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RESEARCH ARTICLE

Paternal expressed emotion influences psychobiological indicators of threat and safety learning in daughters: A preliminary study

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This preliminary study examined the association of children's anxiety, paternal expressed emotion (EE), and their interaction with psychophysiological indices of children's threat and safety learning. Participants included 24 father–daughter dyads. Daughters (ages 8–13 years, 100% Latina) self-reported their anxiety levels and completed a differential threat conditioning and extinction paradigm, during which psychophysiological responding was collected. Fathers completed a *Five-Minute Speech Sample*, from which paternal EE (i.e., criticism, emotional overinvolvement) was assessed. Anxiety-dependent associations emerged between paternal EE and individual differences in daughters' psychophysiological responding to safety signals during threat conditioning. Paternal EE was positively associated with psychophysiological responding to safety in daughters with high and mean, but not low, levels of anxiety. Although previous work suggests that chronic harsh maternal parenting is a potential risk factor for children's general threat and safety learning, these preliminary findings implicate milder forms of negative parenting behavior in fathers, particularly for highly anxious children.

KEYWORDS
daughters, expressed emotion, fathers, psychophysiology, threat learning

1 | INTODUCTION

Threat learning promotes the ability to distinguish safety from danger, which is vital for survival (Maren, 2001); disruptions in this ability are diversely linked with psychopathology (Gao et al., 2010a; Grillon & Morgan, 1999; Pliszka et al., 1993; Waters et al., 2009). Current developmental models of threat learning posit that dispositional traits such as anxiety (Hur et al., 2019; though see Torrents-Rodas et al., 2013) and adverse childhood experiences such as chronic harsh parenting (Boulanger-Bertolus et al., 2017; Kosten et al., 2006; La Buissonnière-Ariza et al., 2019; Machlin et al, 2019; Roth & Sullivan, 2005; Zoicas & Neumann, 2016) affect children's learning processes. However, it is unclear whether other, less severe, forms of negative parental behavior might also be associated with alterations in children's threat learning. Fathers in particular have been neglected in investigations of the proximal influences on children's threat learning and associated psychopathology (Bögels & Phares, 2008). To address this significant gap directly, this preliminary study focused on the association of child anxiety, paternal expressed emotion (EE) (i.e., criticism, emotional overinvolvement [EOI]), and their interaction with respect to psychophysiological indices of children's threat learning.

1.1 | Threat conditioning

Neurocircuitry has evolved to enable rapid learning of threat associations following encounters with danger (LeDoux, 2014). Through threat conditioning, a neutral stimulus (i.e., conditioned stimulus [CS+])

acquires the capacity to elicit fear responses in anticipation of danger after being paired with an intrinsically aversive event (i.e., unconditioned stimulus [US]) (Fanselow, 2018; Pavlov, 1927). Threat conditioning facilitates early detection of potential danger (Beckers et al., 2013) and promotes defensive responding (Fanselow, 2018). Through extinction, such conditioned anticipatory responding is attenuated if the stimulus no longer predicts the occurrence of threat (Milad & Quirk, 2012). In some experimental paradigms, a second, nonreinforced conditioned stimulus (CS−), never paired with the US, serves as a learned safety signal (Glenn et al., 2020; Michalska et al., 2016, 2019; Rogan et al., 2005). Safety signal learning enables inhibition of threat responding in the presence of a safety cue. An individuals' learning can be measured in various ways, including their subjective perceptions of fear of the CS+, CS−, and US, as well as peripheral indices of arousal including skin conductance response (SCR). The current study focused primarily on SCR, given its conceptualization as a less controllable expression of fear. Even though some work suggests psychophysiological indices of threat learning can be sensitive to cognitive influences (Lovibond, 2003; Soeter & Kindt, 2010), they are generally understood as less sensitive when compared to subjective fear ratings (Beckers et al., 2013).

1.2 | Associations between anxiety and threat conditioning

Alterations in threat and safety learning are a prominent feature of anxiety disorders (Mineka & Zinbarg, 2006), although the overwhelming majority of work on these types of learning in humans has not included Latinos and other people of color (see Martínez et al., 2014 for a notable exception), limiting inferences about generalizability. Although evidence from studies of primarily European American samples suggesting that anxious youth discriminate between threat and safety cues differently than nonanxious youth during threat conditioning remains inconclusive (see Dvir et al., 2019 for a meta-analysis), mounting research nonetheless suggests that anxious youth exhibit global alterations in threat and extinction learning. For example, relative to typically developing youth, anxious youth display increased self-reported fear (Lau et al., 2008) and SCR (Abend et al., 2020; Craske et al., 2008) to both threat and safety cues during threat conditioning and are, likewise, more resistant to threat extinction (Dvir et al., 2019). Further, recent work indicates the most significant differentiator between anxious and nonanxious samples lies in grand averaged SCR during threat conditioning (Abend et al., 2020). Yet other research indicates that when compared to healthy controls, anxious patients demonstrate larger levels of fear responses to the CS+ (Lissek et al., 2005) and CS− (Duits et al., 2015), separately. More broadly, anxious individuals also show greater psychophysiological responding across several threat-anticipatory states (e.g., Grupe & Nitschke, 2013). The current study extends this work by focusing on a sample of Latina girls, an understudied group exhibiting higher levels of untreated anxiety compared to other ethnic groups (Anderson & Mayes, 2010; McLaughlin et al., 2007; Pina & Silverman, 2004). Because anxiety in childhood is associated with an increased risk for psychopathological sequelae later in development (Pine et al., 1998), identifying factors that moderate individual-level risk for alterations in threat learning may inform prevention efforts targeting long-term mental health outcomes in underrepresented youth.

1.3 | Parenting influences on threat and safety learning

Beyond anxiety, children's threat learning is sensitive to early exposure to chronic harsh parenting. For example, childhood abuse has been associated with increased startle reactivity to both stimulus types during conditioning, whether threatening or safe (Jovanovic et al., 2009), whereas other work with similar paradigms has observed effects of childhood maltreatment specific to threat cues (Bilodeau-Houle et al., 2020; McLaughlin et al., 2016) and safety cues (Wolitzky-Taylor et al., 2014), separately. Relatedly, maltreatment contributes to elevated fear overgeneralization, the induction of fear by a variety of stimuli, including safety cues, that resemble but are not directly related to the originally threatening event (Haddad et al., 2012; Thome et al., 2018). That is, in addition to blunted SCR to threat cues during fear learning, maltreated children also fail to exhibit a distinct SCR to threat and safety cues, suggesting difficulty with threat–safety discrimination. Such overgeneralization is thought to be potentially adaptive for children raised in unsafe environments by facilitating rapid identification of potential threats (McLaughlin et al., 2016). Histories of harsh parenting have also been empirically linked with altered threat circuitry function in adolescents (La Buissonnière-Ariza et al., 2019). However, we know of no studies investigating less severe, yet more common, forms of negative parenting behaviors on children's threat circuitry.

