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RESEARCH ARTICLE

Threat and deprivation are associated with distinct aspects of cognition, emotional processing, and psychopathology in children and adolescents

Julia Luiza Schäfer[1,2] | Katie A. McLaughlin[3] | Gisele Gus Manfro[1,2] | Pedro Pan[1,4] | Luis Augusto Rohde[1,2] | Eurípedes Constantino Miguel[1,5] | André Simioni[1,2] | Maurício Scopel Hoffmann[1,6,7] | Giovanni Abrahão Salum[1,2]

[1]National Institute of Developmental Psychiatry for Children and Adolescents (INCT-CNPq), São Paulo, Brazil

[2]Department of Psychiatry, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

[3]Department of Psychology, Harvard University, Cambridge, Massachusetts, USA

[4]Department of Psychiatry, Universidade Federal de São Paulo, São Paulo, Brazil

[5]Department & Institute of Psychiatry, University of São Paulo Medical School, São Paulo, Brazil

[6]Neuropsychiatry Departament, Universidade Federal de Santa Maria, Santa Maria, Brazil

[7]Care Policy and Evaluation Centre, London School of Economics and Political Science, London, UK

Correspondence
Julia Luiza Schäfer, Hospital de Clínicas de Porto Alegre, Ramiro Barcelos, 2350—Room 2202; Porto Alegre, 90035-003, Brazil.
Email: julialuizaschafer@gmail.com

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Abstract

Exposure to childhood adversity has been consistently associated with poor developmental outcomes, but it is unclear whether these associations vary across different forms of adversity. We examined cross-sectional and longitudinal associations between threat and deprivation with cognition, emotional processing, and psychopathology in a middle-income country. The sample consisted of 2511 children and adolescents (6–17 years old) from the Brazilian High-Risk Cohort for Mental Conditions. Parent reports on childhood adversity were used to construct adversity latent constructs. Psychopathology was measured by the Child Behavior Checklist (CBCL) to generate a measure of general psychopathology (the "p" factor). Executive function (EF) and attention orienting toward angry faces were assessed using cognitive tasks. All measures were acquired at two time-points 3 years apart and associations were tested using general linear models. Higher levels of psychopathology were predicted by higher levels of threat cross-sectionally and longitudinally, and by deprivation longitudinally. For EF, worse performance was associated only with deprivation at baseline and follow-up. Finally, threat was associated with attention orienting towards angry faces cross-sectionally, but neither form of adversity was associated with changes over time in attention bias. Our results suggest that threat and deprivation have differential associations with cognitive development and psychopathology. Exposure to adversity during childhood is a complex phenomenon with meaningful influences on child development. Because adversity can take many forms, dimensional models might help to disentangle the specific developmental correlates of different types of early experience. A video abstract of this article can be viewed at https://www.youtube.com/watch?v=uEU0L8exyTM.

KEYWORDS
attention bias, childhood adversity, cognition, deprivation, executive functions, psychopathology, threat

1 | INTRODUCTION

Childhood adversity involves negative environmental experiences that require considerable adaptation by an average child, including physical, emotional, and sexual abuse, physical and emotional neglect, domestic violence, and parental absence (McLaughlin, 2016). These experiences are highly prevalent around the world (Costello et al., 2002), especially in low- and middle-income countries (Viola et al., 2016). Exposure to childhood adversity represents a public health problem due to its extensive costs to society and individuals (Magruder & McLaughlin, 2017), leading to poorer mental health (Green et al., 2010; Mclaughlin et al., 2012) and academic achievement in the form of lower grades, higher school-days absence, and more frequent suspensions (Lansford et al., 2002). Determining how adverse childhood experiences influence emotional and cognitive development is critical to developing novel strategies for preventing the emergence of developmental problems in children who have experienced adversity.

Distinguishing core dimensions that underlie distinct adversity experiences is a prominent strategy to address developmental outcomes related to exposure to childhood adversity (Mclaughlin & Sheridan, 2016). One relevant model, the dimensional model of adversity and psychopathology (DMAP), proposes the existence of core underlying dimensions that cut across diverse forms of adversity. It posits that childhood adversity encompasses experiences involving levels of threat and deprivation (Humphreys & Zeanah, 2014). Experiences of threat are defined as those involving the presence of an unexpected input that represents a threat to the physical integrity or well-being of the child, such as physical, sexual, and emotional abuse, witnessing domestic violence, and exposure to violence in the community or at school. Experiences of deprivation are those characterized by the absence of expected social, cognitive, and emotional inputs that provide complex learning opportunities expected throughout development, such as physical and emotional neglect, parental absence, poverty, and material deprivation (McLaughlin, 2016; McLaughlin et al., 2019, 2014; Sheridan & Mclaughlin, 2014). This dimensional model of adversity provides some advantages in understanding the developmental influences of adversity. It allows the simultaneous assessment of the frequency and severity of differential experiences reflecting both dimensions, as well as facilitates the examination of specific mechanisms leading to psychopathology. It argues that experiences characterized by high levels of threat have particularly strong influences on emotional processing—particularly about cues that are negative or potentially threatening, whilst deprivation is more strongly associated with poor performance on complex cognitive tasks, such as those involving executive functions (EFs) (Mclaughlin & Sheridan, 2016; McLaughlin et al., 2014).

