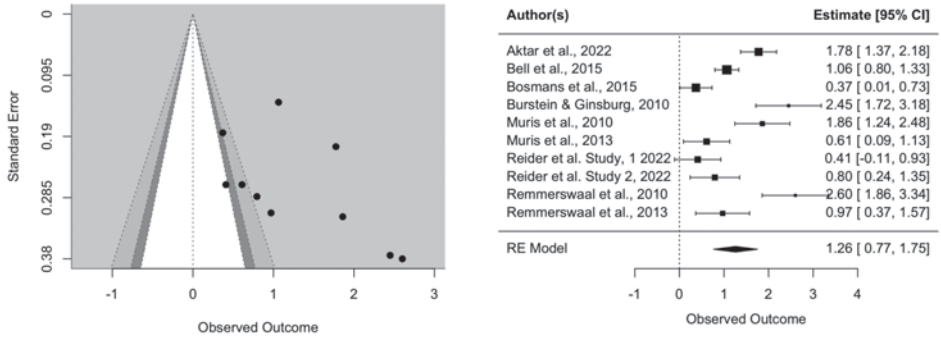

Figure 3. Funnel and forest plots of main effect on child fear in experimental studies only

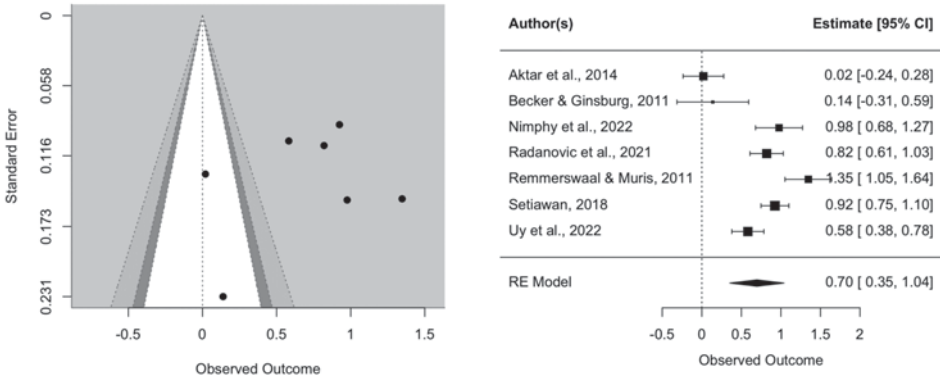

Figure 4. Funnel and forest plots of main effect on child fear in correlational studies only

Table 3. Main outcomes and results of moderators on the association between parental verbal communication and fear/avoidance outcomes

Study	Main Outcomes	Moderator Outcomes	
		Behavioral Inhibition/ Child Anxiety	**Parental Anxiety**
Aktar et al. (2014)	Fear/Avoidance: —	Fear / Avoidance: —	Fear / Avoidance*: —
Aktar et al. (2018)	Fear: — *Avoidance:* ↑	Fear: — Avoidance: —	NA
Aktar et al. (2022)	Fear/Avoidance (observed): — Fear (attention bias): — Fear (heart rate): — *Fear/Avoidance (self-report):* ↑	*Fear/Avoidance (observed):* ↑ Fear (attention bias): — Fear (heart rate): — Fear/Avoidance (self-report): —	*Fear/Avoidance (observed):* ↑ Fear (attention bias): — Fear (heart rate): — Fear/ Avoidance (self-report): —
Becker & Ginsburg (2011)	Distress: —	N/A	N/A
Bell et al. (2015)	*Fear:* ↑ *Avoidance:* ↑	*Fear:* —	Fear: —
Bosmans et al. (2015)	Fear/Avoidance: — *Avoidance: **	N/A	N/A
Burstein & Ginsburg (2010)	*Anxiety:* ↑ *Avoidance:* ↑	N/A	N/A
Muris et al. (2010)	*Fear/Avoidance:* ↑	N/A	N/A
Muris et al. (2013)	*Fear:* ↑	N/A	N/A
Nimphy et al. (2023)	*Fear:* ↑	Fear: —	Fear: —
Radanovic et al. (2021)	*Fear:* ↑	N/A	N/A
Reider et al. (2022) Study 1	Fear/Avoidance: —	N/A	N/A
Reider et al. (2022) Study 2	*Fear/Avoidance (snake/spider):* ↑ Fear/Avoidance (lizard/turtle): —	N/A	N/A
Remmerswaal et al. (2010)	*Fear/Avoidance:* ↑	N/A	N/A
Remmerswaal & Muris (2011)	*Fear:* ↑	N/A	N/A
Remmerswaal et al. (2013)	Fear/Avoidance: — *Avoidance:* ↑	N/A	N/A
Setiawan et al. (2018)	*Fear/Avoidance:* ↑	N/A	N/A
Uy et al. (2022)	*Fear/Avoidance:* ↑	N/A	N/A

Notes: ↑ = increase in (or presence of) verbal threat communication significantly associated with increase in or higher fear/anxiety
$p < .05$; ↑ = increase in (or presence of) verbal threat communication significantly associated with decrease in or lower fear/anxiety
$p < .05$;— = verbal communication not significantly associated with fear/anxiety $p > .05$, if main effect insignificant but 3 or 4-way interaction significant it is labeled as insignificant; NA = interaction not assessed (i.e. only main effect and not interaction with parental verbal fear, or 3-way interactions with another variable), or not assessed at relevant time point/age range; * predictor and outcome not measured in the same paradigm/time point; ** no information in results section.

Child and Parental Anxiety, and Child Age

Meta-Analysis

Child anxiety was not a significant moderator of child fear. The effect of parent responses on child fear did not change as a function of child anxiety (Hedges' g = -.03, SE = 0.06, CI [-0.15, 0.09], k = 4, p = .64). Parental anxiety was not a significant moderator of child fear. The effect of parent responses on child fear did not change as a function of parental anxiety (Hedges' g =. 04, SE = .06, CI [-.09, .17], k = 4, p = .54). Children's age was not a significant moderator of child fear. The effect of parent responses on child fear did not change as a function of child age, Hedges' g =. 05, SE = .06, CI [-.07, .17], k = 16, p = .39. Inspection of the standardized residuals revealed no outliers.

Systematic Review

A summary of the moderator effects can be found in Table 3. Of the 18 studies reviewed, five studies assessed the moderating role of child anxiety (Aktar et al., 2014, 2018, 2022; Bell et al., 2015; Nimphy et al., 2023; Remmerswaal et al., 2013). Of these five studies, none found a significant positive moderating effect of child anxiety in the link between parental verbal threat and child fear. Four studies (80%) did not find a significant moderating effect (Aktar et al., 2014; Aktar et al., 2018; Bell et al., 2015; Nimphy et al., 2023), whereas one study (20%) found an effect in the opposite direction (Aktar et al, 2022).

Of the 18 studies reviewed, four studies assessed the moderating role of parental anxiety (Aktar et al., 2014, 2022; Bell et al., 2015; Nimphy et al., 2023). Of the four studies that investigated parental anxiety as a moderator, one study (25%) found a significant moderating effect of parental anxiety in the link between parental verbal threat and child fear (Aktar et al, 2022). Three studies (75%) did not find a significant moderating effect (Aktar 2014; Bell et al., 2015; Nimphy et al., 2023).

Regarding the possible moderating effect of child age, the one study that assessed child age as a moderator found an effect of parental threat on child fear and avoidance, but only in younger children (Uy et al., 2022).

Discussion

This systematic review and meta-analysis systematically assessed the role of parental verbal threat information in the parent-child transmission of fears. The meta-analytic findings show that parental verbal threat information about novel stimuli can increase child fear – even after a single exposure to these stimuli (Hedges' g = 1.26). In line with our systematic review, the meta-analytic findings did not reveal a moderating role of

parental and child anxiety levels, or child age in this parent-child transmission of fears to novel stimuli. Below, we discuss each of these findings in turn.

Child Fear

This systematic review and meta-analysis revealed that parental verbal expressions about novel stimuli are linked to and can increase child fear reactions to these stimuli. These findings align with social fear-learning models (Olsson, et al., 2007; Rachman, 1977), and corroborate parental verbal threat information as a causal social fear-learning pathway. The average effect size of the impact of parental verbal threat information on child fear was large (Hedges' g = 1.01 in all studies, Hedges' g = 1.26 in experimental studies only, and Hedges g = .70 in correlational studies only). A recent meta-analysis that systematically assessed the effect (size) of the modeling of parental *nonverbal* fear expressions (also known as vicarious learning) in infancy (Nimphy et al., 2023) found small to medium effect sizes (Hedges' g = .39). Hence, the impact of parental *verbal* fear expressions about novel stimuli appears to be larger on children's fear of these stimuli, compared to the impact of parental *nonverbal* expressions. While it could be possible that verbal expressions of anxiety are more direct and impactful on children's reaction than nonverbal expressions, it is important to mention that multiple studies that are included in the current meta-analysis manipulated *both* parental verbal threat information and non-verbal expressions of anxiety. The combined impact of nonverbal and verbal expressions of fear might explain the stronger effect size for our meta-analytic findings on fear learning via parental verbal threat information compared to fear learning via modeling.

Furthermore, in the current meta-analysis, studies predominantly assessed child fear through self-report questionnaires. Exposure to parent verbal threat information might only/to a larger degree impact children's subjective fear levels, rather than the physiological or behavioral fear components. Since fear indices are often unrelated (Bradley & Lang, 2000), if children report more fear of a novel stimulus, it does not necessarily mean that children would also behave more fearful of the stimulus. Studies that only assess one fear index may not be able to capture the entirety of children's fear reactions to the novel stimulus. Hence it is important to stress that our conclusions concern self-reported fears, rather than robustly holding across multiple fear indices, i.e., physiological or behavioral indices.

In our meta-analysis, we found a larger effect size on the link between parental verbal threat information and child fear in the experimental studies than in the correlational studies. While experimental studies investigated fear transmission in a lab by manipulating parental verbal information, the correlational studies assessed the

relationship between naturally occurring communication of parental threat information and child fear of novel stimuli in daily life. The larger effect size in experimental studies might be explained by the increased control in the lab setting and reduction of the influence of confounding variables. Taken together, findings of our systematic review and meta-analysis revealed that parental verbal expressions about novel stimuli are linked to and can increase child self-reported fear of these stimuli.

Child and Parental Anxiety Dispositions

Based on susceptibility models, we expected children with higher anxiety levels/ dispositions to be more susceptible to environmental stressors such as parental verbal threat information (Belsky and Pluess 2009; Ingram and Luxton 2005; Nigg 2006). Against expectation, our meta-analysis did not reveal a moderating effect of child anxiety levels or disposition on child *fear* (Hedges' g = -.03). Our systematic review revealed that the majority of the studies (4 out of 5) found no significant effect on child fear, and one in the opposite direction (decrease in avoidance). It could be that child anxiety dispositions, such as temperament make children more susceptible to parental verbal threat information (or nonverbal fearful expressions) in early life, rather than in childhood (see Nimphy et al., 2023). Moreover, instead of making children more susceptible to parental threat information, child anxiety dispositions in childhood might increase fearful responses to novel stimuli independent of parental information. Lastly, the anticipated moderating effects might not have been detected due to the strength and intensity of the experimental manipulation in most studies. In real life, threat-related information might be less explicit and more ambiguous, compared to the experimental manipulations. For instance, it is possible that children's anxiety disposition plays a stronger role in fear acquisition if children are exposed to more ambiguous and less explicit verbal information. More ecologically-valid designs are needed to investigate the role of anxiety dispositions in parent-child transmission of anxiety (for example, see Muris et al., 2010). Since our interpretation is based on only five studies, more research is needed to investigate whether child anxiety dispositions are a risk factor for heightened fear acquisition after exposure to parental threat information. Nevertheless, until now, our findings suggest that the link between parent verbal threat information and child fear acquisition is not stronger for children with anxiety dispositions.

We explored whether children of parents higher in anxiety disposition are more susceptible to parental verbal threat information. However, our meta-analysis did not reveal a moderating effect of parent anxiety levels on child *fear* (Hedges' g = .04). Our systematic review revealed that the majority of the studies (3 out of 4) found no significant

effect on child fear. The only study that did find an effect was on a behavioral index of child fear, thus it remains possible that the predominant focus on subjective indices made this less visible/apparent. However, only a limited number of studies investigated the moderating role of parental anxiety in the link between parental verbal threat information on child observed fearful/avoidant *behavior*. Further research is needed to establish whether children of anxious parents might show increased fearful and avoidant behavior after parental verbal threat information compared to children of less anxious parents.

Another explanation for the finding that children of parents higher in anxiety disposition were more susceptible to parental verbal threat information might be that parental anxiety disorders rather than parent's anxiety levels make children more susceptible to parental verbal threat information. For example, it could be that the repeated exposure to verbal threat information in families with anxious parents creates an anxiogenic environment and contributes to the familial aggregation of anxiety (also named chronic exposure, Perlman et al., 2022). Additionally, anxious parents may be more inclined to endorse or facilitate their children's anxious or avoidant reactions to novel stimuli and may opt to remove their children from situations where they could get exposed to these stimuli (Fisak & Grills-Tacquechel, 2007). These anxious parents may less frequently use adaptive strategies, such as providing a comforting object, reacting supportively, or demonstrating other problem-solving approaches, for regulating their children's emotions (Stifter & Augustine, 2019). Consequently, these parental behaviors could potentially over time diminish children's sense of self-efficacy for self-regulation and elevate their fears (Stifter & Augustine, 2019) and contribute to the heightened fear learning. Another possibility is, that rather than making children more susceptible to parental threat information, parent anxiety dispositions might act more as a risk factor for increased fear and anxiety responses independent of parental verbal information. Given the limited number of studies assessing the moderating role of parental anxiety levels, more research is needed to investigate its role in the parent-child fear transmission in community and clinical samples. Until now, the findings do not support a moderating role of parental anxiety levels in fear acquisition after a single exposure to parental verbal threat information.

Child Age

We examined if the impact of parental verbal information on children's fear reactions to novel stimuli may differ across children's age. We expected that younger children, who may have lower emotion regulation capacity to deal with parental verbal threat information, compared to older children, are more sensitive to this information and show increased fear learning. However, our meta-analysis did not reveal a moderating effect of child age on child fear (Hedges' g = .05). Prospective studies, which investigate

the parent-child transmission of fears over time, might help illuminate whether fear learning via verbal threat information differs across age.

Clinical Implications

By investigating social fear learning mechanisms and how they might differ between healthy and at-risk families, we may gain more insight into which specific pathways and factors to focus on in treatment or prevention strategies. In our meta-analysis, we found a large effect of parents' verbal threat information about novel stimuli on child fear reactions towards these stimuli, independent of child or parental anxiety levels. While fear acquisition via this pathway can be seen as an adaptive response to potentially threatening and novel stimuli, it could be that in *at-risk families*, the exposure to parental verbal threat information in day-to-day life occurs more frequently or intensely, which could strengthen the impact of this fear learning pathway. To prevent child anxiety development via this route, prevention strategies could incorporate psychoeducation on parent-to offspring social fear transmission. Given the large effects found in the verbal threat information pathway, prevention efforts could potentially target the (repetitive) verbal communication of the parent.

As parental verbal threat information can lead to fear acquisition towards novel stimuli in children, listening to parents' positive or confident information may reduce or prevent fear acquisition. A recent systematic review assessed if children's positive modeling (of parents, experimenters, and peers) in experimental studies can reduce or prevent fear acquisition to novel stimuli (Krause & Askew, 2022). Although their conclusions rely mostly on modeling rather than verbal information/instructional learning, from a limited number of studies, it might still be a promising pathway to reduce or prevent children's fear acquisition to novel stimuli. Ultimately, gaining insight into children's fear acquisition in developmentally sensitive designs and investigating potential strategies to reduce or prevent parent-to-child fear transmission is crucial to inform treatment and prevention efforts.

Limitations and Future directions

This is the first meta-analysis on the effect of parental verbal threat information about novel stimuli on child fear of these stimuli. While this meta-analysis provides a less biased summary of existing studies on the parent-child transmission of fears via verbal threat information, this study still embodies the shortcomings of the individual empirical studies.

First, the studies included in our meta-analysis mainly consist of WEIRD (Western, educated, industrialized, rich, and democratic) samples, specifically predominantly Caucasian families with moderate to high SES (socio-economic status). Considering cultural factors when investigating children's perception and reaction to parental emotional expressions is crucial (review by Raval and Walker, 2019; Nielsen et al.,

2017). To enhance the generalizability of our findings, future research investigating this fear-learning pathway should include more diverse samples, and/or compare this fear-learning pathway across multiple cultural environments.

Second, caution is warranted for the generalizing of our findings to real life parent-child fear transmission. The majority of studies, which are included in this meta-analysis, utilized an experimental design and tested the verbal learning effects in lab-based artificial contexts. While conducting experimental studies on this parent-child fear transmission pathway allows for stronger conclusions on causality (Kazdin, 2021), it may limit the generalizability of the findings to experiences in daily life. Children's experience with the novel stimuli presented in the lab might not generalize well to their experience outside of the lab. Furthermore, in experimental studies, parents are trained to display specific verbal and nonverbal expressions of anxiety, which might also not represent how parent show fear in daily life. While children can be exposed to one parent's reaction in the lab, in real life they might get exposed to conflicting emotional reactions from two parents/individuals, successively or simultaneously. These conflicting reactions may alter the child's response to the novel stimuli. Hence, future research should assess this fear-learning pathway in multiple contexts, as well as investigate naturalistic observations in families with children or parents with an anxiety disorder.

It is also important to note that the majority of studies included in the systematic review and meta-analysis assessed fear reaction to non-social stimuli, such as animals. Thus, more research is needed to assess children's fear acquisition via parental verbal threat information to social stimuli. Moreover, in multiple studies from our meta-analysis, children were not actually exposed to the novel stimulus. Rather, some studies asked children how they feel about or would react to the stimulus in a hypothetical encounter, or in anticipation of being exposed to the stimulus. Future research could try to disentangle the different effects of parental verbal threat information on children's fear reaction in anticipation or as a reaction in an actual encounter with the novel stimulus, utilizing multiple fear indices, such as cognitive, behavioral, and physiological indices measured at multiple time points.

Conclusion

In this meta-analysis, we found a large effect of parental verbal threat information towards a novel stimulus on child fear of the stimulus – even after a single exposure. Parents' verbal information about novel stimuli matter and can prompt child fear learning. There was no support for the hypotheses that child's anxiety disposition, child age, or parental anxiety disposition strengthen environmental acquisition of fears via parental verbal threat information.

References

Aktar. (2022). Intergenerational Transmission of Anxious Information Processing Biases: An Updated Conceptual Model. *Clinical Child and Family Psychology Review*, 25(1), 182–203. https://doi.org/10.1007/s10567-022-00390-8

Aktar, E., Majdandžić, M., de Vente, W., & Bögels, S. M. (2014). Parental social anxiety disorder prospectively predicts toddlers' fear/avoidance in a social referencing paradigm. *Journal of Child Psychology and Psychiatry*, *55*(1), 77–87. https://doi.org/10.1111/jcpp.12121

Aktar, E., Majdandžić, M., De Vente, W., & Bögels, S. M. (2018). Parental Expressions of Anxiety and Child Temperament in Toddlerhood Jointly Predict Preschoolers' Avoidance of Novelty. *Journal of Clinical Child and Adolescent Psychology*, S421–S434. https://doi.org/10.1080/15374416.2017.1371029

Aktar, E., Nimphy, C. ., van Bockstaele, B., & Pérez-Edgar, K. (2022). The social learning of threat and safety in the family: Parent-to-child transmission of social fears via verbal information. *Developmental Psychobiology*, 64(3), e22257. https://doi.org/10.1002/dev.22257

American Psychiatric Association. (2013). DSM-V. *American Journal of Psychiatry*. https://doi.org/10.1176/appi.books.9780890425596.744053

Bakermans-Kranenburg, M. J., van IJzendoorn, M. H., & Juffer, F. (2003). Less Is More. *Psychological Bulletin*, 129(2), 195–215. https://doi.org/10.1037/0033-2909.129.2.195

Bandelow, B. & Michaelis, S. (2015). Epidemiology of anxiety disorders in the 21st century. *Dialogues in Clinical Neuroscience*, 17(3), 327–335. https://doi.org/10.31887/DCNS.2015.17.3/bbandelow

Beesdo, K., Knappe, S., Pine, D. (2009). Anxiety and anxiety disorders in children and adolescents: developmental issues and implications for DSM-V. *Psychiatric Clinics of North America*., 32(3), 483–524. https://doi.org/10.1016/j.psc.2009.06.002

Beidel, D. C., & Turner, S. M. (1997). At risk for anxiety: I. Psychopathology in the offspring of anxious parents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *36*(7), 918-924.

Bell, C. M., Waters, A. M., & Zimmer-gembeck, M. J. (2015). The impact of mothers' trait anxiety on their expectations of approach-avoidance behaviour in anxious and non-anxious children. *Australian Journal of Psychology*, 67(1), 55–64. https://doi.org/10.1111/ajpy.12060

Belsky, J., & Pluess, M. (2009). Beyond Diathesis Stress. *Psychological Bulletin*, 135(6), 885–908. https://doi.org/10.1037/a0017376

Berman, R. A. (2004). Language development across childhood and adolescence. John Benjamins Publishing Company.

Bosmans, G., Dujardin, A., Field, A. P., Salemink, E., & Vasey, M. W. (2015). Fear Acquisition through Maternal Verbal Threat Information in Middle Childhood: The Role of Children's Attachment to Mother. *Parenting, Science and Practice*, *15*(4), 288–294. https://doi.org/10.1080/15295192.2015.1053336

Bradley, M. M., & Lang, P. J. (2000). Measuring emotion: Behavior, feeling, and physiology. In R.D.R. Lane, L. Nadel, G.L. Ahern, J. Allen, A.W. Kaszniak (Eds.*), Cognitive Neuroscience of Emotion* (pp. 25-49). Oxford University Press.