Conversely, across species, maternal presence or sensory cues toward a mother can reduce fear and stress reactivity in offspring, in a process referred to as "maternal buffering" (Gee et al., 2014; Hostinar et al., 2014; Moriceau & Sullivan, 2006). In a study using fear potentiated startle, children exhibited an attenuated fear response to the safety signal (i.e., CS−) when their mother was available during threat conditioning and were unable to discriminate between danger and safety signals when their mother was not available (van Rooij et al., 2017). Of note, mere caregiver presence and positive caregiver behaviors are likely distinct in their influence on children's physiology and threat learning. Although this particular conditioning study on maternal presence and warmth on threat–safety discrimination observed no effect of maternal warmth on discrimination (van Rooij et al., 2017), other emerging research posits that positive maternal parenting behaviors may enhance the efficacy of maternal buffering on children's threat responsivity (Gee et al., 2014; Gunnar & Hostinar, 2015). Indeed, even though prominent theories (Sapolsky, 2009) and cross-species work (Hostinar et al., 2014; Kikusui et al., 2006; Moriceau & Sullivan, 2006) show that the simple presence of the mother can decrease fear in the offspring by reducing cortisol elevations to threatening stimuli, presence alone may not always be sufficient to attenuate threat responding. Specifically, caregiving behaviors such as maternal warmth are known to positively affect children's well-being

(McCabe et al., 1999) and may therefore act as a moderator of the potency of the maternal buffer under some circumstances. Likewise, secure attachment relationships with the parent who is present during a stressor have been shown to block increases in cortisol, particularly for temperamentally vulnerable children, whereas elevations were still observed for children who were insecurely attached to the parent (Gunnar et al., 1996). Given the mixed findings and overall nascent literature, characterizing various parenting behaviors that influence children's threat and safety learning will improve traction about putative mechanisms.

To date, only limited work has examined the contribution of paternal parenting to threat learning during childhood, even though mounting evidence demonstrates that fathers play a unique role in children's socioemotional development (Barker et al., 2017; Bögels & Phares, 2008; Paquette, 2004; Phares & Compas, 1992) with some theoretical models specifically positing children may be differentially influenced by information signaled by paternal versus maternal behavior with respect to potential external threats (Bögels & Perotti, 2011). More broadly, investigations of associations among dimensions of positive and negative parenting and children's emotional functioning have been dominated by a focus on mothers' behaviors and parenting styles. A growing number of scholars (e.g., Cabrera & Tamis-LeMonda, 2013; Cabrera et al., 2018) underscore that we know considerably less about fathers' parenting, and its impact on children's mental health outcomes. Of note, a recent study documented that children's anxiety sensitivity moderated the influence of father–child relationships on children's SCR during a form of indirect threat learning, or observational threat learning. Specifically, children with high anxiety sensitivity and less secure relationships with their fathers exhibited elevated SCR to vicariously experienced threat (Bilodeau-Houle et al., 2020). In the current investigation, two hypotheses with regard to paternal parenting were derived from the preceding studies. First, daughters exposed to a history of negative paternal parenting would display alterations in psychophysiological indices of threat and safety learning. Second, the association between exposure to negative paternal parenting and psychophysiological reactivity during threat and safety learning would be moderated by daughters' anxiety severity. This hypothesis is based on developmental psychopathology principles wherein developmental trajectories are sensitive to interactions between parenting behaviors and the child's individual characteristics (Cowan & Cowan, 2006; Lahey et al., 2012). Thus, children who were most likely to display alterations in threat and safety learning based on their high anxiety would be most affected by negative paternal parenting.

Parental EE is an aspect of family functioning defined by attitudes of high criticism and EOI in the caregivers of a child and has been conceptualized as a form of toxic family stress (Peris & Miklowitz, 2015). Conventionally, EE is assessed with the Camberwell Family Interview, a semi-structured interview conducted with a child's close relatives (Hooley & Parker, 2006). However, administration and scoring of this assessment are time-consuming and labor-intensive. A reliable alternative to assessing EE is via a *Five-Minute Speech Sample* (FMSS), during which a family member describes their thoughts and feelings about the identified child for five uninterrupted minutes (Brown et al., 1972; Magaña et al., 1986; Sandoval et al., 2019). Although brief, utilization of the FMSS to assess EE has proven highly effective in indexing the quality of caregiver–relative relationships, assessing caregiver behaviors with respect to the relative, and predicting family outcomes, including the recurrence of psychopathology in youth (Magaña et al., 1986; Yan et al., 2004). The speech is recorded and later coded for the two primary components of EE, criticism and EOI. Criticism captures blame, dislike, or resentment that parents may feel toward an ill offspring and EOI reflects attitudes of overprotectiveness, marked over concern, inordinately self-sacrificing behaviors, or exaggerated emotional responses regarding the child (Peris & Miklowitz, 2015). High parental EE has been identified as a risk factor for a variety of maladaptive outcomes in children, including behavioral inhibition (Hirshfeld et al., 1997), poorer patient clinical outcomes (Peris et al., 2013), diminished treatment response (Przeworski et al., 2012), and higher rates of relapse across a broad range of psychiatric disorders, including anxiety (Peris & Miklowitz, 2015). Whether parental EE impacts children's threat and safety learning is unknown, and research on paternal EE, specifically, has been limited.

Beyond main effects of EE and anxiety on child psychophysiological responding to threat, and consistent with growing evidence for Person × Environment interactions (Bilodeau-Houle et al., 2020; Gilissen et al., 2007; La Buissonnière-Ariza et al., 2019), EE and anxiety may exacerbate or attenuate the effects of one another. One possibility is that parents' attempts to socialize high anxious children through EE may be especially counterproductive because of these children's potential overarousal in the face of stressful circumstances. Frequent exposure to high EE may be harmful insofar as it could lower the threshold for triggering threat responses among anxious children (Peris & Miklowitz, 2015). Furthermore, overaroused (i.e., more anxious or more fearful) children may be more likely to respond to harsh discipline with increased reactivity and thereby trigger contentious parent–child interactions.

1.4 | Study overview

To estimate independent and interactive associations of child anxiety and paternal parenting with psychophysiological indices of children's threat and safety learning, the current preliminary study examined child-reported anxiety and paternal EE during an audiotaped speech sample, in conjunction with children's SCR data recorded during a well-validated threat learning paradigm (Britton et al., 2013; Lau et al., 2011; Michalska et al., 2017). Given potential differential effects of anxiety and parenting on children's responsivity to any cue, as well as to threat and safety cues separately, we examined three outcomes of interest: SCR to both CS types across all task phases, SCR to the CS+ during the acquisition phase, and SCR to the CS− during the acquisition phase. We tested three hypotheses. First, child anxiety would be positively associated with SCR to both threat and safety cues during threat conditioning. Second, paternal EE would be associated with alterations in child SCR to threat and safety cues. Specifically, we expected paternal EE to be positively associated with SCR to safety

cues. We hypothesized no particular direction of effects with regard to SCR to threat cues, given work that has linked harsh parenting to both elevated (Bilodeau-Houle et al., 2020) and blunted (McLaughlin et al., 2016) responding to threat. Third, child anxiety and paternal EE would interact in their association with daughters' SCR to threat and safety cues, such that the observed effect of paternal EE would be strongest for highly anxious youth. We complement and extend prior work in several ways. First, we study a sample of Latino families with daughters ages 8–13 years. This sample is primarily of Mexican origin by self-identification and youth fall on a range of anxiety symptoms, which increases generalizability of prior studies in primarily European American samples. Second, previous work has examined the effects of harsh parenting on children's sensitivity to threat cues, which may elicit greater variation in threat neurocircuitry and subsequent learned threat responding. Here, we focus instead on less severe forms of negative parenting behavior that may be more frequent in the lives of children. Third, we use parenting data from fathers, enabling preliminary inferences about the role of fathers in daughters' psychophysiological responding during threat conditioning.