Even though prior work examining the correlates of different forms of childhood adversity on developmental outcomes can present some mixed results, they generally support a pattern of differential associations of threat and deprivation with important developmental outcomes. For example, threat has already been found to have a unique effect on fear conditioning (Machlin et al., 2019), deficits in automatic emotion regulation (Lambert et al., 2017), and physiological reactivity (Busso et al., 2017), while deprivation has already been found to have a unique effect on cognitive control (Machlin et al., 2019) and to be more strongly associated with reduced executive functioning when compared to threat (Johnson et al., 2021). Moreover, children who have experienced violence, one form of threat, required less perceptual information to identify anger (Pollak & Sinha, 2002; Pollak et al., 2000), classified a wider range of negative emotions as anger (Pollak & Kistler, 2002), and exhibited attention biases to threatening social information (Shackman & Pollak, 2014) in previous studies. Different patterns have been observed among children exposed to deprivation. Despite relying on relatively small samples, some previous studies suggest that children exposed to deprivation had more difficulty discriminating emotional expressions than nonexposed or threat-exposed children (Pollak et al., 2000) and that previously institutionalized children identified fewer emotional expressions correctly when compared to nonexposed children (Wismer Fries & Pollak, 2004). It is important to note, however, that evidence concerning emotion recognition and deprivation might also be mixed, considering previous findings reporting on certain areas of emotion recognition being unaffected among institutionalized children (Miller et al., 2016). Furthermore, previous data report on the association of threat with both internalizing and externalizing psychopathology (Busso et al., 2017), as well as deprivation with externalizing psychopathology through verbal abilities (Miller et al., 2020) and with internalizing and externalizing psychopathology through language ability (Weissman et al., 2000).

The previous literature is limited in two important ways. First, most research investigating the correlates of childhood adversity in child development has focused on youth living in high-income countries. However, previous data have shown that estimates of trauma exposure in childhood are higher among youth living in low-/middle-income countries when compared to high-income countries (Viola et al., 2016), stressing the need for more studies focusing on such populations. Second, most existing research investigating the associations between childhood adversity, psychopathology, and cognition is cross-sectional and does not examine how these experiences longitudinally influence the development of emotion, cognition, and psychopathology.

RESEARCH HIGHLIGHTS

- Exposure to threat and deprivation are associated with psychopathology longitudinally, but threat seems to play a more important role in this association;
- Exposure to deprivation, and not threat, is associated with worse performance in executive functions tasks at baseline and longitudinally;
- Exposure to threat is associated with attention orienting towards angry faces cross-sectionally, but neither form of adversity is associated with attention bias longitudinally;
- Threat and deprivation seem to have differential associations with cognitive development and psychopathology.

In this study, we examined the longitudinal associations of threat and deprivation with cognition, emotion, and psychopathology in children and adolescents in a large school-based community sample from a middle-income country. Specifically, we aimed (McLaughlin, 2016) to evaluate the latent constructs of threat and deprivation in a large community sample from Brazil, and (Costello et al., 2002) to investigate associations of threat and deprivation experiences with EF, emotional processing measured by attention orienting toward angry faces, and psychopathology. We hypothesized that a model specifying distinctions among adversities would provide a good fit for the data. We also expected that attention orienting toward angry faces would be associated with threat, but not deprivation, that worse EF would be associated with deprivation, but not threat, and that psychopathology would be associated with both threat and deprivation.

2 | METHODS AND MATERIALS

2.1 | Study design, procedures, and participants

Data for this study are drawn from the baseline and 3-year follow-up waves of the Brazilian High-Risk Cohort for Mental Conditions (BHRCS), a school-based community cohort from the cities of São Paulo and Porto Alegre. Briefly, in the year 2010, 9937 parents of 6–14-year-old children from 57 schools in São Paulo and Porto Alegre were screened using the Family History Survey (Salum et al., 2014). From this sample, two subgroups were recruited for further assessments. One subgroup was randomly selected ($n = 957$), while the other was selected from a high-risk score procedure used to identify children with current symptoms and/or family history of psychiatric disorders ($n = 1554$). The high-risk score procedure consists of the calculation of an index of family load based on the FHS considering mother, father, or siblings' presentation of any of the five disorders of interest for this study (Attention deficit and hyperactivity disorder, anxiety disorders, obsessive compulsive disorder, psychotic experiences, and learning disorders). This index expresses the percentage of members in the family that screened positively for each of the disorders assessed, adjusted for relatedness.

A total of 2511 children/adolescents and their parents were assessed at two time-points through questionnaires and interviews about the history of exposure to adversities and psychopathology. Children/adolescents also completed neurocognitive tests at both time points. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects were approved by the institutional review boards of all institutions involved in the study (CAAE: 74563817.7.1001.5237). Written, and verbal informed consent was obtained from all participants. For a detailed description of the study, its procedures, and sample see Salum et al. (2014) (Goodman et al., 2000).