Burstein, M., & Ginsburg, G. S. (2010). The effect of parental modeling of anxious behaviors and cognitions in school-aged children: An experimental pilot study. *Behaviour Research and Therapy*, 48(6), 506–515. https://doi.org/10.1016/j.brat.2010.02.006

Clauss, J. A., & Blackford, J. U. (2012). Behavioral Inhibition and Risk for Developing Social Anxiety Disorder: A Meta-Analytic Study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 51(10), 1066–1075.e1. https://doi.org/10.1016/j.jaac.2012.08.002

Creswell, C., Cooper, P., & Murray, L. (2010). Intergenerational transmission of anxious information processing biases. In J. A. Hadwin & A. P. Field (Eds.), *Information processing biases and anxiety: A developmental perspective* (pp. 279–295). Wiley Blackwell. https://doi.org/10.1002/9780470661468.ch12

Dusseldorp, E., Elderen, T. van, Maes, S., Meulman, J., & Kraaij, V. (1999). A Meta-Analysis of Psychoeducational Programs for Coronary Heart Disease Patients. *Health Psychology*, *18*(5), 506–519. https://doi.org/10.1037/0278-6133.18.5.506

Eley, T. C., McAdams, T. A., Rijsdijk, F. V., Lichtenstein, P., Narusyte, J., Reiss, D., … Neiderhiser, J. M. (2015). The Intergenerational Transmission of Anxiety: A Children-of-Twins Study. *The American Journal of Psychiatry*, *172*(7), 630–637. https://doi.org/10.1176/appi.ajp.2015.14070818

Emerson, L.-M., Ogielda, C., & Rowse, G. (2019). A systematic review of the role of parents in the development of anxious cognitions in children. *Journal of Anxiety Disorders*, 62, 15–25. https://doi.org/10.1016/j.janxdis.2018.11.002

Feinman, S. (1982). Social referencing in infancy. *Merrill-Palmer Quarterly (1982-)*, 445-470.Feinman, S. (1985). Emotional expression, social referencing and preparedness for learning in infancy. *The development of expressive behavior: Biology-Environment Interactions*, 291-318. Orlando, FL: Academic Press.

Fliek, L., Dibbets, P., Roelofs, J. *et al.* Cognitive Bias as a Mediator in the Relation Between Fear-Enhancing Parental Behaviors and Anxiety Symptoms in Children: A Cross-Sectional Study. *Child Psychiatry Hum Dev* 48, 82–93 (2017). https://doi.org/10.1007/s10578-016-0655-2

Fliek, L., Roelofs, J., van Breukelen, G. *et al.* A Longitudinal Study on the Relations Among Fear-Enhancing Parenting, Cognitive Biases, and Anxiety Symptoms in Non-clinical Children. *Child Psychiatry Hum Dev* 50, 631–646 (2019). https://doi.org/10.1007/s10578-019-00868-7

Gregory, A. M., & Eley, T. C. (2007). Genetic influences on anxiety in children: What we've learned and where we're heading. *Clinical Child and Family Psychology Review*, 10(3), 199–212. https://doi.org/10.1007/s10567-007-0022-8

Hettema, J. M., Neale, M. C., & Kendler, K. S. (2001). A Review and Meta-Analysis of the Genetic Epidemiology of Anxiety Disorders. *The American Journal of Psychiatry*, 158(10), 1568–1578. https://doi.org/10.1176/appi.ajp.158.10.1568

Hudson, J., L., Dodd, H. F., & Bovopoulos, N. (2011). Temperament, Family Environment and Anxiety in Preschool Children. *Journal of Abnormal Child Psychology*, 39(7), 939–951. https://doi.org/10.1007/s10802-011-9502-x

Ingram, R. E., & Luxton, D. D. (2005). Vulnerability-stress models. *Development of psychopathology: A vulnerability-stress perspective*, *46*. https://doi.org/10.4135/9781452231655.n2

Kazdin, A. E. (2021). *Research design in clinical psychology*. Cambridge University Press. Keller, M. B., Lavori, P. W., Wunder, J., Beardslee, W. R., Schwartz, C. E., & Roth, J. (1992). Chronic Course of Anxiety Disorders in Children and Adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, 31(4), 595–599. https://doi.org/10.1097/00004583-199207000-00003

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry*, *62*(6), 593-602. https://doi.org/10.1001/archpsyc.62.6.59

Krause, L., & Askew, C. (2022). Preventing and reducing fear using positive modelling: A systematic review of experimental research with children. *Behaviour Research and Therapy,* 148, 103992–103992. https://doi.org/10.1016/j.brat.2021.103992

Lawrence, P. J., Murayama, K., & Creswell, C. (2019). Systematic Review and Meta-Analysis: Anxiety and Depressive Disorders in Offspring of Parents With Anxiety Disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, *58*(1), 46–60. https://doi.org/10.1016/j.jaac.2018.07.898

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*, 339(7716), 332–336. https://doi.org/10.1136/bmj.b2535

Morris, A. S., Silk, J. S., Steinberg, L., Myers, S. S., & Robinson, L. R. (2007). The Role of the Family Context in the Development of Emotion Regulation. *Social Development.* https://doi.org/10.1111/j.1467-9507.2007.00389.x

Muris,P., Mayer, B., Borth, M., & Vos, M. (2013). Nonverbal and Verbal Transmission of Disgust From Mothers to Offspring: Effects on Children's Evaluation of a Novel Animal. *Behavior Therapy,* 44(2), 293–301. https://doi.org/10.1016/j.beth.2012.10.002

Muris, P., & Field, A. P. (2010). Role of Verbal Threat Information in the Development of Childhood Fear. "Beware the Jabberwock!" *Clinical Child and Family Psychology Review,* 13(2), 129–150. https://doi.org/10.1007/s10567-010-0064-1

Muris, P., van Zwol, L., Huijding, J., & Mayer, B. (2010). Mom told me scary things about this animal: Parents installing fear beliefs in their children via the verbal information pathway. *Behaviour Research and Therapy, 48*(4), 341–346. https://doi.org/10.1016/j.brat.2009.12.001

Murray, L., de Rosnay, M., Pearson, J., Bergeron, C., Schofield, E., Royal-Lawson, M., & Cooper, P. J. (2008). Intergenerational Transmission of Social Anxiety: The Role of Social Referencing Processes in Infancy. *Child Development*, *79*(4), 1049–1064. https://doi.org/10.1111/j.1467-8624.2008.01175.x

Nielsen, M., Haun, D., Kärtner, J., & Legare, C. H. (2017). The persistent sampling bias in developmental psychology: A call to action. *Journal of Experimental Child Psychology*, 162, 31–38. https://doi.org/10.1016/j.jecp.2017.04.017

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *47*(3-4), 395-422. https://doi.org/10.1111/j.1469-7610.2006.01612.x

Nimphy, C. A., Elzinga, B. M., Van der Does, W., & Aktar, E. (2023). "Covid-19 is dangerous": The role of parental verbal threat information on children's fear of Covid-19. *Journal of Adolescence*, *95*(1), 147-156. https://doi.org/10.1002/jad.12105

Nimphy, C. A., Venetikidi, M., Elzinga, B. M., van der Does, W., & Aktar, E. (2023). Parent to Offspring Fear Transmission via Modeling in Early Life: A Systematic Review and Meta-Analysis. *Clinical Child and Family Psychology Review*, 26(3), 751–772. https://doi.org/10.1007/s10567-023-00448-1

Ollendick, T. H., & King, N. J. (1991). Origins of childhood fears: An evaluation of Rachman's theory of fear acquisition. *Behaviour Research and Therapy*, *29*(2), 117-123.

Olsson, A., Nearing, K. I., & Phelps, E. A. (2007). Learning fears by observing others: the neural systems of social fear transmission. *Social cognitive and affective neuroscience*, *2*(1), 3-11. https://doi.org/10.1093/scan/nsm005

Percy, R., Creswell, C., Garner, M., O'Brien, D., & Murray, L. (2016). Parents' verbal communication and childhood anxiety: A systematic review. *Clinical Child and Family Psychology Review*,. https://doi.org/10.1007/s10567-015-0198-2

Perlman, S. B., Lunkenheimer, E., Panlilio, C., & Pérez-Edgar, K. (2022). Parent-to-child anxiety transmission through dyadic social dynamics: A dynamic developmental model. *Clinical Child and Family Psychology Review*, *25*(1), 110-129. https://doi.org/10.1007/s10567-022-00391-7

Quilty, L. C., Van Ameringen, M., Mancini, C., Oakman, J., & Farvolden, P. (2003). Quality of life and the anxiety disorders. *Journal of Anxiety Disorders*, 17(4), 405–426. https://doi.org/10.1016/S0887-6185(02)00225-6

Rachman, S. (1977). The conditioning theory of fear-acquisition: a critical examination. *Behaviour Research and Therapy*, *15*(5), 375–387. https://doi.org/10.1016/0005-7967(77)90041-9

Radanović, A., Micić, I., Pavlović, S., & Krstić, K. (2021). Don't think that kids aren't noticing: Indirect pathways to children's fear of COVID-19. *Frontiers in Psychology*, 12, 531. https://doi.org/10.3389/fpsyg.2021.635952

Raval, V. V. & Walker, B. L. (2019). Unpacking "culture": Caregiver socialization of emotion and child functioning in diverse families. *Developmental Review,* 51, 146–174. https://doi.org/10.1016/j.dr.2018.11.001

Reider, L. B., Mahaffey, E. M., Barylski, B., & LoBue, V. (2022). "It bites!": The transmission of negative information about snakes and spiders through a naturalistic picture book interaction. *Developmental Psychology*, 58(11), 2140–2157. https://doi.org/10.1037/dev0001429

Remes, O., Brayne, C., Linde, R., & Lafortune, L. (2016). A systematic review of reviews on the prevalence of anxiety disorders in adult populations. *Brain and Behavior*, 6(7), e00497–n/a. https://doi.org/10.1002/brb3.497

Remmerswaal, D., & Muris, P. (2011). Children's fear reactions to the 2009 Swine Flu pandemic: The role of threat information as provided by parents. *Journal of Anxiety Disorders*, **25**(3), 444–449. https://doi.org/10.1016/j.janxdis.2010.11.008

Remmerswaal, D., Muris, P., & Huijding, J. (2013). "Watch Out for the Gerbils, My Child!" The Role of Maternal Information on Children's Fear in an Experimental Setting Using Real Animals. *Behavior Therapy*, 44(2), 317–324. https://doi.org/10.1016/j.beth.2013.01.001

Remmerswaal, D., Muris, P., Mayer, B., & Smeets, G. (2010). "Will a Cuscus bite you, if he shows his teeth?" Inducing a fear-related confirmation bias in children by providing verbal threat information to their mothers. *Journal of Anxiety Disorders*, 24(5), 540–546. https://doi.org/10.1016/j.janxdis.2010.03.012

Setiawan, A. S., Agustiani, H., & Kendhawati, L. (2018). Qualitative study on parental behavior as the source of dental fear development as reported by preschool students in Bandung. *European Journal of Dentistry*, 12(4), 480–484. https://doi.org/10.4103/ejd.ejd_258_18

Stifter, C., & Augustine, M. (2019). Emotion Regulation. *Handbook of Emotional Development*, 405-430. Springer International Publishing.Telman, L. G., van Steensel, F. J., Maric, M., & Bögels, S. (2018). What are the odds of anxiety disorders running in families?: A family study of anxiety disorders in mothers, fathers, and siblings of children with anxiety disorders. *European Child & Adolescent Psychiatry*, *27*(5), 615–624. https://doi.org/10.1007/s00787-017-1076-x

Uy, J. P., Schwartz, C., Chu, K. A., Towner, E., Lemus, A., Brito, N. H., & Callaghan, B. L. (2022). Parenting under pressure: Parental transmission and buffering of child fear during the COVID-19 pandemic. *Developmental Psychobiology*, 6**4**(3), e22253. https://doi.org/10.1002/dev.22253

Supplementary Material

Material A.

Search strategy

The search term was created after searching for synonyms in dictionaries and in previous literature for the key components: "child", "parent", "fear" and "verbal threat/ instructional learning". The resulting terms were combined, and the search term was adjusted.

Our final search term was based on a previous meta-analysis on non-verbal anxiety transmission in early life (Nimphy et al., 2023) and existing systematic reviews, and consisted of the following terms: (child* OR adolescent* OR toddler* OR teenager*) AND (parent* OR mother* OR father* OR caregiver* OR guardian*) AND ((transmission OR acquisition* OR ("observation* learning") OR ("verbal threat*") OR conditioning) AND (fear* OR avoid* OR anxi*)) AND (verbal OR instruction OR information)

To identify relevant articles, WebOfScience, PUBMED, Embase (Medline), and PsycINFO databases were searched. The search includes studies up to **10-11-2023** in the following language: English.

Material B.

Quality Assessment of studies included in Systematic Review.

Table S1. Quality Assessment Included Studies

Background	Randomization	Deviations		Dropout	Outcome Measurement		Reported Results		Overall Score
Author	**1**	**2.a**	**2.b**	**3.a**	**4.a**	**4.b**	**5.a**	**5.b**	
Aktar et al., 2014	1	1	NR	1	1	1	1	1	100 %
Aktar et al., 2018	1	1	NR	1	1	1	1	1	100 %
Aktar et al., 2022	1	1	1 (6/68 not blind)	0.75 (HR data)	.67	1	1	1	92.8%
Becker & Ginsburg, 2011	1	1	NR	1	0	0	1	1	71.4%
Bell et al., 2015	1	1	NR	1	0	0	1	1	71.4%
Bosmans et al., 2015	1	1	NR	1	0.5	1	0	1	78.6%
Burstein & Ginsburg, 2010	1	1	NR	1	1	1	1	1	100 %
Muris et al., 2010	1	1	NR	1	1	1	1	1	100 %
Muris et al., 2013	1	1	NR	1	0	1	1	1	85.7%
Nimphy et al., 2022	1	1	NR	1	1	1	1	1	100 %
Radanovic et al., 2021	1	1	NR	1	1	1	1	1	100 %
Reider et al., 2022; Study 1	1	1	NR	1	0	NR	1	1	83.3%
Reider et al., 2022; Study 2	1	1	NR	1	0	NR	1	1	83.3%
Remmerswaal et al., 2010	1	1	NR	1	1	1	1	1	100 %
Remmerswaal et al., 2011	1	1	NR	1	1	1	1	1	100 %
Remmerswaal et al., 2013	1	1	NR	1	1	1	1	1	100 %
Setiawan et al., 2018	1	1	NR	1	1	NR	1	1	100 %
Uy et al., 2022	1	1	NR	1	1	NR	1	1	100 %

Note. NR = not relevant

Material C.

Table S2. Prisma Checklist.

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	4-8
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	8
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	9-10
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	9
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	9, 46
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	9-10
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	9
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	10
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	9-10
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	11, 47-48

Table S2. Continued

Section and Topic	Item #	Checklist item	Location where item is reported
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	10-11
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	9
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	10
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	10-11
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	10-11
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	11
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	11
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	11
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	11
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	11-12
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	11-13
Study characteristics	17	Cite each included study and present its characteristics.	13-22
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	13,47
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	23-26

Table S2. Continued

Section and Topic	Item #	Checklist item	Location where item is reported
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	23-25
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	23-27
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	23-27
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	23-27
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	23-24
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	23-24
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	29-33
	23b	Discuss any limitations of the evidence included in the review.	34-35
	23c	Discuss any limitations of the review processes used.	34-35
	23d	Discuss implications of the results for practice, policy, and future research.	33-34
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	8
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	8
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	8
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	2
Competing interests	26	Declare any competing interests of review authors.	2
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	2-3, 8

Chapter 4

“Nobody here likes her” - The Impact of Parental Verbal Threat Information on Children's Fear of Strangers

Nimphy, C. A., Elzinga, B. M., Van der Does, W., Van Bockstaele, B., Pérez-Edgar, K., Westenberg, M., & Aktar, E. (2024). “Nobody Here Likes Her”—The Impact of Parental Verbal Threat Information on Children's Fear of Strangers. *Developmental Psychobiology*, 66(6), e22526. https://doi.org/10.1002/dev.22526

Abstract

Background: Parental verbal threat (vs. safety) information about strangers may induce fears of these strangers in adolescents. **Method**: In this multi-method experimental study, utilizing a within-subject design, parents provided standardized verbal threat or safety information to their offspring (N = 77, M_{age} = 11.62 years, 42 girls) regarding two strangers in the lab. We also explored whether the impact of parental verbal threat information differs depending on the social anxiety levels of parents or fearful temperaments of adolescents. Adolescent's fear of strangers during social interaction tasks was assessed using cognitive (fear beliefs, attention bias), behavioral (observed avoidance and anxiety), and physiological (heart rate) indices. We also explored whether the impact of parental verbal threat information differs depending on the social anxiety levels of parents or fearful temperaments of adolescents. **Results**: The findings suggest that a single exposure to parental verbal threat (vs. safety) information increased adolescent's self-reported fears about the strangers, but did not increase their fearful behaviors, heart rate, or attentional bias. Furthermore, adolescents of parents with higher social anxiety levels or adolescents with fearful temperaments were not more strongly impacted by parental verbal threat information. **Future Directions**: Longitudinal research and studies investigating parents' naturalistic verbal expressions of threat are needed to expand our understanding of this potential verbal fear-learning pathway.

Keywords: Verbal Threat, Parent, Adolescent, Social fear, Instructional learning, Temperament

Introduction

Adolescence is a sensitive period for developing normative and clinical forms of social fears (Beesdo et al., 2009). Individuals with social fears experience fear of social situations and may consequently try to avoid them. These social situations include interacting with strangers, being watched in specific situations (e.g., eating or drinking), and performing in front of others (e.g., giving a speech) (American Psychiatric Association, 2013). By gaining insight into how social fears and anxiety develop during adolescence, we can enhance our understanding of the processes and factors prevention and treatment endeavors should focus on.

The family is an important context in the development of adolescent's social fears and anxiety (Kiel & Kalomiris, 2019). These fears can be acquired via multiple pathways, including learning from or through parental behavior (Murray et al., 2009; Nimphy et al., 2023). According to social fear learning theories, even without prior experiences with a novel stimulus, adolescents can learn indirectly from parents to be fearful of that stimulus 1) via observing and modeling parents' fearful reactions to it (also known as vicarious learning), as well as 2) via receiving verbal threat information from their parents about the stimuli (also known as instructional learning) (Rachman, 1977; Olsson, et al., 2007). Verbal information during childhood may be the origin of most fears in everyday life (Rachman, 1977), as children and adolescents can express fears for objects or situations, they have not themselves encountered or experienced. In line with Rachman's social fear learning theory, previous research has shown that verbal comments by parents signaling threat can affect offspring fear reactions to novel stimuli (for reviews, see Percy et al., 2016; Muris & Field, 2010). Laboratory studies revealed that verbal threat information has a significant effect on multiple indices of offspring fear, including cognitive (i.e., self-reported fear beliefs), physiological (i.e., heart rate), and behavioral (i.e., observed avoidance) indices (Percy et al., 2016; Muris & Field, 2010). Parental verbal expressions of fear in the face of novel stimuli may thus shape their offspring's fearful reactions to these stimuli. In the current literature, the novel stimuli that were paired with the parental threat information were almost always non-social stimuli, such as novel toys or animals (Percy et al., 2016; Muris & Field, 2010; Nimphy et al., accepted for publication). Studying the acquisition of fear towards such objects (i.e., toys) can give insight into the general processes underlying fear learning. Understanding the acquisition of social anxiety may require studying fear acquisition in social contexts or towards social stimuli. While the evidence is mixed, some findings suggest that social learning pathways, including learning via both modeling and verbal threat information from various sources (i.e., parents, teachers, experimenters), can contribute to children's fear beliefs about *social* stimuli (for reviews and meta-analyses,

see Askew & Field, 2008; Muris & Field, 2010; Nimphy et al., 2023; Nimphy et al, accepted for publication). Regarding the social learning pathway via verbal threat information, one study investigated the effects of verbal information from adults, peers, and older children on children´s fear beliefs regarding social situations in two experiments (Lawson et al., 2007). The authors found that negative verbal information increased children's fear beliefs relating to this particular social situation (i.e., meeting a favorite celebrity). Another study found the effect of verbal information to play a role in fear acquisition, but the impact depended on the type of social activity considered and the source of information (Field et al., 2003). Although they provide invaluable insights, a limitation of these two studies is that they did not expose children to the actual social stimulus, and consequently could not measure children's immediate *in vivo* reactions to this social stimulus. Furthermore, they did not include parents as the source of threat (vs. safety) information. Overall, research has rarely examined how *social* fears could be transmitted from parents to children via the verbal threat information pathway (Nimphy et al., accepted for publication).

To date, only one study with a sample of 4- to 6-year-olds has experimentally investigated the proposed social fear-learning pathway by manipulating parental verbal threat information in the context of social stimuli (Aktar et al., 2022). Children reported more fear of a stranger when paired with threat information. However, they did not display heightened attention bias (i.e., a preference to attend to stranger paired with threat information), heart rate response, or increased fearful/ avoidant behavioral responses to the stranger paired with threat (vs. safety) information. Children's expression of fears and anxiety symptoms as well as the salience of various novel stimuli might differ depending on the developmental period (Weems & Costa, 2005). Indeed, both early childhood and adolescence have been discussed as sensitive periods for the emergence of anxiety symptoms/disorder (i.e., separation anxiety) (Knappe et al., 2015). Importantly, social fears typically increase between middle childhood and adolescence, both in clinical and nonclinical samples (Bokhorst et al., 2008; Sumter et al., 2009). As such, research is needed to understand whether the previous findings from a sample of 4- to 6-year-olds (Aktar et al., 2022) extend to older samples. Since children show a clear increase in emotion understanding with increasing age and language skills (Pons et al., 2003), older children may have a greater cognitive or emotional sophistication to receive, internalize, and act upon verbal threat cues. In our current study, we assessed the impact of parental verbal threat information on children's fear to novel social stimuli in early adolescence.

In addition, we were also interested in the role of parental trait social anxiety in this fear learning pathway. Parents' social anxiety is one of the strongest risk factors for offspring social anxiety development (Cooper et al, 2006). Parents with anxiety disorders may pass on their fears to their offspring both through genetic and environmental pathways (Eley

et al., 2015; Gregory & Eley, 2011; Hettema et al., 2001; Percy et al., 2016). Children who grow up with socially anxious parents may also be more receptive to parental negative comments about strangers, which could affect their acquisition of social fear and anxiety (Muris & Field, 2010). Hence, adolescents of socially anxious parents might acquire more (intense) fears towards novel social stimuli after receiving negative information about these stimuli from their parents. The typical variation in parents' (social) anxiety levels has not yet been investigated as a possible moderator in the link between parental verbal threat information and *adolescent's* fear of social stimuli.

Besides parental anxiety, child fearful temperament has also been established as a key risk factor for the development of social anxiety (Clauss & Blackford, 2012). Children with a fearful temperament may be more vulnerable to parental expressions of fear and anxiety (Belsky & Pluess, 2009; Ingram & Luxton, 2005; Nigg, 2006). Prior research has found that fearful children had an increased heart rate, larger attention bias, and displayed more avoidance behavior towards a novel animal after they had been given threatening information about that animal (Field, 2006; Field & Price-Evans, 2009). To date, no study has tested these moderators in the verbal threat information pathway in parent-adolescent dyads.

