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# The Role of Family-Level Factors in Childhood Anxiety during the COVID-19 Pandemic

**Elizabeth R. Kitt[1], Emily M. Cohodes[1], Sarah McCauley[1], Grace Hommel[1], Cristina Nardini[1], Sadie J. Zacharek[1], Alyssa Martino[1], Tess Anderson[1], Hannah Spencer[1], Paola Odriozola[1], Georgia F. Spurrier[1], Alexis Broussard[1], Carla E. Marin[1], Wendy K. Silverman[1], Eli R. Lebowitz[1], Dylan G. Gee*[1]**

[1]*Yale University, Department of Psychology, USA*

**Abstract**
The COVID-19 pandemic has caused pervasive disruptions to family life. In light of the established role of parent-child dynamics in the maintenance of pediatric anxiety, we conducted a multilevel, multimodal study to examine how family-level factors moderate anxious youths' responses to the COVID-19 pandemic. Prior to the pandemic ("pre-pandemic"), children with anxiety disorders ($n$ = 28; ages 6-12) completed an fMRI task probing parental modulation of amygdala reactivity to fearful faces. During the first peak of the COVID-19 pandemic ("mid-pandemic"), parents completed questionnaires about their family's exposure to COVID-19-related stress, their child's COVID-19-related fears and behaviors, and their own (parental) functioning. Pre-pandemic parental modulation of amygdala reactivity moderated the association between children's exposure to COVID-19-related stress and their COVID-19-related fears and behaviors. Furthermore, greater mid-pandemic parental assistance with their child's use of venting and with their child's use of expressive suppression as emotion regulation strategies exacerbated the effects of COVID-19-related stress on children's COVID-19-related fears and behaviors, respectively. These results provide preliminary insight into the ways in which distinct family-level factors may buffer or exacerbate the effects of COVID-19-related stress on youth with a history of anxiety disorders.

**Keywords** COVID-19; childhood anxiety disorders; family; functional magnetic resonance imaging (fMRI); parental assistance with child emotion regulation

The COVID-19 pandemic is a major, complex stressor that has caused widespread disruptions to family life (Liu & Doan, 2020; Pfefferbaum & North, 2020). Particularly in the first wave of the COVID-19 pandemic, extensive social distancing measures vastly altered family functioning. Across the globe, children transitioned to virtual schooling, options for childcare and psychotherapy became inaccessible to many, and stay-at-home guidelines limited social interactions beyond the home (Andrejek et al., 2021; Gruber et al., 2021; Hale et al., 2021; Roos et al., 2021). Against this backdrop of significant disruptions to daily life, many families also contended with the economic consequences of the pandemic, including job loss, as well as food and housing insecurity (Gruber et al., 2021; Pfefferbaum & North, 2020). While navigating these stressors, many families reported pervasive feelings of uncertainty and worries about the trajectory of the pandemic, novel coronavirus infection, and socioeconomic consequences of the pandemic (Chu et al., 2021; Koffman et al., 2020; Taylor et al., 2020).

In the context of this major stressor, it is not surprising that a growing body of research suggests a link between exposure to pandemic-related stress and youth mental health. Emerging evidence highlights an increase in symptoms of depression and anxiety, greater negative affect, and worse general mental health among children and adolescents during the COVID-19 pandemic (Deng et al., 2021; Racine et al., 2020; Racine et al., 2021; Samji et al., 2021; Silk et al., 2021). Furthermore, children's internalizing symptoms have been found to increase as their exposure to

*Corresponding Author: Dylan G. Gee ✉ dylan.gee@yale.edu
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COVID-19-related stress increases (e.g., Cohodes, McCauley, et al., 2021; Liang et al., 2021; Weissman et al., 2021).

Children with pre-existing mental health disorders, especially anxiety, are expected to be particularly vulnerable to the effects of exposure to COVID-19-related stress (Jefsen et al., 2021; Pfefferbaum, 2021). Preliminary research examining rates of pandemic-related stress reported by adults supports this likelihood of increased vulnerability, as adults diagnosed with anxiety-related disorders prior to the pandemic have been found to exhibit greater COVID-19-related stress compared to adults with pre-existing mood disorders and adults with no pre-existing mental health disorder (Asmundson et al., 2020). In light of this potential increased vulnerability for children with a history of anxiety disorders, examining potential moderators of the association between COVID-19-related stress and negative outcomes within this population could prove particularly important for intervention efforts.

## Parental Buffering and Exacerbation of Children's Stress during the COVID-19 Pandemic

Exposure to stress does not have the same effect on all children (Cohodes, Kitt, et al., 2021), and parental factors are key predictors of child outcomes following stress (Williamson et al., 2017). Parents can effectively buffer their children's responses to stress, both at physiological and behavioral levels. Children have been shown to exhibit reduced cortisol reactivity in the presence of a parent (Hostinar et al., 2014) and reduced amygdala reactivity in the presence of parental visual stimuli (Gee et al., 2014). Furthermore, this parental buffering of children's neural reactivity to stress is tied to alterations in children's behavioral regulation. Specifically, parental modulation of their child's behavioral regulation is stronger in children who exhibit a greater discrepancy in amygdala reactivity when in the presence versus absence of parental stimuli (Gee et al., 2014). Of note, the degree to which parents effectively buffer their children from the negative effects of exposure to stress varies widely across families. Whereas some parental factors are associated with more effective buffering, other factors may result in less effective buffering or even exacerbation of children's responses to exposure to stress (Williamson et al., 2017).

Early research indicates specific family-level factors that may buffer or exacerbate youth's responses to COVID-19-related stress. For example, maintaining predictable, structured home routines and engaging in emotion coaching of children's negative emotions (i.e., helping one's child to identify and develop strategies to cope with their negative emotions) can buffer the effects of exposure to COVID-19-related stress on children's symptoms (Cohodes, McCauley, et al., 2021; Glynn et al., 2021; Rosen et al., 2021). On the other hand, high levels of parenting stress and parental anxiety symptoms have been shown to exacerbate the effects of COVID-19-related stress on children's mental health (Cohodes, McCauley, et al., 2021). Similarly, in adolescent girls, family conflict was associated with greater depressive symptoms, whereas enjoying spending more time with family was associated with greater positive affect (Silk et al., 2021).

Family-level buffering or exacerbating factors may be particularly important to consider for children with a history of anxiety disorders. Family-level factors are theorized to play a key role in the maintenance of childhood anxiety disorders (Lebowitz et al., 2014). In tandem with a growing literature on parental buffering or exacerbating factors, research on the role of family-level factors in maintaining childhood anxiety indicates that such family-level factors may also play a critical role in moderating anxious children's responses to the COVID-19 pandemic. Research and theory highlight four specific family-level factors, across neural and behavioral levels, that may be particularly tied to parental buffering of anxious children's responses to the COVID-19 pandemic: parental modulation of their child's amygdala reactivity, family accommodation of anxiety, parental anxiety, and parental assistance with their child's emotion regulation.

### Neural, Pre-Pandemic Buffering or Exacerbating Factors.

***Parental Modulation of their Child's Amygdala Reactivity to Fearful Faces.*** Neuroimaging data collected prior to the pandemic may provide a unique and important opportunity to examine the neural underpinnings of children's differential responses to stress. A recent study found that the positive association between exposure to COVID-19-related stressors and internalizing symptoms was stronger among youths who showed greater left amygdala activation to calm versus fearful faces prior to the pandemic (Weissman et al., 2021). Although the direction of these results is unexpected given past research on the association between neural reactivity to fearful faces and responses to stress (e.g., Swartz et al., 2015), these findings suggest that pre-pandemic amygdala activity could indicate vulnerability to future stress. However, no research to date has examined the neural underpinnings of parental buffering of children's stress responses during the COVID-19 pandemic. Given the links between greater parental buffering of amygdala reactivity and both stronger parental modulation of their child's affect regulation and lower child anxiety (Callaghan et al., 2019; Gee et al., 2014), it is possible that parental buffering of their child's amygdala reactivity (i.e., reduced amygdala reactivity in the presence of a parent) may be associated with buffering of the child's response to the COVID-19 pandemic. This may be particularly important to study in anxious children, given that youth with anxiety disorders have been found to show elevated amygdala reactivity to fearful faces (e.g., Monk et al., 2008; Thomas et al., 2001), and pre-treatment amygdala activation has been found to predict treatment response in youth with anxiety disorders (McClure et al., 2007). Leveraging neural data collected prior to the pandemic using a task specifically designed to measure parental modulation of children's neural reactivity to stress provides the unique opportunity to examine the potential buffering effect of parental modulation of their child's amygdala reactivity on children's exposure to future stress.