2.2 | MEASURES

2.2.1 | Adversity experiences

Selected variables from the baseline evaluation of the BHRCS were chosen based on theoretical models of adversity (McLaughlin et al., 2014). We examined the number and frequency of different forms of threat experiences to model the dimension of threat. Variables selected for measuring experiences of threat were drawn from two sources: the Posttraumatic Stress Disorder (PTSD) assessment of the Development and Well-Being Assessment (DAWBA) (Salum et al., 2016) and questionnaires specifically designed for the BHRCS (Goodman et al., 2000). Lifetime exposure to physical and sexual abuse, attack or threat, witnessing domestic violence, and witnessing attack were investigated from parent reports only using the first section of the PTSD assessment in the DAWBA with questions such as "*Has the child ever suffered physical violence (maltreatment) that he/she remembers?*." Some variables, such as life experiences of bullying, and frequency (never, once or twice, from time to time, and often) and experiences of physical and emotional abuse were informed by both, parents and the children, through questions such as *"Has the child (you) ever been bullied in his/her(your) life?," and "Has your child(you) ever been cursed by some adult, with words like "ass," "idiot," "stupid," or being yelled that he/she was(you were) no good?"* (Mclaughlin et al., 2017). Sexual abuse experiences were reported only by the parents and due to its low frequency (see Table 2 in the supplemental material) on both sources of information (DAWBA's PTSD assessment and the questionnaire), both variables were combined to form one sexual abuse exposure variable.

Deprivation measures included indicators of neglect, parental absence, and measures of material forms of deprivation that are strongly associated with cognitive forms of deprivation (e.g., reduced exposure to complex language early in development) (Associação Brasileira de Empresas (ABEP) 2010; Romeo et al., 2018). Deprivation was measured through the assessment of mother's educational level (adjusted into four categories ranging from higher education to no study), family income (measured in quintiles), socioeconomic classification according to Brazilian Economic Classification Criterion (A/B—the wealthiest, C, or D/E—the poorest) (Achenbach & Rescola, 2001), father presence (in contact, noncontact, deceased, or unknown), and the frequency (never, once or twice, from time to time, and often) of exposure to physical neglect (Mclaughlin et al., 2017). Physical neglect was informed by both, parents, and the children, through the question "*Has it ever happened to your child(you) of not having anything to eat and/or having to wear dirty or torn clothes?,"* and father contact was assessed through the question "*What is the current contact status of the child's father?*." (See the Supplemental Table S1 for more detailed information). Our assessment of deprivation was composed mostly of proxy measures, in a way that their presence does not necessarily indicate deprivation directly, but merely increases the likelihood of living under deprived conditions. Those types of indicators are well-suited for latent analysis, for which deprivation is a latent concept indicated by several indicators.

2.2.2 | Psychopathology

Psychopathology was measured dimensionally at baseline and follow-up through the Child Behavior Checklist (CBCL) (Bordin et al., 2013; Clark et al., 2021). The CBCL is a parent-report questionnaire that assesses the child's emotional, behavioral, and social problems yielding a total score (including all items), as well as an internalizing and externalizing score. A bifactor model with one dimension of general psychopathology (the "p" factor) was fitted to the data with two residualized dimensions of internalizing and externalizing psychopathology. Our goal was not to estimate the structure of psychopathology in the sample, but rather to generate a dimensional measure capturing the severity of psychopathology symptoms transdiagnostically. Although debate exists about measurement models of p-factor, recent work suggests that the rank order stability of individuals is similar across these approaches, making p-factor estimation appropriate for studying individual differences in transdiagnostic psychopathology (Wechsler, 2002). Only general psychopathology scores were used for further analysis. Details on the model are in the Supplemental Material.

2.2.3 | Cognition

EFs. Three dimensions of EF were calculated to create a second-order model of EF. The dependent variable was a single EF standardized score encompassed by latent variables representing working memory, inhibitory control, and temporal processing dimensions. Higher scores represent better EF. At both baseline and follow-up, we performed a second-order model in which EFs were a high-order factor informed by three lower-order factors: working memory (Digit Span Backwards and Corsi Blocks Backwards), inhibitory control (Go/No-Go task (GNG) and Conflict Control Task (CCT)), and temporal processing (time anticipation (TA) 400 ms). The benefit of using a second-order model, instead of a single factor model where all tasks load on a first-order EF latent variable, is that such first-order model resulted in an unacceptable fit. For a detailed description of the EF measure, see the Supplemental Material.

Working memory was measured by the *digit span* (a subtest of the WISC-III) (Vandierendonck et al., 2004) and Corsi *blocks* tasks (Hogan et al., 2005). Both tasks involve the repetition of a given sequence. While in the *digit span task*, the participants hear and repeat an increasingly difficult sequence of numbers, either forward or backward, in the Corsi *blocks task*, they repeat an increasingly difficult spatial sequence tapped by a researcher on up to nine identical blocks. Both outcomes are the level at which a correct repetition failed twice consecutively.

Inhibitory control was measured by the CCT (Bitsakou et al., 2008) and the GNG (Toplak & Tannock, 2005). Both consist of arrow-based visual stimuli with a total of 100 trials divided into two different instructions. In the *CCT*, participants are asked to press a button indicating the direction or opposite direction of arrows shown on the screen. Participants either press the button indicating the correct direction of a green arrow (75 congruent trials) or press the button indicating the opposite direction of a red arrow (25 incongruent trials). The *GNG* requires participants to completely suppress the tendency to press the buttons indicating the direction of the green arrows (75 *go* stimuli trials) when a double-headed green arrow (25 *no-go* stimuli trials) appears on the screen. For both tasks, the intertrial interval was 1500 ms, and the stimulus duration was 100 ms. The outcomes were the percentage of correct responses in the incongruent trials (CCT) and the percentage of successful inhibitions in the *no-go* trials (GNG).

