Grit as a Protective Factor for The Effects of Adverse Childhood Experience on Item and Source Memory Errors

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Abstract

This study investigated the influence of grit as a protective factor against the impact of childhood adversity on item and source memory accuracy. Childhood adversity is defined as experiences related to abuse, neglect, and household dysfunction (Felitti et al., 1998). Drawing on trauma theory and outcomes associated with grit, the study aimed to explore how adverse childhood experiences affect item and source memory in different contexts. A total of 131 participants (M_{age} = 21.40) completed tasks assessing item and source memory accuracy in both threat and safety conditions, measures of adverse childhood experiences, and grit. Results revealed that emotional context influenced memory retrieval, with better performance in the safety condition compared to the threat condition. Additionally, participants with higher levels of sexual abuse showed better item memory accuracy in the threat condition but not in the safety condition, while emotional abuse influenced source memory accuracy differently depending on the emotional context. Furthermore, grit emerged as a moderator in the relationship between sexual abuse and item memory accuracy in the threat condition, suggesting a protective role in encoding and retrieval processes. These findings underscore the importance of considering individual differences and situational factors in understanding memory outcomes in populations with adverse childhood experiences.

Keywords: adverse childhood experiences, ACEs, grit, item memory, source memory

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Adverse Childhood Experiences (ACEs) encompass the traumatic events or adverse circumstances during childhood or adolescence (Felitti et al., 1998). Emerging in the literature over the past two decades, ACEs shed light on the physical, socio-emotional, and cognitive outcomes individuals encounter during their transition into adulthood (Felitti et al., 1998). These experiences are categorized into three groups: abuse (physical, emotional, and sexual), neglect (physical and emotional), and household dysfunction, which encompasses living situations involving substance abuse, mental illness, maternal domestic violence, parental divorce, and/or family member incarceration (Felitti et al., 1998). ACEs can accumulate across categories or manifest in specific ones (Felitti et al., 1998).

Trauma theory, as proposed by Herman (1992), serves as the explanatory framework for adverse outcomes associated with ACEs, delving into the emotional and psychological impact of trauma and its relationship to the recovery process (Herman, 1992). While some adversity may foster resilience and a positive sense of well-being, accumulating ACEs during childhood heightens the risk of long-term consequences in adulthood (Seery & Silver, 2010). Although there is not a singular threshold applicable to every individual, those reporting four or more ACEs face an increased risk of severe outcomes, including physical conditions such as cancer, diabetes, and heart disease (Felitti et al., 1998), alongside socio-emotional consequences like anxiety, depression, and suicide attempts (Felitti et al., 1998), as well as cognitive impairments in memory and processing (Dannlowski et al., 2012; Hawkins et al., 2021; Zhang et al., 2023).

ACEs may also induce dissociation, disrupting conscious awareness and narrative memory (Herman, 1992).

Prior research has established that ACEs can alter memory function, affecting physical changes in the brain (Anda et al., 2006). Chronic exposure to stress or trauma during childhood can lead to structural and functional changes in the memory-related brain areas, such as the hippocampus, which is critical for memory storage and retrieval (Anda et al., 2006). The constant activation of the body's stress response system can elevate cortisol levels, impair memory processes, and result in deficiencies, learning difficulties, and challenges adapting to new information and experiences (Anda et al., 2006).

In addition to memory consolidation and retrieval deficits, impairments in working and spatial working memory have been found in those with ACEs. Working memory, the form of memory that briefly holds and manipulates information for active mental processing, is notably impacted due to challenges in concentration and cognitive flexibility (Becker & Morris, 1999; Rush, 2021). Similarly, spatial working memory, which involves maintaining and utilizing spatial information as needed, can also be affected (Majer et al., 2010). Majer et al. (2010) observed that increased ACEs, particularly emotional abuse and physical neglect, were associated with poorer performance in spatial working memory. Additionally, individuals experiencing physical neglect encounter difficulties in long-term memory, responsible for organizing large amounts of information over time (Cowan, 2008; Majer et al., 2010).