**Behavioral, Mid-Pandemic Buffering or Exacerbating Factors.**

***Family Accommodation.*** Family accommodation refers to changes that family members make to their behaviors and/or schedules with the goal of reducing or preventing their child's distress (Lebowitz et al., 2013). For example, a parent might choose to sleep beside their child with separation anxiety disorder. While often arising out of a family's best intentions to help their child, growing evidence suggests that family accommodation may contribute to the maintenance or exacerbation of a child's anxiety (Iniesta-Sepúlveda et al., 2020; La Buissonnière-Ariza et al., 2018). Family accommodation is prevalent among families with anxious youth (Benito et al., 2015; Thompson-Hollands et al., 2014). Moreover, higher levels of family accommodation have been shown to be associated with greater functional impairment and symptom severity in youth, perhaps reflecting the impact of reduced opportunities for youth to face their fears and learn to independently reduce and/or tolerate their anxiety (Benito et al., 2015; Iniesta-Sepúlveda et al., 2020; Storch et al., 2015; Thompson-Hollands et al., 2014). In fact, recent work has found that greater family accommodation is associated with greater youth avoidance and reduced youth self-efficacy (Kitt et al., 2022). In the context of the COVID-19 pandemic and our growing understanding of the moderating role of family-level factors, this link between family accommodation and continued or worsened anxiety in youth suggests that family accommodation could exacerbate a child's response to exposure to COVID-19-related stress.

***Parental Anxiety.*** Decades of research have identified parental anxiety as a risk factor for child anxiety (e.g., Fisak & Grills-Taquechel, 2007; McClure et al., 2001; Lawrence et al., 2019; Turner et al., 1987). Children of parents with anxiety disorders are approximately five to seven times more likely to be diagnosed with anxiety than children with non-anxious parents (e.g., Beidel & Turner, 1997; Turner et al., 1987), and children with anxiety disorders are approximately five times more likely to have anxious parents than children without anxiety disorders (e.g., Cooper et al., 2006; Last et al., 1991). Parental anxiety is expected to contribute to child anxiety through numerous possible mechanisms, including parental modeling of anxiety, direct transfer of information, and reinforcement of children's anxious behaviors (Fisak & Grills-Taquechel, 2007). While early evidence suggests that higher levels of parental anxiety may exacerbate the effects of exposure to COVID-19-related stress on children in community samples (Cohodes, McCauley, et al., 2021), the potential moderating role of parental anxiety for children with a history of anxiety disorders has not yet been explored.

***Parental Assistance with their Child's Use of Emotion Regulation Strategies.*** Parents play a critical role in supporting their children's development of emotion regulation strategies (Eisenberg & Fabes, 1994; Hofer, 1978). A growing body of research indicates that parental engagement in emotion coaching can moderate the effect of exposure to stress—including COVID-19-related stress—on the development of internalizing symptoms in children (Cohodes et al., 2017; Cohodes, McCauley, et al., 2021; Greene et al., 2020; Lobo et al., 2021). Furthermore, parental assistance with prototypically adaptive emotion regulation strategies (e.g., reappraisal, acceptance, and social support search) is associated with lower levels of youth internalizing and externalizing symptoms (Cohodes, Preece, et al., 2021). While parental facilitation of their child's use of certain prototypically adaptive emotion regulation strategies may buffer the effects of exposure to stress, parental assistance with other, prototypically maladaptive strategies (e.g., rumination, expressive suppression, and venting) has been associated with higher levels of youth internalizing symptoms (Cohodes, Preece, et al., 2021). In the context of the COVID-19 pandemic, preliminary evidence suggests that strategies that focus on dampening or suppressing negative emotions, such as rumination, expressive suppression, and venting, may be associated with increased internalizing symptoms in children (Duan et al., 2020). Examining the buffering or exacerbating role of parental facilitation of distinct child emotion regulation strategies may shed light on the specific strategies that may be most beneficial for children with a history of anxiety disorders in the context of major stressors such as the COVID-19 pandemic.

## The Present Study

The current study takes a multilevel, multimodal approach to provide a preliminary assessment of how family-level factors affect functioning during the

COVID-19 pandemic among youth with a history of anxiety disorders. Our first aim was to examine associations among family-level factors (i.e., family accommodation, parental anxiety, and parental assistance with their child's emotion regulation) assessed during the COVID-19 pandemic. We predicted that higher levels of parental anxiety would be associated with higher levels of family accommodation and lower levels of parental assistance with prototypically adaptive emotion regulation strategies.

Our second aim was to examine possible pre- and mid-pandemic family-level moderators of the association between children's exposure to COVID-19-related stress and their COVID-19-related anxiety. Specifically, we hypothesized that the association between children's exposure to COVID-19-related stress and children's COVID-19-related fears and behaviors would be relatively weaker for children exhibiting less pre-pandemic parental modulation of amygdala reactivity. Furthermore, we hypothesized that the association between COVID-19-related stress and children's COVID-19-related fears and behaviors would be relatively weaker in families that endorsed higher levels of mid-pandemic parental behaviors previously associated with stress buffering (e.g., lower parental anxiety, lower family accommodation, and/or greater parental assistance with prototypically adaptive emotion regulation strategies). Through these aims, the current study is poised to play a critical role in continued hypothesis generation by providing a preliminary examination of the buffering or exacerbating role of specific family-level factors in this high-risk population.

## Method

### Participants

The data used in the present study were collected as part of a larger randomized controlled trial (RCT) of psychosocial treatment for pediatric anxiety in New Haven, Connecticut. Participants were recruited from the community through a variety of methods, including flyers, online postings, newsletters, and ongoing evaluations conducted at the Yale Child Study Center. Of the 73 families who were contacted about completing questionnaires during the COVID-19 pandemic, 41 expressed interest and 28 completed the questionnaires and thus were included in the current sample. Children were between 6 and 12 years old at the start of study participation ($M_{age}$ = 8.39, $SD$ = 1.83). Of the 28 children in the sample (10 female, 18 male), the majority of participants were White (89.29%) and not of Hispanic or Latino descent (92.86%; see Table 1 for descriptive statistics).

All child participants met Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013) criteria for a primary anxiety disorder. Trained evaluators interviewed all parent/child dyads using the Anxiety Disorders Interview Schedule-Child and Parent Versions (ADIS-C/P; Silverman et al., 2001). All diagnoses were confirmed by a child and adolescent psychologist.

In addition to meeting DSM-5 diagnostic criteria for a primary anxiety disorder, child participants were also required to score below 2 on the Petersen Pubertal Development Scale (Petersen et al., 1988), indicating that the child had not yet begun pubertal development, and have an IQ above 80, as assessed using the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999). There were no notable inclusion criteria for parents. Exclusionary criteria for child participants included: a) neurological disorders, psychotic disorders, or pervasive developmental disorders; b) high risk for harming themselves or others; c) current psychopharmacological or psychosocial treatment; d) lifetime history of neurological illness or head injury resulting in loss of consciousness exceeding five minutes; e) visual or physical disability that would interfere with seeing stimuli presented on a screen or rapidly and repeatedly clicking a mouse button; and f) contraindication for MRI scanning such as braces, claustrophobia, or metal implants. Exclusionary criteria for parents included: a) pervasive developmental disorders, mental retardation, selective mutism, bipolar disorder, psychotic disorders, or drug/alcohol abuse or dependence; b) living with the child for less than 1 year prior to the start of the study; or c) a suicide attempt within the past 6 months. Children were excluded from participation when the parent was excluded, and parents were excluded if the child was excluded (unless the parent participated with another child).

### Procedure

All procedures were reviewed and approved by the Yale University Institutional Review Board. Data for this study were assessed across two distinct timepoints: pre-pandemic measures collected prior to the onset of the COVID-19 pandemic and mid-pandemic measures collected during the early months of the pandemic. Prior to the onset of the COVID-19 pandemic, all parent-child dyads completed an initial clinical assessment, during which they completed the ADIS-C/P and provided their informed consent/assent. Following this clinical assessment, child participants completed an fMRI task probing parental modulation of children's amygdala reactivity to fearful faces. All

**Table 1.** Demographic Information

| | Participants |
|---|---|
| N | 28 |
| Female [N (%)] | 10 (35.71) |
| Male [N (%)] | 18 (64.29) |
| Child Age at Scan [years, M (SD)] | 8.39 (1.83) |
| Child Age at Time of Mid-Pandemic Measures [years, M (SD)] | 9.28 (1.87) |
| Race [N (%)] | |
| Black or African American | 1 (3.57) |
| White | 25 (89.29) |
| Multiracial | 2 (7.14) |
| Ethnicity [N (%)] | |
| Hispanic or Latino | 2 (7.14) |
| Not Hispanic or Latino | 26 (92.86) |

scanning sessions occurred prior to the pandemic. In the late spring and early summer of 2020, shortly following the onset of the pandemic, parents were re-contacted via phone and email and offered the opportunity to complete additional online questionnaires regarding their family's exposure to COVID-19-related stress, their child's COVID-19-related fears and behaviors, and their own functioning and parenting behaviors during this phase of the pandemic. Parents completed these questionnaires between May and July of 2020, shortly following the first peak in daily COVID-19 infections and deaths and in the midst of significant social distancing requirements in Connecticut (i.e., ongoing school closures and restrictions on social gatherings; *COVID-19 Projections*, 2021; *Governor Lamont Provides Update on Connecticut's Coronavirus Response Efforts*, 2020). In the current study, only one parent (the child's mother) was contacted to complete these questionnaires. Mid-pandemic questionnaire data were collected and managed using Research Electronic Data Capture (REDCap) tools (Harris et al., 2019; Harris et al., 2009). The average number of days between the pre-pandemic scanning visit and completion of the mid-pandemic questionnaires was 326.32 days (range: 76-568 days).