Finally, *temporal processing* was measured by *TA tasks* 400 ms (Barkley, 1997) on baseline and follow-up. This task requires participants to anticipate when a visual stimulus will appear. In a game-like manner, the task involves an allied spaceship running out of oxygen and the participant has to give it to them to save the crew. In each task, the allied spaceship is visible for the first 10 trials, while for the remaining 16 trials, the spaceship is invisible due to an invisible shield. Then, participants are asked to press a button to anticipate when it arrives. A 750-ms window of time to respond correctly and feedback after every trial are given. The anticipation interval is 400 ms. The outcome is the mean percentage of the button pressed in the correct time window interval for the invisible part of the task. Tasks involving temporal delays with flexible cognitive demands have been proposed to be a part of EF in some models (Martel et al., 2016). Temporal processing tasks used have previously been well-correlated with the other EF tasks in our sample (Manfro et al., 2019; Salum et al., 2012). Results for EF model fit are reported in the Supplemental Material.

2.2.4 | Emotional processing

Attention orienting toward angry faces. Attention orienting toward angry faces was assessed using a dot-probe task in Eprime 2.0 (Psychology Software Tools, USA) and has been used in a previous study derived from the BHRC (Hu & Bentler, 1999). The task consists of the presentation of paired threatening (angry) and neutral face photographs followed by a probe at the location of one of the two photographs. Each trial starts with a central fixation cross (for 500 ms), followed by the face pair (for 500 ms) which is replaced with the probe (for 1100 ms). Participants are instructed to press one of the response keys to indicate whether the probe appeared on the left, or right side of the screen. Trials are, randomly, either congruent (16 trials), with threatening faces and probes appearing on the same side of the screen, or incongruent (16 trials), with threatening faces appearing on opposite sides of the screen. The intertrial interval varies randomly from 750 to 1250 ms. Since the neutral and the threatening stimuli are in different screen locations, they compete for attention. Therefore, attention orienting toward angry faces is measured as the difference in reaction time between the task's trials in which the probe replaces a neutral stimulus versus those in which the probe replaces a threatening stimulus. Response times were excluded as errors from trials where the response was incorrect or did not occur before probe offset. Additionally, response times less than 200 ms or more than 2 standard deviations above each participant's mean were excluded as outliers,

as well as attention bias scores were not calculated if more than 50% response times data were missing. Therefore, the dependent variable was a standardized score of attention orienting toward angry faces. Scores greater than zero represent biases in attention toward threats and lower than zero biases in attention away from threats.

2.3 | Data analysis

First, we conducted factor analyses to assess the latent structure of threat and deprivation adversity experiences at baseline, and the EF and psychopathology models at baseline and follow-up. Missing data were accounted for using full information maximum likelihood estimation. Model goodness of fit was evaluated using root-mean-square error of approximation (RMSEA), comparative fit index (CFI), and Tucker–Lewis index (TLI). RMSEA equal to or below 0.06, and a CFI and a TLI above 0.95 indicate a good fit (Kline et al., 2013; Platt et al., 2018).

Second, we used the observed factor scores from the validated models to test the cross-sectional and longitudinal associations of threat and deprivation with each outcome following a series of steps. First, we tested cross-sectional associations using three linear regression models adjusted for age and sex with threat and deprivation levels at baseline as simultaneous predictors of (McLaughlin, 2016) psychopathology, (Costello et al., 2002) EF, and (Viola et al., 2016) attention bias at baseline as dependent variables. Second, longitudinal associations were tested also using three models adjusted for age and sex with threat and deprivation levels at baseline as simultaneous predictors of (McLaughlin, 2016) psychopathology, (Costello et al., 2002) EF, and (Viola et al., 2016) attention bias 3 years later as dependent variables. Longitudinal models were adjusted and controlled for the outcome variable levels at baseline. Sensitivity analyses were conducted testing the same models described above excluding the measure of family income as a marker of deprivation. No significant differences were found when comparing the results from the models with and without family incomed as a marker of deprivation. Third, to check the assumptions of linear models, interaction effects of threat and deprivation with age and sex were tested independently for each one of the adversity measures using fully saturated models for three- and two-way interactions (Supplemental Tables S7–S10). If interactions were found, marginal analyses were conducted to further understand such results and are depicted in detail in the supplemental material (Supplemental Tables S11 and S12). The same approach of cross-sectional and longitudinal models, followed by multiple two- and three-way interaction models and marginal analyses were conducted as exploratory analyses to examine specific associations of threat and deprivation, and (McLaughlin, 2016) internalizing and (Costello et al., 2002) externalizing psychopathology. Detailed results are reported in the supplemental material (Supplemental Table S13). Two- and three-way interactions between adversity, age, and sex were conducted (Supplemental Tables S14–S17) followed by marginal analyses (Supplemental Figure S5).