However, research on other ACEs-related memory processes, such as item and source memory, remains limited. The current study seeks to address this gap by investigating item and source memory deficits resulting from ACEs and exploring possible protective factors, such as grit, against these deficits.

Explicit memory for context information, such as item and source memory, has received limited attention in adversity-affected populations. Item memory involves retaining items or elements within focused attention, facilitating their recall or recognition later (Johnson et al., 1993). For example, deciding whether a face or specific object has previously been seen. Source memory pertains to the recall of the source of acquired information, including when or where it was learned (Johnson et al., 1993). Signal detection theory states that source memory discriminates between relevant and irrelevant information sources or signals, enabling the differentiation between correct and incorrect sources to inform decision-making (Wixted, 2007). The environmental context in which the information is presented, such as whether it is perceived as safe or threatening, significantly influences memory processes (Ventura-Bort et al., 2015). A robust source memory is indispensable for human functioning, facilitating accurate recall of the origin of specific information, which is critical for decision-making and learning from past experiences (Schellhaas et al., 2022). Source memory also plays a pivotal role in social interactions, enabling effective communication and discernment of reliable sources from unreliable ones (Schellhaas et al., 2022). Notably, source memory is intricately linked to adaptive decision-making and necessitates simple reciprocal strategies (Schaper et al., 2019). Consequently, deficits in item and source memory can lead to challenges in communication, interpersonal relationships, and social cooperation (Schaper et al., 2019).

Nondeclarative memory, which encompasses procedural and emotional memory, may be relatively spared in individuals with adverse childhood experiences (ACEs) due to its distinct neural pathways and encoding processes (Reber, 2008). ACEs often involve chronic stress and trauma, which can detrimentally affect higher-order cognitive functions like item and source memory, which rely heavily on the hippocampus and prefrontal cortex. However, nondeclarative

memory systems, particularly procedural and emotional memory, are predominantly encoded and stored in regions such as the basal ganglia and amygdala, which are less susceptible to the disruptive effects of chronic stress (Reber, 2008). Additionally, the formation of procedural memories, such as motor skills or conditioned responses, often occurs implicitly and through repetitive practice, bypassing conscious cognitive processing that ACEs may impair (Brown et al., 2007). Emotional memories, likewise, may be preserved due to the amygdala's involvement in their formation and retrieval, which can occur with high emotional salience even in the absence of conscious recollection (Brown et al., 2007). Therefore, while ACEs may impact various memory systems differently, nondeclarative memory may be relatively spared, offering a potential avenue for resilience and adaptive functioning in individuals with such experiences.

Extensive research has explored risk factors associated with ACEs and their correlated negative outcomes. While investigations into protective factors have been more limited, they have gained traction over the past two decades (Crouch et al., 2018). Intrapersonal and interpersonal factors, including coping mechanisms, resilience, personal growth, grit, emotional support, and the nature and timing of interventions, have been suggested as potential protective factors against ACEs and severe mental health disorders (Liu et al., 2021; Parks et al., 2022; Silovsky et al., 2022).

Grit refers to an individual’s perseverance and passion for achieving long-term goals (Duckworth & Peterson, 2007). It encompasses two key traits: consistency of interests and perseverance of effort. Individuals with grit are more likely to sustain effort and interest in pursuing their objectives despite adversity and setbacks (Duckworth & Peterson, 2007). Importantly, grit is not considered a fixed personality trait but can be cultivated through practice, determination, and adopting the appropriate mindset (Duckworth & Peterson, 2007). In terms of

cognitive health, this determination may lead to more consistent engagement in activities that promote memory and overall cognitive function. (Duckworth & Peterson, 2007). Duckworth and Peterson (2007) argue that many accomplishments require sustained effort and dedication, and individuals with grit are better equipped to navigate setbacks and persevere through challenges.

