History of Childhood Maltreatment and College Academic Outcomes: Indirect Effects of Hot Execution Function

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College students who report a history of childhood maltreatment may be at risk for poor outcomes. In the current study, we conducted an exploratory analysis to examine potential models that statistically mediate associations between aspects of maltreatment and aspects of academic outcome, with a particular focus on executive functions (EF). Consistent with contemporary EF research, we distinguished between relatively “cool” EF tasks (i.e., performed in a context relatively free of emotional or motivational valence) and “hot” EF tasks that emphasize performance under more emotionally arousing conditions. Sixty-one male and female college undergraduates self-reported childhood maltreatment history (emotional abuse and neglect, physical abuse and neglect, and sexual abuse) on the Childhood Trauma Questionnaire (CTQ), and were given two EF measures: (1) Go-No-Go (GNG) test that included a Color Condition (cool); Neutral Face Condition (warm); and Emotion Face condition (hot), and (2) Iowa Gambling Task (IGT), a measure of risky decision making that reflects hot EF. Academic outcomes were: (1) grade point average (GPA: first-semester, cumulative, and semester concurrent with testing), and (2) Student Adaptation to College Questionnaire (SACQ). Correlational patterns suggested two EF scores as potential mediators: GNG reaction time (RT) in the Neutral Face condition, and IGT Block 2 adaptive responding. Indirect effects analyses indicated that IGT Block 2 adaptive responding has an indirect effect on the relationship between CTQ Total score and 1st semester GPA, and between CTQ Emotional Abuse and concurrent GPA. Regarding college adaptation, we identified a consistent indirect effect of GNG Neutral Face RT on the relationship between CTQ Emotional Neglect and SACQ total, academic, social, and personal–emotional adaption scores. Our results demonstrate that higher scores on a child maltreatment history self-report negatively predict college academic outcomes as assessed by GPA and by self-reported adaptation. Further, relatively “hot” EF task performance on the IGT and GNG tasks serves as a link between child maltreatment experiences and college achievement and adaptation, suggesting that hot EF skills may be a fruitful direction for future intervention efforts to improve academic outcomes for this population.

Keywords: child maltreatment, executive functions, academic achievement, academic adaptation, college students
HISTORY OF CHILD MALTREATMENT AND COLLEGE ACADEMIC OUTCOMES: MEDIATION BY EXECUTION FUNCTION

College students with a developmental history of child maltreatment represent a significant subset of the university population. We believe these students may comprise an important but overlooked group for targeted interventions aimed at promoting educational success. Although we are not aware of any definitive epidemiological studies, current research suggests that the base rate of maltreatment history among university students ranges from the mid-20% to more than 40% (e.g., Duncan, 2000; Freyd et al., 2001; Gibb et al., 2009). Across several semesters of research in our laboratory, recruiting from a mid-sized university in the western United States, we have consistently yielded a base rate of approximately 30% students with a maltreatment history. Presumably, differences in base rate across the extant studies reflect characteristics related to each individual college setting (the average socioeconomic status of students, etc.) or factors specific to mechanism of recruitment (specific trauma measures employed, sampling methods, etc.). Moreover, all studies of childhood history of maltreatment rely on self-report or clinical interview measures (Roy and Perry, 2004), which results in an unavoidably heterogeneous population of students with regard to the timing, nature, and severity of childhood trauma. Nevertheless, college students reporting childhood maltreatment represent an important, understudied subgroup of the general student population that are at increased risk for a range of cognitive, emotional, behavioral, and psychiatric sequelae (e.g., Mersky and Topitzes, 2010).

Whereas the negative impact of child maltreatment on academic performance in children has been well documented (e.g., Perzow et al., 2013; Kiesel et al., 2016), an examination of college achievement and adaptation in students with a history of maltreatment has not been a priority in research. In the only longitudinal study to date, Duncan (2000) followed 210 college freshmen, 36% who were identified as having experienced child abuse (emotional, physical, and/or sexual). Four years later, those students reporting multiple forms of abuse or sexual abuse only were significantly less likely to be still enrolled in college than non-victims, and PTSD symptoms during the second week of freshman year interacted with abuse to predict attrition. A small empirical literature suggests that college students reporting a history of childhood trauma also report lower levels of college adaptation and adjustment (Banyard and Cantor, 2004; Elliot et al., 2009; Maples et al., 2014). In a rare study of grade point average (GPA) as a college outcome, Jordan et al. (2014) reported that women who had been sexually assaulted as adolescents not only entered college with lower high school GPAs, but also earned lower GPAs by the end of their first year in college. This emerging literature suggests adverse college adaptation and achievement in students reporting a history of maltreatment; however, very little is known about which specific maltreatment sequelae mediate poor adaptation to the college environment. Identification of such variables would provide potential directions for effective intervention to enhance the chances of academic success and its resultant health and economic benefits (e.g., Leonhardt, 2014; Pew Social Research Center, 2014).

While it is clear that maltreatment history confers risk for poor outcome, the problem of heterogeneity among the maltreatment group presents an inherent challenge for the identification of individuals who may carry the greatest risk. This reflects the potential range of different negative experiences that may have influenced retrospective self-report, but it also reflects the varying degrees of individual resilience. Given the multifactorial relationship between developmental history and outcome, we examine current phenotype in an effort to determine which individuals who report maltreatment may be at the greatest risk for poor outcome. This study represents the first in the published literature to examine a novel potential mediator in the pathway between a self-reported history of maltreatment in childhood and academic achievement and adaptation in college: the indirect effects of executive function (EF) processes, and more specifically “hot” EFs.

Executive function (including planning, working memory, inhibition, and flexibility) is a particularly relevant cognitive domain to examine for three reasons. First, evidence shows that stress early in life has deleterious effects on the development and function of the prefrontal cortex (e.g., McEwen, 2008), the brain system that mediates EF (e.g., Kane and Engle, 2002). Performance in traditional cool EF has been particularly associated with the dorsolateral prefrontal cortex. However, since the seminal work of Bechara et al. (2000) and Bechara (2004), researchers have examined the role of orbitofrontal and ventromedial regions of prefrontal cortex in contexts that involve managing heightened emotional arousal (Goel and Dolan, 2003). Given our interest in hot executive processes, the evidence of functional (Etkin and Wager, 2007) and structural (Gold et al., 2016) imaging of ventromedial impairment associated with trauma is particularly relevant. Consistent with these early neurocognitive impacts, deficits in EF processes mediated by the prefrontal cortex have been demonstrated in adolescents, college students, and adults with self-reported maltreatment histories (Spann et al., 2012; Nikulina and Widom, 2013; Kirk-Smith et al., 2014; Mothes et al., 2015; Vasilievski and Tucker, 2016). For example, college women reporting a history of repeated childhood sexual abuse exhibited performance deficits on a modified Go-No-Go task (Navalta et al., 2006), one of the measures used in the current study.