Finally, further exploratory analyses were conducted examining whether EFs and attention orienting toward angry faces could serve as mediators linking exposure to threat and deprivation to general psychopathology, as well as internalizing and externalizing specific psychopathology. Such hypothesis was tested through two similar longitudinal mediation models, both having threat and deprivation at baseline as concurrent predictors and general, internalizing and externalizing psychopathology at follow up as concurrent outcomes, and EFs and attention orienting toward angry faces (McLaughlin, 2016) at baseline and (Costello et al., 2002) at follow-up as concurrent mediators. Detailed results are presented in the Supplemental Material (Supplemental Figures S6 and S7 and Supplemental Tables S18 and S19). Data analysis was performed using the *Mplus* software (version 7.3) and the *lavaan* package from R (version 3.6.1).

3 | RESULTS

3.1 | Descriptive statistics

The total sample was comprised of 2511 children and adolescents with a mean age of 10.42 years old at baseline and 13.71 years old on follow-up. Among those, 1375 (54.8%) were male, and 1256 (50.1%) were from the city of São Paulo. Descriptive data on variables of interest are shown in Table 1 and additional descriptive data are in the Supplemental Material (Supplemental Table S2).

3.2 | Threat and deprivation latent structure

The model of threat and deprivation as latent variables (Supplemental Figure S1) was tested using the baseline measures. The model consisted of eleven indicators for the dimension of threat and six indicators of the dimension of deprivation (Supplemental Table S1). The model had acceptable fit indexes (CFI = 0.937, TLI = 0.922, RMSEA = 0.032), with all indicators presenting significant contributions to each distinct construct. Detailed information about the model is provided in Table 2.

3.3 | General psychopathology (the "p" factor)

Higher levels of threat at baseline were associated with higher levels of general psychopathology at baseline ($\beta = 0.522$, $p < 0.001$; 95% CI [0.475, 0.569]), and three years later ($\beta = 0.176$, $p < 0.001$; 95% CI [0.119, 0.232]), while higher levels of deprivation at baseline predicted higher levels of general psychopathology only 3 years later ($\beta = 0.072$, $p = 0.003$; 95% CI [0.025, 0.119]), with smaller effect size (Table 3). One interaction between threat and age in predicting psychopathology at follow-up was found ($\beta = -0.030$, $p = 0.021$; 95% CI [−0.055, −0.004]) (Supplemental Table S9), suggesting that the influence of threat on psychopathology was stronger for younger children than older children (Supplemental Table S11 and Supplemental Figure S3). The latent model that generated the general psychopathology measure fits the data well according to recommended goodness-of-fit statistics, as described in the Supplemental Material.

TABLE 1 Sample description

	Baseline				3-year follow-up			
	N	%	Valid *N*					
Sex: male	1375	54.8	2511					
Site: São Paulo	1256	50	2511					
	Mean (sd)	Range	Skewness/Kurtosis	Valid *N*	Mean (sd)	Range	Skewness/Kurtosis	Valid *N*
Age (years)	10.2 (1.9)	5.83–14.37	0.13, −0.91	2511	13.5 (1.9)	9.2–17.87	0.13, −089	2010
Family income (BRL)	757.6 (536.6)	29.94–4910.18	2.04, 6.9	2110	783.8 (656.8)	21.65–8658.01	3.78, 27.83	1679
CBCL: Total CBCL scores	17.2 (16.1)	0–101	1.34, 1.69	2511	14.6 (15.0)	0–90	1.41, 1.78	2010
Working memory								
Corsi block (backward)	4.8 (2.1)	0–14	0.08, −0.12	2223	5.6 (2.5)	0–13	−0.44, −0.06	1880
Digit span (backward)	3.5 (1.6)	0–12	0.45, 1.34	2249	4.1 (2.0)	0–13	0.15, 0.69	1880
Inhibitory control								
CCT% correct inhibitions	0.6 (0.2)	0–1	−0.37, −0.47	2165	0.7 (0.3)	0–1	−1.06, 0.52	1704
Go/No-Go: comission	0.3 (0.2)	0–1	0.97, 0.12	2158	0.2 (0.2)	0–1	1.5, 1.83	1701
Temporal processing								
Time anticipaion (0.4 s): hits	0.6 (0.2)	0–1	−0.69, −0.02	2185	0.8 (0.2)	0–1	−1.28, 1.97	1701
Attention orienting toward angry faces (ms)	5.2 (53.0)	−357.17–288	0.17, 3.56	2148	2.9 (40.0)	−297.93–411	0.16, 13.36	1603

Note: Crude scores for psychopathology, executive function tasks, and attention orienting toward angry faces are presented in order to inform about the variables' characteristics on the sample.
Abbreviations: CBCL, Child Behavior Checklist; CCT, Conflict Control Task; GNG, Go/no-go Task.