The research gap lies in understanding whether the presence of grit mitigates the effect of ACEs on item and source memory. This study will investigate whether grit operates as a protective factor against memory errors associated with ACEs.

Childhood exposure to physical and sexual abuse exerts enduring effects on both physical and mental health, impacting brain functions and contributing to the development of mental health disorders, which in turn affect cognitive and emotional processing, including memory (Herzog & Schmahl, 2018). Notably, abused, and neglected children often demonstrate poorer cognitive performance, particularly in visual episodic memory and executive functioning. However, the severity and duration of ACEs exacerbate disruptions and can lead to heightened hypervigilance, thus increasing item and source memory accuracy in response to threats (Berthelot et al., 2015; Herzog & Schmahl, 2018).

Research indicates that individuals with a history of sexual abuse and emotional neglect may exhibit improved facial recognition, particularly those with social anxiety, possibly due to heightened awareness in stressful situations (Schellhaas et al., 2022). Moreover, individuals exposed to sexual and emotional abuse may demonstrate enhanced working memory during threat conditions, potentially attributable to increased vigilance (Schellhaas et al., 2022). Conversely, physically abusive parents may exhibit significantly lower emotion recognition accuracy, while children exposed to maltreatment may display altered recognition rates for different facial expressions (Ardizzi et al., 2015; Wagner et al., 2015). Early neglect can lead to

alterations in the identification and processing of facial expressions, particularly negative emotions (Doretto & Scivoletto, 2018).

Research on adults exposed to early life stress associate abuse and neglect with deficits in visual memory, executive functioning, and emotional processing, especially under non-threatening conditions (Gould et al., 2012). Visual memory, which represents the relationship between the perceptual properties of stimuli and the encoding or retrieval processes, is supported by the hippocampus, possibly explaining deficits observed in individuals exposed to ACEs (Gould et al., 2012; Luck & Hollingworth, 2008). Distinct forms of abuse are associated with specific deficits, with sexual abuse linked to executive functioning and spatial working memory deficits. In contrast, physical abuse and neglect are associated with deficits in executive functioning, processing speed, and emotion processing (Gould et al., 2012). Emotional neglect emerges as a significant predictor of dysfunction in declarative memory, a type of memory storing episodic and factual information (Terock et al., 2020). The prefrontal cortex and hippocampus, critical for declarative memory, are stress-sensitive areas (Gunnar & Quevedo, 2007). These findings underscore the lasting impact of early life stress on cognitive functions, highlighting the prevalence and significance of childhood abuse and neglect. In the context of the current study, where item and source memory recall for neutral expressions will be assessed, these established patterns suggest anticipated differences in recall based on the type of ACEs, contributing to our understanding of the impact of childhood adversity on memory processes.

While research has explored the effects of abuse and neglect on various memory processes, their impact on item and source memory remains less understood. However, Schellhaas et al. (2022) addressed this gap by investigating item and source memory in individuals with ACEs. Participants were presented with a series of faces on a computer, each

displayed against either a green or blue background, designating a ‘threatening’ or ‘safe’ condition, respectively. In the threatening condition, participants were informed they might receive a shock while viewing the faces, whereas no shock would occur during the safety condition. Item memory, involving the recall of the faces, and source memory, measured by recalling the background color of the face, were assessed. Results indicated that individuals with social anxiety exhibited better item and source memory in the threatening condition compared to the safety condition, suggesting processing differences in face perception and recognition among adults with ACEs.

Furthermore, Schellhaas et al. (2022) found distinctions within different domains of ACE exposure, particularly in abuse and neglect. Specifically, sexual abuse and emotional neglect were associated with improved recognition of faces under threatening conditions. Conversely, emotional neglect scores were associated with better working memory under safety conditions, indicating increased cognitive resource recruitment during low-stress tasks. Therefore, the current study anticipates observing differences in memory accuracy based on the type and severity of adverse childhood experiences.