Second, the types of self-regulatory behaviors that are subserved within the construct of EF have been linked empirically to success in school for children (e.g., St Clair-Thompson and Gathercole, 2006; Masten et al., 2012; Willoughby et al., 2016) and have recently been the target of interventions to improve academic performance (Diamond and Lee, 2011; Diamond, 2012). Although there are established links between individual differences in EF and academic achievement and adjustment for children, parallel research with the college population is relatively sparse. Individual differences in EF, such as attentional control, planning, self-monitoring and self-regulation have been found to predict college achievement in terms of credits achieved (Baars et al., 2015) and academic task completion.
predict only a small amount of variance in these outcomes (e.g., a multifactorial enterprise, such that any single variable will prediction of college academic achievement and adaptation is understudied area of inquiry. Research demonstrates that the literature suggests that a history of childhood maltreatment confers risk for college outcomes; however, it remains a relatively sequela of maltreatment.

As reviewed above, the literature suggests that individuals with a child maltreatment history are at risk for both negative college outcomes and deficits in EF, and a specific focus on hot executive processes may be particularly relevant to the study of cognitive sequelae of maltreatment.

The college academic setting places demands on emotion regulation (in testing settings, interpersonal contexts, etc.) and it seems likely that hot EF tasks may be sensitive to deficits associated with emotion regulation in college students, as it is in children (e.g., Woltering et al., 2015). In summary, a small extant literature suggests that a history of childhood maltreatment confers risk for college outcomes; however, it remains a relatively understudied area of inquiry. Research demonstrates that the prediction of college academic achievement and adaptation is a multifactorial enterprise, such that any single variable will predict only a small amount of variance in these outcomes (e.g., more proximal variables such as motivation and metacognition predicting GPA yielded correlations ranging from 0.13–0.39; Komarraju and Nadler, 2013). Even a study that examined the degree to which intelligence predicted college GPA yielded correlations ranging from 0.15–0.21 (Murray and Wren, 2003). Not only is the examination of academic outcomes in this potentially vulnerable subgroup of college students relatively rare, we know of no published study of EF processes as a potential mediator of this association.

**Purpose and Research Questions**

Our study addresses the question: which EFs have an indirect effect on the relationship between a self-reported history of exposure to different types of child maltreatment (emotional, physical, and sexual abuse, as well as neglect) and college GPA and adaptation? Recent studies have targeted a range of interesting adulthood outcomes of maltreatment, such as mental health, risk taking, social relationships, cognition, and academic performance (e.g., Duncan, 2000; Higgins and McCabe, 2000; Banyard and Cantor, 2004; Cromheeke et al., 2014). However, very few published studies have tested mediational models linking maltreatment history to a given outcome (e.g., Allwood and Bell, 2008; Bachrach and Read, 2012). We are not aware of any published studies that have addressed the central aim of the current exploratory, descriptive study: EF processes as mediators between experiences of child maltreatment and academic outcomes in college students.

**MATERIALS AND METHODS**

**Participants**

The sample included 64 undergraduate students (17 males, 47 females; $M = 19.33$, $SD = 2.21$) who volunteered to participate through the Psychological Sciences participant pool. These participants volunteered for an earlier screening session with the study name “Stressful Life Experiences, Cognition, Emotion, and Academic Adaptation.” In this earlier session, we administered a maltreatment screen using the Child Trauma Questionnaire (see descriptions below), the Vocabulary subtest of the WAIS-IV, and a demographics survey that included years of maternal education (as a proxy for SES; see Zhang and Wang, 2004; Classen and Hokayem, 2005; Baum and Ruhmb, 2009). Screening participants also were given the opportunity to provide informed consent for us to contact them back for participation in a future study (i.e., the current study) and to allow us to monitor their academic progress longitudinally (i.e., recording academic outcomes such as grade point average, GPA, at the conclusion of each semester). The only exclusionary criteria applied in this invitation were: (1) not born in the United States (given potential differences in self-reporting child maltreatment history), (2) no consent given for follow-up, and (3) validity problems on the Childhood Trauma Questionnaire (see description, below). The descriptive statistics for age, gender, Vocabulary subtest raw score, and years of maternal education are displayed in Table 1.
TABLE 1 | Descriptive statistics for variables used in subsequent analyses.

| Variable Category          | Variable                          | Min.  | Max.  | Mean  | SD   |
|----------------------------|-----------------------------------|-------|-------|-------|------|
| Demographic Variables      | Age                               | 18    | 34    | 19.33 | 2.21 |
|                           | SES                               | 8     | 18    | 14.73 | 2.25 |
|                           | WAIS Vocabulary Score             | 5     | 16    | 11.37 | 2.45 |
| Predictor Variables        | CTQ Emotional Abuse               | 5     | 22    | 10.62 | 4.99 |
|                           | CTQ Physical Abuse                | 5     | 22    | 7.56  | 4.16 |
|                           | CTQ Sexual Abuse                  | 5     | 25    | 6.49  | 3.47 |
|                           | CTQ Emotional Neglect             | 5     | 25    | 9.79  | 4.72 |
|                           | CTQ Physical Neglect              | 5     | 20    | 6.83  | 2.96 |
|                           | CTQ Total                         | 25    | 93    | 41.29 | 15.19|
| Mediating Variables        | Neutral Face GNG RT               | 299.74| 618.97| 502.82| 61.99|
|                           | Anger Face GNG RT                 | 285.73| 595.31| 491.51| 57.28|
|                           | Fear Face GNG RT                  | 322.67| 589.16| 471.78| 53.45|
|                           | Neutral Face GNG Accuracy         | 0.47  | 1     | 0.93  | 0.08 |
|                           | Anger Face GNG Accuracy           | 0.44  | 1     | 0.90  | 0.11 |
|                           | Fear Face GNG Accuracy            | 0.64  | 1     | 0.89  | 0.10 |
|                           | IGT Block 1                       | −18   | 16    | −2.71 | 6.05 |
|                           | IGT Block 2                       | −10   | 20    | 4.29  | 7.10 |
|                           | IGT Block 3                       | −12   | 20    | 5.90  | 7.64 |
|                           | IGT Block 4                       | −10   | 20    | 6.55  | 8.41 |
|                           | IGT Block 5                       | −20   | 20    | 4.74  | 9.94 |
| Outcome Variables          | SACQ Academic                     | 76    | 192   | 138.76| 28.26|
|                           | SACQ Social                       | 53    | 172   | 125.41| 23.47|
|                           | SACQ Personal/Emotion             | 28    | 119   | 77.75 | 21.19|
|                           | SACQ Attachment                   | 50    | 125   | 91.9  | 17.94|
|                           | SACQ Total                        | 236   | 538   | 402.35| 70.01|
|                           | First semester GPA                | 0.00  | 4.00  | 2.50  | 1.06 |
|                           | Spring 2016 GPA                   | 0.20  | 4.00  | 2.81  | 0.86 |
|                           | Current Cumulative GPA            | 0.10  | 3.98  | 2.68  | 0.86 |

SACQ scales: Academic Adjustment; Social Adjustment; Personal/Emotional Adjustment; Attachment (to college); Total Adjustment. GNG Accuracy scores for the No Go conditions. IGT scores reflect number of adaptive choices – number of maladaptive choices.