Current study

In the current study, we aimed to assess the effect of parental verbal threat (vs. safety) information on adolescent's acquisition of fear of strangers in a community sample. Since impairment of social interactions would be very impactful in an adolescent's life, we focused on investigating whether parental verbal comments impact how adolescents interact with a stranger in a social interaction task. Adolescents' acquisition of fear of strangers was assessed using cognitive (fear beliefs, attention bias), behavioral (observed avoidance and anxiety), and physiological (heart rate) indices. Based on theoretical models as well as previous work on the role of verbal threat information in child fear acquisition, we expected adolescents to report higher fear beliefs, show faster reaction times (RT) in visual search tasks involving the strangers, express stronger behavioral anxiety and avoidance signals, and have higher heart rate responses towards the stranger paired with parental threat information compared to the stranger paired with safety information (Percy et al., 2016; Muris & Field, 2010; Rachman, 1977). We also explored whether the effect of parental verbal threat information is stronger for adolescents with more fearful temperaments and adolescents of parents with higher social anxiety levels. We explored these potential moderators in the cognitive, behavioral, and physiological components of fear reactions in early adolescence.

Methods

Participants

The sample consists of 77 Dutch children (35 boys and 42 girls) aged 9 to14 years (M_{age} = 11.62 years, *SD* = 1.18) and 137 parents (55% mothers). See Table 1 for demographics. Most of the parents in this study were the biological parent of the child, highly educated, and from a moderate to high socioeconomic level. One child participated with two mothers. The families were recruited through social media advertisements and printed flyers shared with schools and in public spaces (i.e., libraries) in the Leiden area. Families interested in participating were included if they have a Dutch- or English-speaking child between 9.5 and 13 years of age at the time of recruitment. This study was approved by the ethics committee of the psychology department of Leiden University (Ethics Number: 2019-10-24-E.Aktar-V1-1930).

Table 1. Sample Characteristics.

Parents Questionnaire Data *N*		137	Children *N*	77
Mothers/Fathers filled in Questionnaires *N*		75/62	Age M (SD)	11.62 (1.18)
Parents at Lab Visit (*N*, % Mothers)		77 (65, 84%)	Girls N (%)	42 (55%)
Education level %			Birthplace Netherlands %	95.3
	Primary school education	1 (1%)	School	
	Primary professional education	2 (1%)	Primary School %	65%
	(Higher) Secondary education	7 (5%)	Secondary Education %	31%
	Secondary scientific education	1 (1%)	Missing %	4%
	Secondary professional education	27 (20%)		
	Higher professional education	50 (37%)		
	Higher scientific education	47 (35%)		
Work %				
	Part-time	58 (43%)		
	Full-time	66 (49%)		
	Sick leave	2 (1%)		
	No work	6 (4%)		
	Other	4 (3%)		

Notes. N = sample size, *M* = Mean, *SD* = Standard deviation, % = percentage.

Design

In this multi-method experimental study, we used a within-subject design to test the impact of parental verbal threat (vs. safety) information about strangers on adolescents' behavioral, physiological, and cognitive responses to these strangers. This study focuses on the impact of parental verbal threat (vs. safety) information about strangers on their adolescents' fear acquisition in the *social interaction task.*

Materials

Child Fear Indices

Child Observed Anxiety and Avoidance.

During the social interaction task, the adolescent's anxious and avoidant responses to each of the strangers were assessed using an adapted version of the coding protocol from Aktar et al. (2022). Adolescent *anxiety* was evaluated based on the frequency and duration of facial, bodily, and vocal/verbal expressions of fear. Adolescent *avoidant* behavior was assessed by observing the adolescent's tendency to avoid the stranger. Both were scored on a five-point scale (1 = no avoidance/ anxiety, 2 = fleeting/ambiguous avoidance/ anxiety, 3 = moderate avoidance/anxiety, 4 = intense avoidance/anxiety, and 5 = very intense avoidance/anxiety).

The coding of the observed anxiety and avoidance during the social interaction started with the stranger's first word starting the conversation and ended with the stranger thanking the adolescent for the conversation. The 2.5-minute interaction was divided into five 30-second episodes, with an additional interval added for cases where the conversation lasted longer. Four trained master students, who were blind to the condition, coded the adolescent's anxiety and avoidance behavior based on the recordings of the social interaction. Mean anxiety and avoidance scores were calculated per stranger (one for safety and one for threat). A higher anxiety and avoidance score indicates more observed adolescent anxiety and avoidance during the social interaction task. The recordings of 15 adolescents were double-coded to assess the inter-rater reliability between the four coders. The intraclass correlations (ICC) for the observed anxiety composite across the six coding intervals ranged from .54 to .96, with a mean of .81. The ICC for the observed avoidance score across the six coding intervals ranged from .85 to .98, with a mean of .96.

Child Heart rate.

Adolescent's heart rate (HR) was measured using the VU Ambulatory Monitoring System (VU-AMS; de Geus et al., 1995) and data were stored using the Data Analysis

and Management Software (VU-DAMS). HR was recorded continuously during the social tasks. To measure HR, seven single-use Ag/AgCl hydrogel (4% chloride salt) electrodes were placed and attached to leads, (1) slightly below the right collarbone (4cm to the right), (2) on the right side, between the lower two ribs, (3) at the apex of the heart on the left lateral margin of the chest approximately at the level of the processus xiphodius, (4) at the suprasternal notch above the top of the sternum, (5) at the processus xiphodius at the bottom of the sternum, (6) at the back of the spine, at least 3cm above electrode 4, and (7) at the back of the spine, at least 3cm below electrode 5. We used the PhysioDataToolbox (Version 0.6.1) to pre-process and clean the HR data (Sjak-Shie, 2022).

We applied an ECG signal analyzer to the raw ECG data with a 1 Hz high-pass filter and a 50 Hz low-pass filter. The R-peaks were detected automatically by the software (with a minimum R-peak value of 0.5mV and a minimum distance between R-peaks of 0.3s). HR data were inspected visually and corrected manually in case of artifacts and/or misidentified R-peaks. No HR data were available for nine adolescents, due to stopping the experiment (n = 1), equipment failure (n = 5), and conversion error of the data file (n = 3). For two adolescents we had partial data, meaning there was heart rate data during the interaction with one of the strangers but not the other. Mean HR (beats-per-minutes or BPM) was calculated per stranger (one for safety and one for threat).

Child Fear beliefs.

Adolescents reported their fear and avoidance of strangers with a modified version of the Fear Beliefs Questionnaire (FBQ) from Aktar et al. (2022) (original version from Field & Lawson, 2003). The social version of the FBQ included eight questions for each of the strangers, scored on a five-point scale, ranging from 1 = no, to 5 = yes, definitely. Higher scores on this questionnaire represent greater fear beliefs of the stranger. Cronbach's alpha of the subscale in the current sample was .81.

Child Attention Bias.

We assessed adolescents' attention bias to strangers (paired with threat vs. safety information) with a visual search task (for similar task, see Aktar et al., 2022), using a Dell laptop (1920 × 1080 pixel, image dimension 506 × 618 pixel per picture with 10 pixel between the pictures). Following a 500-ms fixation cross, we presented images of neutral facial expressions from nine models who were researchers acting as strangers on a 3x3 matrix. In total, the task consisted of 54 trials, of which 18 trials contained a picture of the threat-paired stranger, 18 trials contained a picture of the safety-paired stranger, and

18 trials contained neither of the information-paired strangers (but instead nine random strangers). The adolescents were instructed to press a button indicating the presence or absence of one of the two strangers they had interactions with during the experiment. RT's were averaged across trials per condition. Mean RT was calculated per stranger (one for safety and one for threat) and used as an index of the adolescents' attention to strangers. Faster RTs indicate heightened attention to a specific stranger.

The visual search data of two adolescents were missing due to stopping the experiment, and for three adolescents the equipment failed. Due to a programming error, 16 out of the 72 adolescents (22%) only performed 20 trials of the task, after which the script stopped. As previously employed in attention bias research (Bockstaele et al., 2021; Aktar et al., 2022), we used the scoring and outlier procedure for the visual search task described by Aktar et al. (2019). Specifically, we removed the trials in which none of the strangers appeared. Trials were also excluded if RTs were three *SD*s below or above the group mean (6 trials excluded) or their own mean (22 trials excluded). Lastly, data of three participants were removed due to high error rate (less than 50% correct). To calculate the reliability of the visual search task, we computed attention bias scores by subtracting the RT of the safety-paired stranger from the RT of the threat paired stranger, separately for odd and even trials. Using 5000 random splits, the spearman-brown corrected reliability estimate was .36, 95% CI [-.03, .65]. The reliability estimate was poor, probably due to the data of adolescents with low trial numbers. The spearman-brown reliability of the task for the adolescents who completed all 54 trials was better and in line with previous studies (i.e., Aktar et al., 2022), .50, 95% CI [0.25, 0.69]. We decided to only include data of adolescents with the total 54 trials in the final analyses (n = 54).

Moderators

Child Fearful Temperament.

Adolescents' temperament was measured using the Early Adolescent Temperament Questionnaire (EATQ-R, Ellis & Rothbart), which consisted of 65 items on a 5-point scale, ranging from 1 = almost always untrue to 5 = almost always true, filled in by the adolescent. For this study, we focused on the Shyness and Fear subscales of the EATQ-R. The higher the mean score, the more fearful the adolescent's temperament is. Cronbach's alpha in the current sample was .78.

Parental Social Anxiety.

We assessed parent social anxiety with the short version of the Social Phobia and Anxiety Inventory (SPAI, de Vente et al., 2014). Items of the SPAI were scored on a 7-point Likert

scale (1 = never to 7 = always) and have a high internal consistency (Cronbach's alpha of .95). We assessed parental social anxiety from the parent who visited the lab with the child. Higher scores on this questionnaire represent higher levels of parental social anxiety.

Covariate

Child doubt of manipulation.

The impact of parental verbal threat (vs. safety) information on adolescent fear might depend on whether the adolescent believed the parental information. Therefore, we asked adolescents to rate their doubt of the manipulation before the debriefing on a continuous scale from 1 to 10, with a higher score indicating more doubt that the parent information was true.

Procedure

This study is part of a larger project, which consisted of online questionnaires and a lab visit. First, adolescents and their parents filled in online questionnaires about parental negative emotions, parental (social) anxiety, adolescent anxiety, adolescent fear of negative evaluation, and adolescent temperament. Second, adolescents and their primary caregiver participated in a lab visit (see Figure 1 for lab visit procedure), during which adolescents' cognitive, behavioral, and physiological responses were assessed.

Lab Visit

The lab visit included the intake, the social tasks with strangers, computerized attention tasks with stranger's faces, and a debriefing. This study used deception: Parents and adolescents were told that the study was about shyness and confidence, and they were not aware of the main aim of the study examining the effect of parents' verbal remarks about strangers. At the beginning of the visit, the parent-child dyad received general information about the study after which they provided their consent. Once the heart rate device and electrodes were attached to the adolescent, adolescents completed the first lab questionnaire. Meanwhile the parent was invited to follow the experimenter to the control room. The parent was first debriefed about the deception and given the opportunity to withdraw or renew their consent to participate, then instructed on the manipulation, which entailed providing their offpsring with verbal information about two strangers during the preparation phase for the performance task. No parent withdrew their consent. One stranger was described as kind and liked by other lab members, and the other unkind and not liked (see the appendix for parental verbal information).

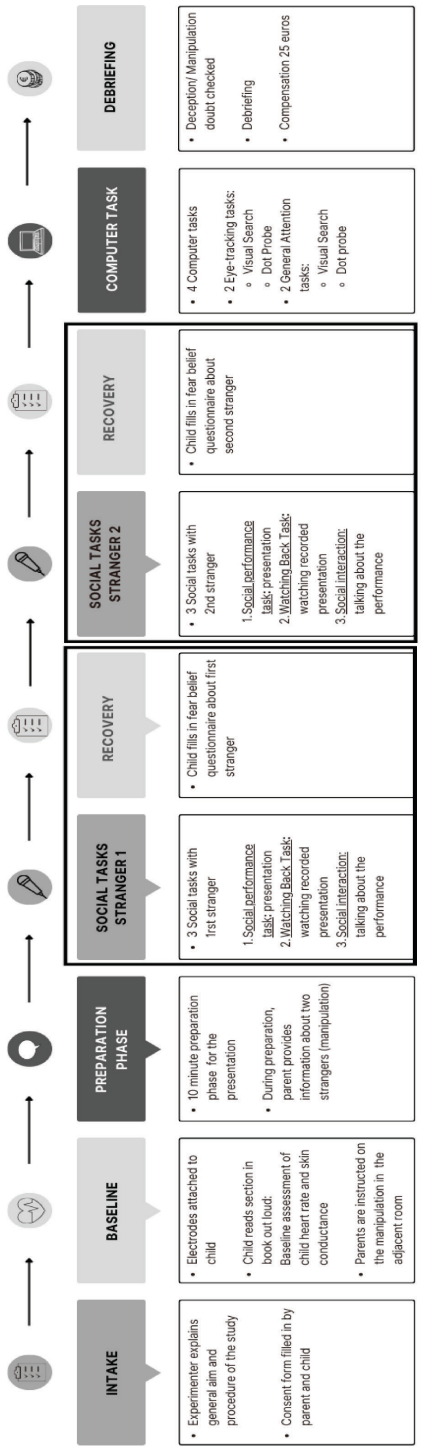

Figure 1. Lab Visit Procedure.

Next, the adolescent participated in social tasks with adult (mostly female) strangers, including a social performance task, a watching back task, and an interaction task. Before the social performance task, the adolescent prepared for the presentation with their parent for ten minutes, during which the parent provided the manipulation (parent pointing at pictures on the wall and mentioning information about the strangers). Afterwards the adolescent gave a 2.5-minute presentation on shyness and confidence to a stranger they had received information about from their parent. The performance was recorded, and during the watching back task, both the adolescent and the stranger watched the recording of the adolescent's presentation afterward. In the final social task, the stranger and adolescent sat across each other and talked about the adolescent's experience of the performance task. During this task, the stranger asked the adolescent questions for approximately 2.5 minutes, including for example how nervous the adolescent was during the presentation. After the conversation the stranger thanked the adolescent and smiled once. Following a short break, the procedure was repeated with the second stranger (social performance, watching back, social interaction). During all tasks, the strangers were instructed to maintain a neutral but friendly attitude. Before and after each social task, adolescents also completed visual analogue scales (VAS) on the intensity and frequency of their nervousness and physical symptoms, such as whether they experienced an elevated heart rate. The order of the interaction with the "threatening" and "safe" strangers was counterbalanced across participants.

After all social tasks were completed, the heart rate device and electrodes were removed and the adolescent took part in attention tasks, including a visual search task. The visit ended with a debriefing during which the adolescents were informed about the deception that was part of the study. Specifically, the adolescents were told that the comments from their parents about the strangers were in fact instructions from the experimenters, and that investigating the impact of these comments on their social interactions with the strangers was the actual aim of the study. The adolescent received a 25-euro gift card as a reward.

Statistical Analyses

The current dataset has various measures of the adolescents' fear reactions during the stranger interaction task. First, the distributions of the study variables were checked for normality and the scores were standardized. Next, correlations between fear indices were computed. We also checked whether adolescent doubt of the manipulation correlated with the outcome measures. The observed anxiety and avoidance scores, attentional bias to strangers, heart rate scores, and reported fear beliefs were analyzed

using repeated general linear models. Each model included Stranger Information (safety versus threat) as independent variable and an outcome variable (fear beliefs, observed anxiety, observed avoidance, heart rate, reaction time) as dependent variable. The main effects of moderators (child temperament and parental social anxiety) and two-way interactions with Stranger Information were tested in all models.

Results

Descriptive statistics for and correlations between the variables of interest are presented in Table 2. None of correlations across cognitive, behavioral, and physiological indices of adolescent fear were significant (*p's* >.17), except for one significant positive correlation between observed avoidance and heart rate during the interaction task with the safety-paired stranger (r = .41, p < .001). This indicates that adolescents who displayed more avoidance of the stranger paired with the safety information also had a higher heart rate when interacting with this stranger.

Table 2. Descriptive Information and Correlations between Study Variables .

	N	*M*	*SD*	1	2	3	4	5	6	7
1. Child Fear Beliefs	76	2.98	.52	-	.04	.07	.06	-.05	.15	-.01
2. Child Heart rate	68	84.35	8.68	.08	-	.17	.23	-.11	.27*	-.002
3. Child Observed Fear	77	3.48	.40	.03	.20	-	.56***	-.19	.04	-.03
4. Child Observed Avoidance	77	3.38	.54	.05	.41***	.49***	-	-.04	.07	.28*
5. Child Visual Search RT	54	1993.93	542.10	-.02	.07	.004	.08	-	-.06	-.02
6. Child Temperament	72	2.40	.70	.18	.16	.12	.21	.05	-	.25*
7. Parent Social Anxiety	75	2.64	.80	.09	.04	-.06	.09	.06	.25*	-

Notes. N = sample size, *M* = Mean, *SD* = Standard deviation, * = p < .05, ** p < .01, *** = p < .001, top half correlations are between outcome variables assessed during the interaction task with threat-paired stranger, bottom half displays correlations between variables assessed during the interaction task with safety-paired stranger.

Furthermore, we found adolescent doubt of manipulation to be related to observed avoidance (but not to other outcome variables). Specifically, adolescents who doubted the manipulation more, displayed less avoidance during the social interaction task, r = -.32, p = .01. We therefore included adolescent doubt of manipulation as a covariate in the analysis assessing the impact of parental verbal threat information on observed avoidance.

Reported Child Fear

Adolescents reported significantly higher fear beliefs for the strangers paired with threat (*M* = 3.18, *SD* = 0.61) than for the strangers paired with the safety message (*M* = 2.80, *SD*

= 0.61), F (1, 74) = 29.08, $p < .001$, $\eta^2 = 0.28$, CI [.14, .40]. In the models with parent social anxiety scores and adolescent fearful temperament scores included as moderators, no significant two-way interactions were found between Stranger Information and adolescent temperament, and between Stranger Information and parent social anxiety (*p'*s = .74 and .24, respectively). The main effects of adolescent temperament and parent social anxiety were also not significant (*p'*s = .12 and .93, respectively).

Observed Child Fear and Avoidance

Adolescents' observed *fear* reactions to the strangers paired with the threat information (M = 3.46, SD = 0.46) did not differ from the reactions to the strangers paired with safety information (M = 3.49, SD = 0.42), F (1, 76) = 0.43, p = .51, $\eta^2 = 0.006$, CI [0, .03]. Adolescents observed *avoidant* reactions to the strangers paired with the threat information (M = 3.36, SD = 0.51) did not differ from the reactions to the strangers paired with safety information (M = 3.40, SD = 0.66), F (1, 76) = 0.40, p = .53, $\eta^2 = 0.005$, CI [0, .03] The model including adolescent manipulation doubt as a covariate revealed no significant interaction between Stranger Information and doubt on avoidance, F (1, 62) = 0.75, p = .39. Rather, adolescents with more doubt were less avoidant of the stranger, independent of Stranger Information, p = .01.

In the models with parent social anxiety and adolescent fearful temperament scores included as moderators, no significant two-way interaction emerged between Stranger Information and adolescent temperament (p = .48) or between Stranger Information and parental anxiety (p = .63) on observed *fear*. The main effects of the adolescent temperament or parent social anxiety were not significant (*p'*s = .45 and .93, respectively).

In the models with parent social anxiety and adolescent fearful temperament scores included as moderators, no significant two-way interaction was noted between Stranger Information and adolescent temperament (p = .38) and between Stranger Information and parental anxiety (p = .35) on observed *avoidance*. The main effect of the adolescent temperament was not significant (p = .31), and the main effect of parent social anxiety was also not significant, p = .05.

Child Heart Rate

Adolescents' heart rate during the interaction with the strangers paired with the threat (M = 84.51 SD = 8.69) did not differ from the heart rate responses to the strangers paired with safety information (M = 84.31, SD = 9.37), F (1, 65) = 0.17, p = .68, $\eta^2 = 0.003$, CI [0; .03]. In the models with parent social anxiety scores and adolescent fearful

temperament scores included as moderators, no significant two-way interactions were noted between Stranger Information and adolescent temperament, and between Stranger Information and parent social anxiety, (*p'*s = .11 and .57, respectively). The main effects of the adolescent temperament or parent social anxiety were also not significant (*p'*s = .09 and .90, respectively).

Child Attention Bias

Adolescent reaction times to the image of the stranger paired with threat information (*M* = 1999.21, *SD* = 570.97) versus safety information (*M* = 1988.65, *SD* = 584.52) did not differ, *F* (1, 53) = .038, *p* = .85, η^2= 0.001, CI [0, .02]. In the model with parent social anxiety scores and adolescent fearful temperament scores included as moderators, the two-way interactions between Stranger Information and adolescent temperament (*p* = .28), and between Stranger Information and parent social anxiety (*p* = .31) were not significant. The main effects of the adolescent temperament or parent social anxiety were not significant (*p'*s = .97 and .79, respectively).

Discussion

In this experimental study, we aimed to investigate the effect of parental verbal threat (vs. safety) information on adolescent's acquisition of fear of strangers during a social interaction task. Adolescent's fear was captured on multiple indices, including the cognitive (fear beliefs, attention), behavioral (observed avoidance and anxiety) and physiological (heart rate) indices. Additionally, we also explored whether the impact of parental verbal treat information differed depending on social anxiety levels of parents or fearful temperaments of adolescents.

A single exposure to parent verbal threat information impacted adolescent's subjective fear levels. Adolescents reported more fear beliefs for the stranger paired with parental verbal threat information for the stranger paired with parental safety information. This showcases that adolescents that heard negative information about a social stimulus from parents just once, clearly understood and internalized the information, as seen in the subjective report. Our findings align with the results of Aktar et al. (2022), who also investigated the effect of parental verbal threat information about social stimuli on children's fear toward those social stimuli, but in 4- to 6-year-olds. Just as in Aktar et al.'s (2022) study, we found that parental verbal threat information increased adolescent self-reported fear, but it did not lead to heightened attentional bias, increased heart rate, increased behavioral fearful or avoidant responses. The impact of parental verbal threat information about strangers on their children's fear

responses regarding strangers may be limited to subjective reflection of parental input across a wide developmental window (from our study and Aktar et al., 2022).

Our findings are in contrast with evidence from earlier laboratory studies, which found that verbal threat information also impacted child cognitive (i.e., self-reported fear beliefs), physiological (i.e., heart rate), and behavioral (i.e., observed avoidance) fear indices (Percy et al., 2016; Muris & Field, 2010). However, in these studies children were mainly exposed to verbal threat information (from experimenters or parents) relating to novel non-social stimuli, such as animals (Percy et al., 2016; Muris & Field, 2010), rather than social stimuli, as is the case in our study. It is possible that the intensity of the threat information in our study was not as strong as in other studies. Specifically, threat information about being negatively evaluated by a stranger might be less threatening than information that one could possibly be physically harmed (i.e., by an *'animal that drinks blood'*, see Field, 2006). Hence, the lower intensity of the parental threat information in our study might explain why we did not find a significant effect of parental verbal threat information on the behavioral and physiological indices of child fear.

It may also be that the social evaluative nature of our manipulation (and that of Aktar et al., 2022) is more relevant for older adolescents. One study found that social anxiety and social performance symptoms are more prominent in adolescents aged 14 to 17 years, compared to 6-9 and 10-13-year-old children (Weems & Costa, 2005). Future research could investigate whether parental verbal threat information about strangers, as operationalized in our study, increases cognitive, physiological, and behavioral indices of social anxiety during mid and late adolescence.