All participants received treatment at the Yale Child Study Center as part of the larger RCT. In addition, participants received monetary compensation ($50) for their participation in the MRI scanning session, as well as an additional $50 if they completed all components of the session. Participants also received monetary compensation ($15) for completing the COVID-19-related questionnaires.

**Measured Variables**

**Pre-Pandemic.**

***Parental Modulation of their Child's Amygdala Reactivity.*** Child participants completed an fMRI task probing the degree to which amygdala reactivity to fearful and neutral faces differed in the presence versus absence of a parent. During the event-related fMRI paradigm, participants viewed faces exhibiting fearful expressions interspersed among faces exhibiting neutral expressions. Face stimuli were selected from the NimStim set of facial expressions (Tottenham et al., 2009). The presentation of stimuli was randomized and fixed across participants. Each of the two runs consisted of 48 trials (24 fearful and 24 neutral faces), with each face presented for 500 ms. Children were instructed to press a button each time they saw a neutral face to ensure attention to the task. In one run of this task ("Parent-Present"), the parent was physically present in the scanner room and held their child's hand during the scan. While in the scanner room, parents were unable to see the face stimuli that their child was viewing. Parent and child participants were instructed not to converse during the task and to gently hold each other's hands without squeezing or intertwining their fingers. In the other run ("Parent-Absent"), the child completed the task alone. The order of the two runs, Parent-Present and Parent-Absent, was counterbalanced across consecutive participants. The metric of interest in this study was the difference in amygdala reactivity to fearful versus neutral faces in the Parent-Present versus Parent-Alone runs (see below).

**Mid-Pandemic.**

***Family Exposure to COVID-19-Related Stress (EPII-Parent)***. Parents reported on their family's exposure to COVID-19-related stress using a modified version of the Epidemic-Pandemic Impacts Inventory (EPII-Parent; Grasso et al., 2020). The EPII-Parent is a 92-item measure that assesses the impacts of epidemics and pandemics on eight domains of personal and family life: work and employment, education and training, home life, social activities, economic wellbeing, emotional health and wellbeing, physical health problems, and physical distancing and quarantine. At the end of each set of questions assessing a certain domain of personal or family life, we added a question probing the amount of distress felt regarding that domain (e.g., "In general, what is the level of distress you have experienced with regard to the impact of the COVID-19 outbreak on your or your family's *work and employment*?"). These questions were answered on a 7-point Likert scale ranging from 1 ("Mildly distressing") to 7 ("Highly distressing"), modeled after the COVID-19 and Perinatal Experiences (COPE) study (Thomason et al., 2020). As in previous work, these eight items assessing distress across the eight domains were summed to form a composite score (Cohodes, McCauley, et al., 2021). In the current sample, Cronbach's alpha for the composite score of family exposure to COVID-19-related stress was .89.

***Child's COVID-19-Related Fears and Behaviors (FIVE-Parent)***. Parents reported on their child's fear and behaviors related to the COVID-19 pandemic using the Fear of Illness and Virus Evaluation (FIVE-Parent; Ehrenreich-May, 2020). The FIVE-Parent is composed of 35 items divided among four subscales: fears about contamination and illness, fears about social distancing, behaviors related to illness and virus fears (e.g., "My child checks the internet for illness or virus information"), and impact of illness and virus fears (Ehrenreich-May, 2020). In the current project, the subscale for fears about contamination and illness and the subscale for behaviors related to illness and virus fears were isolated as metrics of interest. Across subscales, parents rated each question on a four-point Likert scale ranging from 1 to 4. The subscale for fears about contamination and illness included options ranging from "My child is not afraid of this at all" (1) to "My child is afraid of this all the time" (4). The subscale for behaviors related to illness and virus fears included options ranging from "My child did not do this last week" (1) to "My child did this all of the time last week" (4). Cronbach's alpha for the present sample was .84 for the fears about contamination and illness subscale and .77 for the behaviors related to illness and virus fears subscale.

***Parent's COVID-19-Related Fears and Behaviors (FIVE-Adult)***. Additionally, parents completed a second version of the Fear of Illness and Virus Evaluation (FIVE-Adult) assessing their own fears and behaviors in relation to the COVID-19 pandemic (Ehrenreich-May, 2020). Like the FIVE-Parent, the FIVE-Adult is composed of four identical subscales, totaling 35 items, which were rated on a four-point Likert scale from 1 (e.g., "I am not afraid of this at all") to 4 (e.g., "I am afraid of this all the time"). The fears about contamination and illness subscale and the behaviors relating to illness and virus fears subscale were again isolated as metrics of interest for the present study. Cronbach's alpha for the present sample was .89 for the fears about contamination and illness subscale and .71 for the behaviors related to illness and virus fears subscale. As is the case for the FIVE-Parent, additional psychometric data are not yet available for this measure.

***Family Accommodation (FASA).*** Parents completed the Family Accommodation Scale–Anxiety (FASA; Lebowitz et al., 2013) as a measure of family accommodation. The first 9 items ask parents to report on the frequency of their engagement in specific accommodation behaviors using a 5-point Likert-type scale ranging from 0 ("Never") to 4 ("Daily"). These items are summed to calculate a total accommodation score (possible scores ranging from 0 to 36), which was the metric used in the current study. The FASA includes 5 additional items examining parental distress associated with this accommodation and the perceived consequences for their child of not engaging in accommodating behavior. The FASA has good internal consistency, discriminant validity, and high interrater reliability and test-retest reliability (Lebowitz et al., 2019; Lebowitz et al., 2013). In the current sample, Cronbach's alpha for the total accommodation score was .92.

***Parental Anxiety (BAI)***. Parents completed the Beck Anxiety Inventory (BAI; Beck et al., 1988) as a self-report measure of parental anxiety. The BAI includes 21 items assessing common symptoms of anxiety (e.g., "heart pounding/racing") on a 4-point Likert-type scale ranging from 0 ("Not at all") to 3 ("Severely—it bothered me a lot"). The total score was the sum of the 21 items assessed. The BAI has demonstrated high test-retest reliability and good convergent and discriminant validity (Beck et al., 1988). Cronbach's alpha in the present sample was .89.

***Parental Assistance with their Child's Emotion Regulation Strategies (PACER)***. The Parental Assistance with Child Emotion Regulation (PACER; Cohodes, Preece, et al., 2021) questionnaire was used to assess the role of parents in promoting children's emotion regulation skills. The PACER questionnaire is composed of 50 items assessing parental assistance with their child's emotion regulation across 10 different strategies, including both prototypically adaptive and prototypically maladaptive strategies: acceptance, avoidance, behavioral disengagement, distraction, expressive suppression, problem-solving, reappraisal, rumination, social support search, and venting. Parents were instructed to rate the degree to which the questions related to their experiences with their child's emotions on a Likert-type scale of 1 ("Strongly disagree") to 7 ("Strongly agree"). The PACER has generally adequate test-retest reliability, as well as good convergent validity (Cohodes, Preece, et al., 2021). For this study, Cronbach's alpha for the 10 measured areas ranged between .79 and .96.

**Neuroimaging Data Acquisition and Analysis.**

***Acquisition of fMRI Data.*** To help children acclimate to the scan environment and to minimize motion during the scan, participants engaged in two practice scans in a mock scanner: one during the initial screening visit and another at the start of the MRI visit. Mock scans were performed in replicas of the actual scanner with real-time motion feedback provided to help children practice staying still. The imaging data used in this study were acquired on one of two 3.0 Tesla Siemens MAGNETOM Prisma scanners (Siemens, Erlangen, Germany) at the Yale Magnetic Resonance Research Center ($n$ = 4) and the Yale Brain Imaging Center ($n$ = 24) using a 32-channel head coil. Scan parameters were modeled on the imaging data collection used in the Adolescent Brain Cognitive Development Study (Casey et al., 2018). The parental presence/absence task was completed across 2 whole-brain echo-planar imaging (EPI) scans (292 continuous BOLD volumes, voxel size = 2.4 mm x 2.4 mm x 2.4 mm; repetition time [TR] = 809 ms; echo time [TE] = 32 ms; flip angle = 54°; base resolution = 96; field of view [FOV] = 230 mm). Immediately before these functional scans, two spin echo EPI scans with opposite phase encoding directions were collected to correct for spatial distortion. Additionally, a high-resolution, T1-weighted, whole-brain anatomical magnetization-prepared rapid acquisition gradient echo (MPRAGE) scan was collected for localization, co-registration, and normalization (176 slices in the sagittal plane, voxel size =1.0 mm x 1.0 mm x 1.0 mm, TR = 2500 ms, TE = 2.9 ms, flip angle = 8°, FOV = 256 mm).

***Preprocessing of fMRI Data.*** Using heudiconv (www.github.com/nipy/heudiconv), raw neuroimaging data were converted to Brain Imagining Data Structure (BIDS; Gorgolewski et al., 2016). These data were then preprocessed in line with the Human Connectome Project minimal preprocessing pipeline (Glasser et al., 2013) using the BIDS app (www.github.com/BIDS-Apps/HCPPipelines). Preprocessing included removing the first eight timepoints of functional scans to avoid signal inhomogeneity as the magnetic field stabilized, correcting for gradient distortion, preprocessing and correcting for distortion in EPI field maps, correcting for motion, non-linearly registering the functional data to the Montreal Neurological Institute template (MNI 152, 2mm space), and normalizing intensity to a global mean. Specifically, spin echo EPI scans with opposite phase encoding directions (Andersson et al., 2003; Smith et al., 2004) were used to correct EPI fMRI images. The results from the fMRIVolume preprocessing pipeline were used in all analyses (Glasser et al., 2013; Meyer et al., 2019).