2 | METHODS

2.1 | Participants

Participants included 33 Latina girls (M_{Age} = 9.94, SD = 1.42, range = 8–13 years) and their fathers (97.0% biological, 3.0% adoptive), residing largely in the Inland Empire Region of Southern California. Of these 33 dyads, seven were missing physiological data as a result of technical difficulties (N = 1) or task abortion (N = 6), one was missing speech sample data as a result of paternal refusal to participate, and one was missing anxiety data as a result of a procedural error. A series of independent samples t-tests run in SPSS 27 (SPSS Inc, Chicago, IL) indicated participants with complete data did not differ from participants with incomplete data as to annual household income ($t(30) = 0.98$, $p = .206$), child age ($t(31) = 0.43$, $p = .444$), child pubertal status ($t(28) = 0.43$, $p = .278$), paternal EE ($t(30) = 0.08$, $p = .462$), child trait anxiety ($t(30) = 1.67$, $p = .577$), child anxiety symptoms ($t(30) = -1.04$, $p = .861$), overall psychophysiological responding ($t(24) = -3.70$, $p = .187$), psychophysiological responding to threat ($t(24) = -5.74$, $p = .197$), and psychophysiological responding to safety ($t(24) = -3.29$, $p = .293$). Analyses utilized only participants with complete data for all study variables. As such, the final sample included 24 Latina girls (M_{Age} = 9.82, SD = 1.22, range = 8–12 years) and their fathers (95.8% biological, 4.2% adoptive).

Father–daughter dyads were recruited to participate in two ongoing longitudinal studies of youth emotional development. Participants were recruited via fliers in outpatient mental health clinics and local hospitals, community centers, and a university psychology department's shared database of community-based child participants. Participant eligibility was determined by phone screening with a parent. Children were eligible for participation if they were fluent in English, age 8–13 years, self-identified as Latina, were premenstrual, had no contraindications for neuroimaging (as part of a neuroimaging component not reported here), and did not meet any exclusionary criteria. Due to a recruitment error, one participant was postmenstrual at study entry. Exclusionary criteria for children were an IQ below 70; current psychiatric diagnosis of Tourette's syndrome or obsessive–compulsive disorder; suicidal ideation; lifetime history of mania, psychosis, or pervasive developmental disorder; and active medical problems. Current psychopathology was assessed via an intake screener. On average, families had household incomes below the median annual household income in the United States ($68,703; U.S. Census Bureau, 2019).

2.2 | Procedures

Data for the present analyses were collected at participants' first laboratory assessment. Upon participant arrival, written parent consent and child assent were obtained. If the child's father was not the caregiver present at the laboratory visit, permission to contact him via phone was obtained. During the laboratory session, children completed a battery of self-report questionnaires assessing demographics, behavior, anxiety, and other mental health outcome measures not reported here. They also completed a differential threat conditioning and extinction paradigm, during which psychophysiological responding was assessed. Fathers completed an FMSS, and those who were not present at this visit (N = 18) completed the speech sample by phone. At the end of the laboratory session, participants were compensated with a gift card and a small prize. Fathers who completed their participation over the phone were compensated separately with a gift card, which was mailed to them. The Institutional Review Board approved all study procedures.

2.3 | Measures

2.3.1 | Child anxiety symptoms

Daughters self-reported their trait anxiety using the *State Trait Anxiety Inventory* (STAI; Spielberger et al., 1983). The STAI consists of 20 statements (e.g., I am secretly afraid, I worry about things that may happen, etc.) for which children indicated on a 3-point Likert scale (1 = *Hardly ever* to 3 = *Often*) the extent to which each was true for them. Items were summed to assess overall levels of children's trait anxiety. Daughters also completed the 41-item *Screen for Child Anxiety Related Disorders* (SCARED; Birmaher et al., 1999) to provide continuous measures of anxiety disorder symptoms across five domains: panic/somatic, generalized anxiety, separation anxiety, social phobia, and school phobia. For each item, children indicated on a 3-point Likert scale (0 = *Not true or hardly ever true* to 2 = *Very true or often true*) the extent to which each was true for them. Responses were summed across all items, as well as within each subdomain. On average, daughters' total SCARED scores (M = 38.03, SD = 14.26) met diagnostic criteria for anxiety disorder (Birmaher et al., 1999). Although scores of this

magnitude are unexpected in a primarily community-based sample of participants, this is consistent with a growing body of research showing heightened levels of untreated anxiety in Latina youth (Anderson & Mayes, 2010; McLaughlin et al., 2007; Pina & Silverman, 2004). Both the STAI and SCARED demonstrated strong reliability in our sample with Cronbach's αs of .85 and .91, respectively (SPSS 27).

2.3.2 | Expressed emotion

Fathers' EE was assessed using FMSS, a brief instrument used to measure an individual's feelings about a family member and their perception of the quality of their relationship (Magaña et al., 1986). Fathers were asked to speak, with no interruptions, for 5 min about what type of person their daughter is, their relationship with their daughter, and how they get along together. Responses were recorded, audiotaped, and coded by five trained raters to evaluate the content and tone of their speech sample. We adapted the coding procedure used in several recently published papers (Moroney et al., 2017; Peris & Hinshaw, 2003). The two dimensions of EE, criticism and EOI, were assessed separately and coded ordinally (low, borderline, high; 0–2). Fathers were coded high for the criticism dimension if any of the following were present: a negative initial statement expressed by the father, a negative parent–child relationship described at any point throughout the speech sample, or one or more critical comments about their child (Kovac, 2018). Critical statements had to be severe in content and tone (e.g., "she drives me crazy"), and fathers who expressed only mild statements of frustration or dissatisfaction (e.g., "I'd rather she was not like that") were coded as "borderline." Any statements that were purely descriptive with no evaluative judgement attached (e.g., "my daughter gets bored at school") were not coded as criticism. EOI was scored as present or absent on the basis of the following: self-sacrificing behavior (e.g., "I don't spend much money on things for myself so that I can give it to my daughter"), overprotective behavior (e.g., "I take her with me everywhere I go, so she won't be home alone"), extreme emotional displays during the recording (e.g., crying), extreme statements of positive attitude, excessive detail or irrelevant information about the past, and excessive praise. Fathers were rated as high in EOI if they displayed at least two of these behaviors or attitudes during the sample and were coded as "borderline" for EOI if they displayed only one of these behaviors or attitudes during the speech sample. Speech samples that did not indicate criticism or EOI were assigned low EE scores. The second author (EZ) trained the first author (JM) and three undergraduate research assistants in coding the FMSS via weekly meetings until all coders met at least 80% agreement. Coders met weekly as a team to resolve discrepancies. To assess the interrater reliability, an intraclass correlation coefficient (ICC) was calculated on the basis of five randomly selected participants (SPSS 27). A two-way mixed-effects model based on average rating and absolute agreement indicated interrater reliability was strong at an ICC of .88 for EE. For speech samples for which there was more than one coder, ratings were averaged across those coders.

2.3.3 | Threat and safety learning

To assess threat and safety learning, daughters completed a differential threat conditioning and extinction paradigm (Figure 1) validated in pediatric populations (Britton et al., 2013; Lau et al., 2011; Michalska et al., 2017).

Task instructions

While parent participants sat in a separate waiting area, daughter participants were accompanied by a researcher into a dark room illuminated by a single night light. Daughters were asked to sit at a computer and place a pair of headphones over their ears. They were told a series of pictures would appear on the screen and at times they would see a mildly unpleasant face and hear a mildly unpleasant sound. Prior to the start of the paradigm, daughters were reassured that nothing in the study would hurt them in any way and that the researcher would be present in the room for the duration of the task.