Materials and Procedures

Childhood Trauma Checklist (CTQ)
The CTQ (Bernstein et al., 2003) is a retrospective self-report of childhood and adolescent abuse and neglect. The measure demonstrates adequate reliability for each scale (Bernstein et al., 1994), and has been validated against clinician’s reports of history of childhood maltreatment that included evidence from Child Protective Services and court records (Bernstein et al., 1997). Across 28 items, respondents rate the frequency of occurrence for each item, ranging from 1 (never true) to 5 (very often true). The CTQ yields five clinical scales, three of which assess abuse (Emotional, Physical, and Sexual) and two that assess neglect (Emotional and Physical). The total CTQ score was used as an overall child maltreatment score, while summed scores from each subscale were used to indicate degree of severity for each type of maltreatment. The CTQ includes three validity-check questions regarding the overall quality of family life during the participant’s childhood and a total score of 3 or 4 indicates a potential bias toward social desirability in the form of over-reporting high-quality childhood experiences. Therefore, participants who scored a 3 or 4 in the original screening sample were not invited to participate in the current study.

Go-No-Go (GNG)
This classic EF task assesses conflict monitoring and inhibitory control, and can be easily manipulated to include both “cool” stimuli (e.g., colors, shapes) and “hot” stimuli (faces) to examine the involvement of both dorsolateral and ventromedial prefrontal cortical regions (e.g., Hare et al., 2008). In each trial, participants see a target that varies (i.e., a blue shape versus a yellow shape). For one stimulus (the “Go” condition) participants are instructed to make a reaction time (RT) button press response; for the other stimulus (the “No-Go” condition), participants must withhold a response. We adapted the traditional Go-No-Go paradigm to include three blocks: one cool (stimuli were colors, red versus blue); one somewhat heated (stimuli were neutral faces, male versus female); and a third, hot (emotion faces, male and female...
faces displaying anger or fear). All participants completed the blocks in the following order: Color, Neutral Face, Emotion Face. For each block, there were 15 practice trials and 120 test trials with 66.6% Go trials in the Color block and 75% Go trials in the Neutral Face and Emotion blocks (Casey et al., 2011). The stimulus was presented for 1 s (unless terminated earlier by a participant response) and the inter-stimulus interval was 1 s. Go versus No-Go stimuli were counterbalanced across participants such that in the Color block, half of the participants made a reaction time response to the blue circle (i.e., go trials), and the other half responded to the yellow circle as the Go stimulus. In both the Neutral and Emotion Face blocks, half of the participants responded to the male face and half to the female face, with the constraint that the gender of the Go stimulus be equal across both male and female participants. For the Emotion Face block, half of the Go stimulus faces displayed an angry emotion and half displayed a fearful emotion. The source of the face stimuli was the NimStim Face Stimulus Set1. Participants were instructed to respond as quickly as possible to the designated Go stimulus while maintaining reasonable accuracy and to withhold their response to the No-Go stimulus. The dependent measures were RT to the Go stimuli and accuracy of responding (percentage correct) to both the Go stimuli and the No-Go stimuli in each of the three blocks of trials. Within the Emotion Faces block, RT and accuracy were examined separately for the angry and fear faces.

**Iowa Gambling Task (IGT)**
This published, standardized, computerized task (Chan et al., 2008) represents a simulated card game to examine risky decision making and learning from feedback. It has been cited in the literature as a hot EF task (e.g., Zelazo and Carlson, 2012) and performance has been associated with the orbitofrontal/ventromedial region of the prefrontal cortex (Bechara et al., 1994; Damasio, 1999). In their review of the IGT, Buelow and Suhr (2009) conclude that the task is a valid instrument for identifying decision making deficits (i.e., risky decision making) in a range of at-risk and clinical populations, such as substance abusers, pathological gamblers, Obsessive-Compulsive Disorder, Schizophrenia, and Attention Deficit Hyperactivity Disorder. The task presents the participant with 100 trials in which he or she selects a card from one of four decks and each selection is followed by a hypothetical monetary gain or loss, or both. Two of the decks (A and B) yield an initial rapid gain followed by loss across the decks while the other two decks (C and D) confer slow gains resulting in an overall positive outcome. Therefore, the IGT includes 100 selections from four decks, determined by the participant. The scoring typically divides the 100 selections in five blocks of 20 selections each, which differ across participants depending on their deck selections. The score indicates the number of adaptive (less risky) choices minus the number of maladaptive (more risky) choices for each of five blocks of 20 trials. A positive score reflects relatively more adaptive choices on that block. Participants began the task with a hypothetical $2000 such that they could finish above or below this level. To further heat the task to elicit hot EF, participants were told that if they finished the task with more than $2000 (i.e., a positive outcome) they would receive a state lottery $1 scratch ticket.

**Student Adaptation to College Questionnaire (SACQ)**
This normed and standardized, 67-item, Likert-scale self-report instrument (Baker and Siryk, 1999) assesses overall adjustment to college (total score), as well as adjustment in four specific areas: Academic Adjustment, Personal–Emotional Adjustment, Social Adjustment, Attachment (to the institution). The survey is administered in 15–20 min and has been successfully used to identify college students who are at risk for attrition (Crede and Niehorster, 2012). Norms are based on a sample of more than 1,300 male and female college freshmen and stratified by semester of attendance (first and second semesters in college).

**Grade Point Average (GPA)**
Three GPA indices were taken directly from the participants’ official academic transcripts: (1) GPA earned in their first semester at the university; (2) GPA earned during the semester in which the testing took place; and (3) Cumulative GPA across all semesters at the university.

**Overall Procedure**
All participants were recruited from a larger Screening Session (N = 120). Participants who scored in the moderate to severe range in any one of the five CTQ subscales (approximately 33% of the screening sample) and participants scoring at lower levels on CTQ subscales were invited back participate in a lab visit, which included the IGT, GNG, and other tasks and questionnaires, as part of a larger study. Of the 80 participants targeted for the lab visit, 16 did not participate in the lab visit because they could not be contacted, could not be scheduled, declined to participate, or did not show up for the scheduled session. The CTQ was individually administered during a single test session of 1 h. The GNG, IGT, and SACQ were administered in individual lab visits approximately 2 h in length. The GPA information was retrieved from the university academic records system approximately 2 weeks after the end of the semester.

**Data Analysis**
To answer the main questions about the indirect effects of potential mediating EF variables on the relationship between self-reported history of child maltreatment and college outcomes, indirect effects analysis using bias-corrected bootstrapping via Hayes (2013) PROCESS macro for SPSS was utilized; this procedure analyzes the confidence intervals to determine indirect effects of mediating variables. As Preacher and Selig (2012) state, “bias-corrected bootstrapped confidence intervals have fairly accurate Type I error rates and higher power when compared to competing methods” (p. 81), and other researchers have demonstrated that bias-corrected bootstrapping procedures require the smallest sample size of several methods of analyzing indirect effects to achieve comparable levels of power (Fritz and MacKinnon, 2007). While others have found increases in Type I error rates with bias-corrected bootstrapping in small sample sizes (e.g., Fritz and MacKinnon, 2007; Fritz et al., 2012),
this statistical approach is still considered to be the strongest and most robust method of analyzing indirect effects. Hayes (2009) referred to it as one of the more valid and powerful methods for testing intervening variable effects. In fact, Fritz and MacKinnon (2007) provide the recommendation that researchers use the bias-corrected bootstrap test for mediation analyses because of its increased power. Further, to determine which EF variables might have an indirect effect on these relationships, correlation analyses were conducted between predictor, potential mediating, and outcome variables, and the magnitude of the relationships was examined for potential mediators. While we also considered significance of the relationships, the magnitude of the correlations was of more import because of the exploratory and novel nature of this research.