We also explored whether adolescent temperament and parental social anxiety symptoms exacerbated the effect of verbal threat information. We found no support for the idea that adolescents with more fearful temperaments show more fear to the stranger paired with threat information than the stranger paired with safe information on any of the fear indices. This is at odds with theoretical models (Belsky & Pluess, 2009; Ingram & Luxton, 2005; Nigg, 2006) and contrasts with previous evidence (Field, 2006; Field & Price-Evans, 2009). Interestingly, one previous study found that children with more fearful temperaments show more fear and avoidance to the stranger paired with *safety* information (Aktar, et al., 2022). In our study, as well as in the study by Aktar et al. (2022), children were directly exposed to the social stimulus (stranger). It could be that children with more fearful temperaments have more fear beliefs and a higher heart rate in *anticipation* of meeting the stranger paired with negative information rather than reacting differently to strangers paired with parental threat (vs safety) information

in the social interaction task. Taken together, we did not find any support for parental verbal threat information affecting adolescent's fear reaction more for adolescents with more fearful temperaments. Moreover, we did not find support for the hypothesis that adolescents of parents with higher social anxiety symptoms would be more affected by parent verbal threat information on any of the fear indices. It could be that parental social anxiety levels (in a community sample) are not a risk factor for enhanced social fear learning via verbal threat information, but rather (over time) strengthen the tendency to avoid novel social stimuli or situations in general.

Future Research

In our study adolescents had to interact with an adult stranger. During adolescence peer evaluations become increasingly important (Crone & Dahl, 2012). Hence, adolescents might be more sensitive to being negatively evaluated by a peer than being evaluated by an adult that they might never see again. Future research could investigate whether the effect of parental verbal threat information on child fear to novel stimuli might vary for different intensities of threat messages and different social stimuli.

Moreover, we only exposed adolescents to parental verbal information once and assessed its effect immediately after. Since we only found increases in fear beliefs, it would be interesting to investigate whether reinforcement shifts the impact onto other fear indices over time. Hence, experimental studies that includes multiple exposures to parental threat information or longitudinal studies are warranted to assess the impact of repeated exposure to parental verbal threat information on children's longer-lasting social fears.

Strengths and Limitations

The current study is the first to investigate Rachman's (1977) verbal fear acquisition pathway in the context of social stimuli using an early adolescent sample, while also considering possible parent and offspring risk factors that might impact adolescent's fear learning. In line with Lang's tripartite model, we measured fear responses in different response domains, including self-reported, physiological, and behavioral responses. Given that these response systems are only loosely related (Bradley & Lang, 2000), we consider it a strength of our design to have measured fear responses in a relatively comprehensive manner, thus allowing to assess the effect of parental threat information on each of these outcomes. Nevertheless, the study also comes with its limitations.

First, we did not assess parental nonverbal fear expression during the delivery of the verbal threat information to their children. Hence, we do not know whether parental nonverbal communication influenced the effect of their verbal information. Further research could investigate whether the additional manipulation of parental behavior (nonverbal communication) on top of verbal information might lead to effects on behavioral and physiological adolescent fear responses to social stimuli.

Second, since we trained the participating parents to say the specific verbal statements during the experiment, these verbal statements might not capture how parents would express verbal threat information in real life. In our study, adolescents may have been less likely to display fear responses if the parents' verbal statements during the experiment did not reflect the way parents express fear in daily life. Hence, it is important to complement this experimental study with insights from more naturalistic studies, in which the impact of naturalistic verbal expressions of parental fear on adolescents' fear are captured.

Third, the impact of parental verbal threat information on adolescent fear and avoidance of the strangers might depend on the believability of parent's information. Thus, we cannot exclude the possibility that adolescents guessed the nature of the manipulation and doubted parental information, which might decrease the impact on their responses to the strangers. However, since we did not find a relationship between adolescent's doubt of the manipulation and the majority of their outcomes (their self-reported fears, heart rate, observed fear or attentional bias), it is unlikely that it can explain the non-significant effect of the manipulation on adolescent observed behavior, physiology, and attention bias. Furthermore, our findings are in line with the previous study on this social fear learning pathway in parent-child dyads (Aktar et al., 2022), which was conducted in younger children (4- to 6-year-olds), and which also found an effect on self-reported fears. Nevertheless, future research on social fear learning pathways should consider assessing manipulation doubt in their study to assess and deepen our understanding of the role of believability of parental information in parent-offspring fear transmission.

Fourth, we may have lacked power for some of the investigated relations. Given the previous findings of a large effect of verbal threat information on physiological responses (Field & Shorah, 2007, Field & Price-Evans, 2009) with smaller sample sizes than ours, it is unlikely that lack of power can explain why we did not find an effect on adolescent physiology in our study. However, the size of the effects of verbal threat information on adolescent attention bias and observed behavior might be smaller than, for example, the effects on self-reported fear beliefs (see Aktar et al., 2022), meaning

we might have needed larger sample sizes to find potential significant differences between the conditions. Furthermore, we did not adjust the adolescents' fear indices with baseline measures. This might have made the measurement of physiological responses across conditions less sensitive and introduced more 'noise' from individual differences. However, previous studies with a within-subject design that also measured physiological response by assessing average heart rate still found an effect of verbal threat information on child heart rate responses (Field & Price-Evans, 2009; Field & Shorah, 2007). Taken together, future studies could assess the effect of parental verbal threat information on for example adolescent behavior and attention with larger sample sizes. Lastly, our sample consisted of predominantly white participants with medium to high SES. Therefore, future research may need to include a more diverse sample to establish the generalizability of our findings.

Conclusions

Overall, a single exposure to parental verbal threat information about a novel social stimulus induced adolescents' subjective fear beliefs about this social stimulus. However, this subjective response does not seem evident in behavioral, cognitive, or physiological indices of fear. Future studies investigating parents' naturalistic verbal expressions of threat regarding social stimuli on adolescent's fear are needed to expand our understanding of this verbal fear-learning pathway.

References

Aktar, E., Nimphy, C., van Bockstaele, B., & Pérez-Edgar, K. (2022). The social learning of threat and safety in the family: Parent-to-child transmission of social fears via verbal information. Developmental Psychobiology, 64(3), e22257. https://doi.org/10.1002/dev.22257

American Psychiatric Association. (2013). DSM-V. American Journal of Psychiatry. https://doi.org/10.1176/appi.books.9780890425596.744053

Beesdo, K., Knappe, S., Pine, D. (2009). Anxiety and anxiety disorders in children and adolescents: developmental issues and implications for DSM-V. *Psychiatric Clinics of North America*., 32(3), 483–524. https://doi.org/10.1016/j.psc.2009.06.002

Belsky, J., & Pluess, M. (2009). Beyond Diathesis Stress. *Psychological Bulletin*, 135(6), 885–908. https://doi.org/10.1037/a0017376

Berman. (2004). Language development across childhood and adolescence. John Benjamins Publishing Company.

Bokhorst, C. L., Westenberg, P. M., Oosterlaan, J., & Heyne, D. A. (2008). Changes in social fears across childhood and adolescence: Age-related differences in the factor structure of the Fear Survey Schedule for Children-Revised. *Journal of Anxiety Disorders*, 22(1), 135–142. https://doi.org/10.1016/j.janxdis.2007.01.014

Bradley, M.M., Lang, P.J., 2000. Measuring emotion: Behaviour, feeling, and physiology. In: Lane, R.D., Nadel, L. (Eds.), Cognitive Neuroscience of Emotion. University Press, Oxford, pp. 242–276

Clauss, J. A., & Blackford, J. U. (2012). Behavioral inhibition and risk for developing social anxiety disorder: a meta-analytic study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(10), 1066-1075. https://doi.org/10.1016/j.jaac.2012.08.002

Cooper, P., Fearn, V., Willetts, L., Seabrook, H., & Parkinson, M. (2006). Affective disorder in the parents of a clinic sample of children with anxiety disorders. Journal of Affective Disorders, 93(1-3), 205–212. https://doi.org/10.1016/j.jad.2006.03.017

Crone, E., Dahl, R. Understanding adolescence as a period of social–affective engagement and goal flexibility. *Nature Reviews Neuroscience,* 13, 636–650 (2012). https://doi.org/10.1038/nrn3313

De Geus, E. J., Willemsen, G. H., Klaver, C. H., & van Doornen, L. J. (1995). Ambulatory measurement of respiratory sinus arrhythmia and respiration rate. *Biological psychology*, *41*(3), 205-227. https://doi.org/10.1016/0301-0511(95)05137-6

de Vente, W., Majdandžić, M., Voncken, M. J., Beidel, D. C., & Bögels, S. M. (2014). The SPAI-18, a brief version of the Social Phobia and Anxiety Inventory: Reliability and validity in clinically referred and non-referred samples. *Journal of Anxiety Disorders*, 28(2), 140–147. https://doi.org/10.1016/j.janxdis.2013.05.003

Eley, T. C., McAdams, T. A., Rijsdijk, F. V., Lichtenstein, P., Narusyte, J., Reiss, D., ... Neiderhiser, J. M. (2015). The Intergenerational Transmission of Anxiety: A Children-of-Twins Study. *The American Journal of Psychiatry*, *172*(7), 630–637. https://doi.org/10.1176/appi.ajp.2015.14070818

Ellis, L. K., & Rothbart, M. K. (2001). Revision of the Early Adolescent Temperament Questionnaire. Poster presented at the Biennial Meeting of the Society for Research in Child Development. Minneapolis, Minnesota.

Field, A. P. (2006). The behavioral inhibition system and the verbal information pathway to children's fears. *Journal of Abnormal Psychology*, 115(4), 742–752. https://doi.org/10.1037/0021-843x.115.4.742

Field, A. P. (2006b). Watch out for the beast: Fear information and attentional bias in children. *Journal of Clinical Child and Adolescent Psychology*, 35(3), 431–439. https://doi.org/10.1207/s15374424jccp3503_8

Field, A. P., & Lawson, J. (2003). Fear information and the development of fears during childhood: Effects on implicit fear responses and behavioural avoidance. *Behaviour Research and Therapy*, 41(11), 1277–1293. https://doi.org/10.1016/S0005-7967(03)00034-2

Field, A. P., & Price-Evans, K. (2009). Temperament moderates the effect of the verbal threat information pathway on children's heart rate responses to novel animals. *Behaviour Research and Therapy*, 47(5), 431–436. https://doi.org/10.1016/j.brat.2009.01.020

Field, A. P., & Schorah, H. (2007). The verbal information pathway to fear and heart rate changes in children. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 48(11), 1088–1093. https://doi.org/10.1111/j.1469-7610.2007.01772.x

Gregory, A. M., & Eley, T. C. (2007). Genetic influences on anxiety in children: What we've learned and where we're heading. *Clinical Child and Family Psychology Review*, 10(3), 199–212. https://doi.org/10.1007/s10567-007-0022-8

Hettema, J. M., Neale, M. C., & Kendler, K. S. (2001). A Review and Meta-Analysis of the Genetic Epidemiology of Anxiety Disorders. *The American Journal of Psychiatry*, 158(10), 1568–1578. https://doi.org/10.1176/appi.ajp.158.10.1568

Ingram, R. E., & Luxton, D. D. (2005). Vulnerability-stress models. *Development of psychopathology: A vulnerability-stress perspective*, *46*. https://doi.org/10.4135/9781452231655.n2

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry*, *62*(6), 593-602. Hhttps://doi.org/10.1001/archpsyc.62.6.593

Kiel, E. J., & Kalomiris, A. E. (2019). Emotional development and anxiety. In V. LoBue, K. Pérez-Edgar, & K. A. Buss (Eds.), *Handbook of Emotional Development* (pp. 665–693). Springer. https://doi.org/10.1007/978-3-030-17332-6_25

Knappe, S., Sasagawa, S., & Creswell, C. (2015). Developmental epidemiology of social anxiety and social phobia in adolescents. In *Social anxiety and phobia in adolescents: Development, manifestation and intervention strategies*, 39-70. Springer International Publishing. https://doi.org/10.1007/978-3-319-16703-9_2

Lawson, J., Banerjee, R., & Field, A. P. (2007). The effects of verbal information on children's fear beliefs about social situations. *Behaviour Research and Therapy*, 45(1), 21–37. https://doi.org/10.1016/j.brat.2006.01.007

Moore, P. S., Whaley, S. E., & Sigman, M. (2004). Interactions between mothers and children: Impacts of maternal and child anxiety. *Journal of Abnormal Psychology*, 113(3), 471–476. https://doi.org/10.1037/0021-843X.113.3.471

Muris, P., & Field, A. P. (2010). The role of verbal threat information in the development of childhood fear. "Beware the Jabberwock!". *Clinical Child and Family Psychology Review*, 13(2), 129–150. https://doi.org/10.1007/s10567-010-0064-1

Murray, L., Creswell, C., & Cooper, P. J. (2009). The development of anxiety disorders in childhood: an integrative review. Psychological Medicine, 39(9), 1413–1423. https://doi.org/10.1017/S0033291709005157

Murray, L., De Rosnay, M., Pearson, J., Bergeron, C., Schofield, E., Royal-Lawson, M., & Cooper, P. J. (2008). Intergenerational transmission of social anxiety: The role of social referencing processes in infancy. *Child Development*, 79(4), 1049–1064. https://doi.org/10.1111/j.1467-8624.2008.01175.x

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *47*(3-4), 395-422. https://doi.org/10.1111/j.1469-7610.2006.01612.x

Nimphy, C. A., Mitrou, V., Elzinga, B., Van der Does, W., & Aktar, E. (accepted for publication). The Role of Parental Verbal Threat Information in Children's Fear Acquisition: A Systematic Review and Meta-Analysis. *Clinical child and family psychology review*.

Nimphy, C. A., Venetikidi, M., Elzinga, B., Van der Does, W., & Aktar, E. (2023). Parent to Offspring Fear Transmission via Modeling in Early Life: A Systematic Review and Meta-Analysis. *Clinical child and family psychology review*, *26*(3), 751-772. https://doi.org/10.1007/s10567-023-00448-1

Olsson, A., Nearing, K. I., & Phelps, E. A. (2007). Learning fears by observing others: the neural systems of social fear transmission. *Social cognitive and affective neuroscience*, *2*(1), 3-11. https://doi.org/10.1093/scan/nsm005

Percy, R., Creswell, C., Garner, M., O'Brien, D., & Murray, L. (2016). Parents' verbal communication and childhood anxiety: A systematic review. *Clinical Child and Family Psychology Review*, 19(1), 55–75. https://doi.org/10.1007/s10567-015-0198-2

Pons, F., Lawson, J., Harris, P. L., & De Rosnay, M. (2003). Individual differences in children's emotion understanding: Effects of age and language. *Scandinavian Journal of Psychology,* 44(4), 347–353. https://doi.org/10.1111/1467-9450.00354

Rachman, S. (1977). The conditioning theory of fear-acquisition: a critical examination. *Behaviour Research and Therapy*, *15*(5), 375–387. https://doi.org/10.1016/0005-7967(77)90041-9

Sjak-Shie, E. E. (2022). PhysioData Toolbox (Version 0.6.3) [Computer software]. Retrieved from https://PhysioDataToolbox.leidenuniv.nl

Stein, D.J., Lim, C.C.W., Roest, A.M. et al. The cross-national epidemiology of social anxiety disorder: Data from the World Mental Health Survey Initiative. BMC Med 15, 143 (2017). https://doi.org/10.1186/s12916-017-0889-2

Sumter, S., Bokhorst, C. ., & Westenberg, P. . (2009). Social fears during adolescence: Is there an increase in distress and avoidance? *Journal of Anxiety Disorders,* 23(7), 897–903. https://doi.org/10.1016/j.janxdis.2009.05.004

Weems, C. F., & Costa, N. M. (2005). Developmental differences in the expression of childhood anxiety symptoms and fears. *Journal of the American Academy of Child & Adolescent Psychiatry*, 44(7), 656-663. https://doi.org/10.1097/01.chi.0000162583.25829.4

Appendix

Verbal Threat Information

Standardized verbal information for the threat and safety information paired with the strangers.

Safe

1. I heard that she/he is very nice. (YES/NO)

2. She/he always gives high grades. (YES/NO)

3. Everyone in the lab likes her/him. (YES/NO)

Threat

1. I heard that she/he is very strict. (YES/NO)

2. She/he always gives low grades. (YES/NO)

3. Everyone in the lab likes her/him.(YES/NO)

Chapter 5

"Covid-19 is dangerous": The Role of Parental Verbal Threat Information on Children's Fear of Covid-19

Nimphy, C. A., Elzinga, B. M., Van der Does, W., & Aktar, E. (2023). "Covid-19 is dangerous": The role of parental verbal threat information on children's fear of Covid-19. *Journal of Adolescence*, 95(1), 147-156. https://doi.org/10.1002/jad.12105

Abstract

Background: Theoretical and empirical evidence suggests that the effect of parental verbal threat information on the offspring's fear acquisition of novel stimuli may be causal. The current study investigated this verbal fear acquisition pathway from parents to children in the unique context of Covid-19 as a novel environmental threat for parents and children. **Methods**: Using an online cross-sectional survey, we collected data about fear of Covid-19, parent-child communication, parental anxiety, and child temperament. Participants were 8-to-18 year-old children (N = 195; M_{age}= 14.23; 113 girls) and their parents (N = 193; M_{age}= 47.82; 146 mothers) in the Netherlands, in the period between June 11th 2020 and May 28th 2021. **Results**: Children of parents with stronger Covid-19 fears also reported stronger Covid-19 fears. Moreover, parents who were more fearful of Covid-19 provided more threat-related information about the virus to their children. More parental threat information in turn was related to stronger fear of Covid-19 in their children, and partly mediated the link between parent and child fear of the virus. The link between parental threat information and children's fear of Covid-19 was not moderated by child temperament or parental anxiety. **Conclusions**: Parental communication about Covid-19 may play a role in children's fear acquisition of Covid-19. The lack of moderation of this link by parental anxiety and child temperament may reflect the potentially adaptive nature of verbal fear transmission during the first year of the pandemic and the non-clinical levels of fear in this community sample.

Keywords: Covid-19 fear, information transmission, parental negative comments, child temperament, parental anxiety

Introduction

The Covid-19 pandemic has led many to worry about their own physical and mental health, as well as of significant others (Taylor et al., 2020). While fear is a natural and adaptive response to potentially threatening situations, it can become maladaptive when it is disproportional to the severity of the threat and impairs daily functioning (Delgado, Olsson, & Phelps, 2006; Ferrari, 1986). Individuals suffering from Covid-19 anxiety report lower well-being, increased psychological distress, and safety behaviors, such as hand washing and social isolation (Chen et al., 2021; Knowles & Olatunji, 2021). Yet, more research is needed to understand how adaptive fear of Covid-19 develops, before investigating the development and prevention of Covid-19 anxiety.

The development of Covid-19 fears can be conceptualized within the broader context of fear-acquisition frameworks and social fear learning. One of the ways that fears may be acquired is via direct aversive experiences (classical conditioning; Pavlov, 1927). For instance, people may learn to fear a situation (such as a crowded area due to risk of contamination) following an aversive experience with Covid-19, for example in cases where they got severely sick or lost a loved one. However, personal experiences are not even necessary, since it is possible to acquire fears indirectly from others (social fear learning; Rachman, 1977; Olsson, Nearing, & Phelps, 2007). These indirect pathways include fear acquisition as a result of observing others' fearful reactions (vicarious learning) or of hearing verbal threat information from others (information transmission) about a novel situation.

In earlier empirical research, these indirect fear learning pathways were investigated by exposing children to threatening nonverbal and verbal expressions about novel stimuli (such as dolls), and afterward assessing their attitude as well as emotional, physiological, and behavioral responses towards them (Askew & Field, 2007; Field, Argyris, & Knowles, 2001; Reynolds, Field, & Askew, 2014; Muris & Field, 2010). It has been demonstrated that new fears are readily acquired through social learning alone.

The development of fear and anxiety in childhood often emerges within the family context (Kiel & Kalomiris, 2019). One theoretical model suggests that the way parents talk about, react to, and model emotions (emotion socialization, Eisenberg, Cumberland, & Spinrad 1998) is directly related to their children's emotional understanding, expressivity, and regulation. Previous reviews have summarized findings on the role of verbal comments signaling threat on children's fear of novel stimuli. The reviewed evidence suggests that verbal threat information about novel stimuli leads to an increase in child fearful and anxious cognitions, heart rate, and avoidant behavior

toward these novel stimuli (Emerson, Ogielda, & Rowse, 2019; Percy et al., 2016; Muris & Field, 2010). Thus, there is empirical support for the notion that children can acquire new fears through their parents verbally expressing fear of novel stimuli.

One of the most widely studied risk factors for offspring development of anxiety is parental anxiety. Theoretical models propose that besides passing on genes, parents with an anxiety disorder might also pass on their fears and anxiety via environmental pathways (Gregory and Eley 2007; Hettema et al., 2001; Hudson and Rapee 2004; Murray et al., 2009, Percy et al., 2016). Parents with anxiety disorders are more likely to react to novelty with verbal and non-verbal expressions of anxiety. Repeated exposure to parents' anxiety expressions during the confrontation with novel stimuli is a risk factor for the acquisition of fears and anxiety (Murray et al., 2009; Percy et al., 2016). Anxious and non-anxious parents differ in how frequently they verbally communicate threat (Moore, Whaley, & Sigman, 2004; Muris, et al., 2010). Furthermore, evidence suggests that the impact of verbal threat information on children's fear beliefs towards novel animals varies between mothers with higher and lower trait anxiety. In a sample of 88 8-to-13 year-old children with their mothers, they found that parental trait anxiety was associated with giving more threatening narratives about the novel animal, which in turn was associated with increased fear in the offspring of the novel animal (Muris et al., 2010). Parental anxiety might not only affect the amount of anxious signals parents express to their children, but repeated exposure to parents' anxiety might also create a context in which children are sensitized to parent's negative comments (Muris and Field, 2010). Children who grow up in an environment high in conflict or stress might be more receptive to parental negative comments based on learned vigilance to parental cues or increased arousal levels, or might be more affected by these comments (Davies, Winter, & Cichetti, 2006). Nevertheless, until now there is little research on how parental verbal information and parental anxiety interact and possibly shape child acquisition of fear and anxiety (Percy et al., 2016). Establishing whether the link between parental verbal threat information and child fear is stronger for children of parents with higher levels of anxiety might hint at increased salience towards parental cues for these children.