Task description

The paradigm consisted of a preacquisition phase, an acquisition phase, and an extinction phase. In each phase, a series of approximately 4- × 6-inch photos were presented on screen. During preacquisition, which consisted of eight trials, children passively viewed neutral faces of two women, the conditioned stimulus (CS), in the absence of the unconditioned stimulus (US). During acquisition, which consisted of 20 trials, one woman, the CS+, predicted the US, a 1-s image of a fearful face paired with a loud, aversive 95 dB scream, whereas the other woman, the CS−, did not. The two faces were counterbalanced for CS+ and CS− assignment. The CS+ was followed by the US with an 80% reinforcement schedule. During these paired trials, the CS+ was presented first, then disappeared and was replaced by the US, which co-terminated with the scream. Participants were told they could learn to predict when the US would occur but were not informed of the CS/US contingency. During extinction, which consisted of 16 trials, the CS+ and CS− were presented repeatedly in the absence of the US. Throughout all three phases, the CS+ and CS− were presented for 7–8 s (7 s when paired with the US, 8 s when unpaired), followed by an interstimulus interval of a blank gray screen for 8–21 s ($M = 15$ s). The task was presented using E-prime version 2.0.10 and was approximately 30 min in length.

2.3.4 | Skin conductance response

SCR indexed daughters' psychophysiological responding to conditioned and unconditioned threat cues across the three phases of the threat conditioning task. SCR was recorded from two Ag/AgCl electrodes from the middle and ring finger of the nondominant hand, using a BioPac MP160 system (EDA100C; Biopac Systems, Goleta, CA). Together, with AcqKnowledge 4.3 (Biopac) software, skin conductance was sampled continuously at 2000 Hz. SCR amplitude to each CS+ and CS− was determined by the difference between baseline activity

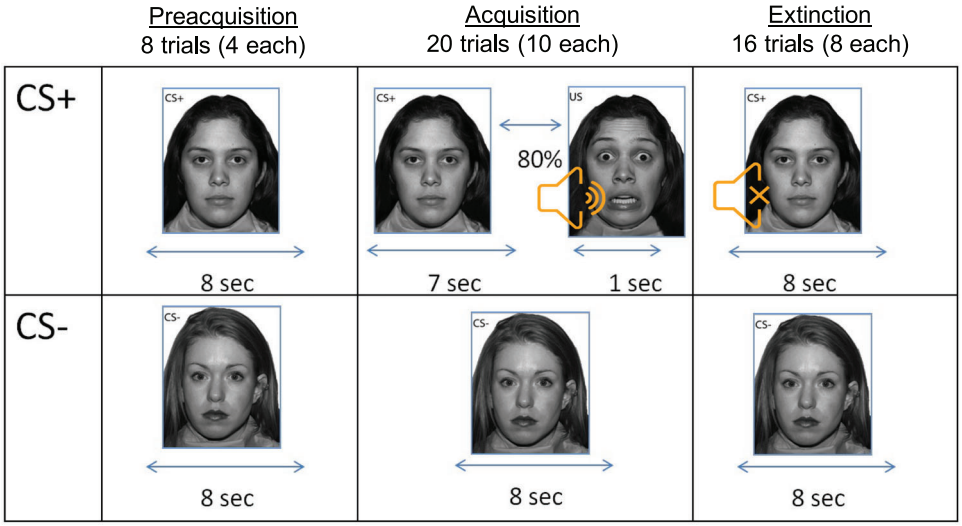

FIGURE 1 During the preacquisition phase of conditioning, children passively viewed neutral faces of two women, the conditioned stimulus (CS), in the absence of the unconditioned stimulus (US). During the acquisition phase, one woman, the CS+, predicted the US, a 1-s image of a fearful face paired with a scream, whereas the other woman, the CS−, did not. During the extinction phase, the CS+ and CS− were presented repeatedly in the absence of the US

(minimum amplitude within 0–1 s prior to stimulus onset) to peak activity (maximum amplitude within 1–5 s following stimulus onset). Raw values for each trial were normalized to that trial's baseline value and expressed as a percent change with the following equation: SCR = % Signal Change from Baseline = [(Maximum Amplitude − Minimum Amplitude) / Minimum Amplitude] * 100 (Balderston & Helmstetter, 2010). Typically, any negative SCR values are coded as missing, but this was not needed in the current sample (all raw SCR values > 0). In line with previous work (Michalska et al., 2017), outliers were determined by computing the global SCR average across all trials for each participant. Individual trials that were ±2 *SD* of the global average were considered artifacts and replaced with that participant's global average. Data from subjects who had >20% outlier trials or missing data were excluded from analyses (Boucsein, 2012). Percent signal change values were averaged within stimulus types and phases to assess SCR to the CS+ (whether paired or unpaired) and CS− during preacquisition, acquisition, and extinction. SCR to the US was not accounted for in the current analyses.

2.3.5 | Subjective fear ratings

For each of the three threat conditioning phases, participants also rated the CS+ and CS− on several dimensions using a 10-point Likert scale. Specifically, prior to preacquisition, participants were shown a picture of each CS and asked to rate how anxious they were when they viewed each CS (1 = *Not at all anxious* to 10 = *Extremely anxious*), how much they liked each CS (1 = *Do not like* to 10 = *Like a whole lot*), and how unpleasant each CS was (1 = *Not unpleasant* to 10 = *Extremely unpleasant*). The preacquisition phase was followed immediately by the acquisition phase, after which participants completed these questions a second time. Then, the extinction phase began at the end of which participants completed these questions a third and final time. Following reverse coding of the likeability item, responses were averaged to assess subjective fear ratings of the CS+ and CS− during each phase of conditioning.

2.3.6 | Additional covariates

Child puberty was assessed via *Tanner Staging*, a set of standardized pictures depicting the five stages of pubertal development (Emmanuel & Bokor, 2019). Daughters and one parent (23.8% fathers, 76.2% mothers) indicated on a 5-point Likert scale (1 = *Prepubertal Stage 1* to 5 = *Postpubertal Stage 5*) the extent of the child's breast growth and presence of pubic hair. Responses were averaged for each informant across the two domains. Because *Tanner Staging* was not administered to children until about halfway through data collection, a significant portion of the current sample (38%) was missing child self-reported puberty. Parent and child reports were highly correlated (r = .731, p = .005) and a paired-samples t-test indicated no significant difference between them ($t(12)$ = 0.610, p = .553) (SPSS 27). As such, parent reports were utilized wherever available, and child reports were utilized only in cases where the parent report was unavailable (N = 2). One participant did not have pubertal status reports from either informant. A one-way analysis of variance (ANOVA; SPSS 27) indicated pubertal status did not differ with regard to informant (i.e., father, mother, child) ($F(2, 22)$ = 0.310, p = .737). Previous work identifies both child age (Abend et al., 2020; Gao et al., 2010b) and hormonal fluctuations (Pattwell et al., 2013; Stenson et al., 2020), which correlate highly with participant reports of pubertal status (Shirtcliff et al., 2009), as important predictors of threat learning. As such, both child age and pubertal status were included as covariates in all regression analyses.