RESULTS

Descriptive Statistics
The means and standard deviations of all variables included in subsequent analyses are included in Table 1 below. While demographic variables likely influence the relationships between history of child maltreatment and college outcomes, the relatively small sample size and exploratory nature of this study resulted in a decision to not statistically control for these variables.

Associations between Childhood Trauma, Academic Outcomes, and Executive Functioning Performance
Because the nature of this research is exploratory, correlational analyses were conducted to guide our decision making on variables with potential indirect effects. This is considered to be steps one and two (i.e., show that the predictor and outcome are correlated; show that the predictor and mediators are correlated) of conducting traditional mediational analyses (see, for example, Baron and Kenny, 1986). Based on the results of these analyses, five potential mediators were found: GNG Neutral Face RT, GNG Fear Face RT, GNG Anger Face RT, IGT Block 2 adaptive reasoning, and IGT Block 3 adaptive reasoning. Mediators explored in the indirect analyses satisfied the requirement of associations with both the predictor (CTQ) and outcome (academic) variables.

Potential mediator, IGT Block 2 adaptive responding, correlated significantly with CTQ Emotional Abuse, Emotional Neglect, and CTQ Total Score (r = −0.28, r = −0.26, r = −0.28, respectively). Moreover, IGT Block 2 adaptive responding correlated significantly with cumulative GPA, concurrent GPA, and first semester GPA (r = 0.30; r = 0.36, r = 0.27, respectively). IGT Block 3 adaptive responding correlated significantly with CTQ Emotional Abuse (r = −0.26), as well as with cumulative GPA and first semester GPA (r = 0.29; r = 0.30).

Other potential mediators were identified in the GNG task. GNG Neutral Face RT correlated with CTQ Emotional Abuse (r = −0.23), CTQ Emotional Neglect (r = −0.23), and CTQ Total (r = −0.22), and GNG Fear RT correlated with CTQ Emotional Abuse (r = −0.29). Additionally, GNG Neutral Face RT correlated significantly with SACQ Academic Adjustment, Personal Emotional Adjustment, Attachment, and Total Score (r = 0.34; r = 0.35, r = 0.26; r = 0.39), as well as with all three GPA measures (r = 0.32 with cumulative, r = 0.29 with concurrent, and r = 0.32 with first semester). GNG Fear Face RT correlated significantly with SACQ Personal Emotional Adjustment (r = 0.25) as well as concurrent GPA (r = 0.25). GNG Anger Face RT correlated significantly with CTQ Emotional Abuse (r = −0.29), CTQ Total (r = −0.25), SACQ Personal Emotional Adjustment (r = 0.29), and SACQ Total (r = 0.26).

Indirect Effects Analysis
Based on the correlational patterns, GNG Neutral Face, Fear Face, and Anger Face RTs, as well as IGT Blocks 2 and 3 adaptive responding were tested as mediators of the relationship between the CTQ scores and academic measures (i.e., first semester GPA, cumulative GPA, GPA concurrent with testing semester, and total and subscale scores of the SACQ) using indirect effects analysis. See Figure 1 for the general mediation model being tested.

First, bivariate correlational analyses demonstrated that the CTQ Emotional Abuse (EA) and Total scores were marginally associated with concurrent and first-semester GPA, respectively (Table 2), thus, we examined the indirect effects of the potential mediators with the outcome of academic achievement. There was a significant indirect effect of CTQ Total Score on first semester GPA through IGT Block 2 adaptive responding, $b = −0.005$, BCa CI $[−0.015, −0.0007]$. This represents a small effect, $η^2 = 0.093$, BCa CI $[0.013, 0.231]$. There was also an indirect effect of CTQ Emotional Abuse subscale score and Spring 2016 (concurrent with testing) GPA through IGT Block 2 adaptive responding, $b = −0.02$, BCa CI $[−0.043, −0.002]$, which also represents a small effect, $η^2 = 0.094$, BCa CI $[0.01, 0.232]$ (see Figure 2).

Though correlations indicated that GNG Neutral Face RT, GNG Fear RT, and GNG Anger RT may serve as mediators through which the relationships between CTQ Total and CTQ Emotional Abuse and first semester GPA are effected, the indirect effects analyses did not support these potential mediators. Next, we examined the indirect effects of these mediators with the academic measure of total and subscale scores of the SACQ as the outcome variable. The bivariate correlational analyses demonstrated that the CTQ Emotional Neglect (EN) score was related to aspects of college adaptation (Table 2), and that GNG Neutral Face RT, and IGT Blocks 2 and 3 were potential mediators of this association. Regarding college adaptation, a consistent indirect effect of GNG Neutral Face RT on the relationship between CTQ Emotional Neglect and SACQ total ($b = −1.314$, BCa CI $[−2.977, −1.012]$), academic ($b = −0.473$, BCa CI $[−1.138, −0.009]$), social ($b = −0.268$, BCa CI $[−0.809, −0.017]$), and personal-emotional adaptation ($b = −0.341$, BCa CI $[−0.829, −0.011]$) scores was found. Measures of effect size for all indirect effects were small ($η^2 = 0.083, 0.073, 0.05, 0.07$, respectively) (see Figure 3).

Though correlations indicated that IGT Block 2 might mediate the relationship between CTQ EN and SACQ Total scores, the indirect effects analysis failed to support this by showing no effect of IGT Block 2 on this relationship. Indirect effects analysis also
failed to support IGT Block 3 as a mediating variable in any analyses.

**DISCUSSION**

The purpose of this study was to add to a small, but emerging, literature regarding the extent to which a self-reported history of child-maltreatment (including emotional and physical abuse and neglect, and sexual abuse) predicts college outcomes in terms of GPA and self-reported adjustment (academic, social, etc.). While college students with trauma histories have been studied extensively, the focus has been mainly on mental health and other life adaptation outcomes, with surprisingly little attention paid to a critical milestone of emerging adulthood that has enormous public health value: success in college. We studied a volunteer sample of college undergraduates, as opposed to a sample of clinically diagnosed young adults (Radomski et al., 2016) or college students with documented PTSD symptoms (e.g., Kaysen et al., 2014). We believe this to be the first study to examine cognitive mediators between the self-reported maltreatment history and academic outcomes, in the form of hot and cool EF processes.