Yet, not every child reacts the same to their parents' expressions of fear about novel situations. The theoretical models on the role of child temperament in the development of child anxiety propose that children with a fearful temperament are more susceptible to environmental stressors such as parental expressions of fear and anxiety (Belsky & Pluess, 2009; Ingram & Luxton, 2005; Nigg, 2006). One well-studied child temperamental dimension is behavioral inhibition (BI), which has been strongly linked to later anxiety (Clauss & Blackford, 2012). BI is described as a fearful style of

reacting to ambiguous stimuli (Fox et al., 2005). Previous studies found that children higher in BI showed increased heart rate and behavioral avoidance towards a novel animal after being exposed to threatening information (Field, 2006; Field & Price-Evans, 2009). Taken together, parental anxiety and child BI might be possible moderators in the link between parental verbal information about a novel stimulus and offspring fear of that stimulus.

Despite accumulating evidence on the effect of parental verbal communication of threat information on their offspring's fear acquisition in experimental lab designs, research on this link is scarce in the context of novel and potentially threatening situations that parents themselves confront in real-life settings, such as a pandemic. Due to regulations, such as curfews and lockdowns, families spend a lot of time together at home, which inadvertently means that children are frequently exposed to their parent's emotional reactions and verbal information, including possibly their fear of Covid-19. An earlier study investigated the link between parents' verbal threat information on child fear acquisition in the context of the swine flu pandemic in a sample of Dutch families (Remmerswaal & Muris, 2011). They reported a positive significant link between parents' communication of threat about the swine flu and offspring fear towards the swine flu (Remmerswaal & Muris, 2011). This study also confirmed that this link was partly accounted for by parents who were more scared of the swine flu being more likely to communicate threatening information. These findings suggest that parental verbal communication as a pathway to child fear acquisition might also hold in the context of a naturally occurring threat, such as a pandemic. Two recent studies investigated the vicarious learning and verbal threat information pathways to Covid-19 fears. The first one, investigated it in 7-to-19 year-old Serbian children (Radanović et al., 2021), using an online survey. They asked parents and their children to report their fear of the virus as well as assessed to what extent parents verbally expressed fear, nonverbally modeled fear, and whether they had Covid-19. They found that stronger Covid-19 fear in parents was related to stronger behavioral and verbal fear expressions, which in turn related to their children's increased fear of Covid-19. The second study examined the role of parental verbal threat information in the parent-child transmission of Covid-19 fears in 255 families (mainly residing in the United States) with children aged between 5.5 and 17 years (Uy et al., 2022). They found parental verbal fear expressions partially mediated the link between parent and child fear of Covid-19 in younger children but not adolescents. The study suggests that younger children might be more sensitive to parental verbal threat information. Taken together, the aforementioned studies suggest that the verbal pathway might also hold up in the context of the Covid-19 pandemic.

In this study, we collected online cross-sectional survey data about fear of Covid-19, parent-child communication, parental anxiety, and child temperament from 195 8-to-18 year-old children and their parents in the Netherlands, in the period between June 11th 2020 and May 28th 2021. The aim was twofold. First, the study aimed to extend earlier findings on the link between parent and child fears of Covid-19 and the mediating role of parental verbal information about Covid-19 to a Dutch sample. It is important to replicate the studies by Radanović et al. (2021) and Uy et al. (2022) in different countries as fear of Covid is context-dependent and relates not only to governmental measures but also to cultural differences (Lin et al., 2021). Furthermore, this study is the first to assess parental verbal threat information about Covid-19 using both child and parent reports. Previous studies reported the benefit of using multiple informants to assess parenting behavior (Renk, 2005). Therefore, including child and parent reports on parental threat communication can provide a more complete picture of whose perspective drives the studied associations. We expected that parents' fear of Covid-19 would be positively related to their children's fear of Covid-19 and that this link will be partly mediated by parental verbal threat information.

Second, we explored whether the relationship between parental verbal threat information and children's fear of Covid-19 is stronger for behaviorally-inhibited children and children of more anxious parents, compared to children lower in BI and children of parents with lower levels of trait anxiety. While earlier literature discussed the role of child temperament (grounded in the susceptibility theory, Belsky & Pluess, 2009; Ingram & Luxton, 2005; Nigg, 2006) and parental anxiety (Murray et al., 2009, Percy et al., 2016) in the parent-child anxiety transmission, this study will be the first to consider the potential moderating role of parental anxiety and child behavioral inhibition in the context of fear of Covid-19.

Method

Participants

Participating families were recruited via social media platforms, and via printed flyers and posters, which were distributed in the area of Leiden, The Hague, and Amsterdam. Furthermore, we recruited at high schools in South Holland, by hanging posters, and invitation emails to parents via their secretaries. Inclusion criteria included the participant's proficiency in Dutch or English, as the questionnaires were available in these two languages. Children had to be between 8 and 18 years old and their parents 18 years or older. We only included families in the sample if they currently lived in the Netherlands, and at least one child and one parent filled in the outcome measure on fear of Covid-19.

The Fear of Covid-19 questionnaire was filled in by 280 parents and 225 children. Data from 25 children were excluded as they did not have the accompanying parent data. The data of additional five children and accompanied parent data were deleted because the children fell outside of the age range. Eighty-two of the parent responses were deleted, as there were no linked child responses. The final sample consisted of 195 Dutch parent-child dyads. Demographic information about the final sample can be found in Table 1.

Table 1. Sample Characteristics

Parents *N*		**193**	**Children *N***	**195**
Age Mothers *M* (*SD*)		47.26 (5.86)	Age M (*SD*)	14.23 (2.99)
Age Fathers *M (SD)*		49.58 (6.33)	Girls *N (%)*	113 (58%)
Mothers *N (%)*		146 (76%)	Birthplace Netherlands *%*	95.3
Education level %			School	
	Primary professional education	1.56	Primary School %	28.42
	(Higher) Secondary education	7.81	Secondary Education %	56.84
	Secondary scientific education	1.56	Other %	14.74
	Secondary professional education	18.75		
	Higher professional education	36.98		
	Higher scientific education	33.33		
Work %				
	Part-time	47.15		
	Full-time	40.41		
	Sick leave	2.07		
	No work	5.70		
	Other	4.15		

Notes. N = sample size, *M* = Mean, *SD* = Standard deviation, % = percentage.

Procedure

Participants were introduced to the purposes of the study and gave their online informed consent before filling in the questionnaires. The children had to fill in the questionnaires independently from their parents. The questionnaires took approximately 20 minutes to complete. Families who joined the study could take part in a raffle, in which one in every fifty participating families would receive 50 euros. The study was approved by the Leiden University Psychology Ethics Committee (#2020-05-15-NameAuthor-V1-2456).

Materials

Fear of Covid-19. Fear of Covid-19 was measured with the Fear of Covid-19 questionnaire (FCQ), which is an adaptation of the Fear of Swine Flu Questionnaire (FSFQ; Remmerswaal and Muris (2011)). The FSFQ consists of twelve items with a 4-point scale (1 = not true to 4 = very true). We created the FCQ by replacing the term swine flu with Covid-19 and adding two items. The two added items in the parent/child version are "Do you think something bad will happen to your child/parents if they had Covid-19?" and "Would you be scared if your child/parent has Covid-19?". A higher mean item score represents a higher level of fear of Covid-19. The reliability of the adapted questionnaire in the current sample is .78 for the children and .85 for the parents.

Parental Communication of Threat Information. We assessed the quantity of parental communication of threat about Covid-19 with an adapted version of the Source of Information about the Swine Flu Scale (SISFS, Remmerswaal & Muris, 2011). The SISFS assesses how children acquire information about the swine flu from various sources. The original scale consists of ten items on a 4-point scale. For the present study, we adapted these items by exchanging the term swine flu with Covid-19. Due to our focus on parent communication, we used the four items relating to parent verbal communication of threat. In these four items, parents are asked about the specific information they share with their children regarding Covid-19, whereas children are asked about the information they receive from their parents about the virus. A final mean item score of the combined child and parent reports was computed. The higher the mean, the more frequently the parent exchanged threat-related information about Covid-19 with their child. The reliability of the adapted questionnaire in the current sample is .84 for the combined variable.

Behavioral Inhibition. Child behavioral inhibition was measured with the Behavioral Inhibition Scale (BIS) from Carver and White's (1994) BIS/BAS scales. This subscale consists of seven items (i.e., "I feel worried when I think I have done poorly at something"), on a 4-point scale (1 = strongly disagree to 4 = strongly agree). The higher the final mean score, the more behaviorally inhibited the child is. The reliability of the questionnaire in the current sample is .76.

Parental Anxiety. Parents reported their anxiety in the adult version of Screen for Child Anxiety Related Disorders SCARED-A (Bögels & Van Melick, 2004). The SCARED-A consists of 71 items on a 3-point Likert scale (0 = almost never to 2 = often). Higher scores on this

scale indicate a higher level of parent anxiety. The reliability of the questionnaire in the current sample is .93.

Statistical Analyses

First, the data was manually inspected to check for erroneous data. Parents that were excluded based on missing child responses did not differ based on any of the study variables (such as parent report of fear of Covid, frequency of verbal threat information or family variables, such as parental gender or child gender), $p > .13$. Then we checked means and standard deviations of all variables, outliers, and the normality of distributions. To simultaneously test the associations between child fear of Covid-19, parent fear of Covid-19, and parental verbal threat information, a structural equation model was computed in R, using the lavaan package. To test whether the link between parent fear of Covid-19 on child fear of Covid-19 was mediated by parental verbal information, we assessed the parameter estimate of the indirect effect of parental verbal information. Based on the findings regarding age in Uy and colleagues (2022) study, we added child age as a covariate in all analyses. Additionally, we explored whether the link between parental verbal threat information on child fear of Covid-19 was stronger for children higher in BI, and children with parents higher in anxiety symptoms. Predictors were centered on the group mean, and two interaction variables between 1) parent trait anxiety and parental threat communication and 2) child BI with parental threat communication were created. The model parameters were calculated with a Maximum Likelihood estimation (Rosseel, 2012), and the hypotheses were tested bi-directionally, reporting bootstrapped (1000 iterations) 95% confidence levels. Full Information Maximum Likelihood was used to handle missing values.

Results

Preliminary Analyses

Three outlying scores (one on child fear of Covid-19 and two on parental anxiety) with z-values larger than 3.29 or smaller than -3.29 were found. Analyses were done with and without outliers. Results did not significantly differ at alpha level of .05. Therefore, the outlying scores were retained in the final analyses (Tabachnick & Fidell, 2013). Means, standard deviations and correlations between the study variables are presented in Table 2. The descriptives and correlations between the separate mother and father scores of the study variables can be found in the supplementary Table S1.

Table 2. Descriptives, reliabilities, and intercorrelations of study variables

	N	*M*	*SD*	1	2	3	4	5
1. Parent Verbal Info	195	2.65	0.62	-	.44***	.55***	.01	.13
2. Child Fear of Covid	195	2.15	0.45		-	.43***	-.22**	.16*
3. Parent Fear of Covid	195	2.16	0.45			-	.02	.25**
4. Child BI	192	2.26	0.61				-	-.08
5. Parent Anxiety	171	0.32	0.21					-

Notes. N = sample size, *M* = Mean, *SD* = Standard deviation, * = $p < .05$, ** $p < .01$, *** = $p < .001$, *BI* = Behavioral Inhibition.

Main Analyses

In the first structural equation model the associations between child fear of Covid-19, parent fear of Covid-19, and parental verbal threat information were simultaneously tested (see Table 3, Figure 1). Parent fear of Covid-19 was positively associated with child fear of Covid-19, β = .29, *SE* = .08, *CI* [0.13, 0.46], $p < .001$. Furthermore, the more scared parents were of Covid-19, the higher the frequency of verbal threat information about Covid-19 towards their children, β = .58, *SE* = .07, *CI* [0.46, 0.72], $p < .001$. The covariate child age was not significant (β = .06, *SE* .02, *CI* [-0.03, 0.06], p = .42). Additionally, parents' communication of threatening information about Covid-19 to their child was positively related to child fear of Covid-19, β = .29, *SE* = .09, *CI* [0.13, 0.49], $p < .001$. Child age was not related to parents' communication of threatening information, β = -.07, *SE* .02, *CI* [-0.06, 0.01], p = .22. The indirect effect of parental communication of verbal threat information about Covid-19 in the link between parent fear of Covid-19 and child fear of Covid-19 was significant, β = .17, *SE* = .06, *CI* [0.08, 0.31], $p < .01$. Given that parental verbal threat information was a combined variable between parent and child reports on parental threat communication, we explored whether these results differ depending on the reporter, by repeating the analyses with parent report of parental verbal threat information, as well as child report of parental threat information as parallel mediators in the same model (see additional analyses in Supplementary Material, Figure S1). Findings from the parallel mediation indicate that the link between parent and child fear of Covid-19 is partly explained by the children's but not parents' reports of parental verbal threat information.

Table 3. Mediation Analysis

						95% CI	
Direct effect		***β***	***SE***	***z***	***p***	**Lower**	**Upper**
Parent Fear of Covid	→ Child Fear of Covid	0.29	0.08	3.59	<.001	0.13	.46
Indirect effect							
Parent Fear Covid →	Parent Verbal Info → Child Fear Covid	0.17	0.06	3.06	< .01	0.08	0.31

Note. Delta method standard errors, bias-corrected percentile bootstrap confidence intervals.

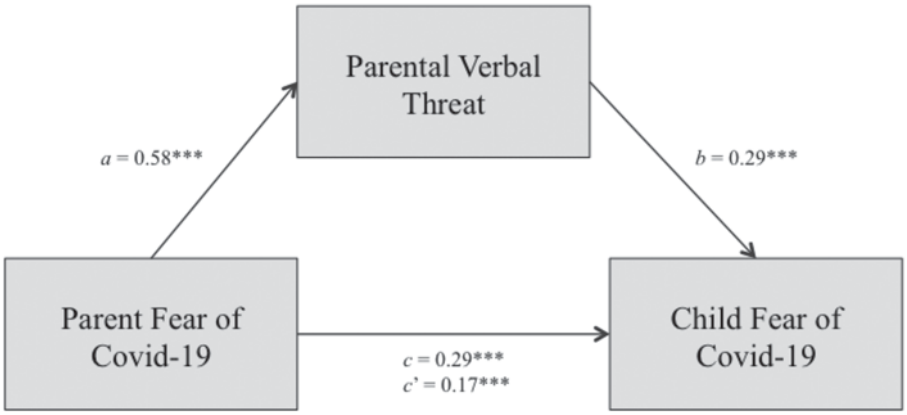

Figure 1. Path Model with parental verbal information as mediator between parents' and children's fear of Covid-19.

Notes. c= direct effect, *c'*= indirect effect. Children's age was used as covariate but is not depicted. Statistics are standardized regression coefficients

Concerning the moderating roles of parental anxiety and child behavioral inhibition, the model revealed that the relationship between parental verbal threat information and child fear of Covid-19 was not moderated by child temperament or parental anxiety levels. In other words, we found no support to the idea that the association between parental verbal threat information and child fear was not stronger for children with higher levels of BI (β = .00, *SE* = .07, *CI* [-0.13, 0.13], *p* = .996), or children of parents with higher levels of anxiety (β = .03, *SE* = .08, *CI* [-0.13, 0.21], *p* = .71). Child age was not significantly linked to child fear of Covid-19 in either moderation model (*p*'s > .26).

Discussion

The present study investigated the link between parents and children's fear of Covid-19, and whether this link can be at least partially accounted for by parental verbal threat information. Additionally, we explored whether the relationship between parental verbal threat information and children's fear of Covid-19 is stronger for children higher in behavioral inhibition and children of parents with higher levels of trait anxiety. In line with our hypotheses, parents who were more scared of Covid-19 have children who were also more scared of Covid-19. Furthermore, parents who were more scared of Covid-19 provided more frequent negative comments about the virus to their children. Parental negative comments, in turn, were related to higher levels of Covid-19 fears in their children. These findings are in line with earlier literature, which reported that parents' fear of a novel stimulus was related to higher levels of behavioral and verbal fear expressions, which in turn related to their children's increased fear of that novel stimulus (Remmerswaal & Muris, 2011; Radanović et al., 2021; Muris et al., 2010; Uy et al., 2022). Like Radanović and colleagues (2021), we also found parental verbal information to partially mediate the link between parent and child fear of Covid-19. Lastly, we did not find age to relate to child fear of Covid-19 in our models. This is in line with earlier work, which also did not find age to be a confounding factor in the verbal transmission pathway (Radanović et al., 2021). However, they did find children's age to be linked to children's fear of Covid in the parental modeling pathway as well as in the non-family information pathway (Radanović et al., 2021). The influence of children's age might be stronger in the transmission of fears via other learning pathways than parental verbal fear transmission. More research is needed to disentangle in which developmental phase various fear transmission pathways relating to Covid-19 are especially salient.

Interestingly, based on our exploratory analyses, our model combining child-reported and parent-reported scores of parental verbal threat information was driven by the child's perspective on parental threat information. While the frequency of parental information reported by children partially mediated the link between parent and child fear of Covid-19 in the model, parent-reported scores of verbal threat information did not, as it was not linked to child fear of Covid-19. This discrepancy might be due to parents being less aware of their communications about Covid-19 to their child, the child's sensitivity to or inflated interpretation of parental verbal threat information, especially when they are already scared of Covid-19. These findings highlight the importance to consider possible reporter bias when investigating parent-child communication or interactions using self-report.

In our study, parental verbal information accounted for only 8% of the variance in children's fear of Covid-19, when taking into account parent's fear of Covid-19 and child age. Thus, other factors play an important role in children's fear acquisition. One of these factors concerns the non-verbal pathways to social learning. Parents' fear of Covid-19 was earlier found to be related to parental modeling of their fear of the virus and to children's fear of the virus (Radanović et al., 2021). However, parental fear modeling did not mediate the relationship between parent and child fear of Covid-19, suggesting that nonverbal parental transmission cannot by itself explain the family fears of Covid-19. Another factor that may play a role in the overlap in parent and child fear of Covid-19 is their shared environment. If parents and children watch the same news or talk to family friends who voice or express their fears about the virus in front of both the parents and their children, this might shape their fear acquisitions similarly. Radanović and colleagues (2021) found that verbal information from other sources (such as teachers, peers, TV, or the Internet) significantly contributed to children's fear of the virus. However, they did not investigate whether parents and children share the same information sources and their impact on parent and child fears of the virus. Lastly, in exploratory analyses, we checked whether children who had direct exposure to the virus were more scared of Covid-19. In line with Uy et al (2022), we did not find child's exposure to the virus to be linked to children's fear of Covid-19, which suggests that it is not likely a confounding factor in the parent-child transmission of Covid-19 fears. Nevertheless, subsequent research should expand our study by investigating the influence of other information sources or direct exposure to the virus on child fear acquisition towards Covid-19.

We also assessed parental anxiety and child BI as moderators in the link between parental verbal threat information and child fear of Covid-19. No support was found for the idea that the link between parental verbal threat information and children's fear of Covid-19 was stronger for children of parents with higher levels of anxiety. It is important to note that in our community sample parents reported very few anxiety symptoms. The lack of moderation might be explained by the little variance in parental anxiety. Future studies could also investigate parental stress, which is more represented in community samples and is a risk factor for anxiety development (Pêgo et al., 2009). Compared to anxiety measures which often focus on physical manifestations of anxiety (such as trouble breathing and trembling), stress scales focus less on physical symptoms, and more on agitation and lower frustration tolerance (see Lovibond and Lovibond, 1995). Parental stress has increased since the onset of the Covid-19 pandemic (Lucassen et al., 2021). Similar to anxiety, parental stress might diminish parents' emotion regulation skills or make them express their fears more intensely (Havighurst & Kehoe, 2017). Given that stress is increased during this

stressful period, and might inhibit parents' ability to regulate their own fears, highly stressed parents might be expressing their Covid-19 fears more frequently or intensely compared to less stressed parents. Hence, future studies could look into increased parental stress as a possible moderator in the link between parental verbal threat information and child fear of Covid-19. While parental anxiety was not associated with the amount of verbal threat information provided to their children, it was linked to parental and child fear of the virus. This might indicate that broader anxiety disposition in parents might not influence how they react to this novel virus themselves but might still impact their own and their children's development of fear of the virus. Future research could investigate other mechanisms in which parental anxiety might influence the development of child fear of Covid-19.

Lastly, we also did not find child temperament, specifically child behavioral inhibition, to moderate the relationship between parental verbal information and child fear of Covid-19. This contrasts the findings of previous studies that the relationship between verbal threat information on child fear towards novel animals is stronger for behaviorally inhibited children (Field, 2006; Field & Price-Evans, 2009). Note, however, that the previous studies assessing this link have measured child fear towards novel animals in a laboratory setting, being exposed to information of only the experimenter or the parent, before their fears towards the novel animals were assessed. In contrast, our study started after the Covid-19 outbreak had already been named a pandemic, which means that we assessed children's fear of Covid-19 after they had been informed about this virus from various sources.

The current study is limited in that it remains unknown whether children's first 'encounter' or information they received about the virus was from their parents, or whether they have already formed (fear) beliefs about the virus beforehand. Since BI relates to fear of *novel* stimuli, it is possible that behaviorally-inhibited children are not more strongly affected by parental verbal information, because they have received less threatening information from various other sources beforehand, and the virus was not a novel stimulus anymore. Furthermore, the BI scores in our sample were overall lower than the averages reported in non-clinical samples of children (Broeren & Muris 2010). The little variance in children's behavioral inhibition may have also limited our ability to find a moderating role of BI in the link between parental verbal threat information on child fear of Covid-19. Lastly, against expectations, there was a weak negative link between children's behavioral inhibition and their fear of Covid-19: Lower levels of behavioral inhibition were related to stronger Covid-19 fears. One possible explanation is that children with lower levels of behavioral inhibition may have exposed themselves more often to situations that would potentially directly expose them to the virus, whereas children high in behavioral

inhibition possibly stayed more at home, avoided the news, and exposed themselves less to the virus or others expressing fears. This avoidant style may have helped the regulation of fears in this context, and dampened the fear-inducing impact of parent verbal threat information about the virus. Taken together, we found no direct support for the idea that parental anxiety or child behavioral inhibition are risk factors in the link between parental verbal threat information and children's fear of Covid-19. Future research should continue the quest to find out which children might be at increased risk to develop fear towards Covid-19 after being exposed to parents' comments.