2.4 | Data analysis

First, SCR data were submitted to a repeated-measures ANOVA (SPSS 27), with phase (preacquisition, acquisition, and extinction) and CS type (CS+, CS−) as within-subject factors. This ANOVA revealed no significant phase by CS type interaction. Visual examination of SCR patterns suggested relatively rapid habituation to the CS+, so following prior established approaches (LaBar et al., 1998; Raio et al., 2012), a second ANOVA tested a phase × CS type interaction with all trials of the preacquisition phase, but only the early trials of the acquisition (the first five of 10 trials) and extinction (the first four of eight trials) phases. Although the primary outcome of interest was SCR, to demonstrate the efficacy of the threat conditioning paradigm on the basis of participants' self-reports, subjective fear ratings were also submitted to a repeated-measures ANOVA, with phase and CS type as within-subject factors. In cases where the assumption of sphericity was violated, Huynh Feldt corrections were applied. For significant interactions resulting from the ANOVA, post hoc *t*-tests were performed for the CS+ and the CS− within each phase. For all analyses, statistical significance was set to $\alpha = .05$.

On the basis of prior work showing anxiety group differences in SCR across CSs and task phases (Abend et al., 2020), we first tested main effects of anxiety, paternal EE, and their interaction on averaged SCR to both CS types across all three task phases (i.e., *Overall SCR*). Because unique parenting effects have been observed for both threat (Bilodeau-Houle et al., 2020) and safety stimuli (Wolitzky-Taylor et al., 2014), we also tested main effects and interactions on SCR to the CS+ during acquisition (i.e., *SCR to Threat*) and SCR to the CS− during acquisition (i.e., *SCR to Safety*), separately.

Analyses were conducted in SPSS, using the Process macro (Hayes, 2013). Moderated linear regression was conducted to examine the interactive effects of child anxiety and paternal EE on child SCR to threat conditioning. Separate regression models were conducted for trait anxiety and anxiety symptoms (i.e., STAI, SCARED) and for each outcome. As such, *Overall SCR* was regressed onto STAI trait anxiety, paternal EE, the product of STAI trait anxiety and EE, and the covariates (age and pubertal status). In a separate analysis, *Overall SCR* was regressed onto SCARED anxiety symptoms, paternal EE, the product of SCARED anxiety symptoms and EE, and the covariates. A second and third set of regression models repeated these analyses with *SCR to Threat* and *SCR to Safety* as the outcome variables. Finally, exploratory analyses probed interactive effects between paternal EE and SCARED anxiety subdomains on child SCR (see the Supporting Information).

In the end, six a priori moderated linear regression models were executed, one for each outcome (i.e., *Overall SCR*, *SCR to Threat*, *SCR to Safety*) and child anxiety predictor (i.e., STAI, SCARED) combination. All variables were continuous and centered prior to analysis, and the estimated effects are reported as unstandardized regression coefficients. To address any nonnormality in the distribution of the outcomes, the models were estimated using bootstrapped samples (bootstrap $N = 5000$) to produce 95% bias-corrected confidence intervals (BC CI) around the parameter estimates. Effects were determined to be significant at $p < .05$ if the upper and lower limits of the CIs did not contain zero. For significant interactions, each outcome was examined across three levels (average; +1 *SD*; −1 *SD*) of each predictor variable.

TABLE 1 Descriptive statistics for key study variables

			Skew		Kurtosis		
Variables	*M*	*SD*	Statistic	*SE*	Statistic	*SE*	*N*
Child age	9.82	1.22	0.67	0.47	−0.58	0.92	24
Child pubertal status	1.78	0.90	1.08	0.48	0.26	0.94	23
Paternal EE	0.40	0.55	1.52	0.47	2.03	0.92	24
Child SCR to threat	8.26	5.80	1.52	0.47	3.09	0.92	24
Child SCR to safety	5.30	6.58	3.38	0.47	12.95	0.92	24
Child STAI	37.33	8.07	−0.02	0.47	−0.80	0.92	24
Child SCARED	38.29	16.03	−0.14	0.47	−0.22	0.92	24

Abbreviations: EE, expressed emotion; SCARED, Screen for Child Anxiety Related Disorders; SCR, Skin Conductance Response; STAI, State Trait Anxiety Inventory.

TABLE 2 Bivariate correlations among key study variables

	1	2	3	4	5	6	7
1. Child age	–						
2. Child pubertal status	.47**	–					
3. Paternal EE	−.03	−.09	–				
4. Child SCR to threat	.10	.02	.18	–			
5. Child SCR to safety	.28	.10	.18	.73**	–		
6. Child STAI	.19	−.21	.09	−.26	−.03	–	
7. Child SCARED	.18	.05	.07	−.27	−.11	.90**	–

Note: The *p*-values of Pearson correlation analysis are shown. Results are listed for the variables of interest using a *p*-value < .05.
Abbreviations: EE, expressed emotion; SCARED, Screen for Child Anxiety Related Disorders; SCR, Skin Conductance Response; STAI, State Trait Anxiety Inventory.
**$p < .01$.

3 | RESULTS

Descriptive statistics appear in Table 1 and bivariate correlations appear in Table 2.

3.1 | Skin conductance response to conditioned cues

A repeated-measures ANOVA testing the phase by CS type effect on SCR yielded a significant main effect of CS type ($F(1, 25) = 19.480$, $p < .001$) such that SCR was greater to the CS+ than to the CS− across all phases. No main effect of phase ($F(2, 50) = 3.244$, $p = .066$) or phase by CS type interaction emerged ($F(2, 50) = 1.210$, $p = .307$).

A second repeated-measures ANOVA testing the phase by CS type effect on SCR during preacquisition, early acquisition, and early

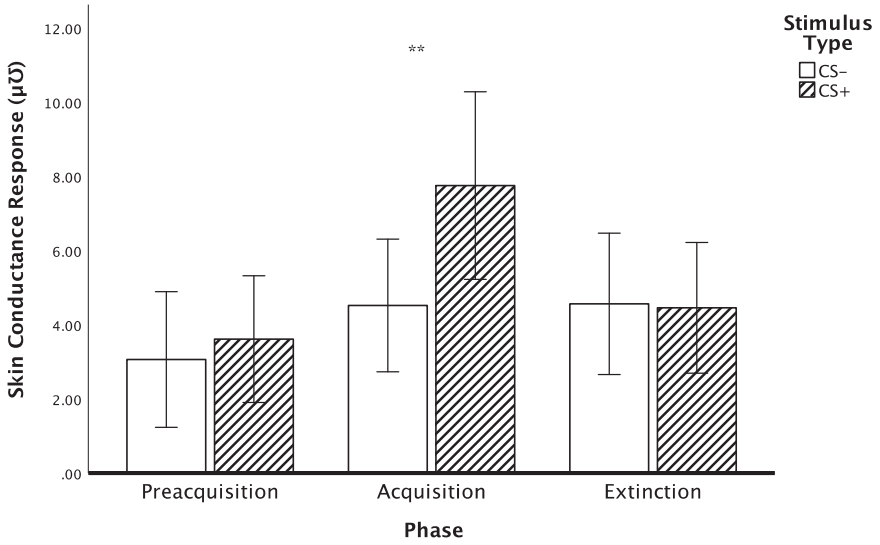

FIGURE 2 Skin conductance response to the paired (CS+) and unpaired (CS–) conditioned stimuli across all trials of preacquisition, early trials of acquisition, and early trials of extinction phases. Error bars represent standard error. $^{**}p < .01$