In our relatively heterogeneous volunteer sample we found that higher total scores on the CTQ, and on the Emotional Abuse and Neglect scales in particular, predicted poorer outcomes in terms of both GPA and self-reported adaptation. These findings are consistent with recent studies involving college students with a maltreatment history that have identified difficulties with adjustment to college (Banyard and Cantor, 2004; Elliot et al., 2009; Maples et al., 2014) and achievement as measured by
on the IGT mediated both the pathways between CTQ Total between childhood maltreatment and adult college performance. That we are aware of to report indirect effects of EF processes measures of academic success. This is the first published study students. Further, different hot EF tasks predicted different maltreatment and academic outcomes in this sample of college population. Aligned with these expectations, we identified small, suggests that hot EF may be particularly vulnerable in this emotion regulation ( Cloitre et al., 2005; Etkin and Wager, 2007) outcomes in this sample. We believe the evidence for impaired EF , assessed in relatively cooler and warmer testing contexts. In light of the literature on EF deficits in children experiencing maltreatment, evidence that such deficits continue into young adulthood ( Navalta et al., 2006), and documented deficits in adults with a trauma history ( Navalta et al., 2006; Spann et al., 2012; Mothes et al., 2015; Vasilevski and Tucker, 2016), we wished to examine the indirect role of EF in predicting academic outcomes in this sample. We believe the evidence for impaired emotion regulation ( Cloitre et al., 2005; Etkin and Wager, 2007) suggests that hot EF may be particularly vulnerable in this population. Aligned with these expectations, we identified small, but significant, indirect effects of EF processing in relatively hot conditions on the pathway between history of childhood maltreatment and academic outcomes in this sample of college students. Further, different hot EF tasks predicted different measures of academic success. This is the first published study that we are aware of to report indirect effects of EF processes between childhood maltreatment and adult college performance. With regard to academic achievement, adaptive responding on the IGT mediated both the pathways between CTQ Total GPA ( Jordan et al., 2014), as well as increased risk for attrition ( Duncan, 2000).

Our primary goal was to examine a mediational pathway from child maltreatment to college academic outcomes through EF, assessed in relatively cooler and warmer testing contexts. In light of the literature on EF deficits in children experiencing maltreatment, evidence that such deficits continue into young adulthood ( Navalta et al., 2006), and documented deficits in adults with a trauma history ( Navalta et al., 2006; Spann et al., 2012; Mothes et al., 2015; Vasilevski and Tucker, 2016), we wished to examine the indirect role of EF in predicting academic outcomes in this sample. We believe the evidence for impaired emotion regulation ( Cloitre et al., 2005; Etkin and Wager, 2007) suggests that hot EF may be particularly vulnerable in this population. Aligned with these expectations, we identified small, but significant, indirect effects of EF processing in relatively hot conditions on the pathway between history of childhood maltreatment and academic outcomes in this sample of college students. Further, different hot EF tasks predicted different measures of academic success. This is the first published study that we are aware of to report indirect effects of EF processes between childhood maltreatment and adult college performance. With regard to academic achievement, adaptive responding on the IGT mediated both the pathways between CTQ Total GPA and first-semester GPA, and CTQ Emotional Abuse score and GPA concurrent with testing. In the original IGT, a classic hot EF task, participants respond to feedback regarding gains and losses of hypothetical money in an arousing testing context. We further heated the task by providing a state lottery scratch ticket to participants who managed to complete the task with winnings, rather than an overall loss. During the second block of 20 IGT trials, we observed that individuals with higher scores on the CTQ (more reported overall maltreatment or specific emotional abuse) were less likely to shift their risky decision making to adaptive responses than individuals reporting lower levels of maltreatment. Our finding that deficits in hot EF in the form of IGT performance correlate with both reports of childhood emotional abuse and college GPA is a novel contribution to literature. It will be of interest to examine further how adaptive responding, reflecting learning from positive and negative feedback, is impacted by experiences of maltreatment during childhood, and may therefore impact success in academic settings.

With regard to self-reported adaptation to college, our findings suggest a different EF mediator, reaction time to Go stimuli in the Neutral Face Condition of the Go-No-Go Task of inhibition. This heated condition served as the significant indirect effect, rather than the cool Color Condition. We predicted that potential EF mediators would be found among our heated EF measures ( IGT, Neutral and Emotion Face IGT reaction time and accuracy), and we did find evidence of this in the form of IGT adaptive responding and Go-No-Go Neutral Face reaction time. Individuals with higher scores on CTQ Emotional Neglect exhibited faster reaction times to the Neutral Face Condition of the Go-No-Go Task, and faster reaction times to this condition also predicted less positive adaptation to college in the academic, social, and personal–emotional domains. For a few reasons, we believe the use of faces as a heated stimulus makes good sense for our central research question. First, central importance of faces for social interaction is well appreciated. From early infancy, humans are “wired” to attend to faces and yet the development of face expertise continues into adulthood ( Gliga and Csibra, 2007; Germine et al., 2011).

In the maltreatment literature, many studies point to atypical face processing development ( Pollak and Sinha, 2002). There is certainly evidence that development in a maltreatment milieu can be associated with relatively more exposure to negative facial expressions ( Pollak and Sinha, 2002). Given the evidence for amygdala participation of processing all face emotions (though negative faces, in particular, Adolphs, 2002) and also just attention to faces in general (e.g., looking at the eye region of another, Adolphs, 2008), it also makes sense that individuals with maltreatment history may experience relatively greater arousal to faces. An important question raised by our results concerns the effect for neutral faces despite the lack of an effect for emotion face stimuli. First, we consider the neutral face stimuli that yielded an effect. The notion that even neutral faces can serve as a potential threat stimulus such that face attention might yield individual differences in amygdala arousal was highlighted by a study by Schwartz et al. ( 2003). Following up on a longitudinal
are likely to identify traumatic experiences among a larger associated with adult retrospective self-report of maltreatment in maltreatment history. We should emphasize that limitations many other studies with college students we used a validated child maltreatment in an adult non-clinical sample. Following one limitation reflects difficulties inherent in the study of participant.

We had originally hypothesized that the relatively hotter Emotion Face condition would yield relatively greater mediation (i.e., emotion greater than neutral). However, as demonstrated by the temperament study (reviewed above), it is a mistake to think of non-emotion faces as neutral stimuli. As powerful social stimuli, neutral faces are capable of generating arousal and they have been used effectively for eliciting individual differences in amygdala arousal. In our study design, all participants performed the neutral face block before the emotion face block. With this point in mind it is interesting to consider some additional alternatives. First, it is possible that for all participants the effect of the emotion content of the second block of faces was dampened by habituation. A second intriguing possibility is that for the purposes of our goal, non-emotion face stimuli had more power to discriminate between the groups. Following the literature, it is reasonable to hypothesize that all participants regardless of maltreatment history would show some arousal to threatening faces (e.g., Adolphs, 2002, 2008). Thus, it may be that the most sensitive stimuli for discriminating groups were the non-emotion faces. A third possibility that may be difficult to test concerns the lack of clarity among the findings using emotion faces with trauma groups. While there is evidence of atypical emotion face processing, there are conflicting findings as to which emotional displays (e.g., angry, fearful, happy) are more arousing and disruptive to performance (e.g., Caldwell et al., 2014; Cromheeke et al., 2014). Therefore, had we conducted separate conditions with a range of emotion faces (e.g., happy, fearful, angry, disgust), we may have observed specific indirect effects of a particular emotion face stimuli in this sample. It should be noted such a comprehensive emotion comparison would not be feasible in a single study such as ours, both because of the likely problem of habituation, discussed above, and because such a Go-No-Go paradigm with so many blocks would be excessive for a single participant.