Research exploring potential protective factors for item and source memory accuracy has been limited. Grit emerges as a potential protective factor in this study, given its significant role in shaping memory processes and cognitive performance (Spencer-Smith et al., 2023). Grit has been associated with higher education attainment rates and academic achievement, surpassing traditional measures like IQ or talent (Duckworth & Peterson, 2007). Additionally, individuals with higher levels of grit exhibited better prospective and retrospective memory in academic settings (Underwood, 2023). However, research on grit’s relation to memory is still growing, particularly regarding its association with item and source memory.

Cheung et al. (2022) is one of a few studies investigating the association between ACEs and grit. Conducted with college students in China, the authors found that sexual and emotional abuse and neglect were significantly related to lower levels of grit. These findings hold implications for education, mental health support, and interventions targeting college students with ACEs experiences. Thus, this study will delve into the potential protective role of grit among individuals exposed to ACEs, particularly examining its influence on memory processes.

Current Research

Given the scarcity of research on the protective role of grit against adverse childhood experience outcomes, particularly deficits in item and source memory, this study aimed to investigate how grit may mitigate such memory deficits resulting from ACEs exposure. The findings of this research could offer valuable insights into cognitive skill enhancement strategies for ACEs survivors.

To achieve this objective, participants completed an item and source memory task followed by a battery of self-report measures. The item and source memory task mirrored the protocol of Schellhass et al. (2022). Participants viewed faces in blocks of ten on different background colors, corresponding to either a threat or a safety condition. A sequence of 40 faces was presented, half in the threat condition and half in the safety condition. Subsequently, these faces were shown again, along with 20 new faces, and participants were tasked with recognizing previously seen faces and identifying the initial context. After completing the study, participants were asked to complete questionnaires assessing adverse childhood experiences and grit. Upon completion, participants underwent a manipulation check to assess their understanding of the tasks and their thoughts and feelings regarding the threat and safety conditions.

Based on previous findings, I hypothesize that:

1. There will be differences in the level of performance item and source memory task performance based on the stimuli condition, such that participants will perform better overall under safety conditions (Schellhaas et al., 2022).
2. Individuals who report higher levels of abuse will perform better under threat conditions and worse under safety conditions when compared to those who report lower levels of abuse and household dysfunction (Ardizzi et al., 2015; Schellhaas et al., 2022; Wagner et al., 2015).
3. Individuals who report higher levels of neglect will demonstrate lower task performance regardless of condition than those who report lower levels of neglect (Ardizzi et al., 2015; Schellhaas et al., 2022; Wagner et al., 2015).
4. Individuals with higher levels of grit will demonstrate better overall item and source memory task performance than those with lower levels of grit in threat and safety conditions. In addition, I predict that individuals with greater exposure to abuse, household dysfunction, and neglect-related experiences yet with higher levels of grit will have better item and source memory accuracy in either condition than those with low grit (Ardizzi et al., 2015; Cheung & Huang, 2022; Clements-Noelle & Waddington, 2019; Duckworth et al., 2007; Schellhaas et al., 2022; Wagner et al., 2015).

Methods

Participants

Data was collected from 174 participants; however, 43 participants were dropped due to their overall accuracy level on the task. A total of 131 undergraduate participants (M_{age} = 21.40, *SD* = 5.825, *range* = 18 to 54) participated in the study. Of these participants, 106 were female, 23 male, 1 nonbinary, and 1 other. The racial identities and ethnicities of the participants vary

from 55% White, 9.9% Black or African American, 9.2% Asian or Asian American, 0.8% Middle Eastern or North African, 19.8% Hispanic or Spanish Origin, 2.3% Biracial, and 3.1% other. Regarding college majors, 52.7% of the participants were psychology majors, and 47.3% of participants were other majors such as health science, biology, or other social sciences. This study was approved by the IRB at Stockton University. Before beginning the study, participants read and signed a consent form agreeing to participate. Participants were recruited through the online SONA system at Stockton University and were granted two research credits for their time. Further demographic information is presented in Table 1.