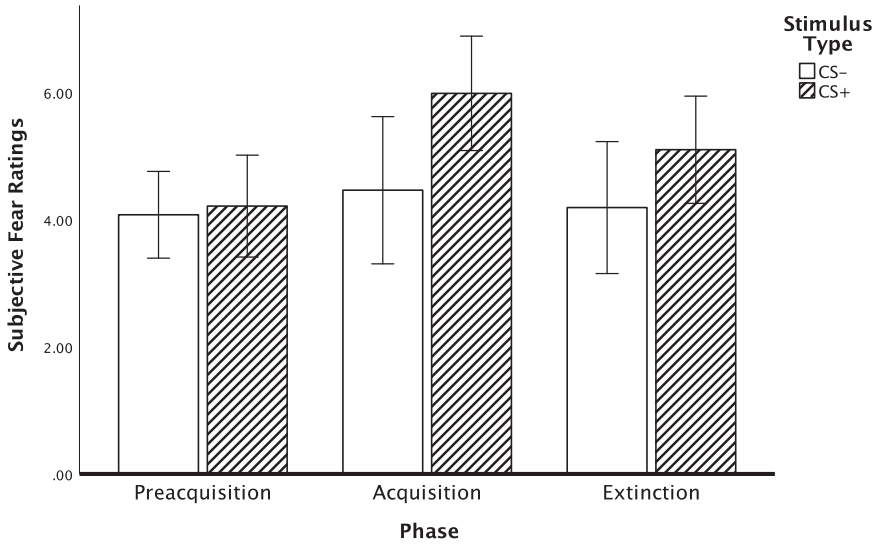

FIGURE 3 Subjective fear ratings of the paired (CS+) and unpaired (CS–) conditioned stimuli across preacquisition, acquisition, and extinction. Error bars represent standard error

extinction trials revealed a significant main effect of phase ($F(2, 46) = 7.772$, $p = .001$) and CS type ($F(1, 23) = 8.965$, $p = .006$) as well as a significant Phase × CS type interaction ($F(2, 46) = 5.479$, $p = .007$) (Figure 2). Follow-up paired-samples *t*-tests indicated greater response to the CS+ relative to the CS– during acquisition ($t(23) = -3.860$, $p = .001$), but not during preacquisition or extinction ($ps > .424$) (Figure 2). This pattern indicates successful conditioning followed by extinction when examining early acquisition and extinction trials. As such, only the SCR values from this second repeated-measures ANOVA were included in remaining analyses.

3.2 | Subjective fear ratings of conditioned cues

A repeated-measures ANOVA testing the phase by CS type effect on subjective fear ratings yielded a significant main effect of phase ($F(2, 42) = 5.920$, $p = .005$) and CS type ($F(1, 21) = 7.777$, $p = .011$) such that self-reported fear was greatest during acquisition as compared to preacquisition and extinction and greater to the CS+ relative to the CS– (Figure 3). No significant phase by CS type effect was observed ($F(2, 42) = 1.875$, $p = .166$). Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(2) = 6.73$, $p = .035$), so degrees of freedom were corrected using Huynh–Feldt estimates of sphericity ($\varepsilon = .778$). Following these corrections, the interaction remained nonsignificant ($F(1.66, 34.80) = 1.875$, $p = .174$). Even though the interaction was not significant, for completeness we conducted exploratory paired samples *t*-tests within each phase separately, which revealed greater self-reported fear to the CS+ than the CS– during acquisition ($t(22) = -2.175$, $p = .041$) and extinction ($t(23) = -2.179$, $p = .040$), but not during preacquisition ($p = .676$). Given the current study's interest in less controlled responses to threat, subsequent analyses focused exclusively on physiological indices of anticipatory responding. However, these patterns indicate a trend toward greater subjective fear to the threat stimulus compared to the safety stimulus relative to baseline.

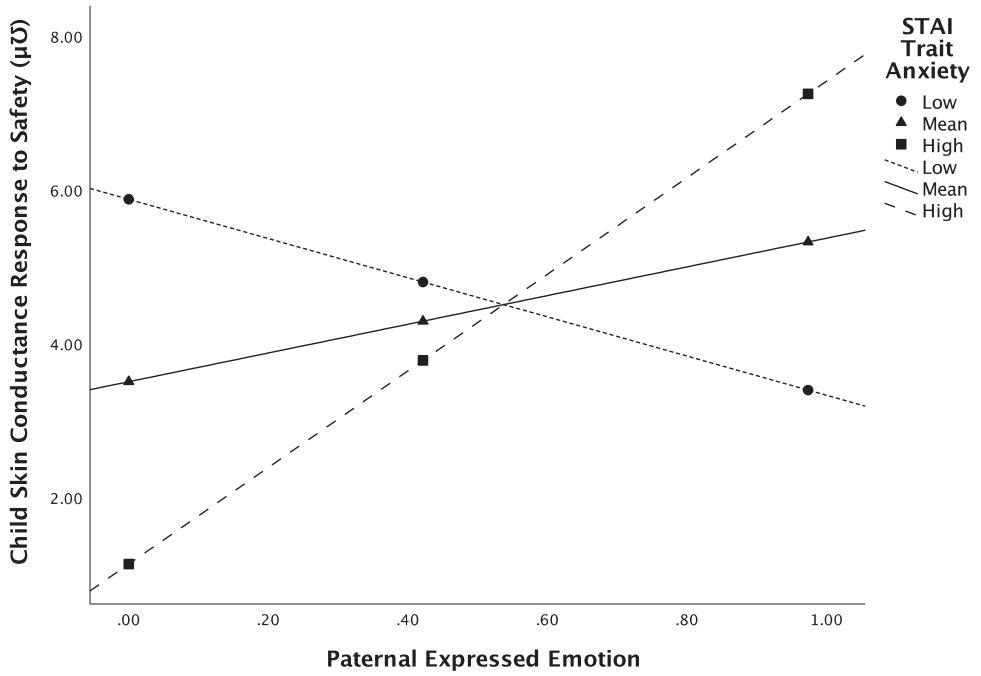

FIGURE 4 Paternal expressed emotion and children's *SCR to Safety* were positively associated at high ($b = 6.28$, $p = .023$, 95% BC CI [0.9932, 11.5667]), but not mean ($b = 1.87$, $p = .245$, 95% BC CI [−1.4049, 5.1369]) or low ($b = -2.55$, $p = .288$, 95% BC CI [−7.4540, 2.3580]), levels of child trait anxiety, as measured by the STAI. SCR, Skin Conductance Response; STAI, State Trait Anxiety Inventory

3.3 | Anxiety, paternal EE, and threat conditioning

3.3.1 | Overall SCR (CS+, CS− at preacquisition, acquisition, and extinction)

Averaged SCR across CSs and phases was used to index *Overall SCR* (Abend et al., 2020). The first set of moderated linear regression analyses examined whether *Overall SCR* varied as a function of STAI trait anxiety and paternal EE and, separately, whether *Overall SCR* varied as a function of SCARED anxiety symptoms and paternal EE (see the Supporting Information for results of moderated linear regression analyses with *Baseline SCR* as the outcome). Controlling for age and pubertal status, the interaction between children's trait anxiety and paternal EE was not a significant predictor of children's *Overall SCR*. Likewise, the interaction between anxiety symptoms and paternal EE was not significant. No main effects of trait anxiety, anxiety symptoms, or paternal EE emerged (all *ps* > .106) (see the Supporting Information for results of simple linear regression analyses).