Four particular limitations in our work deserve consideration. One limitation reflects difficulties inherent in the study of child maltreatment in an adult non-clinical sample. Following many other studies with college students we used a validated self-report measure, the CTQ, to examine individual differences in maltreatment history. We should emphasize that limitations associated with adult retrospective self-report of maltreatment status are limitations that challenge the broader field of researchers interested in exploring the impact of deleterious childhood events on adult adaptation. Adult self-report measures are likely to identify traumatic experiences among a larger percentage of the population of interest; however, it is also true that alternative measurement instruments (i.e., informant studies) are likely to miss cases (Stoltenborgh et al., 2014; Waxman et al., 2014). This issue may be especially clear when one considers emotional abuse in childhood, which is now recognized as a significant risk for adult outcome (e.g., Spertus et al., 2003). Unlike the kinds of child abuse that are likely to yield legal and medical evidence, emotional abuse may be unobserved and, therefore, require subjective participant report. We should note that when we administered a second instrument, the Trauma Symptom Checklist, both in our previous studies and in this present sample we found evidence that responses on the CTQ co-varied in predictable ways with trauma symptoms. Although, we did not seek out participants who were clinically diagnosed or in treatment (currently or in the past), we cannot determine the proportion of our volunteer sample that may fit this description. We assume that our sample is heterogeneous with respect to the specific profiles of trauma history (e.g., age and frequency of exposure), early risk and protective factors both at the levels of the individual (e.g., genetic vulnerability) and the context (e.g., neighborhood effects, etc.). Further, we assume risk and protective factors also vary in each individual’s current lives (e.g., possible adult trauma, other life stressors). It is important to stress that we cannot determine the degree to which our sample is biased based on our recruitment from an introductory psychology course participant pool. It is conceivable that students recruited from this course differ from other students at the university in ways we cannot account for. For example, introductory psychology courses may appeal more strongly to students who carry psychiatric or environmental risk. We are not aware of any college studies of maltreatment that satisfy methodological requirements to draw epidemiological conclusions. Our continued work in this area is designed to add more measures, such as clinical interviews, to better characterize our sample beyond the CTQ. The CTQ is a survey that is validated and well established in the literature, but still suffers from some degree of measurement error that could either depress or inflate correlations.

A second limitation is that our sample was majority female. To a large extent, this mirrors the demographics of the university population from which it was drawn; however, it may be the case that the title of our study selectively attracted female participants over males. It should be noted that a substantial proportion of studies examining history of childhood maltreatment involve exclusively female samples (e.g., Aspelmeier et al., 2007; Elliot et al., 2009; Kendra et al., 2012); nevertheless, our findings may not generalize to a more diverse population of individuals with maltreatment histories. To address this limitation, our future research will broaden our recruitment of participants. For example, we plan to include a sample of student veterans, a population that may be characterized by trauma at two developmental stages (Orcutt et al., 2003) and that is at high risk for academic difficulties and attrition (Rumann and Hamrick, 2007; DiRamio et al., 2008). The above limitations regarding the homogeneity of the sample highlight the potential problem of random versus non-random measurement error, likely inherent in most research in this domain. Non-random
research program is to identify individuals within the large of vulnerable college students. The overarching goal of our a novel approach to understanding an understudied subgroup we must stress that this work represents the early stages of between history of maltreatment to college outcomes. Contributing new information regarding the potential pathways in the college adaptation and attrition literature, while also EF tasks are very much in line with the effect sizes reported (e.g., Murray and Wren, 2003; Kitsantas et al., 2008), as we did in this study. Thus, we examined two accepted hot EF tasks, each with several indices of performance. We found that adaptive responding on a particular block of the IGT, and reaction time to the neutral face condition of the GNG were significant mediators between a history of maltreatment and GPA and self-reported college adaptation, respectively. Our future research will explore potential mechanisms (e.g., cognitive strategies, emotion regulation) underlying each of these findings. Further, we will continue to examine the degree to which other hot EF tasks, such as a heated working memory paradigm, demonstrate the same associations with both history of childhood maltreatment and college adaptation and achievement.

A fourth and final limitation involves our small effects. In this first study to examine the indirect effects of EF on the association between childhood maltreatment history and college outcomes, it is the case that the indirect effects we did identify were small, albeit significant. However, it should be noted that research designed to explain individual differences in the multifactorial domains of college adaptation and achievement (e.g., GPA) typically identify very small effects of single variables, even those factors much more proximal to the college outcomes (e.g., intelligence, self-efficacy, metacognition) than we examined in the current study (e.g., Murray and Wren, 2003; Kitsantas et al., 2008). Therefore, our small indirect effects utilizing only two hot EF tasks are very much in line with the effect sizes reported in the college adaptation and attrition literature, while also contributing new information regarding the potential pathways between history of maltreatment to college outcomes.

While we certainly acknowledge these various limitations, we must stress that this work represents the early stages of a novel approach to understanding an understudied subgroup of vulnerable college students. The overarching goal of our research program is to identify individuals within the large heterogeneous group of college students who might benefit from targeted interventions that are informed by our findings regarding the mediational pathways between childhood trauma and academic outcomes. From the start, our approach has rested on the assumption that any effort to identify patterns of relative risk within the large heterogeneous group with a maltreatment history must involve in exploration of current phenotype. The importance of understanding current cognitive and emotional factors reflects the multifactorial relationship between child developmental history and academic outcome. In this first, exploratory investigation we identified hot executive processes as a potential meditational connection. While our results should be considered preliminary and in need of further study, we believe that the examination of EFs within relatively hotter contexts may be a very fruitful direction for researchers interested in understanding the mechanisms that connect child maltreatment history to academic outcome. Promoting successful adaptation in the college setting may be one of our most effective means of contributing to positive life outcomes for individuals who carry developmental risk.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the Institutional Review Board for the Protection of Human Subjects in Research of the University of Northern Colorado, with written informed consent from all subjects. All subjects gave written informed consent in accordance with the American Psychological Association ethical guidelines. The protocol was approved by the Institutional Review Board of the University of Northern Colorado.

AUTHOR CONTRIBUTIONS

MW and EP collaborated in the conceptualization of the study, as well as in its design, execution, and the preparation of this manuscript. MJ contributed her expertise in data analysis and interpretation, as well as collaborated in the preparation of this manuscript.

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REFERENCES

Adolphs, R. (2002). Recognizing emotion from facial expressions: psychological and neurological mechanisms. Behav. Cogn. Neurosci. Rev. 1, 21–61. doi: 10.1177/1534582302001001003

Adolphs, R. (2008). Fear, faces, and the human amygdala. Curr. Opin. Neurobiol. 18, 166–172. doi: 10.1016/j.conb.2008.06.006