TABLE 2 Factor loadings of the Threat and Deprivation Model

	Estimate	S.E.	Est./S.E.	*p*-value
Threat				
Bullying exposure (parent report)	0.483	0.033	14.650	<0.001
Bullying exposure (child report)	0.159	0.039	4.123	<0.001
DAWBA: physical abuse	0.830	0.037	22.399	<0.001
Physical abuse (parent report)	0.658	0.038	17.383	<0.001
Physical abuse (child report)	0.245	0.044	5.589	<0.001
Emotional abuse (parent report)	0.542	0.028	19.038	<0.001
Emotional abuse (child report)	0.229	0.038	5.962	<0.001
Sexual abuse (total)	0.559	0.061	9.090	<0.001
DAWBA: attack or threat	0.522	0.049	10.656	<0.001
DAWBA: domestic violence witnessing	0.666	0.037	17.929	<0.001
DAWBA: attack witnessing	0.685	0.042	16.414	<0.001
Deprivation				
Mother's educational level	0.327	0.033	10.020	<0.001
ABEP 2009: stratified score	0.616	0.035	17.582	<0.001
Father status	0.408	0.043	9.429	<0.001
Neglect (parent report)	0.673	0.047	14.399	<0.001
Neglect (child report)	0.201	0.057	3.554	<0.001
Family income	0.975	0.065	14.936	<0.001

Model fit baseline: CFI = 0.937, TLI = 0.922, RMSEA = 0.032.
Note: All variables that were informed by the children were correlated in the model.
Abbreviations: DAWBA, Development and Well-being Assessment; ABEP, Brazilian Economic Classification.

TABLE 3 Influences of threat and deprivation on psychopathology, executive functions, and attention bias

	Baseline			Follow-up		
	β	*p* value	CI 95%	*β*	*p* value	CI 95%
Psychopathology						
Threat	**0.522*****	**<0.001**	**0.475, 0.569**	**0.177*****	**<0.001**	**0.121, 0.233**
Deprivation	0.012	0.569	−0.030, 0.054	**0.072****	**0.003**	**0.025, 0.119**
Age	0.004	0.664	−0.013, 0.020	**−0.023***	**0.013**	**−0.041, −0.005**
Sex	−0.021	0.500	−0.083, 0.041	**0.174*****	<0.001	**0.105, 0.244**
Executive function						
Threat	−0.019	0.348	−0.059, 0.021	−0.034	0.154	−0.080, 0.013
Deprivation	**−0.115*****	**<0.001**	**−0.151, −0.079**	**−0.045***	**0.038**	**−0.088, −0.003**
Age	**0.188**	**<0.001**	**0.174, 0.202**	0.010	0.286	−0.008, 0.028
Sex	−0.013	0.639	−0.066, 0.040	−0.043	0.174	−0.105, 0.019
Attention bias						
Threat	**0.079**	**0.029**	**0.008, 0.151**	−0.048	0.132	−0.111, 0.014
Deprivation	−0.061	0.062	−0.025, 0.003	0.021	0.468	−0.036, 0.078
Age	−0.026	0.036	−0.051, −0.002	−0.015	0.188	−0.036, 0.007
Sex	0.075	0.117	−0.019, 0.169	−0.026	0.543	−0.109, 0.057

Note: Main associations of threat and deprivation on the outcomes were adjusted for age at the outcome's assessment and sex for the baseline and follow-up models. For the longitudinal models, all effects were also adjusted and controlled for the outcome variable values at baseline. *p<0.05.**p<0.01.***p<0.001.

3.4 | Internalizing- and externalizing-specific psychopathology

Exploratory analyses indicated that higher levels of threat at baseline were associated with higher levels of both internalizing ($\beta = 0.143$, $p < 0.001$; 95% CI [0.101, 0.186]) and externalizing psychopathology ($\beta = 0.170$, $p < 0.001$; 95% CI [0.129, 0.211]) at baseline. No longitudinal associations, nor association with levels of deprivation were found (Supplemental Table S13). One significant interaction between threat and age in predicting internalizing psychopathology at baseline was found ($\beta = 0.033$, $p = 0.002$; 95% CI [0.012, 0.053]) (Supplemental Table S16), suggesting that the influence of threat on internalizing psychopathology was stronger for older children than younger children (Supplemental Figure S5). Detailed results can be found in the Supplemental Material.

3.5 | Executive functions

Higher levels of deprivation at baseline were associated with worse performance on EF tasks at both baseline ($\beta = -0.115$, $p < 0.001$, 95% CI [−0.151, −0.079]) and follow-up ($\beta = -0.045$, $p = 0.038$, 95% CI [−0.088, −0.003]). Exposure to threat was not associated with performance on EF tasks at baseline or follow-up. No interactions were found between either dimension of adversity with age and sex. The latent model that generated the EFs measures fits the data well according to recommended goodness-of-fit statistics, as described in the Supplemental Material.

3.6 | Attention orienting toward angry faces

Biases toward angry faces at baseline were associated with higher levels of threat at baseline ($\beta = 0.079$, $p = 0.029$, 95% CI [0.008, 0.151]). One interaction between deprivation and age in predicting attention orienting toward angry faces at baseline was found ($\beta = 0.041$, $p = 0.007$; 95% CI [0.011, 0.072]) (Supplemental Table S10). For younger children, higher deprivation levels were associated with attention orienting *away* angry faces, whereas for older children, higher deprivation levels were associated with attention orienting toward angry faces (Supplemental Table S12 and Supplemental Figure S4).