3.3.2 | SCR to Threat (CS+ at acquisition)

Averaged SCR to the CS+ at acquisition was used to index *SCR to Threat* (Zbozinek & Craske, 2017; Zbozinek et al., 2015). The second set of regression analyses examined whether *SCR to Threat* varied as a function of STAI trait anxiety and paternal EE and, separately, whether *SCR to Threat* varied as a function of SCARED anxiety symptoms and paternal EE. Controlling for age and pubertal status, the interaction between children's anxiety and paternal EE was not a significant predictor of *SCR to Threat*. No main effects of trait anxiety, anxiety symptoms, or paternal EE emerged (all *ps* > .153) (see the Supporting Information for results of simple linear regression analyses).

3.3.3 | SCR to Safety (CS− at acquisition)

Averaged SCR to the CS− at acquisition was used to index *SCR to Safety* (Gazendam et al., 2013; Lissek et al., 2005). The third set of regression analyses examined whether *SCR to Safety* varied as a function of STAI trait anxiety and paternal EE and, separately, whether *SCR to Safety* varied as a function of SCARED anxiety symptoms and paternal EE.

Controlling for age and pubertal status, the interaction between children's trait anxiety and paternal EE was a significant predictor of children's *SCR to Safety* ($\Delta R^2 = .22$, $p = .029$). Paternal EE and *SCR to Safety* were positively associated at high ($b = 6.28$, $p = .023$, 95% BC CI [0.9932, 11.5667]), but not mean ($b = 1.87$, $p = .245$, 95% BC CI [−1.4049, 5.1369]) or low ($b = -2.55$, $p = .288$, 95% BC CI [−7.4540, 2.3580]), levels of child trait anxiety (Figure 4). No main effects of child trait anxiety or paternal EE emerged (all *ps* > .245) (see the Supporting Information for results of simple linear regression analyses).

Controlling for age and pubertal status, the interaction between children's anxiety symptoms and paternal EE was also significant ($\Delta R^2 = .18$, $p = .045$). Paternal EE and *SCR to Safety* were positively associated at high ($b = 6.56$, $p = .030$, 95% BC CI [0.7314, 12.3834]), but not mean ($b = 2.06$, $p = .208$, 95% BC CI [−1.2610, 5.3816]) or low ($b = -2.44$, $p = .332$, 95% BC CI [−7.5824, 2.7088]), levels of child

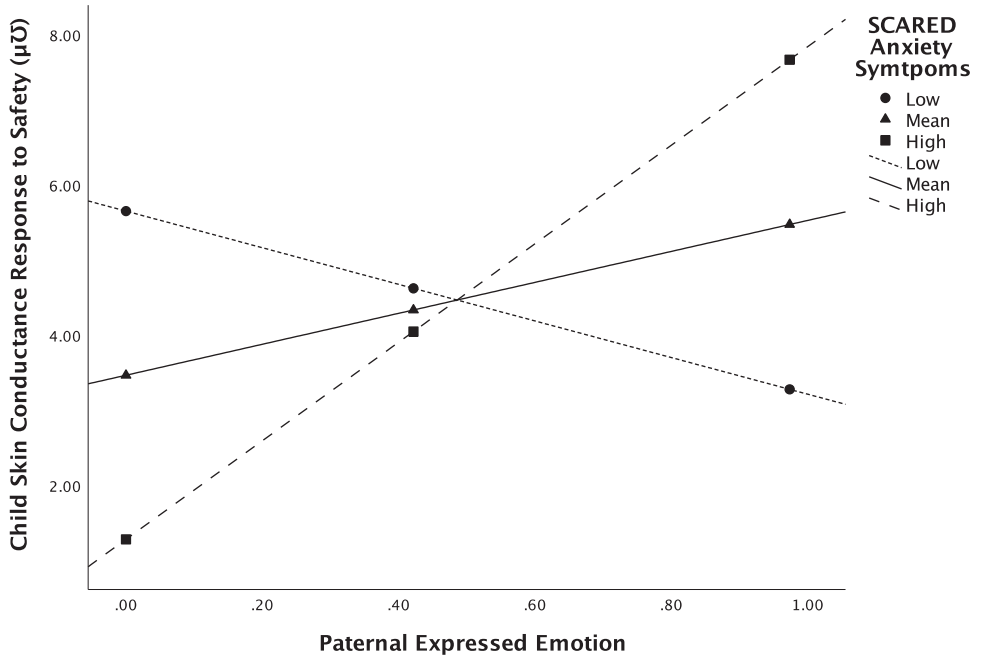

FIGURE 5 Paternal expressed emotion and children's *SCR to Safety* were positively associated at high ($b = 6.56$, $p = .030$, 95% BC CI [0.7314, 12.3834]), but not mean ($b = 2.06$, $p = .208$, 95% BC CI [−1.2610, 5.3816]) or low ($b = -2.44$, $p = .332$, 95% BC CI [−7.5824, 2.7088]) levels of child anxiety symptoms, as measured by the SCARED. SCR, Skin Conductance Response; SCARED, Screen for Child Anxiety Related Disorders

anxiety symptoms (Figure 5). No main effects of child anxiety symptoms or paternal EE emerged (all *p*s > .208) (see the Supporting Information for results of simple linear regression analyses).

4 | DISCUSSION

Three key findings emerged from this preliminary study of anxiety and paternal parenting effects on threat and safety learning in Latina girls. First, the task was tolerated by over 80% of the sample, thus extending extant models of threat conditioning in youth beyond the specific ecology of middle SES European American youth. Second, contrary to our predictions, neither child trait anxiety nor anxiety symptoms uniquely influenced children's psychophysiological responding to any of our indices of threat learning. Third, although paternal EE did not uniquely predict psychophysiological responding during threat conditioning, child trait anxiety, as well as child anxiety symptoms, moderated this association such that higher paternal EE was associated with higher psychophysiological responding to safety cues in children with high but not low anxiety levels.

Contrary to our initial hypothesis, anxiety was not directly related to psychophysiological indices of threat and safety learning during threat conditioning. Although prior meta-analyses showed comparable differential threat conditioning in anxious and nonanxious youth (Dvir et al., 2019), previous findings generated in separate studies have also demonstrated anxiety-related enhancement of responding to CS−, CS+, or both CS types in both children (Dvir et al., 2019; Lissek et al., 2005) and adults (Gazendam et al., 2013; Lissek et al., 2005; Zbozinek et al., 2015; Zbozinek & Craske, 2017). Heightened response to CS− has been hypothesized to reflect anxiety-related aberrations in safety learning (Grupe & Nitschke, 2013; Tanovic et al., 2018) and heightened response to CS+ has been hypothesized to reflect enhanced threat learning (Orr et al., 2000). Both patterns of responding indicate some form of perturbations in learning, and neither pattern was observed in our data. One possibility to account for the discrepant findings is that prior observed anxiety-related effects have largely been documented among European American treatment-seeking youth and the more modest anxiety levels of our community-based Latina sample may not reflect the same effect on threat learning. Even though a significant portion of our sample met criteria for an anxiety disorder, future work should examine threat learning indices in larger ethnically diverse clinical samples. We note that this study is the first to examine threat and safety learning processes in an exclusively Latina sample, an understudied group at an increased risk for anxiety when compared to other ethnic groups (Anderson & Mayes, 2010; McLaughlin et al., 2007; Pina & Silverman, 2004). If empirical work is to identify treatment targets for anxiety and related psychopathology, then more sampling diversity is needed.