***Analysis of fMRI Data.*** Individual-level analyses were conducted using the Functional Magnetic Resonance Imaging of the Brain (FMRIB) Software Library (FSL, https://fsl.fmrib.ox.ac.uk/fsl) version 6.0.1's FMRI Expert Analysis Tool (FEAT) Version 6.00. In these lower-level FEAT analyses, predictors for each stimulus type (i.e., fearful or neutral face) were convolved with a double-gamma canonical hemodynamic response function (HRF). To account for slice-timing differences and variability in HRF delay across regions, temporal derivatives of each predictor were added to the general linear model as confound terms. Timeseries were high-pass filtered with a cutoff estimated for each subject using FSL's *cutoffcalc* function (range: 90-136 seconds), and timeseries were prewhitened within FMRIB's Improved Linear Model (FILM) in order to correct for autocorrelations in the timeseries.

To limit the potential effects of motion on task-related results, fMRI data were subjected to rigorous motion correction, in line with previous work from our group (Meyer et al., 2019). Motion parameters obtained from FSL's Motion Correction FMRIB's Linear Image Registration Tool (MCFLIRT; Jenkinson et al., 2002), including parameters for motion in each of the 6 rigid directions and their temporal derivatives, were included as nuisance regressors in each participant's lower-level design matrix. In addition, regressors were added to address the effect of intermediate to large motion, which corrupts images such that linear motion parameter regression methods cannot correct the images without disrupting the temporal structure of the timeseries (Meyer et al., 2019). Within each participant's data, timepoints that were corrupted by large motion were detected using FSL's *fsl_motion_outliers* (https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FSLMotionOutliers) function. Outliers were defined using the default definition of outliers (i.e., 1.5 times the interquartile range above the upper quartile; Tukey, 1977) and using framewise displacement (FD; Power et al., 2012) as the motion metric. The participant-specific confound matrix created by this function included a regressor for every detected outlier timepoint for that participant. To regress out the effect of these timepoints on the results, these participant-specific confound matrices were added to the participant-specific lower-level design matrix.

Based on prior research on threat and anxiety disorders, the amygdala was isolated as a region of interest (ROI). The amygdala ROIs (right and left) were derived from FSL's Juelich histological atlas (Amunts et al., 2005; Gabard-Durnam et al., 2014). Mean percent signal change for the fearful versus neutral face contrast was extracted for these ROIs for each of the two task runs using FSL's featquery tool.

To compare neural reactivity across the two task runs, mean percent signal change for fearful versus neutral faces during the Parent-Absent run was subtracted from mean percent signal change during the Parent-Present run, resulting in an index of the difference in amygdala reactivity in the presence versus absence of a parent.

### Statistical Analyses

All hypotheses and analyses were pre-registered on the Open Science Framework website prior to analysis of the data, and the pre-registration was embargoed to prevent modification (*https://osf.io/cu9h7/?view_only=736fe1f0080f49788a4aff71abb2d9c3*). There were no deviations from the analysis plan.

Our first aim was to isolate patterns of association among family-level factors during the COVID-19 pandemic in children with a history of anxiety disorders. We conducted two separate Pearson's correlations to examine the concordance between parent and child COVID-19-related fears and behaviors. Using a series of Pearson's correlations, we then examined the relations among the measured mid-pandemic family-level factors that were selected *a priori* (i.e., family accommodation, parental anxiety, and parental assistance with their child's emotion regulation across 10 pre-selected strategies).

Our second aim was to evaluate potential pre- and mid-pandemic moderators of the association between children's exposure to COVID-19-related stress and, separately, their COVID-19-related fears and behaviors. To test whether the pre-pandemic measure (i.e., the degree to which parental presence was associated with differential amygdala reactivity to fearful faces) moderated this association, we conducted two sets of linear models with differing dependent variables: COVID-19-related fears and COVID-19-related behaviors. In all models, exposure to COVID-19-related stress was the independent variable, the degree to which parental presence affected a child's amygdala reactivity to fearful faces was the moderator (with separate analyses for the left and right amygdala), and the child's age at the time of the scan and the number of days between the scan and completion of the mid-pandemic questionnaires were included as covariates.

To test whether the mid-pandemic measures (i.e., concurrent family-level factors) moderated this association between COVID-19-related stress and COVID-19-related fears and behaviors, we conducted another series of two sets of linear models: one with COVID-19-related fears as the dependent variable, and one with COVID-19-related behaviors as the dependent variable. For all models, the independent variable was exposure to COVID-19-related stress.

All correlation and moderation analyses were conducted in R (R Core Team, 2021) and used an alpha of .05. Predictors were mean centered in all linear models. Simple slopes analyses (using the mean, greater than 1 standard deviation above the mean, and less than 1 standard deviation below the mean as conditional values of the moderator; Cohen & Cohen, 1983) and the Johnson-Neyman approach were used to probe all significant interactions using the *interactions* package (Long, 2019). Across measures, outliers were defined as values more extreme than 3 standard deviations from the mean. The following measures each had a single outlier: parental anxiety, parent's COVID-19-related fears, and child's COVID-19-related behaviors (resulting $n = 27$ for these analyses). Furthermore, 3 participants were excluded from analyses involving fMRI data because their in-scanner mean absolute translational motion in any of the 6 rigid directions was above 5 mm in either task run ($n = 1$) or because greater than 15% percent of their data would need to be regressed out due to motion outlier timepoints as determined by FD ($n = 2$; resulting $n$ for analyses involving fMRI data = 25).

## Results

### Examining Patterns of Association among Family-Level Factors during the COVID-19 Pandemic

We detected a large,[1] positive correlation between parents' COVID-19-related fears and their child's COVID-19-related fears, $r(25) = .51$, $p = .007$. Similarly, there was a large, positive correlation between parents' COVID-19-related behaviors and their child's COVID-19-related behaviors, $r(25) = .54$, $p = .004$.

We detected a large, positive correlation between family accommodation and parental assistance with their child's use of distraction to regulate their emotions, $r(26) = .52$, $p = .005$. There was also a moderate, positive correlation between family accommodation and parental assistance with their child's use of reappraisal to regulate their emotions, $r(26) = .40$, $p = .036$. Furthermore, we detected a moderate, negative correlation between family accommodation and parental assistance with their child's use of venting to regulate their emotions, $r(26) = -.39$, $p = .038$. Family accommodation was not significantly correlated with any of the other mid-pandemic family-level factors (see Table 2 for pairwise correlations between all measured mid-pandemic family-level factors).

There was a large, positive correlation between parental anxiety and parental assistance with their child's use of expressive suppression to regulate their emotions, $r(25) = .51$, $p = .006$. Parental anxiety was not significantly correlated with any of the other mid-

**Table 2.** Pairwise Correlations among Family-Level Factors during the COVID-19 Pandemic

| | Parental Assistance with their Child's Emotion Regulation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Acceptance | Avoidance | Behavioral Disengagement | Distraction | Expressive Suppression | Problem Solving | Reappraisal | Rumination | Social Support Search | Venting |
| Family Accommodation | -.06 | .37 | .06 | .52** | .19 | .08 | .40* | .07 | .22 | -.39* |
| Parental Anxiety | .10 | .22 | .30 | -.02 | .51** | -.18 | .10 | -.22 | -.05 | -.10 |
| Parental Assistance with their Child's Emotion Regulation | | | | | | | | | | |
| Acceptance | - | -.15 | -.08 | .08 | -.48** | .30 | .02 | -.30 | .24 | .01 |
| Avoidance | -.15 | - | .71*** | .37 | .38* | .11 | .42* | .05 | .47* | -.21 |
| Behavioral Disengagement | -.08 | .71*** | - | .34 | .19 | .13 | .21 | -.08 | .20 | .05 |
| Distraction | .08 | .37 | .34 | - | -.05 | .56** | .71*** | -.16 | .45* | -.09 |
| Expressive Suppression | -.48** | .38* | .19 | -.05 | - | -.26 | .06 | .25 | -.21 | -.39* |
| Problem Solving | .30 | .11 | .13 | .56** | -.26 | - | .52** | -.35 | .48** | .01 |
| Reappraisal | .02 | .42* | .21 | .71*** | .06 | .52** | - | -.16 | .48** | -.28 |
| Rumination | -.30 | .05 | -.08 | -.16 | .25 | -.35 | -.16 | - | -.42* | -.16 |
| Social Support Search | .24 | .47* | .20 | .45* | -.21 | .48** | .48** | -.42* | - | .11 |
| Venting | .01 | -.21 | .05 | -.09 | -.39 | .01 | -.28 | -.16 | .11 | - |

*Note.* [a] Family Accommodation = Family Accommodation Scale for Anxiety (Lebowitz et al., 2013).
[b] Parental Anxiety = Beck Anxiety Inventory (Beck et al., 1988).
[c] Parental Assistance with their Child's Emotion Regulation = Parental Assistance with Child Emotion Regulation Questionnaire (10 subscales; Cohodes, Preece, et al., 2021).
* $p < .05$; ** $p < .01$; *** $p < .001$.