Our study is the first to investigate Rachman's verbal fear acquisition pathway in the context of Covid-19 using a Dutch sample, while also assessing possible risk factors that might strengthen children's fear learning. Furthermore, in contrast to previous work, this study assesses parental verbal threat information about Covid-19 with both child and parent reports. Nevertheless, the following limitations should be taken into account. First, reported associations are correlational, meaning we cannot infer causality in this cross-sectional design. Second, the study was conducted over the span of a year, and the Covid-19 infection rates and governmental measures to combat the infection rates differed during the various stages of the pandemic. Future research that assesses Covid-19 fears at multiple time points could assess fluctuations of parental and child fear of Covid-19 and the influence of parental comments while taking the severity of the pandemic into account. Third, the current parent sample consisted mainly of mothers (76%). A previous study found mothers to voice more Covid-19 concerns and display more safety behaviors than fathers (Lauri Korajlija, & Jokic-Begic, 2020). In our sample, mothers report more Covid-19 fears and more frequent communication of their fears than fathers (see Supplementary Material, Table S1). Due to the overrepresentation of mothers in our study, the generalizability of the results to fathers is limited, and future research should expand our findings by incorporating both parents. Lastly, this study should be interpreted in the context that at the point of data collection Covid-19 fears were adaptive given the novelty of the virus, the absence of vaccines or medication, and therefore possibly high severity of threat. Additionally, our sample contains parents with overall low levels of anxiety. Hence, no conclusion can be drawn to the transmission of maladaptive fears/clinical fears/Covid-19 anxiety. Despite these limitations, the current study contributes to our knowledge of Rachman's social fear learning model, by highlighting the role of parental communication in children's fear acquisition in a typically developing sample of 8-to-18-year-olds and their parents during the Covid-19 pandemic. While parental anxiety and child behavioral inhibition did not moderate the relationship between parental verbal threat information and child fear of Covid-19, the link of parental anxiety to child fear of Covid-19 warrants further investigation.

References

Askew, C., & Field, A. P. (2007). Vicarious learning and the development of fears in childhood. *Behaviour Research and Therapy*, *45*(11), 2616-2627. https://doi.org/10.1016/j.brat.2007.06.008

Belsky, J., & Pluess, M. (2009). Beyond diathesis stress: differential susceptibility to environmental influences. *Psychological bulletin*, *135*(6), 885. https://doi.org/10.1037/a0017376

Bögels, S. M., & van Melick, M. (2004). The relationship between child-report, parent self-report, and partner report of perceived parental rearing behaviors and anxiety in children and parents. *Personality and Individual Differences*, *37*(8), 1583-1596. https://doi.org/10.1016/j.paid.2004.02.014

Broeren, S., & Muris, P. (2010). A psychometric evaluation of the behavioral inhibition questionnaire in a non-clinical sample of Dutch children and adolescents. *Child Psychiatry & Human Development*, *41*(2), 214-229. https://doi.org/10.1007/s10578-009-0162-9

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: the BIS/BAS scales. *Journal of personality and social psychology*, *67*(2), 319. https://doi.org/10.1037//0022-3514.67.2.319

Chen, S. X., Ng, J. C. K., Hui, B. P. H., Au, A. K. Y., Wu, W. C. H., Lam, B. C. P., … Liu, J. H. (2021). Dual impacts of coronavirus anxiety on mental health in 35 societies. Scientific Reports, 11(1), 8925–8925. https://doi.org/10.1038/s41598-021-87771-1

Clauss, J. A., & Blackford, J. U. (2012). Behavioral inhibition and risk for developing social anxiety disorder: a meta-analytic study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(10), 1066-1075. https://doi.org/10.1016/j.jaac.2012.08.002

Davies, P. T., Winter, M. A., & Cicchetti, D. (2006). The implications of emotional security theory for understanding and treating childhood psychopathology. *Development and Psychopathology*, *18*(3), 707-735. https://doi.org/10.1017/S0954579406060354

Delgado, M. R., Olsson, A., & Phelps, E. A. (2006). Extending animal models of fear conditioning to humans. *Biological psychology*, *73*(1), 39-48. https://doi.org/10.1016/j.biopsycho.2006.01.006

Eisenberg, N., Cumberland, A., & Spinrad, T. L. (1998). Parental socialization of emotion. *Psychological inquiry*, *9*(4), 241-273. https://doi.org/10.1207/s15327965pli0904_1

Emerson, L. M., Ogielda, C., & Rowse, G. (2019). A systematic review of the role of parents in the development of anxious cognitions in children. *Journal of anxiety disorders*, *62*, 15-25. https://doi.org/10.1016/j.janxdis.2018.11.002

Ferrari, M. (1986). Fears and phobias in childhood: Some clinical and developmental considerations. *Child Psychiatry and Human Development*, *17*(2), 75-87. https://doi.org/10.1007/BF00706646

Field, A. P. (2006). Watch out for the beast: Fear information and attentional bias in children. *Journal of Clinical Child and Adolescent Psychology*, *35*(3), 431-439. https://doi.org/10.1207/s15374424jccp3503_8

Field, A. P., & Price-Evans, K. (2009). Temperament moderates the effect of the verbal threat information pathway on children's heart rate responses to novel animals. *Behaviour Research and Therapy*, *47*(5), 431-436. https://doi.org/10.1016/j.brat.2009.01.020

Field, A. P., Argyris, N. G., & Knowles, K. A. (2001). Who's afraid of the big bad wolf: a prospective paradigm to test Rachman's indirect pathways in children. *Behaviour Research and therapy*, *39*(11), 1259-1276. https://doi.org/10.1016/S0005-7967(00)00080-2

Fox, N. A., Henderson, H. A., Marshall, P. J., Nichols, K. E., & Ghera, M. M. (2005). Behavioral inhibition: Linking biology and behavior within a developmental framework. *Annual Review of Psychology*, *56*(1), 235–262. https://doi.org/10.1146/annurev.psych.55.090902.141532

Gregory, A. M., & Eley, T. C. (2007). Genetic influences on anxiety in children: what we've learned and where we're heading. *Clinical Child and Family Psychology Review*, 10(3), 199–212. https://doi.org/10.1007/s10567-007-0022-8

Havighurst, S., & Kehoe, C. (2017). The role of parental emotion regulation in parent emotion socialization: Implications for intervention. In *Parental stress and early child development* (pp. 285-307). Springer, Cham. https://doi.org/10.1007/978-3-319-55376-4_12

Hettema, J. M., Neale, M. C., & Kendler, K. S. (2001). A Review and Meta-Analysis of the Genetic Epidemiology of Anxiety Disorders. *The American Journal of Psychiatry*, 158(10), 1568–1578. https://doi.org/10.1176/appi.ajp.158.10.1568

Ingram, R. E., & Luxton, D. D. (2005). Vulnerability-stress models. *Development of psychopathology: A vulnerability-stress perspective*, *46*. https://doi.org/10.4135/9781452231655.n2

Kiel, E. J., & Kalomiris, A. E. (2019). Emotional development and anxiety. In *Handbook of Emotional Development* (pp. 665-693). Springer, Cham. https://doi.org/10.1007/978-3-030-17332-6_25

Knowles, K. A., & Olatunji, B. O. (2021). Anxiety and safety behavior usage during the COVID-19 pandemic: The prospective role of contamination fear. *Journal of anxiety disorders*, *77*, 102323. https://doi.org/10.1016/j.janxdis.2020.102323

Lauri Korajlija, A., & Jokic-Begic, N. (2020). COVID-19: Concerns and behaviours in Croatia. British Journal of Health Psychology, 25(4), 849–855. https://doi.org/10.1111/bjhp.12425

Lin, C., Hou, W., Mamun, M. A., Aparecido da Silva, J., Broche-Pérez, Y., Ullah, I., ... Pakpour, A. H. (2021). Fear of COVID-19 Scale (FCV-19S) across countries: Measurement invariance issues. *Nursing Open*, *8*(4), 1892–1908. https://doi.org/10.1002/nop2.855

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour research and therapy*, *33*(3), 335-343. https://doi.org/10.1016/0005-7967(94)00075-U

Lucassen, N., de Haan, A. D., Helmerhorst, K. O., & Keizer, R. (2021). Interrelated changes in parental stress, parenting, and coparenting across the onset of the COVID-19 pandemic. *Journal of Family Psychology*. https://doi.org/10.1037/fam0000908

Moore, P. S., Whaley, S. E., & Sigman, M. (2004). Interactions between mothers and children: impacts of maternal and child anxiety. *Journal of abnormal psychology*, *113*(3), 471. https://doi.org/10.1037/0021-843X.113.3.471

Muris, P., & Field, A. P. (2010). The role of verbal threat information in the development of childhood fear."Beware the Jabberwock!". *Clinical Child and Family Psychology Review*, *13*(2), 129-150. https://doi.org/10.1007/s10567-010-0064-1

Muris, P., van Zwol, L., Huijding, J., & Mayer, B. (2010). Mom told me scary things about this animal: Parents installing fear beliefs in their children via the verbal information pathway. Behaviour Research and Therapy, 48(4), 341–346. https://doi.org/10.1016/j.brat.2009.12.001

Murray, L., Creswell, C., & Cooper, P. J. (2009). The development of anxiety disorders in childhood: an integrative review. Psychological Medicine, 39(9), 1413–1423. https://doi.org/10.1017/S0033291709005157

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *47*(3-4), 395-422. https://doi.org/10.1111/j.1469-7610.2006.01612.x

Olsson, A., Nearing, K. I., & Phelps, E. A. (2007). Learning fears by observing others: the neural systems of social fear transmission. *Social cognitive and affective neuroscience*, *2*(1), 3-11. https://doi.org/10.1093/scan/nsm005

Pavlov, I. P. (1927). Conditioned reflexes: an investigation of the physiological activity of the cerebral cortex. Oxford: Oxford University Press.

Pêgo, J. M., Sousa, J. C., Almeida, O. F. X., & Sousa, N. (2009). Stress and the neuroendocrinology of anxiety disorders. *Behavioral Neurobiology of Anxiety and its Treatment*, 97-118. https://doi.org/10.1007/7854_2009_13

Percy, R., Creswell, C., Garner, M., O'Brien, D., & Murray, L. (2016). Parents' verbal communication and childhood anxiety: A systematic review. *Clinical child and family psychology review*, *19*(1), 55-75. https://doi.org/10.1007/s10567-015-0198-2

Rachman, S. (1977). The conditioning theory of fear acquisition: A critical examination. *Behaviour research and therapy*, *15*(5), 375-387.

Radanović, A., Micić, I., Pavlović, S., & Krstic, K. (2021). Don't Think That Kids Aren't Noticing: Indirect pathways to children's fear of COVID-19. *Frontiers in psychology*, *12*, 531. https://doi.org/10.3389/fpsyg.2021.635952

Remmerswaal, D., & Muris, P. (2011). Children's fear reactions to the 2009 Swine Flu pandemic: The role of threat information as provided by parents. *Journal of anxiety disorders*, *25*(3), 444-449. https://doi.org/10.1016/j.janxdis.2010.11.008

Renk, K. (2005). Cross-Informant Ratings of the Behavior of Children and Adolescents: The "Gold Standard" *Journal of Child and Family Studies,* 14(4), 457–468. https://doi.org/10.1007/s10826-005-7182-2

Reynolds, G., Field, A. P., & Askew, C. (2014). Effect of vicarious fear learning on children's heart rate responses and attentional bias for novel animals. *Emotion*, *14*(5), 995. https://doi.org/10.1037/a0037225

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling and more. Version 0.5–12 (BETA). *Journal of statistical software*, *48*(2), 1-36.

Tabachnick, B. G., & Fidell, L. S. (2013). Using Multivariate Statistics. Harlow: Pearson Education UK.

Taylor, S., Landry, C. A., Paluszek, M. M., Fergus, T. A., McKay, D., & Asmundson, G. J. (2020). COVID stress syndrome: Concept, structure, and correlates. *Depression and anxiety*, *37*(8), 706-714**.** https://doi.org/10.1002/da.23071

Uy, J. P., Schwartz, C., Chu, K. A., Towner, E., Lemus, A., Brito, N. H., & Callaghan, B. L. (2022). Parenting under pressure: Parental transmission and buffering of child fear during the COVID-19 pandemic. *Developmental Psychobiology*, *64*(3), e22253. https://doi.org/10.1002/dev.22253

Wong, Q. J. ., & Rapee, R. M. (2016). The aetiology and maintenance of social anxiety disorder: A synthesis of complimentary theoretical models and formulation of a new integrated model. *Journal of Affective Disorders*, 203, 84–100. https://doi.org/10.1016/j.jad.2016.05.069

Supplementary Materials

Table S1. Descriptive information and correlations between mother and father variables

	N	*r*	*M*	*SD*	1	2	3	4	5	6
1. Mother Fear of Covid	143	.84	2.19	0.48	-	.49*	.62***	.40	.23**	.03
2. Father Fear of Covid	50	.74	2.10	0.37		-	.44*	.53***	-.10	.24
3. Mother Verbal Info	140	.81	2.69	0.70			-	.56**	.13	-.17
4. Father Verbal Info	50	.81	2.60	0.74				-	.24	-.16
5. Mother Anxiety	142	.94	0.34	0.22					-	.08
6. Father Anxiety	50	.94	0.25	0.20						-

Notes. *N* = sample size, *r* = reliability, *M* = Mean, *SD* = standard deviation, * = $p < .05$, ** = $p < .01$, ***= $p < .001$.

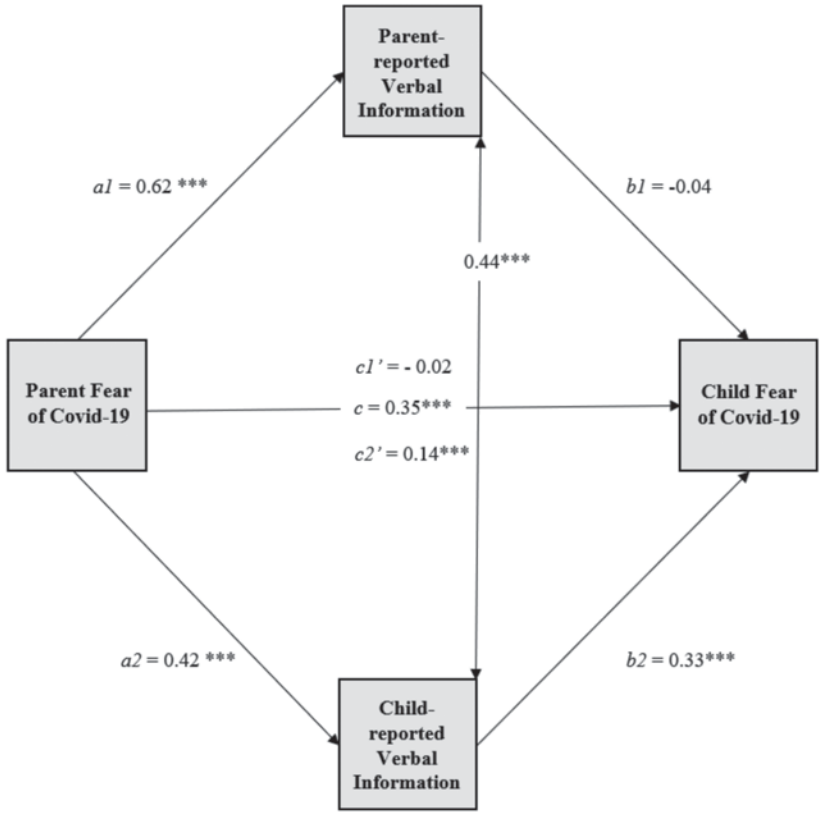

Figure S1. Path Model with parent and child-reported parental verbal information as parallel mediators between parents' and children's fear of Covid-19.

Notes. c = direct effect, *c1'* = indirect effect of parent-reported verbal information, *c2'* = indirect effect of child-reported verbal information. Children's age was included as covariate but is not depicted. Statistics are standardized regression coefficients.

Chapter 6

DISCUSSION

General Discussion

This dissertation aimed to investigate the parent-to-child transmission of fear via two social fear-learning pathways, namely (1) Vicarious Learning and (2) Instructional Learning. Furthermore, it includes the exploration of child temperament and parental (trait) anxiety as potential characteristics that might strengthen child fear learning via these pathways. In this final chapter, I summarize and discuss the main findings, address limitations, as well as directions for future research and clinical implications.

Summary of Main Findings

In infancy, parent-child communication largely depends on non-verbal cues, such as facial expressions, gestures, and body language (Feinman et al., 1992). Following the development of language abilities, social fear learning via verbal threat information becomes the most salient fear-learning pathway (Rachman, 1977). In **Chapter 2,** we examined parent-to-offspring fear transmission via vicarious learning in infancy with a systematic review and meta-analysis. The effect of modeling parents' fearful reactions on infants' acquisition of fear and avoidance of novel stimuli was small to medium in size (Hedges' g = .44). The findings show a strengthened avoidance (not fear) acquisition for children higher in BI. This strengthened avoidance acquisition was only found when including both experimental and correlational studies, but was less strong and no longer significant when exclusively including experimental studies. We did not find support for the idea that infants of anxious parents show stronger fear acquisition via modeling. Overall, these findings suggest that a single exposure to parents' fearful reactions can induce a fear and avoidance response in infants. Fear and avoidance acquisition via manipulated parental fearful expressions is not stronger for infants of anxious parents or behaviorally inhibited infants.

In **Chapter 3, we** examined parent-to-offspring fear transmission via instructional learning in childhood and adolescence**.** We found that the effect of parental verbal threat information on children's acquisition of fear of novel stimuli was large (Hedges' g= 1.26) – even after a single exposure. Children's and parents' anxiety dispositions, as well as child age, did not significantly strengthen the environmental acquisition of fears via parental verbal threat information.

Little research exists on fear transmission regarding social stimuli, even though social fears are highly prevalent and debilitating (Beesdo et al., 2009). We therefore extended the previous literature by examining parent-child fear transmission of social stimuli in **Chapter 4.** Within this experimental study, we assessed parent-child transmission of fear via the instructional learning pathway. This study revealed a significant effect of parental verbal threat information about strangers on a child's fear of

strangers during a social interaction task. Thus, after a single exposure to parental verbal threat (vs. safety) information children reported higher fears regarding that stranger, compared to the stranger paired with safety information. However, children did not display increased fearful behaviors, heart rate, or attentional bias towards the stranger paired with threat-related information. We didn't find any evidence that children of parents with higher social anxiety levels or children with fearful temperaments were more strongly impacted by parental verbal threat information.

Chapter 5 entails the investigation of the instructional learning pathway in the context of the COVID-19 pandemic. The COVID-19 virus presented a real-life threatening 'novel stimulus', which was also novel to the parents. Within the cross-sectional study, we found that children of parents with stronger COVID-19 fears also reported stronger COVID-19 fears themselves. Moreover, parents who were more fearful of COVID-19 provided more threat-related information about the virus to their children. More parental threat information, in turn, was related to a stronger fear of COVID-19 in their children and partly explained the link between parent and child fear of the virus. The association between parental threat information and child fear did not seem to differ as a function of child temperament or parental anxiety.

Parent to offspring fear transmission via social fear learning pathways

This thesis demonstrates parent-offspring transmission of fear towards novel stimuli via two social learning pathways - vicarious learning and instructional learning. Chapters 2, 3, 4, and 5 consistently show that parental nonverbal and verbal expressions about novel stimuli were related to how much children showed fear and avoidance of these stimuli. A comparison of effect sizes in Chapters 2 and 3 suggests that the impact of parental *verbal* fear expressions about novel stimuli appears to be larger on children's fear of these stimuli, compared to the impact of parental *nonverbal* expressions. The stronger effect size for our meta-analytic findings on social fear learning via the instructional pathway compared to fear learning via the vicarious learning pathway might be due to verbal expressions of anxiety being less ambiguous than nonverbal expressions of fear and anxiety (i.e., gazing away). Hence, parental verbal statements might be more direct and impactful on children's reactions than nonverbal expressions. Importantly, the studies included in the meta-analyses (Chapters 2 and 3) on parent-offspring fear transmission varied in how they assessed social fear learning pathways as well as child fear reactions. These methodological choices are relevant to consider when interpreting the study findings. Below, we discuss the findings of Chapters 2 to 5 in the light of three methodological strategies:

1. The examination of multiple child fear indices.

The reviews of the literature on parent-offspring fear transmission via social fear learning pathways in Chapters 2 and 3 highlight that studies differ in how they assess child fear. Multiple studies focusing on social fear learning pathways in infancy investigated child fear through one behavioral index of fear, such as observed expressed fear or observed avoidance (see Chapter 2). Since infants cannot verbally report their fears, using a singular fear index increases the likelihood that an infant's reaction is misinterpreted as fearful (LoBue & Adolph, 2019). To decrease the chance of misattribution, measuring fear in infants should contain multiple complementary methods, such as multiple behavioral (infant distress and avoidance) and physiological indices of fear (LoBue & Adolph, 2019). Furthermore, studies that examined the instructional learning pathway during childhood predominantly assessed children's self-reported fear (see Chapter 3). Since fear indices are often unrelated (Bradley & Lang, 2000), if children report more fear of a novel stimulus, it does not necessarily mean that children also behave more fearfully. Hence, studies focusing on singular indices of fear may not capture the entirety of infant or child fear reactions.

Following this rationale, in Chapter 4, we measured multiple child indices of fear with cognitive, behavioral, and physiological indices. Chapter 4 describes one of the first multi-method investigations of the transmission of social fears from parents to children in the literature. The findings suggest that after a single exposure to parental verbal threat (vs. safety) information children reported higher fears regarding that stranger compared to the stranger paired with safety information. However, children did not display increased fearful behaviors, heart rate, or attentional bias towards the stranger paired with threat-related information. This corroborates earlier findings that fear indices do not necessarily occur together and emphasizes that we should not generalize our findings from one child's fear index to other fear indices. Taken together, the chapters of the dissertation highlight the value of assessing multiple child fear indices to gain a well-rounded understanding of these pathways. Alternatively, studies that focus on one fear index can benefit from critically assessing which aspect of fear researchers intend to measure and be cautious not to generalize across other fear indices.

2. The use of different study designs to investigate social fear learning pathways

Studies on parent-offspring transmission of fear via social fear learning pathways differed in their study design (Chapters 2 and 3). Multiple studies investigated child fear acquisition through experimental studies, whereas other studies that focused on these pathways by assessing the association between parental anxious expressions towards

novel stimuli and child fear of these stimuli in daily life utilized correlational designs. Chapters 2 and 3 demonstrate that the effects of parental anxious expressions on child fear found in studies can differ depending on the study design. Specifically, the effect size regarding the impact of parental expressions on offspring fear in the experimental studies was larger than the effect size assessing the association between parental expressions and offspring fear in the correlational studies. The larger effect size in experimental studies might be explained by the increased control in the lab setting by reducing the influence of confounding variables. However, children's experience with the novel stimuli presented in the lab might not generalize well to their experience outside the lab. In experimental studies, parents are trained to show specific verbal and nonverbal anxious reactions to a novel stimulus, which might not represent how parents display fear in front of their children in daily life. Taken together, while conducting experimental studies allows for stronger conclusions regarding the causal effect of parental anxiety expressions (Kazdin, 2021), it may limit the generalizability of the findings to parents' and children's experiences in daily life. The challenge for future research is to assess social fear learning in more ecologically valid contexts while retaining as much control over confounding factors as possible. Future studies could assess parent-offspring fear transmission by observing parent-child dyads in 'standardized' novel situations that families encounter in real life, such as a child's first visit to the dentist.