Materials

Participants were asked to complete an item and source memory task and two surveys on Qualtrics. These are described below. A manipulation check and demographic information were also collected from participants.

Item/Source Memory Task

Using the methods from Schellaas et al. (2022), participants performed an item and source memory task utilizing face stimuli in which they were asked to recognize and recall faces and, further, the background color on which they were presented. A total of 60 images portraying neutral expressions were selected from Karolinska Directed Emotional Faces (Lundqvist et al., 1998), the NimStim database (Tottenham et al., 2009), and the Chicago Face Database (Ma et al., 2015). These comprised 20 images for the threatening condition, 20 for the safety condition, and 20 foils in the memory test. Each set of 20 images consisted of an equal distribution of male and female faces, and all were White. Prior research has found an own-race bias when asked to recall and recognize facial stimuli when presented with different races (Meissner & Brigham, 2001). The racial distribution of the population at Stockton University is approximately 60%

White, thus supporting the use of all White faces. Faces were randomly selected from the database using their file number and excluded if they had any distinguishing characteristics, such as facial hair or beauty marks. The images were processed using Microsoft Word to convert them to be as similar as possible. To do so, pictures were transformed to grayscale, normalized for brightness, and extraneous features such as hair and ears were removed by cropping the photos with an elliptic mask. The faces were then presented with a black background to be uniform across all presented stimuli.

Two conditions were employed for presenting the faces: threatening or safe. In the threatening condition, faces were displayed against a particular background color, with participants informed that a loud noise might accompany these images. Conversely, in the safe condition, faces were presented against a different background color, with participants informed that no noise would accompany these images. Colors for the threatening and safe conditions were blue and green and counterbalanced across participants.

The task was programmed using E-Prime software and administered on desktop computers in a psychology lab at Stockton University. During the encoding phase, the 40 images were shown for 6 seconds each, with a 500 ms inter-trial interval featuring a fixation cross on a white background after each image. The threat and safety conditions were shown in alternating blocks of ten. The recognition phase followed immediately, where the 40 faces, now devoid of background colors, were mixed with 20 new images. Participants were required to identify whether each face was previously presented in the encoding phase of the task and, further, if it was subsequently presented against a blue or green background. Participants were only asked about the source of the face if they had indicated that it was an old face from the encoding phase. Responses were made using a mouse to click options on a computer screen, and participants

completed the task without time constraints or feedback on accuracy. The same faces were used for each participant trial yet were randomized in terms of the condition and order of presentation. Additionally, participants completed the Self-Assessment Manikin to gauge their subjective ratings of valence, arousal, and perceived threat associated with the contextual background colors of the faces. See Appendix A for an example of the manipulation check, Appendix B for an illustrative example of facial stimuli, and Appendix C for a visual presentation of the task.

Adverse Childhood Experiences

The 28-item Child Trauma Questionnaire (CTQ; Bernstein et al., 2003), in conjunction with 5 household dysfunction items from the Adverse Childhood Experiences Questionnaire (ACE-Q; Felitti et al., 1998), measured exposure to adverse childhood experiences. The CTQ measures emotional, physical, and sexual abuse and emotional and physical neglect. Participants responded on a 5-point Likert scale from 1 (*Never true*) to 5 (*Very often true*) to statements such as "People in my family said hurtful or insulting things to me" and "People in my family hit me so hard that it left me with bruises and marks." Scores were summed up across each subscale with a possible range of 5-25, with higher scores indicating more exposure to childhood trauma and lower scores indicating less exposure to childhood trauma. The household dysfunction portion of ACE-Q measures maternal domestic violence, household substance abuse and mental illness, parental separation, and household incarceration. Participants responded "Yes" or "No" to statements such as "Did you live with anyone who was a problem drinker or alcoholic or used street drugs?" Responses recorded as "Yes" are summed up to create an overall ACE score or, in this instance, an overall household dysfunction score. See Appendix D for the CTQ and ACEs questions.