Allwood, M. A., and Bell, D. J. (2008). A preliminary examination of emotional and cognitive mediators in the relations between violence exposure and violent
behaviors in youth. J. Community Psychol. 36, 989–1007. doi: 10.1002/jcop.20277
Aspelmeier, J. E., Elliott, A. N., and Smith, C. H. (2007). Childhood sexual abuse, attachment, and trauma symptoms in college females: the moderating role of attachment. Child Abuse Negl. 31, 549–566. doi: 10.1016/j.chiabu.2006.12.002
Baars, M. A. E., Bijvank, M. N., Tonnaer, G. H., and Jolles, J. (2015). Self-report measures of executive functioning are a determinant of academic performance in first-year students at a university of applied sciences. Front. Psychol. 6:1131. doi: 10.3389/fpsyg.2015.01131
Bachrach, R. L., and Read, J. P. (2012). The role of posttraumatic stress and problem alcohol in university academic performance. J. Clin. Psychol. 68, 843–859. doi: 10.1002/jclp.21874
Baker, R. W., and Siryk, B. (1999). Student Adaptation to College Questionnaire Manual. Los Angeles, CA: Western Psychological Services.
Banyard, V. L., and Cantor, E. N. (2004). Adjustment to college among trauma survivors: an exploratory study of resilience. J. Coll. Stud. Dev. 45, 207–221. doi: 10.1353/csd.2004.0017
Baron, R. M., and Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, method, and statistical considerations. J. Pers. Soc. Psychol. 51, 1173–1182. doi: 10.1037/0022-3514.51.6.1173
Baum, C. L., and Ruhmb, C. J. (2009). Age, socioeconomic status and obesity growth. J. Health Econ. 28, 635–648. doi: 10.1016/j.jhealeco.2009.01.004
Bechara, A. (2004). The role of emotion in decision-making: evidence from neurological patients with orbitofrontal damage. Brain Cogn. 55, 30–40. doi: 10.1016/j.bandc.2003.04.001
Bechara, A., Anderson, S. W., Damasio, A. R., and Damasio, H. (1994). Insensitivity to future consequences following damage to the human prefrontal cortex. Cognition 50, 7–15. doi: 10.1016/0010-0277(94)90018-3
Bechara, A., Damasio, H., and Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. Cereb. Cortex 10, 295–307. doi: 10.1093/cercor/10.3.295
Bernstein, D. P., Ahluvalia, T., Pogge, D., and Handelsman, L. (1997). Validity of measures of executive functioning are a determinant of academic performance in first-year students at a university of applied sciences. Front. Psychol. 6:1131. doi: 10.3389/fpsyg.2015.01131
Brotman, A. M., Miranda, R., Stovall-McClough, K. C., and Han, H. (2005). Beyond PTSD: emotion regulation and interpersonal problems as predictors of functional impairment in survivors of child abuse. Behav. Ther. 36, 119–124. doi: 10.1016/S0005-7949(05)80060-7
Credé, M., and Niehorster, S. (2012). Adjustment to college as measured by the student adaptation to college questionnaire: a quantitative review of its structure and relationships with correlates and consequences. Educ. Psychol. Rev. 24, 133–165. doi: 10.1007/s10648-011-9184-5
Cromheeke, S., Herpol, L. A., and Mueller, S. C. (2014). Childhood abuse is related to working memory impairment for positive emotions in female university students. Child Maltreat. 19, 38–48. doi: 10.1177/1077559513511152
Diamond, A. (1999). The Feeling of What Happens: Body and Emotion in the Making of Consciousness. New York: Houghton Mifflin Harcourt.
Diamond, A. (2012). Activities and programs that improve children's executive functions. Curr. Dir. Psychol. Sci. 21, 335–341. doi: 10.1177/096372141243722
Diamond, A., and Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. Science 333, 959–964. doi: 10.1126/science.1204529
DiRamio, D., Ackerman, R., and Mitchell, R. L. (2008). From combat to campus: voices of student veterans. NASPA J. 45, 75–102. doi: 10.2202/0027-6014.1908
Duncan, R. D. (2000). Childhood maltreatment and college drop-out rates: implications for child abuse researchers. J. Interpers. Violence 15, 987–995. doi: 10.1177/08862600015090005
Ettin, A., and Wager, T. D. (2007). Functional neuroimaging of anxiety: a meta-analysis of emotional processing in PTSD, social anxiety disorder, and specific phobia. Am. J. Psychiatry 164, 1476–1488. doi: 10.1176/appi.ajp.2007.07030504
Fritz, M. S., and MacKinnon, D. P. (2007). Required sample size to detect mediated effect. Psychol. Sci. 18, 233–239. doi: 10.1111/j.1467-9280.2007.01882.x
Fritz, M. S., Taylor, A. B., and MacKinnon, D. P. (2012). Explanation of two anomalous results in statistical mediation analysis. Multivariate Behav. Res. 47, 61–87. doi: 10.1080/002731712.2016.45896
Freyd, J. J., DePrince, A. P., and Zurbriggen, E. L. (2001). Self-reported memory for abuse depends on victim-perpetrator relationship. J Trauma Dissociation 2, 5–16. doi: 10.1300/J229v02n03_02
Fritz, M. S., and MacKinnon, D. P. (2007). Required sample size to detect mediated effect. Psychol. Sci. 18, 233–239. doi: 10.1111/j.1467-9280.2007.01882.x
Fritz, M. S., Taylor, A. B., and MacKinnon, D. P. (2012). Explanation of two anomalous results in statistical mediation analysis. Multivariate Behav. Res. 47, 61–87. doi: 10.1080/002731712.2016.45896
Germine, L. T., Duchaine, B., and Nakayama, K. (2011). Where cognitive development and aging meet: face learning ability peaks after age 30. Cognition 118, 201–210. doi: 10.1016/j.cognition.2010.11.002
Gibb, B. E., Schofield, C. A., and Coles, M. E. (2009). Reported history of childhood abuse and young adults’ information processing biases for facial displays of emotion. Child Maltreat. 14, 148–156. doi: 10.1177/1077559509083238
Gliga, T., and Csibra, G. (2007). Seeing the face through the eyes: a developmental perspective on face expertise. Prog. Brain Res. 164, 323–339. doi: 10.1016/S0079-6123(07)54018-7
Goel, V., and Dolan, R. J. (2003). Reciprocal neural response within lateral and ventral medial prefrontal cortex during hot and cold reasoning. Neuroimage 20, 2314–2321. doi: 10.1016/j.neuroimage.2003.07.027
Gold, A. L., Sheridan, M. A., Voss, H. U., Glover, G. H., and Casey, B. J. (2008). Biological substrates of emotional reactivity and regulation in adolescence during an emotional go-no-go task. Biol. Psychiatry 63, 927–934. doi: 10.1016/j.biopsych.2008.03.015
Hayes, A. F. (2009). Beyond Baron and Kenny: statistical mediation analysis in the new millennium. Commun. Monogr. 76, 408–420. doi: 10.1080/03637750903310360
Kiesel, L. R., Piescher, K. N., and Edleson, J. L. (2016). The relationship between PTSD symptoms and drinking among female college students: results from a daily monitoring study. *Psychol. Addict. Behav.*, 28, 62. doi: 10.1037/a0035588

Kendra, R., Bell, K. M., and Guimond, J. M. (2012). The impact of child abuse history, PTSD symptoms, and anger arousal on dating violence perpetration among college women. *J. Fam. Violence* 27, 165–175. doi: 10.1007/s10896-012-9415-7

Kiesel, L. R., Piescher, K. N., and Edleson, J. L. (2016). The relationship between child maltreatment, intimate partner violence exposure, and academic performance. *J. Public Child Welf.* 10, 434–456. doi: 10.1007/s15548736.2016.1209150

Kirk-Smith, M., Henry, L., and Messer, D. (2014). Executive functioning: developmental consequences on adolescents with histories of maltreatment. *Br. J. Dev. Psychol.* 32, 305–319. doi: 10.1111/bjdp.12041

Kitsantas, A., Winsler, A., and Huie, F. (2008). Self-regulation and ability predictors of academic success during college: a predictive validity study. *J. Adv. Acad. 20*, 42–68.