**Table 3.** *Regression Testing Pre-Pandemic Parental Modulation of Right Amygdala Reactivity as a Moderator of the Association between Exposure to COVID-Related Stress and Children's COVID-Related Fears*

| Predictor | *b* | *SE(b)* | β | *t* | Sig. (*p*) |
|---|---|---|---|---|---|
| Intercept | 12.52 | 0.56 | .00 | 22.42 | <.001*** |
| COVID-related stress[a] | 0.01 | 0.07 | .03 | 0.16 | .878 |
| Parental modulation of right amygdala reactivity[b] | 0.37 | 2.62 | .03 | 0.14 | .890 |
| Child age at scan | 0.79 | 0.34 | .44 | 2.31 | .032* |
| Days between scan and mid-pandemic questionnaires | -0.003 | 0.004 | -.16 | -0.88 | .388 |
| COVID-related stress*Parental modulation of right amygdala reactivity[b] | 0.91 | 0.30 | .58 | 3.00 | .007** |

*Note.* Adjusted R-squared = .28
[a] COVID-related stress = Modified Epidemic-Pandemic Impacts Inventory (EPII-Parent; Grasso et al., 2020).
[b] Parental modulation of right amygdala reactivity = difference in child's right amygdala reactivity to fearful faces (relative to neutral faces) in the presence versus absence of a parent prior to the pandemic.
* $p < .05$; ** $p < .01$; *** $p < .001$

**Table 4.** Regression Testing Pre-Pandemic Parental Modulation of Left Amygdala Reactivity as a Moderator of the Association between Exposure to COVID-Related Stress and Children's COVID-Related Behaviors

| Predictor | *b* | *SE(b)* | β | *t* | Sig. (p) |
|---|---|---|---|---|---|
| Intercept | 26.86 | 0.88 | .00 | 30.51 | <.001*** |
| COVID-related stress[a] | -0.02 | 0.10 | -.04 | -0.19 | .853 |
| Parental moderation of left amygdala reactivity[b] | 1.51 | 2.48 | .12 | 0.61 | .552 |
| Child age at scan | 1.29 | 0.51 | .48 | 2.55 | .020* |
| Days between scan and mid-pandemic questionnaires | -0.01 | 0.01 | -.25 | -1.33 | .202 |
| COVID-related stress[a] * Parental modulation of left amygdala reactivity[b] | -0.63 | 0.24 | -.46 | -2.62 | .017* |

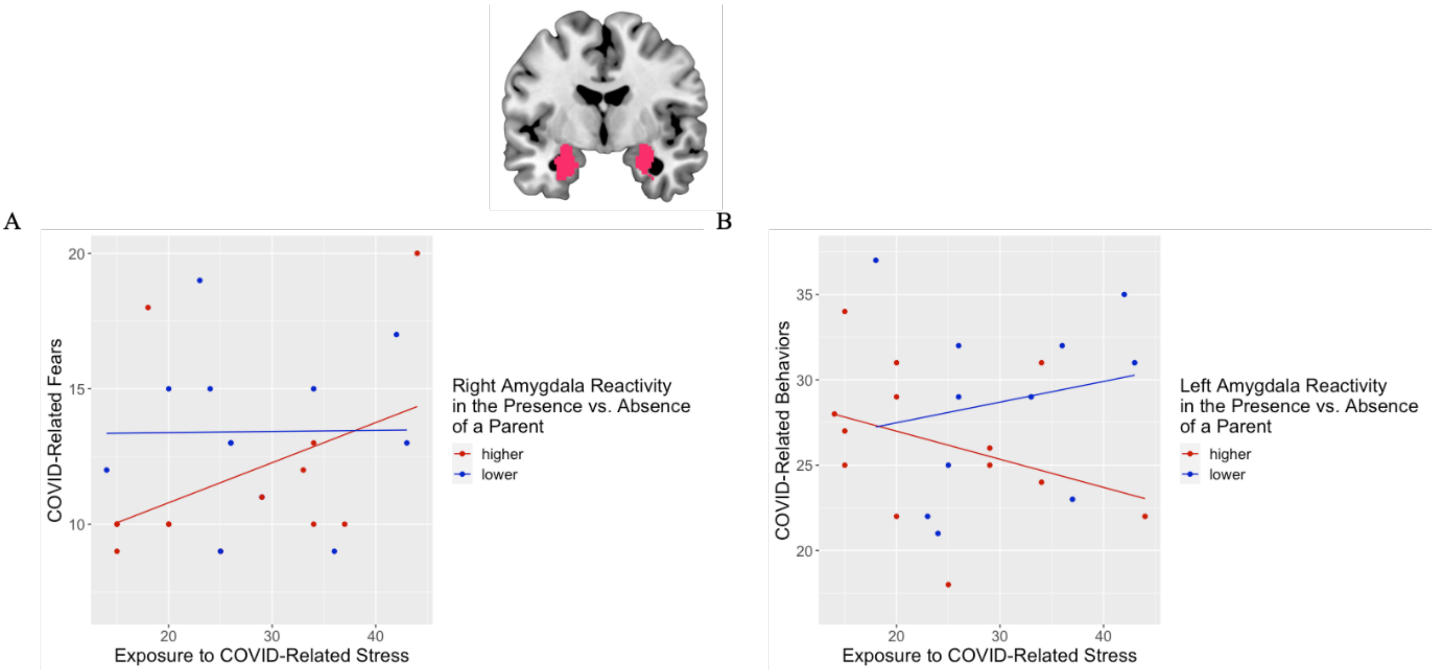
*Note.* Adjusted R-squared = .30
[a] COVID-related stress = Modified Epidemic-Pandemic Impacts Inventory (EPII-Parent; Grasso et al., 2020).
[b] Parental modulation of left amygdala reactivity = difference in child's left amygdala reactivity to fearful faces (relative to neutral faces) in the presence versus absence of a parent prior to the pandemic.
* $p < .05$; *** $p < .001$

**Table 5.** Regression Testing Mid-Pandemic Parental Assistance with their Child's Use of Venting as a Moderator of the Association between Exposure to COVID-Related Stress and Children's COVID-Related Fears

| Predictor | *b* | *SE(b)* | β | *t* | Sig. (p) |
|---|---|---|---|---|---|
| Intercept | 12.67 | 0.55 | .00 | 23.19 | <.001*** |
| COVID-related stress[a] | 0.11 | 0.06 | .33 | 1.84 | .078 |
| Parental assistance with their child's use of venting[b] | 0.04 | 0.13 | .06 | 0.32 | .750 |
| COVID-related stress[a] * Parental assistance with their child's use of venting[b] | 0.03 | 0.01 | .44 | 2.32 | .029* |

*Note.* Adjusted R-squared = .16
[a] COVID-19-related stress = Modified Epidemic-Pandemic Impacts Inventory (EPII-Parent; Grasso et al., 2020).
[b] Parental assistance with their child's use of venting = Parental Assistance with Child Emotion Regulation Questionnaire, Venting Subscale (Cohodes, Preece, et al., 2021).
* $p < .05$; *** $p < .001$

**Figure 1.** Pre-Pandemic Moderators of the Association between Exposure to COVID-Related Stress and COVID-Related Fears and Behaviors




*Note.* The association between children's exposure to COVID-related stress and their COVID-related fears was moderated by the difference in pre-pandemic right amygdala reactivity to fearful faces (relative to neutral faces) in the presence versus absence of a parent (A). The association between children's exposure to COVID-related stress and their COVID-related behaviors was moderated by the difference in pre-pandemic left amygdala reactivity to fearful faces (relative to neutral faces) in the presence versus absence of a parent (B). Analyses were run with amygdala reactivity as a continuous variable; the figures show median splits in amygdala reactivity for visualization purposes only.

pandemic family-level factors (see Table 2 for pairwise correlations between all measured mid-pandemic family-level factors).

**Examining Potential Moderators of the Association between Children's Exposure to COVID-19-Related Stress and their COVID-19-Related Fears and Behaviors**

**Pre-Pandemic Moderators.**

***COVID-19-Related Fears.*** The difference in right amygdala reactivity to fearful versus neutral faces in the presence versus absence of a parent moderated the association between a child's exposure to COVID-19-related stress and their COVID-19-related fears, $b$ = 0.91, $SE$ = 0.30, β = .58, $t$(19) = 3.00, $p$ = .007 (Table 3). Children who exhibited higher right amygdala reactivity to fearful faces (relative to neutral faces) when in the presence of their parent versus when alone showed a significant, positive association between exposure to COVID-19-related stress and their COVID-19-related fears, $b$ = 0.22, $SE$ = 0.08, $t$ = 2.73, $p$ = .013. By contrast, the association between children's COVID-19-related stress and their COVID-19-related fears was not significant for children who exhibited decreases or relatively smaller increases in right amygdala reactivity to fearful faces (relative to neutral faces) when in the presence of their parent versus alone, $p$ > .05 (Figure 1A).