Contrary to our second hypothesis, paternal EE was not directly related to psychophysiological indices of threat and safety learning during threat conditioning. Previous investigations of parental influences on children's threat and safety learning have been conducted with mothers and have examined chronic harsh parenting (Boulanger-Bertolus et al., 2017; Kosten et al., 2006; La Buissonnière-Ariza et al., 2019; Machlin et al, 2019; Roth & Sullivan, 2005; Zoicas & Neumann, 2016). Severely negative forms of maternal parenting have been

found to predict both elevated (La Buissonnière-Ariza et al., 2019) and blunted (McLaughlin et al., 2016) responding during threat and safety learning. Potential differential effects of less severe forms of critical paternal parenting remain unclear. Importantly, the goal of the current study was to investigate whether anxiety models that take family processes into consideration, which have largely been informed by European American samples, apply to Latinx families and to test variations that contribute to heterogeneity among Latinx parents' caregiving behaviors and their children's threat and safety learning. At the same time, however, prior work has also demonstrated group differences in parenting strategies between Latinx and European American families (Berlin et al., 2009; Luis et al., 2008; White et al., 2009) that could carry implications for children's threat and safety learning in that some forms of parenting may be considered more normative among Latinx families and children may develop positive appraisals of these types of parenting. As such, examination of sociocultural influences that may shape the way parent–child interactions give rise to or protect youth from developing anxiety represents an important direction for future research. We are particularly encouraging of work that identifies Latino familial and cultural assets that may uniquely interact with children's trait anxiety to promote positive emotional development.

Consistent with our third hypothesis, anxiety-dependent associations emerged between paternal EE and individual differences in conditioned responding, specifically daughters' SCR to the CS−. Paternal EE was positively associated with psychophysiological responding to safety cues in daughters with high and mean, but not low, levels of anxiety. This suggests a potentially important influence of fathering on anxious daughters' threat and safety learning. It is possible the critical and emotionally overinvolved nature of high EE parenting, in combination with daughters' anxious tendencies, may contribute to a decreased ability to identify safety signals in the context of threat. Although previous work has pointed to chronic harsh parenting as a potential risk factor for children's general threat and safety learning (Boulanger-Bertolus et al., 2017; Kosten et al., 2006; La Buissonnière-Ariza et al., 2019; Machlin et al, 2019; Roth & Sullivan, 2005; Zoicas & Neumann, 2016), the current preliminary findings elucidate the role that milder forms of negative parenting may play. It seems, here, that criticism and EOI pose a particular risk for highly anxious children as compared to less anxious children. However, observed effects were specific to the safety stimulus. Even though prior work largely supports hypotheses regarding trait and parenting influences on response to threat cues (Bilodeau-Houle et al., 2020; Lissek et al., 2005), the trend observed in the current study is also in line with previous findings that anxious individuals exhibit enhanced responding to conditioned safety cues (Lissek et al., 2005), and that individuals high in trait anxiety show stronger fear responding to the safety stimulus, but not the threat stimulus, during acquisition (Duits et al., 2015; Gazendam et al., 2013). In addition, some studies also observe that children exposed to extreme harsh parenting fail to discriminate between threat and safety during conditioning (e.g., McLaughlin et al., 2016), suggesting enhanced generalization of conditioned fear to safety stimuli that resemble threat cues. Here, we focus on less severe forms of parental behavior and show that anxiety and paternal EE amplify children's SCR to safety cues. To the extent that EE reflects overinvolved parenting and the degree to which a parent is critical of, or hostile toward, their child, it is possible that heightened anxiety levels coupled with higher EE parenting may lead children to be particularly vigilant around emotional stimuli in the presence of threat cues. As children in our sample habituated relatively rapidly to the threat stimulus, responses overall may have been attenuated irrespective of anxiety or parenting levels. Future work might consider varying levels of CS+ potency, which could strengthen our understanding of parenting effects on responsivity to threat cues.

When compared to less anxious youth, parents' attempts to socialize highly anxious youth through EE may be more counterproductive. Because of anxious children's potential overarousal in the face of stressful circumstances, frequent exposure to the critical nature of higher EE parenting may contribute to heightened reactivity to both threat and safety cues, as well as a lowered threshold for triggering threat responses. Alternatively, highly anxious children may elicit reassurance and support from parents in the context of any situation, whether threatening or safe, in ways that less anxious children may not. Thus, it is possible the emotionally overinvolved nature of higher EE parenting, characterized by marked concern and overprotectiveness, may lead parents to intervene unnecessarily. This could limit opportunities for children to practice independently distinguishing threat from safety and promote stronger reactions to stimuli that are actually safe. Longitudinal studies focusing on multiple aspects of maternal and paternal parenting are necessary to more completely understand anxiety moderation of associations among parenting behaviors and conditioned response to threat and to tease out potential reciprocal effects.

The current preliminary findings should be considered in the context of several limitations. First, sample size was modest, potentially reducing statistical power; this could have particularly affected some of the interactions tested. Although our analyses utilized bootstrapping techniques to assist with this, future work in larger samples would be informative. Second, this was a cross-sectional design; a longitudinal study would allow stronger inferences about developmental and causal pathways between threat learning, paternal EE, and anxiety. Third, paternal EE was relatively low in our sample and exhibited modest variability, limiting the confidence with which we can interpret the regressor's effect on our outcome; replication of observed effects is warranted to reduce risk of spurious effects. Lastly, we observed habituation to the threat stimulus over time, which may have diminished individual differences in acute responding. Future work on stimulus characteristics that elicit different anxiety effects could further contribute to our understanding of individual and environmental influences on threat responding.

Several strengths mitigate these limitations and offer preliminary data about the role fathers play in their daughters' threat and safety learning. First, we focused on a sample of preadolescent Latina girls, an understudied group exhibiting higher levels of untreated anxiety compared to other ethnic groups (Anderson & Mayes, 2010; McLaughlin et al., 2007; Pina & Silverman, 2004). In both community-based and clinically referred samples of Latinx and European American youth, Latinx children report significantly more anxiety symptoms and have higher rates of anxiety diagnoses than their European American peers

(Ginsburg & Silverman, 1996; Varela et al., 2004). When examining both ethnic and gender differences, Latina American girls, specifically, report more anxiety symptoms than European American and African American children (McLaughlin et al., 2007). Because anxiety in childhood is associated with an increased risk for psychopathological sequelae later in development (Pine et al., 1998), identifying factors that moderate individual-level risk for alterations in threat learning may inform prevention efforts targeting long-term mental health outcomes in underrepresented youth. Second, we examine the impact of less severe forms of negative parenting behavior, which may generally be more frequent in the lives of children. Continued exploration of criticism and EOI may identify parenting practices that could contribute to adaptive developmental trajectories of threat and safety learning, particularly for anxious youth. Third, we use parenting data from fathers, who have been largely neglected from investigations of threat and safety learning processes, despite the potentially differential influence of information signaled by paternal versus maternal behavior with respect to potential external threats (Bögels & Perotti, 2011).

In conclusion, the present preliminary study reports elevated SCR to safety cues during threat conditioning in high anxious children with relatively more critical and overinvolved fathers. We observed no main effects of child anxiety or negative paternal parenting on children's psychophysiological indices of threat and safety learning. These preliminary findings suggest that exposure to mild forms of negative parenting may alter safety learning in anxious children and potentially exacerbate risk for fear-based disorders. Further research with larger samples is needed to elucidate the causal role of paternal parenting in influencing children's psychophysiological responsivity to safety in the context of threat, focusing on risk as well as protective and promotive factors.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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