Komarraju, M., and Nadler, D. (2013). Self-efficacy and academic achievement: Why do implicit beliefs, goals, and effort regulation matter? *Learn. Individ. Differ.* 25, 67–72. doi: 10.1016/j.lindif.2013.01.005

Leonhardt, D. (2014). Is college worth it? Clearly, new data say. *New York Times*, 27th May.

Maples, L. A., Park, S. S., Nolan, J. P., and Rosen, L. A. (2014). Resilience to child abuse and neglect in college students. *J. Aggress. Maltreat. Trauma 23*, 1001–1019. doi: 10.1080/j.chaiba.2014.10.010

Masten, A. S., Herbers, J. E., Desjardins, C. D., Cutchi, J. L., McCormick, C. M., Sapienza, J. K., et al. (2012). Executive function skills and school success in young children experiencing homelessness. *Educ. Res. 41*, 375–384. doi: 10.1037/a0009943

McEwen, B. S. (2008). Understanding the potency of stressful early life experiences on brain body and function. *Metabolism 57*, S11–S15. doi: 10.1016/j.metabol.2008.07.006

Mersky, J. P., and Topitzes, J. (2010). Comparing early adult outcomes of maltreated and non-maltreated children: a prospective longitudinal investigation. *Child. Youth Serv. Rev.* 32, 1086–1096. doi: 10.1016/j.childyouth.2009.10.018

Mothes, L., Kristensen, C. H., Grassi-Oliviera, R., Fonseca, R. P., de Lima Argimon, I. I., and Irigaray, T. Q. (2015). Childhood maltreatment and executive function in children. *Child Adolesc. Ment. Health* 20, 56–62. doi: 10.1111/camh.12068

Murray, C., and Wren, C. T. (2003). Cognitive, academic, and attitudinal predictors of the grade point averages of college students with learning disabilities. *J. Learn. Disabil.* 36, 407–415. doi: 10.1177/00222194030360050201

Navalta, C. P., Polcari, A., Webster, D. M., Boghossian, A., and Teicher, M. H. (2006). Effects of childhood sexual abuse on neuropsychological and cognitive function in college women. *J. Neuropsychiatry Clin. Neurosci.* 18, 45–53. doi: 10.1176/jnp.18.1.45

Nikulina, V., and Widom, C. S. (2013). Child maltreatment and executive functioning in middle adulthood: a prospective examination. *Neuropsychology 27*, 417. doi: 10.1037/a0032811

Orcutt, H. K., King, L. A., and King, D. W. (2003). Male-perpetrated violence among Vietnam veteran couples: relationships with veteran's early life characteristics, trauma history, and PTSD symptomatology. *J. Trauma Stress 16*, 381–390. doi: 10.1023/A:1024470103325

Perzow, S. E., Petenko, C. L., Garrido, E. F., Combs, M. D., Culhane, S. E., and Taussig, H. N. (2013). Dissociative symptoms and academic functioning in maltreated children: a preliminary study. *J. Trauma Dissociation 14*, 302–311. doi: 10.152249732.2012.736928

Pollak, S. D., and Sinha, P. (2002). Effects of early experience on children's recognition of facial displays of emotion. *Dev. Psychol.* 38, 784. doi: 10.1037/0012-1649.38.5.784

Preacher, K. J., and Selig, J. P. (2012). Advantages of Monte Carlo confidence intervals for indirect effects. *Commun. Methods Meas.* 6, 77–98. doi: 10.1080/19312458.2012.679848

Rabin, L. A., Fogel, J., and Nutter-Upham, K. E. (2011). Academic procrastination in college students: the role of self-reported executive function. *J. Clin. Exp. Neuropsychol.* 33, 344–357. doi: 10.1080/13803395.2010.518597

Roy, C. A., and Perry, J. C. (2004). Instruments for the assessment of childhood trauma in adults. *J. Nerv. Ment. Dis.* 192, 343–351. doi: 10.1097/00005718-201211000-00019

Rummann, C. B., and Harrick, F. A. (2007). “Student soldiers: Returning from a war zone,” in *Paper presented at the Joint Meeting of the National Association for Student Personnel Administrators and ACPA*, (Orlando, FL: College Student Educators International).

Schwartz, C. E., Wright, C. I., Shin, L. M., Kagan, J., and Rauch, S. L. (2003). Inhibited and uninhibited infants “growing up”: adult amygdalar response to novelty. *Science 300*, 1952–1953. doi: 10.1126/science1083703

Spann, M. N., Mayes, L. C., Kalmar, J. H., Guiney, J., Womer, F. Y., and Pittman, B. (2012). Childhood abuse and neglect and cognitive flexibility in adolescents. *Child Neuropsychol. 18*, 182–189. doi: 10.1037/a00297049.2011.595400

Spertus, I. L., Yehuda, R., Wong, C. M., Halligan, S., and Seremetis, S. V. (2003). Childhood emotional abuse and neglect as predictors of psychological and physical symptoms in women presenting to a primary care practice. *Child Abuse Negl. 27*, 1247–1258. doi: 10.1016/j.chiabu.2003.05.001

St Clair-Thompson, H. L., and Gathercole, S. E. (2006). Executive functions and achievement in school: shifting, updating, inhibition, and working memory. *Q. J. Exp. Psychol.* 59, 745–759. doi: 10.1080/71470210500162854

Stoltenborgh, M., Bakermans-Kranenburg, M. J., Alink, L. R., and IJzendoorn, M. H. (2014). The prevalence of child maltreatment across the globe: review of a series of meta-analyses. *Child Abuse Rev. 24*, 37–50.

Vasilevski, V., and Tucker, A. (2016). Wide-ranging cognitive deficits in adolescents following early life maltreatment. *Neuropsychology 30*, 239–246. doi: 10.1037/neu0000215

Waxman, R., Fenton, M. C., Skodol, A. E., Grant, B. F., and Hasin, D. (2014). Childhood maltreatment and personality disorders in the USA: specificity of effects and the impact of gender. *Pers. Ment. Health* 8, 30–41. doi: 10.1002/pmh.1239

Welsh, M., and Peterson, E. (2014). Issues in the conceptualization and assessment of hot executive function in childhood. *J. Int. Neuropsychol. Soc.* 20, 152–156. doi: 10.1017/S1355617713001379

Wittliff, B., Magnus, N., Vernon-Feagans, L., and Blair, C. B. (2016). Developmental delays in executive function from 3 to 5 years of age predict kindergarten academic readiness. *J. Learn. Disabil.* 50, 359–372. doi: 10.1177/0022219416619754

Zelazo, P. D., and Carlson, S. M. (2012). Hot and cool executive function in childhood and adolescence: development and plasticity. *Child Dev. Perspect.* 6, 354–360. doi: 10.1177/17568066201200246x
Zhang, Q., and Wang, Y. (2004). Trends in the association between obesity and socioeconomic status in U.S. adults: 1971 to 2000. Obes. Res. 12, 1622–1632.

**Conflict of Interest Statement:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.