To further probe this significant interaction, we used the Johnson-Neyman approach to assess the conditional effect of children's exposure to COVID-19-related stress on their COVID-19-related fears across all levels of parental modulation of amygdala reactivity (Preacher et al., 2006). There was a significant, positive association between COVID-19-related stress and children's COVID-19-related fears when the difference between right amygdala reactivity to fearful (versus neutral) faces in the presence of a parent versus alone was more than 0.64 standard deviations above the mean. By contrast, there was a significant, negative association between COVID-19-related stress and children's COVID-19-related fears when the difference in right amygdala reactivity in the presence of a parent versus alone was lower than 1.44 standard deviations below the mean, although there were limited data in this range in the current sample (Figure 2A).

The difference in left amygdala reactivity to fearful versus neutral faces in the presence versus absence of

**Table 6.** Regression Testing Mid-Pandemic Parental Assistance with their Child's Use of Expressive Suppression as a Moderator of the Association between Exposure to COVID-Related Stress and Children's COVID-Related Behaviors

| Predictor | *b* | *SE(b)* | β | *t* | Sig. (p) |
|---|---|---|---|---|---|
| Intercept | 26.97 | 0.88 | .00 | 30.77 | <.001*** |
| COVID-related stress[a] | 0.05 | 0.10 | .09 | 0.48 | .636 |
| Parental assistance with their child's use of expressive suppression[b] | 0.03 | 0.16 | .04 | 0.19 | .854 |
| COVID-related stress[a] * Parental assistance with their child's use of expressive suppression[b] | 0.04 | 0.02 | .45 | 2.41 | .024* |

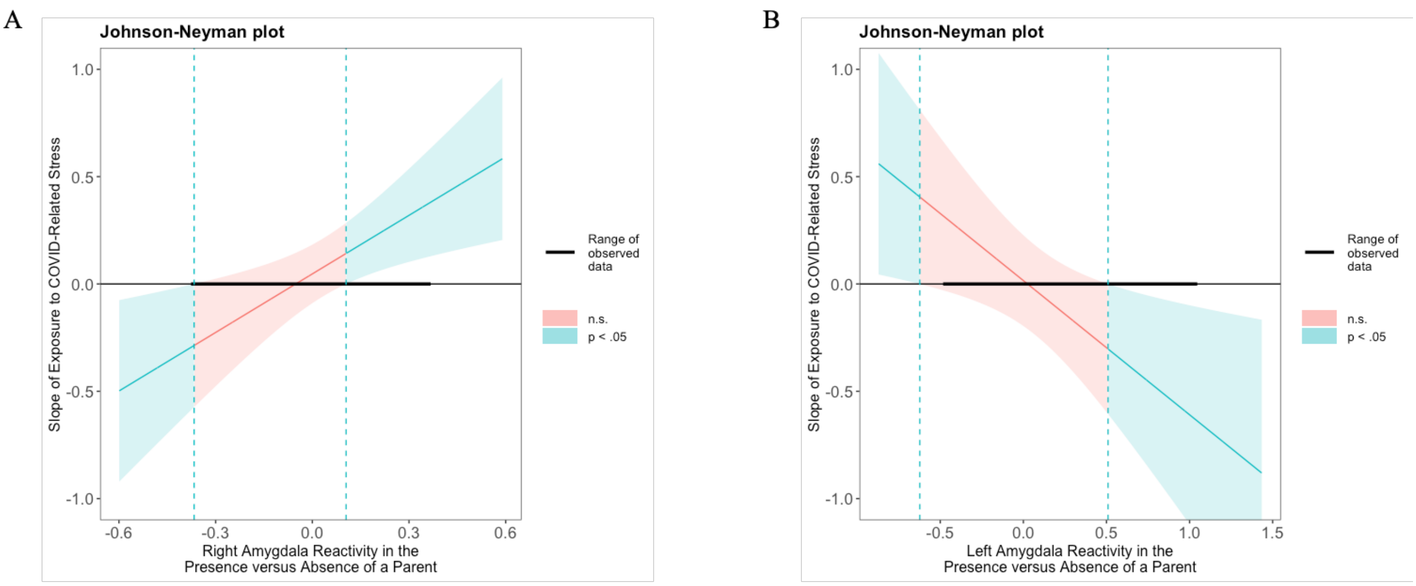
*Note.* Adjusted R-squared = .10

[a] COVID-related stress = Modified Epidemic-Pandemic Impacts Inventory (EPII-Parent; Grasso et al., 2020).

[b] Parental assistance with their child's use of expressive suppression = Parental Assistance with Child Emotion Regulation Questionnaire, Expressive Suppression Subscale (Cohodes, Preece, et al., 2021).

* $p < .05$; *** $p < .001$

**Figure 2.** Johnson-Neyman Plots for the Conditional Effect of Exposure to COVID-Related Stress on COVID-Related Fears and Behaviors at Varying Levels of Pre-Pandemic Parental Modulation of Amygdala Reactivity

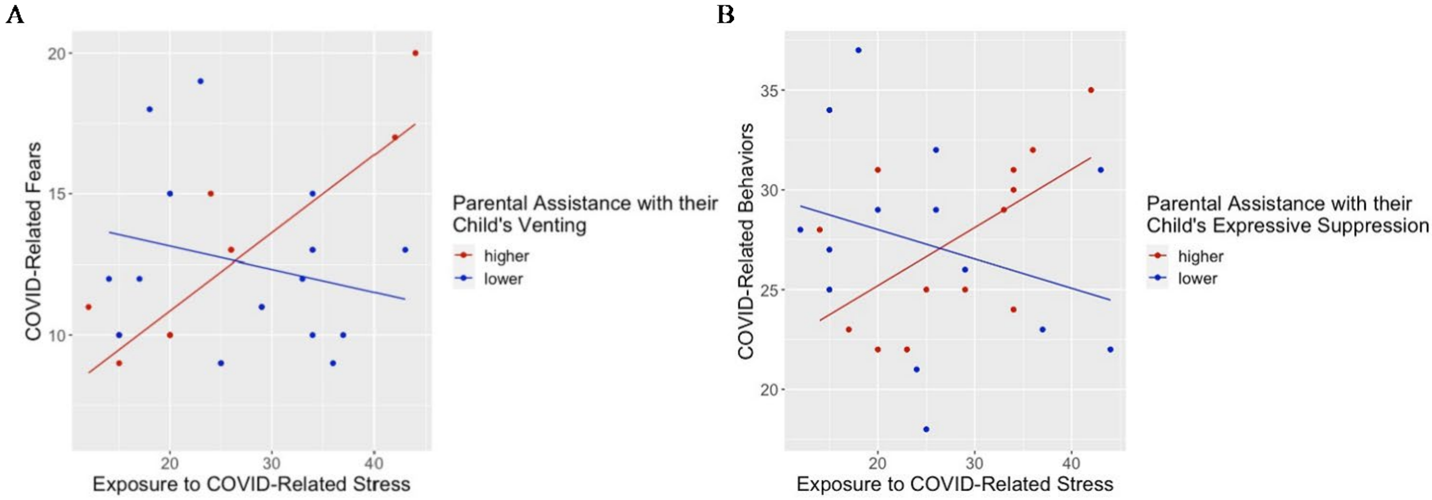



*Note.* The slope of the association between exposure to COVID-related stress and children's COVID-related fears was significant (p < .05) and positive when the difference in a child's right amygdala reactivity to fearful (versus neutral) faces in the presence of a parent versus alone (A) was above a value of 0.11 (0.64 standard deviations above the mean), and the slope of the association was significant and negative when the difference in right amygdala reactivity was below a value of -0.37 (1.44 standard deviations below the mean). The slope of the association between exposure to COVID-related stress and children's COVID-related behaviors was significant and negative when the difference in a child's left amygdala reactivity to fearful (versus neutral) faces in the presence of a parent versus alone (B) was above a value of 0.51 (1.15 standard deviations above the mean), and the slope of the association was significant and positive when the difference in right amygdala reactivity was below a value of -0.62 (1.72 standard deviations below the mean).

a parent did not moderate the association between a child's exposure to COVID-19-related stress and their COVID-19-related fears, $p > .05$.

***COVID-19-Related Behaviors.*** The difference in left amygdala reactivity to fearful versus neutral faces in the presence versus absence of a parent moderated the association between a child's exposure to COVID-

**Figure 3.** Mid-Pandemic Moderators of the Association between Exposure to COVID-Related Stress and COVID-Related Fears and Behavior




*Note.* The association between children's exposure to COVID-related stress and their COVID-related fears was moderated by concurrent parental assistance with their child's use of venting (A). The association between children's exposure to COVID-related stress and their COVID-related behaviors was moderated by concurrent parental assistance with their child's use of expressive suppression (B). Analyses were run with the moderators as continuous variables; the figures show median splits for visualization purposes only.