3. The use of varying stimuli to investigate social fear learning pathways

Previous studies on parent-offspring transmission of fear via social fear learning pathways differed in the stimuli they used. Research has most often examined fear transmission relating to non-social stimuli (such as novel objects or animals) (see Chapters 2 and 3). While studying the acquisition of fear towards such objects can give relevant insight into the general processes underlying fear learning, understanding the acquisition of, for example, social anxiety may require studying fear acquisition in social contexts or towards social stimuli. Given the limited number of studies focusing on social fear learning regarding social stimuli, in the STARS study (Chapter 4), we assessed fear transmission regarding social stimuli that children actually encountered. Contrary to other studies (for review, see Muris & Field, 2010), parental anxious expressions did not increase children's fearful behaviors, heart rate, or attentional bias. Therefore, children's fear acquisition via fear learning pathways might differ depending on which stimuli are utilized in the study. More research is needed to investigate the parent-child transmission of fears to social stimuli to elucidate pathways relevant to *social* fear acquisition.

The role of child and parent anxiety dispositions in the social fear learning pathways

This thesis additionally sheds light on the role of child temperament and parental (trait) anxiety as potential characteristics that strengthen child fear learning via these pathways (Chapters 2 to 5).

The role of child temperament in social fear learning pathways

Across Chapters 3 to 5, we did not find support for a moderating role of child temperament in child fear acquisition after a single exposure to parental verbal threat information. However, the impact of child temperament on social fear learning might be dependent on the fear learning pathway and age of the child. In Chapter 2, which focused on parent-offspring fear transmission via modeling in early life, we did find child temperament to play a role. Possibly, children with fearful temperaments are more susceptible to parental anxiety expressions in infancy than in childhood. A possible explanation is that in early life, infants' reactive tendencies steer their behavior, and they rely predominantly on their parents to help them regulate (Pérez-Edgar & Hastings, 2018; Perez-Edgar, 2019). Nevertheless, the strength of the effect of temperament on this social fear learning pathway in infancy was rather small. Moreover, rather than making children more susceptible to parental anxiety expressions, children with a fearful temperament might show heightened fearful responses to novel stimuli independent of parental expressions.

In summary, temperament is a characteristic to consider when investigating child acquisition of fear via social fear learning pathways in infancy.

The role of parental anxiety in social fear learning pathways

Across all chapters of the dissertation, we found that parental anxiety does not strengthen children's fear acquisition of novel stimuli via social fear learning pathways. Specifically, we did not find support for the idea that children of parents with higher anxiety levels become more fearful after a single exposure to parental fearful expressions. In both Chapters 2 and 3, we could not assess the moderating role of parental anxiety disorders or parental trait anxiety levels in parent-child fear transmission by means of a meta-analysis, due to the limited number of studies investigating this moderating role. In Chapter 2, in which we also systematically reviewed the moderating role of parental anxiety, we did not find support for stronger fear or avoidance acquisition in the infants of anxious parents immediately after being exposed to parents' anxious expressions. However, these parental expressions predicted children's avoidance of that stimulus at a later time point. Rather than the intensity or strength of social fear learning being different in families with anxious

parents, it could be that the repeated transfer of threat information via this pathway in these families contributes to the familial transmission of anxiety. Hence, parental (trait) anxiety is not a risk factor for enhanced social fear learning, but maybe (over time) it strengthens children's tendency to avoid novel social stimuli or situations in general. More research is needed to investigate through which mechanisms parental trait anxiety might contribute to parent-offspring fear transmission.

Limitations and Future Research

We outline several methodological limitations of this dissertation as well as address topics for future research, which could deepen our understanding of these learning pathways.

Single exposure

Across the chapters of this dissertation, we focused on the impact of a *single* exposure to parental expressions of anxiety on children's fear response. In real life, where learning experiences spread over a longer period of time, children rarely get exposed to parental expressions just once. To elucidate familial transmission of anxiety disorders and potential environmental pathways, it is also important to investigate children's repeated exposure to parental anxiety expressions. Moreover, it would be interesting to investigate whether repeated exposure shifts the impact of parental anxiety expressions from more subjective indices (i.e., self-report) onto other fear indices over time. Specifically, it remains to be investigated whether a child displays fearful behavior or has an increased physiological response to the novel stimulus if a parent repeats their comments or behavior in the following encounter(s) with that stimulus. Hence, experimental studies that include multiple exposures to parental threat information or longitudinal studies are warranted to assess the impact of repeated exposure to parental anxiety expressions on children's fear acquisition. While we did not find a role of parental anxiety and mixed findings for the role of child temperament in social fear learning after a single exposure to parental anxiety expressions, this does not preclude a potential role in this process after repeated exposure.

Single pathways

In the individual chapters of the dissertation, we zoomed in on separate fear learning pathways (i.e., vicarious learning or instructional learning). Nevertheless, in daily life, different fear-learning pathways might not occur in isolation and might also interact with

each other (Muris & Field, 2010). For example, the social fear learning pathways might also interact with children's own later experiences (i.e., an aversive encounter) with the novel stimulus. Previous studies have demonstrated that verbal threat information can facilitate associations formed in subsequent conditioning (Askew et al., 2008; Field & Storksen-Coulson, 2007). However, this has not been investigated with parent-child dyads. More research is needed that disentangles the potential interactions between social fear learning pathways within a family context. Lastly, since we did not find a role of child temperament in the instructional learning pathway but a potential role in vicarious learning, this might also suggest that child characteristics could play a different role depending on the (interaction of) social fear pathway(s).

Single information source

While children can be exposed to one parent's reaction in the lab, in real life they might get exposed to conflicting emotional reactions from two parents/caregivers, successively or simultaneously. These conflicting reactions may alter the child's response to the novel stimuli (Krause & Askew, 2022). To come back to the anecdote of Chapter 1: Over time, Carolien got exposed to a multitude of confident and positive reactions to roller coasters (for example, from her sister) and eventually did go on a roller coaster ride. Carolien's initial avoidance completely disappeared and she has since enjoyed rollercoasters as much as her sister. Previous research suggests that confident or positive expressions regarding a novel stimulus before or after being exposed to anxious expressions can potentially reduce or reverse the effects of the anxious expressions (Krause & Askew, 2022). However, in most studies investigating the effect of conflicting information on child fear, the same person (mainly the experimenter) provides the conflicting information rather than the parents. Nevertheless, there is evidence from one experimental study that toddlers' fear acquisition (from experimenters' fear expressions) is reduced if they were first exposed to maternal positive reactions (Egliston & Rapee, 2007). Hence, future observational studies could assess the impact of two parents/caregivers displaying conflicting expressions while facing a novel situation on the child's reaction toward this situation. Furthermore, if the parental conflicting expressions do not occur simultaneously but subsequently, it could be investigated whether the order of expressions (i.e., first fearful and then confident) matters.

Clinical Implications

While fear acquisition via both social fear-learning pathways can be seen as an adaptive response to potentially threatening stimuli, it could be that in *at-risk families*, exposure to parental anxiety expressions occurs more frequently. To prevent child anxiety

development via this route, prevention strategies could incorporate psychoeducation or training on reducing the amount of repeated exposure to parental anxiety expressions. Given that the effect of parental fearful reactions to novel stimuli on infant avoidance was stronger for infants with more fearful temperaments—psychoeducation might be valuable for their parents in particular.

Since parental verbal and nonverbal anxiety expressions can lead to fear acquisition towards novel stimuli in children, watching or listening to parents' positive or confident reactions may reduce or prevent fear acquisition. A recent systematic review suggests that children's positive modeling (of parents, experimenters, and peers) can reduce or prevent fear acquisition of novel stimuli (Krause & Askew, 2022). Given the large effects found in the verbal threat information pathway (Chapter 3), prevention efforts should prioritize targeting the verbal communication of the parent**.**

But is it as simple as parents saying encouraging words to their children in novel situations? Previous studies have investigated the role of parental support or involvement in the effectiveness of psychotherapy interventions for children's anxiety disorders (In-Albon & Schneider, 2007; Simon et al., 2011). Overall the findings suggest that the involvement of parents does not impact the effectiveness of the interventions, but rather that the effectiveness of child-only interventions is comparable to the effectiveness of family interventions including parents (In-Albon & Schneider, 2007). Nevertheless, there is also evidence that treatments targeting child anxiety that only include parents during the sessions (and not their children) can be as efficacious in treating childhood anxiety disorders as child-focused interventions (Lebowitz et al., 2020). Those parent-based treatments focus on increased parental support for anxious children (i.e., by expressing confidence in children's ability to cope with anxiety-provoking situations) as well as decreasing their accommodating behaviors to alleviate child anxiety (Lebowitz et al., 2020). To gain a better understanding of what kind of supportive statements or behaviors from parents can reduce child fear acquisition (and could potentially be implemented in interventions), future qualitative studies could assess children's perspective of what has helped them in the past to face their fears and which statements from their parents they found encouraging. Hence, future research could dive into children's perspectives of what makes them brave in 'scary' situations and how that could be applied to other novel situations.

Conclusion

Taken together, the studies in this dissertation show that parents' anxious expressions can contribute to child fear acquisition toward novel stimuli. It seems that this pathway operates similarly for children of parents with different levels of anxiety. Infants with

a fearful temperament might be more fearful of novel stimuli after witnessing their parents' anxious reactions to them. Last but not least, this dissertation can be seen as a reminder of how powerful our verbal and nonverbal communication can be.

In the face of novelty, lead by example.

References

Aktar. (2022). Intergenerational Transmission of Anxious Information Processing Biases: An Updated Conceptual Model. *Clinical Child and Family Psychology Review*, 25(1), 182–203. https://doi.org/10.1007/s10567-022-00390-8

Askew, C., Kessock-Philip, H., & Field, A. (2008). What Happens When Verbal Threat Information and Vicarious Learning Combine? *Behavioural and Cognitive Psychotherapy, 36*(4), 491-505. https://doi.org/10.1017/S1352465808004402

Bandelow, B. & Michaelis, S. (2015). Epidemiology of anxiety disorders in the 21st century. *Dialogues in Clinical Neuroscience*, 17(3), 327–335. https://doi.org/10.31887/DCNS.2015.17.3/bbandelow

Bandura, A. (1977). *Social learning theory*. Prentice-Hall.

Beesdo, K., Knappe, S., Pine, D. (2009). Anxiety and anxiety disorders in children and adolescents: developmental issues and implications for DSM-V. *Psychiatric Clinics of North America*., 32(3), 483–524. https://doi.org/10.1016/j.psc.2009.06.002

Belsky, J., & Pluess, M. (2009). Beyond Diathesis Stress. *Psychological Bulletin*, 135(6), 885–908. https://doi.org/10.1037/a0017376

Bradley, M.M., Lang, P.J., 2000. Measuring emotion: Behaviour, feeling, and physiology.In: Lane, R.D., Nadel, L. (Eds.), Cognitive Neuroscience of Emotion. University Press,Oxford, pp. 242–276

Clauss, J. A., & Blackford, J. U. (2012). Behavioral inhibition and risk for developing social anxiety disorder: a meta-analytic study. Journal of the American Academy of Child & Adolescent Psychiatry, 51(10), 1066-1075. https://doi.org/10.1016/j.jaac.2012.08.002

Creswell, C., Cooper, P., & Murray, L. (2010). Intergenerational transmission of anxious information processing biases. In J. A. Hadwin & A. P. Field (Eds.), *Information processing biases and anxiety: A developmental perspective* (pp. 279–295). Wiley Blackwell. https://doi.org/10.1002/9780470661468.ch12

Debiec, J., & Olsson, A. (2017). Social Fear Learning: from Animal Models to Human Function. *Trends in Cognitive Sciences*, *21*(7), 546–555. https://doi.org/10.1016/j.tics.2017.04.010

Egliston, K. A., & Rapee, R. M. (2007). Inhibition of tear acquisition in toddlers following positive modelling by their mothers. *Behaviour Research and Therapy*, *45*(8), 1871-1882. https://doi.org/10.1016/j.brat.2007.02.007

Eley, T. C., McAdams, T. A., Rijsdijk, F. V., Lichtenstein, P., Narusyte, J., Reiss, D., … Neiderhiser, J. M. (2015). The Intergenerational Transmission of Anxiety: A Children-of-Twins Study. *The American Journal of Psychiatry*, *172*(7), 630–637. https://doi.org/10.1176/appi.ajp.2015.14070818

Emerson, L.-M., Ogielda, C., & Rowse, G. (2019). A systematic review of the role of parents in the development of anxious cognitions in children. *Journal of Anxiety Disorders*, 62, 15–25. https://doi.org/10.1016/j.janxdis.2018.11.002

Feinman, S. (1982). Social referencing in infancy. *Merrill-Palmer Quarterly (1982-)*, 445-470.

Field, A. P., & Storksen-Coulson, H. (2007). The interaction of pathways to fear in childhood anxiety: A preliminary study. *Behaviour Research and Therapy*, *45*(12), 3051-3059. https://doi.org/10.1016/j.brat.2007.09.001

Fisak, J., & Grills-Taquechel, A. E. (2007). Parental modeling, reinforcement, and information transfer: risk factors in the development of child anxiety? *Clinical Child and Family Psychology Review*, *10*(3), 213–231. https://doi.org/10.1007/s10567-007-0020-x

Gregory, A. M., & Eley, T. C. (2007). Genetic influences on anxiety in children: What we've learned and where we're heading. *Clinical Child and Family Psychology Review*, 10(3), 199–212. https://doi.org/10.1007/s10567-007-0022-8

Hettema, J. M., Neale, M. C., & Kendler, K. S. (2001). A Review and Meta-Analysis of the Genetic Epidemiology of Anxiety Disorders. *The American Journal of Psychiatry*, 158(10), 1568–1578. https://doi.org/10.1176/appi.ajp.158.10.1568

Hudson, J., L., Dodd, H. F., & Bovopoulos, N. (2011). Temperament, Family Environment and Anxiety in Preschool Children. *Journal of Abnormal Child Psychology*, 39(7), 939–951. https://doi.org/10.1007/s10802-011-9502-x

In-Albon, T., & Schneider, S. (2006). Psychotherapy of childhood anxiety disorders: A meta-analysis. *Psychotherapy and psychosomatics*, *76*(1), 15-24. https://doi.org/10.1159/000096361

Ingram, R. E., & Luxton, D. D. (2005). Vulnerability-stress models. *Development of psychopathology: A vulnerability-stress perspective*, *46*. https://doi.org/10.4135/9781452231655.n2

Kazdin, A. E. (2021). *Research design in clinical psychology*. Cambridge University Press. Keller, M. B., Lavori, P. W., Wunder, J., Beardslee, W. R., Schwartz, C. E., & Roth, J. (1992). Chronic Course of Anxiety Disorders in Children and Adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, 31(4), 595–599. https://doi.org/10.1097/00004583-199207000-00003

Kessler, R. C., Avenevoli, S., Costello, E. J., Georgiades, K., Green, J. G., Gruber, M. J., ... & Merikangas, K. R. (2012). Prevalence, persistence, and sociodemographic correlates of DSM-IV disorders in the National Comorbidity Survey Replication Adolescent Supplement. *Archives of general psychiatry*, *69*(4), 372-380.

Krause, L., & Askew, C. (2022). Preventing and reducing fear using positive modelling: A systematic review of experimental research with children. *Behaviour Research and Therapy,* 148, 103992–103992. https://doi.org/10.1016/j.brat.2021.103992

Lang, P. J. (1968). Fear reduction and fear behavior: Problems in treating a construct. In J. M. Shlien (Ed.), *Research in psychotherapy* (pp. 90–102). American Psychological Association. https://doi.org/10.1037/10546-004

Lawrence, P. J., Murayama, K., & Creswell, C. (2019). Systematic Review and Meta-Analysis: Anxiety and Depressive Disorders in Offspring of Parents With Anxiety Disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, *58*(1), 46–60. https://doi.org/10.1016/j.jaac.2018.07.898

Lebowitz, E. R., Marin, C., Martino, A., Shimshoni, Y., & Silverman, W. K. (2020). Parent-Based Treatment as Efficacious as Cognitive-Behavioral Therapy for Childhood Anxiety: A Randomized Noninferiority Study of Supportive Parenting for Anxious Childhood Emotions. *Journal of the American Academy of Child and Adolescent Psychiatry,* 59(3), 362–372. https://doi.org/10.1016/j.jaac.2019.02.014

LoBue, V., & Adolph, K. E. (2019). Fear in Infancy: Lessons From Snakes, Spiders, Heights, and Strangers. *Developmental Psychology*, *55*(9), 1889–1907. https://doi.org/10.1037/dev0000675

Muris, P., & Field, A. P. (2010). Role of Verbal Threat Information in the Development of Childhood Fear. "Beware the Jabberwock!" *Clinical Child and Family Psychology Review,* 13(2), 129–150. https://doi.org/10.1007/s10567-010-0064-1

Muris, P., van Zwol, L., Huijding, J., & Mayer, B. (2010). Mom told me scary things about this animal: Parents installing fear beliefs in their children via the verbal information pathway. *Behaviour Research and Therapy, 48*(4), 341–346. https://doi.org/10.1016/j.brat.2009.12.001

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *47*(3-4), 395-422. https://doi.org/10.1111/j.1469-7610.2006.01612.x

Olsson, A., Nearing, K. I., & Phelps, E. A. (2007). Learning fears by observing others: the neural systems of social fear transmission. *Social cognitive and affective neuroscience*, *2*(1), 3-11. https://doi.org/10.1093/scan/nsm005

Pérez-Edgar, K. (2019). Through the looking glass: Temperament and emotion as separate and interwoven constructs. In V. LoBue, K. Pérez-Edgar, & K.A. Buss (Eds.), *Handbook of Emotional Development*, (pp. 139-168): Springer.

Pérez-Edgar, K., & Hastings, P. D. (2018). Emotion development from an experimental and individual differences lens. *Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience*, *4*, 289-321.

Percy, R., Creswell, C., Garner, M., O'Brien, D., & Murray, L. (2016). Parents' verbal communication and childhood anxiety: A systematic review. *Clinical Child and Family Psychology Rev*iew, 19(1), 55–75. https://doi.org/10.1007/s10567-015-0198-2

Quilty, L. C., Van Ameringen, M., Mancini, C., Oakman, J., & Farvolden, P. (2003). Quality of life and the anxiety disorders. *Journal of Anxiety Disorders*, 17(4), 405–426. https://doi.org/10.1016/S0887-6185(02)00225-6

Rachman, S. (1977). The conditioning theory of fear-acquisition: a critical examination. Behaviour Research and Therapy, 15(5), 375–387. https://doi.org/10.1016/0005-7967(77)90041-9

Simon, E., Bögels, S. M., & Voncken, J. M. (2011). Efficacy of child-focused and parent-focused interventions in a child anxiety prevention study. *Journal of Clinical Child & Adolescent Psychology*, *40*(2), 204-219.

Telman, L. G., van Steensel, F. J., Maric, M., & Bögels, S. (2018). What are the odds of anxiety disorders running in families?: A family study of anxiety disorders in mothers, fathers, and siblings of children with anxiety disorders. *European Child & Adolescent Psychiatry*, *27*(5), 615–624. https://doi.org/10.1007/s00787-017-1076-x

Zimmer-Gembeck, M. J., Rudolph, J., Kerin, J., & Bohadana-Brown, G. (2021). Parent emotional regulation: A meta-analytic review of its association with parenting and child adjustment. *International Journal of Behavioral Development, 46*(1), 63-82. https://doi.org/10.1177/01650254211051086

Chapter 7

Non-scientific parts

Nederlandse Samenvatting

Led by Example: Overdracht van angst van ouders op kinderen via sociale angstleerwegen

Dagelijks worden kinderen blootgesteld aan nieuwe situaties, objecten of mensen. Nieuwe situaties zijn verrijkend voor de cognitieve, sociale en emotionele ontwikkeling van kinderen, maar kunnen ook gevaarlijk zijn en angst oproepen. Een manier om te bepalen of een situatie of stimulus veilig of bedreigend is, en om daarmee potentieel gevaar te vermijden, is door te leren van de reacties van ouders. Dit proces staat bekend als *sociaal angstleren ('social fear learning')*. *Sociaal angstleren* werkt via twee routes: leren via het observeren van ouders (de zogenaamde 'modelleren' route) en leren via verbale informatie van ouders (de zogenaamde 'instructieve' route). 'Modelleren' van non-verbale angstreacties (of voorbeeldgedrag) is met name relevant in de vroege kindertijd, omdat de communicatie tussen ouder en baby dan vooral is gebaseerd op gezichtsuitdrukkingen, gebaren en lichaamstaal. Naarmate kinderen ouder en taalvaardiger worden, spelen verbale boodschappen van ouders een grotere rol bij het leren over nieuwe situaties. Vervolgens kunnen kinderen angsten ontwikkelen op basis van de verbale informatie die ouders delen. Uit onderzoek blijkt dat zowel non-verbale als verbale angstreacties van ouders op nieuwe stimuli of situaties van invloed zijn op hoe kinderen reageren op deze stimuli. Meer inzicht in deze twee routes kan ons helpen de overdracht van angststoornissen van ouders naar kinderen binnen gezinnen beter te begrijpen. Het doel van dit proefschrift was om de overdracht van angst van ouder naar kind te onderzoeken via twee sociale angstleerwegen: (1) Leren via non-verbale informatie ('modelleren' route) en (2) Leren via verbale informatie ('instructieve' route). Een tweede doel was om te onderzoeken in hoeverre andere relevante factoren, zoals het temperament van het kind en angststoornissen (of angstklachten) van de ouder het *sociaal angstleren* bij kinderen via deze routes zouden kunnen versterken.

Resultaten

In het **tweede hoofdstuk** van dit proefschrift werd de overdracht van angst van ouder op kind via 'modelleren' in de kindertijd (0 tot 30 maanden) onderzocht aan de hand van een systematisch literatuuroverzicht en meta-analyse. Het modelleren van angstige reacties op nieuwe stimuli had een klein tot gemiddeld effect op de mate van angst van kinderen en de vermijding van nieuwe stimuli. De resultaten lieten daarnaast zien dat kinderen met een angstig temperament ('behavioural inhibition') vaker nieuwe situaties of stimuli vermijden. Dit effect was echter alleen significant wanneer zowel experimenteel als correlationeel onderzoek werd meegenomen, en niet wanneer uitsluitend experimenteel onderzoek werd geanalyseerd.

In het **derde hoofdstuk** is de overdracht van angst van ouder op kind via de 'instructieve' route in de kinderjaren en adolescentie (2,5 tot 18 jaar) onderzocht aan de hand van systematisch literatuuroverzicht en meta-analyse. Hieruit bleek dat verbale negatieve boodschappen van ouders een groot effect had op hoe angstig kinderen reageren op nieuwe stimuli, zelfs al na een enkele blootstelling. Deze overdracht werd overigens niet beïnvloed door de leeftijd van het kind of het temperament van de ouder of het kind.