3.7 | Exploratory analysis: executive functions and attention orienting towards angry faces as mediators of threat and deprivation on psychopathology, internalizing and externalizing specific psychopathology

Exploratory mediation models with EF and attention orienting towards angry faces at baseline as mediators indicated significant direct associations of threat and deprivation at baseline with higher levels of psychopathology ($\beta = 0.270$, $p < 0.001$; $\beta = 0.073$, $p = 0.002$) and externalizing psychopathology ($\beta = 0.104$, $p < 0.001$) 3 years later. A small mediation of deprivation at baseline on psychopathology 3 years later via EF at baseline was significant in this model ($\beta = 0.009$, $p = 0.005$) (Supplemental Figure S6 and Supplemental Table S18). The same pattern of results was found in the model having EF and attention towards angry faces at follow-up as mediators, showing direct effects of threat and deprivation at baseline on psychopathology ($\beta = 0.269$, $p < 0.001$; $\beta = 0.072$, $p = 0.002$) and externalizing psychopathology ($\beta = 0.099$, $p < 0.001$) 3 years later, as well as a mediation of deprivation at baseline with psychopathology 3 years later via EF at follow-up ($\beta = 0.008$, $p = 0.006$) (Supplemental Figure S7 and Supplemental Table S19). Detailed results can be found in the Supplemental Material (Supplemental Tables S18 and S19 and Supplemental Figures S6 and S7).

4 | DISCUSSION

This study examined theoretical predictions of a dimensional model of childhood adversity (McLaughlin et al., 2014). Our results suggest that threat and deprivation have differential associations with cognitive and emotional development and psychopathology. In particular, higher levels of threat were more strongly associated with psychopathology, and solely predicted higher levels of internalizing and externalizing specific psychopathology cross-sectionally when compared to deprivation. Threat was also the only adversity measure slightly associated with attention bias towards angry faces, while only higher levels of deprivation, but not threat, were associated with worse performance on EF tasks. Additionally, exploratory analyses suggest mediation of higher levels of deprivation with higher levels of psychopathology years later via worse performance on EFs tasks.

Our results are consistent with prior work (Miller et al., 2020; Rosen et al., 2019; Schaefer et al., 2018; Sheridan et al., 2017; Weissman et al., 2000) showing that experiences of threat and deprivation are differentially associated with developmental outcomes in children. The effect sizes we found, except for associations between threat and psychopathology, were generally small. This is not surprising, given that these associations were estimated longitudinally over a 3-year interval. The influences on emotional processing, cognition, and psychopathology are multifactorial, and many other relevant factors associated with these aspects of development were not accounted for in our models. This pattern of findings has theoretical implications for conceptual models of adversity and development, as well as clinical implications regarding potential targets for early interventions aimed at preventing the long-term consequences of adversity for mental health and academic achievement.

There is mounting evidence showing that childhood adversity is associated with high levels of psychopathology, both cross-sectionally and prospectively (Caspi et al., 2014; Miller, 2015). This link tends to span all forms of psychopathology, including both internalizing and externalizing domains (Mclaughlin et al., 2017)—and therefore associations with general indices of psychopathology (such as the "p" factor) are expected (Dunn et al., 2018) as we confirmed here. In line with previous evidence and theoretical models, we showed that associa-

tions between adversity and general psychopathology were revealed for both types of adversity domains (Weissman et al., 2000). The associations with general psychopathology were stronger and present at both time points only for threat and not for deprivation, which might suggest a more prominent role of the threat domain on overall psychopathology. Prior work has already demonstrated direct effects of threat and indirect effects of deprivation on psychopathology (Miller et al., 2016, 2020; Platt et al., 2018), which is also supported by the mediation path of deprivation on psychopathology through worse performance on EFs tasks that we found on our exploratory analysis.

Additionally, only threat was associated with both specific dimensions of psychopathology, which is also supported by previous evidence on direct associations of threat with internalizing and externalizing problems (Miller et al., 2016). Our interaction analyses of adversity and age on psychopathology and its domains suggested that the association of threat with psychopathology may vary with age and might follow different patterns for general and specific dimensions. Higher levels of threat were significantly associated with higher levels of general psychopathology among younger kids, supporting previous longitudinal findings suggesting that childhood psychopathology symptoms could be primarily explained by proximal, rather than distal environmental experiences (Dunn et al., 2018). Nevertheless, when it comes to specific domains of psychopathology, higher levels of threat were associated with higher levels of internalizing psychopathology among older children. Such result is in line with adolescence being a period of heightened vulnerability for the onset of internalizing psychopathology (Mclaughlin & King, 2015), as well as with documented changes in the heterogeneity and heterotypic stability of emotional and behavioral symptoms throughout development (Picoito et al., 2021). Questions about age-related mechanisms involved in the associations of threat and psychopathology hold the potential to expand the field in promising ways.