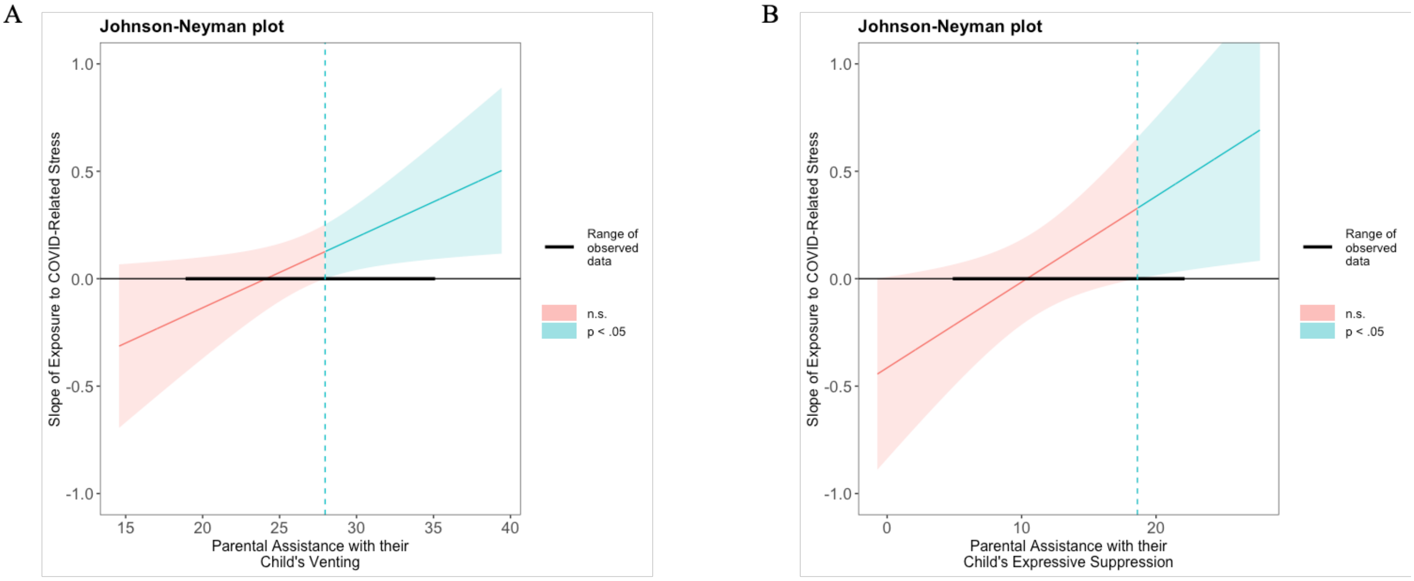
19-related stress and their COVID-19-related behaviors, $b = -0.63$, $SE = 0.24$, $\beta = -.46$, $t(18) = -2.62$, $p = .017$ (Table 4). None of the simple slopes for this interaction reached significance at $p < .05$. However, the association between exposure to COVID-19-related stress and COVID-19-related behaviors approached significance in children who exhibited higher left amygdala reactivity to fearful faces (relative to neutral faces) when in the presence of their parent versus when alone, $b = -0.28$, $SE = 0.14$, $t = -2.02$, $p = .059$ (Figure 1B). Johnson-Neyman analyses indicated that there was a significant, negative association between COVID-19-related stress and children's COVID-19-related behaviors when the difference between left amygdala reactivity to fearful (versus neutral) faces in the presence of a parent versus alone was more than 1.15 standard deviations above the mean. By contrast, Johnson-Neyman analyses indicated that there would be a significant, positive association between COVID-19-related stress and children's COVID-19-related behaviors when the difference in left amygdala reactivity in the presence of a parent versus alone was lower than 1.72 standard deviations below the mean, although there were no data in this range in the current sample (Figure 2B).

The difference in right amygdala reactivity to fearful versus neutral faces in the presence versus absence of a parent did not significantly moderate the association between a child's exposure to COVID-19-related stress and their COVID-19-related behaviors, $p > .05$.

**Mid-Pandemic Moderators.**

***COVID-19-Related Fears***. Parental assistance with their child's use of venting to regulate their emotions moderated the association between a child's exposure to COVID-19-related stress and their COVID-19-related fears, $b = 0.03$, $SE = 0.01$, $\beta = .44$, $t(24) = 2.32$, $p = .029$ (Table 5). Children of parents who reported higher levels of assistance with their child's use of venting to regulate their emotions showed a significant, positive association between exposure to COVID-19-related stress and their COVID-19-related fears, $b = 0.26$, $SE = 0.09$, $t = 2.77$, $p = .011$. The association between a child's COVID-19-related stress and their COVID-19-related fears was not significant for children of parents who reported lower assistance with their child's use of venting to regulate their emotions (Figure 3). Johnson-Neyman analyses indicated that there was a significant, positive association between COVID-19-related stress and children's COVID-19-related fears when parental assistance with their child's use of venting to regulate their emotions was more than 0.11 standard deviations above the mean (Figure 4). No other mid-pandemic family-level factors (i.e., family accommodation, parental anxiety, and parental assistance with their child's use of other emotion regulation strategies) significantly moderated the

**Figure 4.** Johnson-Neyman Plots for the Conditional Effect of Exposure to COVID-Related Stress on COVID-Related Fears and Behaviors at Varying Levels of Mid-Pandemic Moderators




*Note.* The slope of the association between exposure to COVID-related stress and children's COVID-related fears was significant and positive ($p < .05$) when parental assistance with their child's use of venting (A) was above a value of 27.96 (0.11 standard deviations above the mean). The slope of the association between exposure to COVID-related stress and children's COVID-related behaviors was significant and positive ($p < .05$) when parental assistance with their child's use of expressive suppression (B) was above a value of 18.61 (1.25 standard deviations above the mean).

association between a child's COVID-19-related stress and their COVID-19-related fears, $p > .05$.

***COVID-19-Related Behaviors.*** Parental assistance with their child's use of expressive suppression to regulate their emotions moderated the association between a child's exposure to COVID-19-related stress and their COVID-19-related behaviors, $b = 0.04$, $SE = 0.02$, $\beta = .45$, $t(23) = 2.41$, $p = .024$ (Table 6). None of the simple slopes for this interaction reached significance at $p < .05$, although the association between exposure to COVID-19-related stress and COVID-19-related behaviors approached significance in children of parents who reported high levels of assistance with their child's use of expressive suppression to regulate their emotions, $b = 0.28$, $SE = 0.14$, $t = 1.96$, $p = .063$ (Figure 3). Johnson-Neyman analyses indicated that there was a significant, positive association between COVID-19-related stress and children's COVID-19-related behaviors when parental assistance with their child's use of expressive suppression to regulate their emotions was more than 1.25 standard deviations above the mean (Figure 4). No other mid-pandemic family-level factors (i.e., family accommodation, parental anxiety, and parental assistance with their child's use of other emotion regulation strategies) significantly moderated the association between a child's COVID-19-related stress and their COVID-19-related behaviors, $p > .05$.

## Discussion

Building upon a rapidly growing literature on the deleterious effects of the COVID-19-pandemic on children's internalizing symptoms, the present study addresses an important gap in our understanding of the effect of the COVID-19 pandemic on children with a history of anxiety disorders. The results of the present study offer preliminary insight into the ways in which specific family-level factors may buffer or exacerbate the effect of COVID-19-related stress for children in this high-risk population. Although constraints of the pandemic precluded collection of a larger sample, this study examines both pre- and mid-pandemic family-level factors using a neuroimaging task and questionnaire battery specifically designed to assess parent-child dynamics within a well-characterized, clinically vulnerable sample. Results highlight distinct patterns of association among specific mid-pandemic family-level factors, shedding light on the ways in which these factors may relate among this high-risk population in the context of a major stressor. Furthermore, a series of significant moderation effects indicate several key pre- and mid-pandemic family-level processes that may buffer or exacerbate the association between children's exposure to COVID-19-related stress and their fears and behaviors relating to the COVID-19-pandemic.

Parental modulation of children's pre-pandemic right amygdala reactivity moderated the association between exposure to COVID-19-related stress and COVID-19-related fears. Specifically, this positive association between stress exposure and COVID-19-related fears was only significant for children who showed higher pre-pandemic right amygdala reactivity to fearful (relative to neutral) faces when in the presence of a parent than when alone. Among children who showed decreases or smaller increases in right amygdala reactivity in the presence of their parent versus alone, exposure to COVID-19-related stress was not significantly associated with COVID-19-related fears. Past research has indicated that parental cues can buffer amygdala reactivity in children, as evidenced by suppressed right amygdala reactivity to cues of a parent versus cues of a stranger (Gee et al., 2014). Notably, this parental modulation of their child's right amygdala reactivity has been shown to relate to their child's behavioral regulation (Gee et al., 2014). The results of the current study suggest that this developmentally typical parental buffering of amygdala reactivity may further serve to buffer against the impacts of this major stressor on children with a history of anxiety disorders.

By contrast, parental modulation of children's pre-pandemic *left* amygdala reactivity moderated the association between exposure to COVID-19-related stress and COVID-19-related *behaviors.* Although the simple slopes did not reach significance, Johnson-Neyman analyses indicated a negative association between COVID-19-related stress and COVID-19-related behaviors within youth with greater increases in left amygdala reactivity to fearful versus neutral faces in the presence of their parent versus when alone. Whereas the presence of parental stimuli is associated with reduced right amygdala reactivity (Gee et al., 2014), parental cues have been linked with increased activation in the left amygdala (Tottenham et al., 2012). Moreover, elevated left amygdala reactivity to parental cues is associated with greater attachment-related behaviors towards the parent (Tottenham et al., 2012). If future studies find consistent patterns, the current analyses might indicate that patterns of attachment-related neural reactivity track with anxiety-related behaviors during periods of heightened stress in children with a history of anxiety disorders.