Eerder onderzoek heeft zich voornamelijk gericht op angstleren met betrekking tot objecten en veel minder tot sociale stimuli. Gezien de hoge prevalentie en de impact van sociale angsten werd in **hoofdstuk vier** bestaand onderzoek uitgebreid met een studie naar de overdracht van angst voor sociale stimuli (d.w.z. onbekend personen) tussen ouders en adolescenten. In deze experimentele studie werd angstoverdracht via de instructieve route onderzocht. Uit de resultaten bleek dat wat ouders over onbekende personen zeiden, de zelfgerapporteerde angst van het kind voor die persoon tijdens een sociale interactietaak beïnvloedde. Kinderen vertoonden echter geen verhoogd angstig gedrag, geen versnelde hartslag, en geen aandachtsbias ('attention bias') ten opzichte van de onbekende persoon die werd gekoppeld aan de negatieve informatie van hun ouders (in vergelijking met de persoon over wie ouders iets positiefs zeiden). Kinderen van ouders met hogere sociale angstklachten of kinderen met een angstig temperament werden niet sterker beïnvloed door negatieve verbale informatie van de ouder.

In het **vijfde hoofdstuk** is het aanleren van angst via de instructieve route onderzocht in de context van de COVID-19-pandemie. Het COVID-19 virus vertegenwoordigde een nieuwe bedreiging in het echte leven, voor zowel ouder als kind. In deze correlationele studie vonden we dat kinderen van ouders met meer angst rondom COVID-19 ook zelf sterkere COVID-19 angsten rapporteerden. Ouders met meer COVID-19 angsten deelden meer bedreigende of angstinducerende informatie over het virus. Het geven van deze informatie hing samen met meer COVID-19 angst onder hun kinderen, wat deels het verband tussen COVID-19 angst van ouders en hun kinderen verklaarde.

Dit proefschrift toont aan hoe angst met betrekking tot nieuwe stimuli kan worden overgedragen van ouder op kind via twee sociale leerroutes – via voorbeeldgedrag ('modelleren' route) en verbale informatie ('instructieve' route). Hoofdstukken 2, 3, 4 en 5 tonen consistent aan dat de mate waarin kinderen angst en vermijding van deze stimuli vertoonden samenhangt met de non-verbale en verbale uitingen van ouders over nieuwe stimuli. De studies in de meta-analyses (hoofdstukken 2 en 3) verschilden in hoe zij sociale angstleerwegen en angstreacties bij kinderen hebben gemeten. Deze methodologische keuzes zijn belangrijk om in acht te nemen bij het interpreteren

van de resultaten. De effecten werden bijvoorbeeld vaak gevonden wanneer de angst van kinderen werd gemeten met zelfrapportages, maar minder met andere meetinstrumenten.

Kind Temperament en Ouderlijke Angst Symptomen als Risicofactoren

In dit proefschrift is ook onderzocht in hoeverre andere relevante factoren de overdracht van angst van ouders op kinderen versterken, zoals het temperament van het kind en ouderlijke angstklachten of stoornissen. De rol van het temperament van het kind in de angstoverdracht van ouder naar kind lijkt afhankelijk te zijn van de manier waarop de angst werd overgedragen en de leeftijd van het kind. We hebben geen bewijs gevonden dat het temperament van het kind in de kindertijd een rol speelt in de angstoverdracht van ouder naar kind via verbale boodschappen (hoofdstuk 3). Hoofdstuk 2 toont echter aan dat baby's met een angstiger temperament in de vroege kindertijd (in vergelijking met baby's met een minder angstig temperament) meer angst kunnen vertonen in nieuwe situaties na blootstelling aan angstige reacties (voorbeeldgedrag) van hun ouder. Dit effect van temperament op *sociaal angstleren* in de vroege kindertijd was echter klein. In plaats van dat kinderen gevoeliger worden voor angstige verbale boodschappen, kunnen kinderen met een angstig temperament mogelijk sterkere angstreacties vertonen op nieuwe situaties, ongeacht hoe angstig ouders op die situaties reageren. Samenvattend, alleen *in de vroege kindertijd* is temperament mogelijk een belangrijk kenmerk bij de overdracht van angst van ouder naar kind via sociale angstleerwegen.

Samenvattend blijkt dat kinderen van zeer angstige ouders na een eenmalige blootstelling aan angstig gedrag of angstige uitspraken van hun ouders niet angstiger worden dan kinderen van minder angstige ouders (hoofdstukken 2 en 3). In sommige gevallen (hoofdstuk 2) kon de invloed van angststoornissen of symptomen van ouders niet goed worden onderzocht door het beperkte aantal studies hierover. In de vroege kindertijd voorspelden angstige reacties van ouders niet meteen een sterke angst of vermijding bij baby's. Maar later leidde dit wel tot meer vermijding van de stimulus door de kinderen. In gezinnen met angstige ouders is sociaal angstleren niet per se sterker, maar herhaalde overdracht van dreigingsinformatie op den duur kan bijdragen aan de overdracht van angst binnen families. Hoewel angstklachten van ouders mogelijk geen directe risicofactor zijn voor verhoogd sociaal angstleren, kunnen ze er op de lange termijn wel voor zorgen dat kinderen meer geneigd zijn om onbekende sociale situaties of prikkels te vermijden. Toekomstig onderzoek is nodig om beter te begrijpen via welke mechanismen de angststoornissen en angstklachten van ouders bijdragen aan de angstoverdracht van ouder naar kind.

Klinische implicaties en Conclusie

Samenvattend blijkt uit de studies in dit proefschrift dat angstige reacties van ouders bijdragen aan het leren van angst voor nieuwe stimuli of situaties bij kinderen. Het aanleren van angst via ouders kan adaptief zijn in bedreigende situaties. Het kan echter maladaptief zijn als kinderen van hun ouders leren om bang te zijn voor een nieuwe stimulus die geen bedreiging vormt. Het vertonen van angstige reacties of het verbaal uiten van angst richting niet-bedreigende nieuwe stimuli kan vaker voorkomen in gezinnen waar ouders angststoornissen of angstklachten hebben. Het mechanisme waarmee ouders hun angsten overdragen werken op dezelfde manier voor kinderen van ouders met meer of minder angstklachten en voor kinderen met een meer of minder angstig temperament. Alleen baby's met een angstig temperament lijken angstiger te worden voor nieuwe stimuli na het zien van de angstige reacties van hun ouders in vergelijking tot baby's met een niet angstig temperament.

Preventieve strategieën, zoals oudertrainingen of voorlichting, kunnen voorkomen dat kinderen van angstige ouders zelf ernstige angsten ontwikkelen. Deze trainingen zouden zich kunnen richten op het verminderen van angstige reacties van ouders. Dit kan vooral nuttig zijn voor ouders van baby's die van nature een angstiger temperament hebben, aangezien deze baby's waarschijnlijk gevoeliger zijn voor angstige reacties van ouders. Bij oudere kinderen speelt angstoverdracht via zowel verbale als non-verbale reacties van ouders een belangrijke rol. Ouders kunnen angst bij hun kinderen verminderen door in onzekere situaties zelfverzekerd en positief te reageren. Recent onderzoek heeft aangetoond dat positieve voorbeelden van ouders, maar ook van onderzoekers of andere kinderen de angst van kinderen voor nieuwe situaties kunnen verminderen. Om beter te begrijpen welke steunende uitspraken of gedragingen van ouders kunnen helpen om angst bij kinderen te verminderen (en mogelijk in interventies kunnen worden gebruikt), kunnen toekomstige kwalitatieve studies kinderen vragen wat hen in het verleden heeft geholpen om hun angsten te overwinnen en welke uitspraken van hun ouders zij bemoedigend vonden.

English Summary

English Summary

Transmission of Fear from Parents to Children via Social Fear Learning Pathways

Children are exposed to new situations, objects, and people on a daily basis. One way for children to determine whether a situation or novel stimulus is safe or threatening and to avoid potential danger is by learning from their parent's reactions. This process, where children learn to be fearful of a novel stimulus from their parents' responses, is known as social fear learning. Social fear learning can occur via two pathways: by observing parents' behavior (also known as the modeling pathway or vicarious learning) and through verbal threat information from parents (also known as the instructional pathway). In infancy, modeling is particularly relevant because communication primarily occurs through facial expressions, gestures, and body language. As children develop more language skills, they become more receptive to verbal cues from parents, which can lead to the development of fear based on the verbal information provided by parents. Research shows that both non-verbal and verbal fear expressions from parents can influence how children respond to new stimuli. However, many aspects of when and how parents can pass on their fears during parent-child interactions remain to be elucidated.

The goal of this dissertation was to investigate the transmission of fear from parent to child via two social fear-learning pathways: (1) modeling and (2) the instructional pathway. Additionally, it explores how other factors, such as the child's temperament and parental anxiety, might strengthen fear transmission through these social learning pathways.

Results

In **Chapter 2,** the transmission of fear via modeling in infancy (0 to 30 months) was examined using a systematic literature review and meta-analysis. Parents displaying fearful responses to new stimuli had a small to moderate effect on children's fear and avoidance of these new stimuli. Children with a fearful temperament were more likely to avoid new stimuli, although this effect was only significant when findings from both experimental and correlational studies were included.

Chapter 3 explored the transmission of fear via the instructional pathway in childhood and adolescence (2.5 to 18 years) via a systematic literature review and meta-analysis. Results suggest that verbal threat information from parents significantly affected children's fear acquisition of new stimuli, even after a single exposure. However, the anxiety dispositions of both parents and children, as well as the child's age, did not strengthen the acquisition of fear through parental verbal threat information.

Chapter 4 expanded on existing research by examining the fear transmission from parents to adolescents regarding social stimuli (e.g., an unknown person), during an interaction task. This experimental study focused on the instructional pathway and found that verbal information from parents about strangers influenced children's reported fear and perception of these strangers. However, children did not display increased fearful behavior, heart rate, or attention bias toward the stranger that was coupled with negative (vs positive) information from their parents. Children of parents with higher social anxiety or children with more fearful temperaments were not more influenced by parental negative verbal information than children of less anxious parents or children with less fearful temperaments.

Chapter 5 investigated the transmission of fear through the instructional route in the context of the COVID-19 pandemic. The COVID-19 virus represented a real-life threat, for children as well as their parents. In this correlational study, it was found that children of parents who were more scared of COVID-19 also reported stronger COVID-19-related fears themselves. Parents with more COVID-19-related fears shared more threatening or fear-inducing information about the virus. This information was associated with more COVID-19-related fear in their children, which partially explained the link between parents' and children's fear of COVID-19.

This dissertation demonstrates how fear related to new stimuli can be transmitted from parent to child via two social learning pathways—through modeling and instructional learning. Chapters 2, 3, 4, and 5 consistently show that the degree to which children exhibited fear and avoidance of these stimuli was related to both non-verbal and verbal expressions of fear from parents. The methods used to measure social fear learning and children's fear reactions in the meta-analyses (Chapters 2 and 3) varied, and these methodological choices are important to consider when interpreting the results. For example, effects were often found when studies assessed children's fear using self-report measures.

Child Temperament and Parental Fear Symptoms as Risk Factors

This dissertation also sheds light on the role of child temperament and parental anxiety as potential risk factors that could strengthen children's fear acquisition through these pathways. Across several chapters, no evidence was found for a moderating role of the child's temperament in fear acquisition following a single exposure to parental verbal threat information. The influence of the child's temperament on social fear learning might depend on the social fear learning pathway (e.g., modeling vs. verbal information) and the child's age. While we found no support for a role of temperament during childhood,

during infancy, children with fearful temperaments may be more sensitive to parental fear expressions than children without fearful temperaments. However, this effect was small. Rather than making children more susceptible to parental anxiety expressions, children with a fearful temperament might show heightened fearful responses to novel stimuli independent of parental expressions. In summary, temperament is a characteristic to consider when investigating child acquisition of fear via social fear learning pathways in infancy.

Moreover, we did not find support for the idea that children of parents with higher anxiety levels become more fearful after a single exposure to parental fearful expressions, than children of less anxious parents. In some cases (see Chapter 2), the influence of parental anxiety disorders or symptoms could not be adequately examined due to the limited number of studies on this topic. During infancy, fearful responses from parents do not immediately predict strong fear or avoidance in infants. However, these parental expressions predicted children's avoidance of that stimulus at a later time point. This suggests that in families with anxious parents, social fear learning is not necessarily stronger, but that repeated transfer of threat information over time may contribute to the transmission of fear within families. Hence, parental (trait) anxiety is not a risk factor for enhanced social fear learning, but maybe (over time) it strengthens children's tendency to avoid novel social stimuli or situations in general. Further research is needed to better understand the mechanisms through which parental anxiety contributes to the transmission of fear from parent to child.

Clinical Implications and Conclusion

The studies in this dissertation demonstrate that fearful responses from parents contribute to children's fear acquisition regarding new stimuli or situations. Learning to be fearful of something novel from parents' reactions can be adaptive in threatening situations. However, it can be maladaptive if children learn from their parents to be scared of a novel stimulus that is not posing a threat. Displaying fearful reactions or verbally communicating about fear or threat towards non-threatening novel stimuli can occur more often in families where parents have anxiety disorders. Nevertheless, the social fear learning pathways seem to work similarly for children of parents with more anxiety symptoms and children with a fearful temperament. Only infants with a fearful temperament seem to become more fearful of new stimuli after observing their parents' fearful reactions, compared to infants with less fearful temperaments.

To prevent children of anxious parents from developing strong fears themselves, preventive strategies could be implemented, such as education or training for parents to reduce children's exposure to fearful reactions. This could be especially useful for parents of infants who have a naturally more fearful temperament, as these infants are likely to be more sensitive to parental fearful reactions. Since older children can acquire fear through both verbal and non-verbal parental reactions, it may help if parents display positive and confident reactions in ambiguous situations, while also conveying less fear-inducing messages verbally. Recent research suggests that positive or confident responses from parents, as well as from researchers or other children, can reduce and prevent children's fear of new situations. To better understand which supportive statements or behaviors from parents can help reduce children's fear (and potentially be used in interventions), future qualitative studies could ask children what has helped them face their fears in the past and which statements from their parents they found encouraging.

Publications

Publications

Published Refereed Journal Articles:

Nimphy, C.A., Elzinga, B.M., Van der Does, W., Van Bockstaele, B., Pérez- Edgar, K., Westenberg, M., & Aktar, E.(2024).“Nobody Here Likes Her”— The Impact of Parental Verbal Threat Information on Children’s Fear of Strangers. *Developmental Psychobiology*, 66(6), e22526. https://doi.org/10.1002/dev.22526

Nimphy, C.A., Mitrou, V., Elzinga, B.M., Van der Does, W., Aktar, E.(2024). The Role of Parental Verbal Threat Information in Children’s Fear Acquisition: A Systematic Review and Meta-analysis. *Clinical Child Family Psychology Review*, 1-18. https://doi.org/10.1007/s10567-024-00485-4

Nimphy, C.A., Kullberg, M.-L.J., Pittner, K., Buisman, R., van den Berg, L., Alink, L., Bakermans- Kranenburg, M., Elzinga, B.M., &Tollenaar, M.(2024). The Role of Psychopathology and Emotion Regulation in the Intergenerational Transmission of Childhood Abuse: A Family Study. *Child Maltreatment*, 0(0). https://doi.org/10.1177/10775595231223657

Nimphy, C.A., Venetikidi, M., Elzinga, B.M., Van der Does, W., Aktar, E. (2023), Parent to Offspring Fear Transmission via Modeling in Early Life: A Systematic Reviewand Meta- Analysis. *Clinical Child and Family Psychology Review*,26(3),751-772. https://doi.org/10.1007/s10567-023-00448-1

Nimphy, C.A., Elzinga, B.M., Van der Does, W., & Aktar, E.(2023). “Covid- 19 is dangerous”: The role of parental verbal threat informationon children’s fear of Covid-19. *Journal of Adolescence*, 95(1), 147-156. https://doi.org/10.1002/jad.12105

Tollenaar, M.M., Pittner, K.K., Buisman, R.R., Knipping, K.K., Garssen, J.J., van den Berg, L.L., **Nimphy**, C.A., ... & Bakermans-Kranenburg, M.M. (2022). Salivary immune markers are not associated with self-reported childhood maltreatment or psychopathology in adults. *Psychoneuroendocrinology*, 144,105867. https://doi.org/10.1016/j.psyneuen.2022.105867

Aktar, E., **Nimphy**, C.A., Van Bockstaele, B., & Pérez-Edgar, K.(2022). The social learning of threat and safety in the family: Parent-to-child transmission of social fears via verbal information. *Developmental Psychobiology*, 64(3), e22257. https://doi.org/10.1002/dev.22257

Aktar, E., **Nimphy**, C.A., Kret, M.E., Pérez-Edgar, K., Raijmakers, M.E., & Bögels, S.M.(2022). Attention biases to threat in infants and parents: Links to parental and infant anxiety dispositions. *Research on Child and Adolescent Psychopathology*,1-16.https://doi.org/10.1007/s10802-021- 00848-3

Aktar, E., **Nimphy**, C.A., Kret, M.E., Pérez-Edgar, K., Bögels, S.M., & Raijmakers, M.E.(2021). Pupil responses to dynamic negative facial expressions of emotion in infants and parents. *Developmental Psychobiology*, 63(7), e22190. https://doi.org/10.1002/dev.22190

In Revision Journal Articles

Bockstaele, B., **Nimphy**, C.A., Aktar.E., (in revision). Intergenerational Convergence of Emotion Regulation Strategies and Anxiety. *Journal of Child and Family Studies*.

Curriculum Vitae

About the Author (Curriculum vitae)

Cosima Anna Nimphy was born on the 31st of July 1995 in Hamburg. She completed her primary school education in Vienna and moved back to Hamburg for her secondary school education. During her secondary education at Gymnasium Lerchenfeld she went one year abroad to Ireland, and then graduated in 2013 in Hamburg. During her gap year, she worked as a volunteer in a primary school, accompanying children with learning difficulties and autism in their daily tasks at school. In 2014, she moved to Leiden to start with the international Bachelor of Psychology (IBP) program at Leiden University. She obtained her Bachelor's degree (cum laude) in 2017 and began her 2-year Research Master's in Clinical and Health Psychology at Leiden University. She received her Master's degree (cum laude) in 2019.

In September 2019, Cosima started as a PhD candidate on Evin Aktar's Veni grant, with Prof. Bernet Elzinga and Prof. Willem van Der Does as promotors. During her PhD, she investigated parent-child interactions to gain new insights on intergenerational transmission of anxiety (disorder). She conducted her research at the institute of Psychology, specifically the department of Clinical Psychology.

Cosima received training from the Dutch-Flemish Postgraduate School for Experimental Psychopathology (EPP) and the Graduate School of Social and Behavioural Sciences of Leiden University. During her PhD, Cosima supervised multiple master thesis students and taught several Bachelor's and Master's courses (including the courses Clinical Psychology and Experimental Clinical Psychology).

In January 2024, Cosima started working as an Assistant Professor at Leiden University in the Department of Clinical Psychology.

Acknowledgements

Acknowledgements

First and foremost, I would like to thank **Evin** for supervising me and letting me be part of her Veni project. Evin, your sheer passion for research is inspiring and infectious. You continuously encouraged and challenged me to get out of my comfort zone and to become more assertive. Over the past five years, I have learned invaluable lessons during all of our multiple-hour zoom calls during the pandemic, coffee-fuelled meetings, and countless hours in the lab. Thank you for all your guidance!

Bernet. Throughout the past seven years, I have had the opportunity to learn from your insightful questions, feedback, warmth, and leadership style. You have been my internship supervisor, hired me as a research assistant, been part of my master's thesis supervisory team, and been my PhD promotor. Because of you, I already learned during my Re-Pair time that my thoughts and input matter and are valued. It sparked my love for collaboration. Thank you for all your support throughout my PhD journey!

Willem. I am very happy you have been part of the supervision team. Your insights consistently sparked fruitful discussions. I also learned a lot from your expertise and writing skills, especially how to kill many darlings (or how to cut an introduction in half). Thank you for all your insights!

***

Liia & Marike. Colleagues. Friends. Paranymphs. I couldn't have been luckier to have shared office 2b23 and this rollercoaster of a PhD with you. Without you, I know this dissertation would not have been possible. I cried tears laughing with you in the office, went on trips around the world (from Alkmaar to Mexico), and shared every possible up and down. Forever grateful for your friendship.

Re-Pair Team:

Loes, **Mirjam**, **Lisanne**. My favorite internship supervisors. I wouldn't have wanted to spend 9-hour research days with anyone else. I learned so many lessons during my time as an intern and research assistant, especially how fun it is to work in a team.
Wilma: Countless walking breaks, fun and active writing retreats, spinning, playing heads-up, and many exciting collaborations!

Loes & Marie-Louise. From all those Douwe Egberts coffee breaks in the Re-Pair office, a Spain trip, to doing a triathlon together, you showed me how to get the balance into work-life balance.

Gita, **Myrthe**, **Inga-Marie**. Whether we are in Leiden, Hillegom, Bali, or Germany (in the future), I hope we can continue our lovely dinner tradition.

I want to name the entire **Clinical Psychology department** by name because there are so many people who have shaped me not only during my PhD but also as a Bachelor's and Master's student. So many of you have inspired me by being my teacher or collaborator. A special thank you to Marieke Tollenaar (master thesis supervisor) and Peter Putman (my ECP teacher) who inspired me to think a PhD would be something I could enjoy since I really had fun working on my thesis topic and learned (to my surprise) that I was very passionate about research designs.

***

Ricky. Auch wenn du meine kleine Schwester bist, hast du mir immer gezeigt wo es lang geht. Ich weiß früher hättest du lieber einen Nintendo gehabt als eine große Schwester, aber zum Glück hattest du keine Wahl. Ich bin so dankbar dich in meinem Leben zu haben.

Oma und Opa. Wer wir ihr über 65 Jahre glücklich verheiratet ist, und sich seit über 70 Jahre verliebt in die Augen schaut, der hat im Leben gewonnen. Unsere Gespräche - ob in Person oder am Telefon - bedeuten mir unendlich viel.

Evander. PhD by proxy. You inspire me every day. And since I live with you, by frequency, I guess you are the biggest inspiration of my life ;) Excited for our future.

Lara. Du bist meine beste Freundin für mehr als mein halbes Leben. So viele Meilensteine und Höhen und Tiefen habe ich mir dir durchlebt. Egal wo du und ich leben - ich kann dich immer um Rat fragen. Du bist für mich Familie.

Sophia. Von Mitbewohnerin zu einer der wichtigsten Personen in meinem Leben. Leiden und ich haben immer ein Platz für dich.

Puck. Let's be honest, without you I would have not even made it through my Master. Your support and friendship mean a great deal to me.

Marianna, **Sinead**, **Louise**. Without you guys, I would have never fallen in love with Leiden. You made my Bachelor experience full of happiness, travels, and adventures.

***

Mami und **Papi**. Diese Doktorarbeit widme ich euch. Led by Example: Niemand hat mich so beeinflusst und zu dem gemacht wer ich bin wie ihr. Wer euch als Eltern hat, braucht vor nichts Angst zu haben. Ihr gebt mir den Mut und die Zuversicht, dass ich alles kann aber nichts muss. Ich liebe euch von ganzem Herzen.