Consistent with our hypotheses, higher levels of deprivation, but not threat, were associated with worse performance on EF tasks at baseline and follow-up. This pattern is consistent with previous cross-sectional studies observing that experiences characterized by deprivation, and not threat, are related to lower EF (Bos, 2009; Machlin et al., 2019; Sheridan et al., 2017), and is broadly consistent with theoretical predictions arguing that deprivation may uniquely influence the development of EF in children and adolescents (McLaughlin et al., 2014; Sheridan & Mclaughlin, 2014). Also according to our hypotheses, higher levels of threat, but not deprivation, were associated with attention orienting towards angry faces at baseline. Previous research has already shown that children and adolescents who have experienced violence have greater attention bias toward angry faces compared to those that have never experienced threat (Briggs-Gowan et al., 2015; Miller, 2015; Pollak & Tolley-Schell, 2003). Interestingly, our analysis also suggested that deprivation was associated with attention orienting *away* from angry faces in young children, and attention orienting towards angry faces in the oldest adolescents at baseline. These results are consistent with previous data reporting on age varying associations of adversity with attention bias (Reinholdt-Dunne et al., 2012; Weissman et al., 2019), supporting that these associations might depend on the developmental period of assessment. However, previous research has found different developmental patterns. Studies have shown a pattern of maltreated children exhibiting a bias towards threat and adolescents a bias away from threat (Weissman et al., 2019), as well as younger anxious children presenting greater anxiety-related processing bias for angry faces when compared to older children (Reinholdt-Dunne et al., 2012). Such contradictory findings from the ones reported in this study might be related to differential influences of different types of adversities being experienced. They also raise questions concerning what age-relevant mechanisms might be involved in the association between adversity in the form of deprivation and attention bias related to threatful stimuli. Replication of these age interactions in additional samples is an important next step.

Our study has several strengths. First, by using a dimensional approach to childhood adversities, we were able to distinguish possible differential associations of distinct experiences with psychopathology, EF, and attention orienting toward angry faces. We provide supporting evidence of the pathways through which adversity influences different developmental domains in a large, longitudinal sample from a middle-income country, extending prior work that has been done almost exclusively in high-income contexts. Second, our longitudinal design allowed us to explore the associations of threat and deprivation with developmental change in these domains over time, which has rarely been done in existing studies of adversity dimensions.

Some limitations also should be noted. First, our results are mainly observational, therefore no conclusions about the causality of the associations found can be made. Second, the deprivation dimension is also characterized by emotional neglect, and an absence of cognitive stimulation, or the lack of an enriched cognitive environment (Sheridan & Mclaughlin, 2014). Our deprivation dimension was primarily a measure of physical neglect and material deprivation, and as such did not directly measure emotional deprivation or other aspects of cognitive stimulation. The lack of assessment of emotional neglect and cognitive stimulation in this study means that inferences apply largely to the material and physical aspects of deprivation and cannot be generalized to the comprehensive experience of deprivation more broadly. Third, attention orienting toward angry faces captures only one relatively constrained domain of emotional processing. Because no other measure of emotional information processing was assessed in this study, we were not able to capture the associations of adversity with other domains of emotional processing argued to be particularly likely to be influenced by threat-related adversity, including emotional reactivity, emotional learning, and emotion regulation (McLaughlin & Lambert, 2017). Finally, there is no data available on children's age of adversity exposure. To understand possible associations among exposure to adversity, age, and psychopathology, the developmental period of exposure should be assessed.

Exposure to adversity, especially during childhood, is a complex phenomenon with meaningful and well-established influences on child development. Because adversity can take many forms, dimensional models—as the one investigated here—might help to disentangle the specific developmental correlates of different types of adverse early environments and the mechanisms through which they confer risk for

psychopathology. Understanding these pathways is critical for developing interventions to buffer the influence of adversity experiences on children's development.

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CONFLICTS OF INTEREST

Dr. Pan has received payment for the development of educational material for AstraZeneca and Janssen-Cilag. Dr. Rohde has served on speakers bureaus, on advisory boards, or as a consultant for Eli Lilly, Janssen-Cilag, Medice, Novartis, and Shire; he receives royalties from Oxford University Press and ArtMed; the ADHD and Pediatric Bipolar Disorder Outpatient Programs chaired by him have received unrestricted educational and research support from Eli Lilly, Janssen-Cilag, Novartis, and Shire; and he has received travel grants from Shire and Novartis to attend annual association meetings. Dr. Manfro received research grants from the national funding agencies FAPERGS, CAPES, and CNPq. Dr. Miguel received research grants from the national funding agencies CAPES, CNPq, and FAPESP. Dr. Hoffmann is supported by the research grant of the Brazilian Ministry of Health under the "Termo de Execução Descentralizada—TED 12/2019." Dr. Salum is supported by the National Institute of Mental Health (Grant Number R01MH120482). The other authors have no conflict of interests, which impact this work.

ETHICAL STANDARDS

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

AUTHOR CONTRIBUTIONS

Conceptualization: Julia L. Schäfer and Giovanni A. Salum. *Data curation*: Maurício S. Hoffmann and André Simioni. *Formal analysis*: Julia L. Schäfer, Giovanni A. Salum, and Maurício S. Hoffmann. *Funding acquisition*: Luis A. Rohde, Eurípedes C. Miguel, and Giovanni A. Salum. *Project administration*: Julia L. Schäfer, Luis A. Rohde, Giovanni A. Salum, Eurípedes C. Miguel, Pedro Pan, and Gisele G. Manfro. *Supervision*: Giovanni A. Salum and Katie A. McLaughlin. *Writing–original draft*: Julia L. Schäfer. *Writing–review and editing*: Giovanni A. Salum, Katie A. McLaughlin, Pedro Pan, Luis A. Rohde, Eurípedes C. Miguel, and Gisele G. Manfro.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author, JLS. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

ORCID

Julia Luiza Schäfer https://orcid.org/0000-0002-5882-6775

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SUPPORTING INFORMATION

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