With regard to mid-pandemic measures, parental assistance with their child's use of venting to regulate their emotions was found to moderate the association between children's exposure to COVID-19-related stress and their COVID-19-related fears. This positive association was only significant in children whose parents reported higher levels of assistance with their child's venting. Generally considered a maladaptive coping strategy (Stanisławski, 2019), venting is associated with increased rumination after a stressful event (Cann et al., 2011), both immediate and long-term anxiety following a major stressor (Liverant et al., 2004), and, more broadly, both negative affect and general distress (Kato, 2015). Initial evidence suggests that these patterns of association also apply to children's functioning during the COVID-19 pandemic, as children's use of negative emotion-oriented coping strategies, including venting, may be associated with increased depressive symptoms following the onset of the COVID-19 pandemic (Duan et al., 2020). Thus, while evidence suggests that parental engagement in emotion coaching may buffer the effects of exposure to COVID-19-related stress on children's internalizing symptoms (Cohodes, McCauley, et al., 2021), parental assistance with their child's use of venting may in fact exacerbate the impact of exposure to COVID-19-related stress on children's COVID-19-related fears, particularly in children with a history of anxiety disorders.

Finally, mid-pandemic parental assistance with their child's use of expressive suppression to regulate their emotions moderated the association between children's exposure to COVID-19-related stress and their COVID-19-related behaviors. Although none of the simple slopes were significant for this interaction, Johnson-Neyman analyses indicated that the association between COVID-19-related stress exposure and a child's COVID-19-related behaviors was significant and positive for children whose parents reported greater (1.25 standard deviations above the mean or more) assistance with their child's use of expressive suppression. If supported by future research, this might indicate a similar exacerbation effect, whereby greater parental assistance with their child's use of expressive suppression during the pandemic exacerbates the effect of exposure to COVID-19-related stress. While further research with larger sample sizes will be necessary to tease apart this effect, this preliminary result is in line with prior research indicating an association between more frequent use of expressive suppression and greater youth internalizing symptoms following the onset of the COVID-19 pandemic (Weissman et al., 2021). Of note, parental assistance with expressive suppression was found to moderate the association between COVID-19-related stress and children's *behaviors* related to COVID-19, whereas mid-pandemic parental assistance with their child's use of venting moderated the association between COVID-19-related stress and children's *fears* related to COVID-19. As expressive suppression involves attempting to mask outward expressions of emotion (Butler et al., 2003; Gross & Cassidy, 2019), this specific emotion regulation strategy may be particularly tied to children's behavioral responses to COVID-19-related stress.

In the current study, we did not find evidence that family accommodation, parental anxiety, or parental assistance with other emotion regulation strategies moderated the association between exposure to COVID-19-related stress and COVID-19-related fears or behaviors. It is possible that aspects of our sample, such as the relatively small sample and sole inclusion of children with previously diagnosed anxiety disorders, could have contributed to these null findings. However, looking across the broader pattern of results presents an alternative potential interpretation. The two significant mid-pandemic moderators both fall within the category of response modulation (Cohodes et al., 2021; Gross, 1998). Such forms of response-focused emotion regulation, which attempt to inhibit or alter an ongoing negative emotion (Gross, 1998), may have been particularly detrimental to anxious children's responses to the chronic and pervasive stressor presented by the COVID-19 pandemic.

Of note, while parental assistance with both venting and expressive suppression were found to exacerbate the effects of exposure to COVID-19-related stress on children's responses to the COVID-19 pandemic, the two strategies were negatively correlated in the current sample. Furthermore, venting was found to be negatively associated with family accommodation, which is typically associated with the maintenance or exacerbation of anxiety in youth (Iniesta-Sepúlveda et al., 2020; La Buissonnière-Ariza et al., 2018). This pattern of results may provide insight into the nuanced role of family-level factors in anxious children's responses to stressors. While both venting and expressive suppression are considered prototypically maladaptive response modulation strategies, they involve vastly different approaches to modulating responses to negative emotions: venting involves focusing on expressing negative emotions, whereas expressive suppression involves attempting to dampen outward manifestations of negative emotions (John & Gross, 2004). Thus, while parental assistance with either strategy may have an exacerbating effect on different aspects of children's responses to the COVID-19 pandemic, it is perhaps unsurprising that the two would be negatively correlated with one another. With regards to family accommodation, it is possible that families that show high levels of family accommodation may be more likely to respond to their anxious child's distress by changing their own behaviors and/or schedules rather than by assisting with their child's use of venting. Future research will be necessary to continue exploring how these family-level factors interact to predict outcomes for children with anxiety disorders.

It is important to interpret these results in the context of several specific limitations entailed by the challenge of collecting data during the early months of the COVID-19 pandemic. First, as stated above, these findings should be considered preliminary given the relatively small sample size of the current study. While this study can play an important role in generating hypotheses for future research, the relatively small sample size raises concerns regarding the stability of the findings, which should be interpreted with caution. Furthermore, these results should be interpreted in the context of the limited demographic variability of the sample. Particularly given the clinical implications of this work and the long-standing detrimental effects of basing clinical recommendations on samples with limited inclusion of historically underrepresented racial and ethnic populations (Pina et al., 2019), it is essential that future research examine these preliminary findings in larger and more representative samples and across different types of stressors to examine the reliability and generalizability of these results.

Second, it is important to note that all mid-pandemic measures were reported by the parent. Given the established pattern of discrepancies between parents' and children's ratings of child psychopathology (De Los Reyes & Kazdin, 2005), it is possible that our results may have differed if we had collected children's perceptions of their COVID-19-related fears and behaviors. Notably, parents may have a different outlook on their parenting behaviors than their children, particularly when the parent is experiencing high levels of distress (Herbers et al., 2017). Moreover, as only one parent completed these questionnaires, we may have obtained different responses if we had incorporated both parents' perspectives in two-parent families. This approach of collecting only parent-reported mid-pandemic data, and only from one parent, allowed us to collect preliminary data on these family-level factors despite the inherent challenges of data collection during the first peak of the COVID-19 pandemic (Cohodes, McCauley, et al., 2021). Nevertheless, when interpreting these findings, it is necessary to emphasize that the mid-pandemic measures reflect one parent's perceptions, which may be biased by parents' own experiences with the COVID-19 pandemic.

Finally, it is important to highlight that these results capture family functioning during a distinct phase of the COVID-19 pandemic. Specifically, these data were collected early in the pandemic, shortly following the first peak in cases and deaths in the local area (*COVID-19 Projections*, 2021). This period may reflect a time of heightened uncertainty, fear, and social distancing requirements. While these data provide crucial insight into the family-level factors that may affect the responses of youth at clinical high risk for anxiety to major stressors, it is important to interpret the results in this temporal context. As the pandemic continues to affect children and families, future research will be important to identify the long-term role of relevant family-level factors on youth functioning in the context of this chronic stressor and thus to improve our ability to respond to future stressors.

In conclusion, this study provides preliminary but valuable insight into the buffering and exacerbating roles of specific family-level factors on the effect of the COVID-19 pandemic on children with a history of anxiety disorders. Results suggest that parental modulation of their child's amygdala reactivity and parental assistance with their child's use of venting and expressive suppression to regulate their emotions may impact the effects of the COVID-19 pandemic on this vulnerable population. While additional work will be necessary to further explore these initial findings, better understanding how children with elevated anxiety respond to this stressor in the context of distinct family-level factors may instrumentally improve our ability to respond to pandemic-related symptoms in this high-risk population and has the potential to inform future public health efforts aimed at supporting families with children with a history of anxiety disorders during periods of heightened stress triggered by public health emergencies.

## Footnotes

[1] Effect sizes interpreted based on conventions from Cohen (1988).

## Additional Information

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**Conflict of Interest**
The authors declare no conflict of interest.

**Ethical Approval**
All procedures were reviewed and approved by the Yale University Institutional Review Board.

**Data Availability**
The data used in this manuscript are available on request from the authors.

**Author CrediT Statement**
**Elizabeth R. Kitt:** Conceptualization, Formal Analysis, Writing – Original Draft, Visualization. **Emily M. Cohodes:** Conceptualization, Methodology, Investigation, Writing – Review & Editing. **Sarah McCauley:** Methodology, Investigation, Writing – Review & Editing. **Grace Hommel:** Investigation, Writing – Review & Editing. **Cristina Nardini:** Investigation, Writing – Review & Editing. **Sadie J. Zacharek:** Data Curation, Investigation, Writing – Review & Editing. **Alyssa Martino:** Investigation, Writing – Review & Editing. **Tess Anderson:** Investigation, Writing – Review & Editing. **Hannah Spencer:** Investigation, Writing – Review & Editing. **Paola Odriozola:** Methodology, Investigation, Writing – Review & Editing. **Georgia F. Spurrier:** Data Curation, Writing – Original Draft. **Alexis Broussard:** Data Curation, Investigation, Writing – Review & Editing. **Carla E. Marin:** Writing – Review & Editing, Supervision. **Wendy K. Silverman:** Writing – Review & Editing, Supervision, Funding acquisition. **Eli R. Lebowitz:** Conceptualization, Methodology, Writing – Review & Editing, Supervision, Funding acquisition. **Dylan G. Gee:** Conceptualization, Methodology, Writing – Review & Editing, Supervision, Funding acquisition.



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