Grit

The Short Grit Scale (Grit-S; Duckworth & Quinn, 2009) is 8 questions measuring both aspects of grit: consistency of interest (e.g., “New ideas and projects sometimes distract me from previous ones”) and perseverance of effort (e.g., “I am a hard worker”). Participants rated how much each statement reflected their current feelings on a 5-point Likert scale from 1 (*Very much like me*) to 5 (*Not like me at all*). Scores are averaged across each subscale. Higher scores indicate higher levels of grit. See Appendix E for Grit-S questions.

Procedure

This study took place in an on-campus psychology laboratory at Stockton University. After providing written informed consent, participants were informed that they would undertake a memory task involving two types of pictures. If the pictures appeared on a green (or blue) background, a loud noise might be played through their headphones (threatening condition). Pictures on a blue (or green) background would entail no sound (safety condition). Participants were further informed that about 90% of participants would receive a maximum of three loud noise blasts throughout the experiment and then given a demonstration of this sound, with reassurance that its volume would be higher and the duration would be longer during the actual task. The demonstration was set at level 15 on the computer monitor, and the sound was played for approximately 10 seconds. Participants were instructed to pay close attention to the faces and colors for the subsequent part of the experiment.

During the encoding session, 40 pictures were displayed one at a time for 6 seconds each, with a 500 ms inter-trial interval. Background colors alternated in blocks of 10 pictures in a randomized order. Each block started with a colored frame presented for 3 seconds. The color and condition of the stimulus were counterbalanced across participants. Participants viewed the pictures on a computer screen after being told they could put their headphones on and press the

spacebar when ready to begin. Participants were further told they did not need to do anything for this part of the task and that the researcher, sitting outside the lab, would return to the room when it was time for the second part.

Subsequently, participants engaged in the recognition session. The researcher returned to the lab to read the following instructions to the participant: “You will now be shown a series of pictures of faces that you may have seen in the prior task. For each face, you will be asked to determine if you have seen the face before and, if yes, which background color it was shown in front of. For example, a face will be shown with two buttons, "old" and "new." If you believe you remember seeing the face in the prior task, please hit the "old" button. If you do not recognize the face, you may press the "new" button. If you decide the face is an "old" face, you will be asked to recall the background color on which the pictured face was initially presented. Each face will give you a "blue" and "green" button. Click which background you recall; you may guess if you are unsure. The next face will follow directly after your answer choice. Press SPACE to begin.” They then viewed 60 faces, 40 previously encountered in the encoding phase, while 20 were new. Each face presentation prompted participants to indicate whether they had seen it before in the encoding phase (old) and, if so, what background color it had. Participants identified the face by clicking old or new on the computer, then further the background color by clicking on a green or blue box. This option of the colored green and blue box was only presented if a face was determined as old. The next face was presented if a face was determined as new. Item memory was assessed by comparing correct responses to new faces versus old faces. Source memory was assessed by determining whether participants correctly recalled the background color associated with each face.

Following this task, participants completed The Childhood Trauma Questionnaire (CTQ), The Adverse Childhood Experiences Questionnaire (ACE-Q), The Short Grit Scale (GRIT-S), The Self-Assessment Manikin (a manipulation check to assess understanding of and feelings associated with the experiment) and a demographic questionnaire. All participants were thanked for their time and were provided with a feedback form including further information on the study, resources, and contact information of the primary researchers. Participants were also given the choice to provide their email address if they were interested in a further debrief and the study's findings. The entire experiment took less than 30 minutes to complete.

Results

Data Analysis Plan

Item and source memory accuracy were calculated for the threat and safety conditions separately. After matching the participants' threat color backgrounds, scores were summed up to represent the number of faces correctly identified as old when presented on the threat background. Safety accuracy scores were summed up the same way. Overall accuracy on the recognition task is also designated as the sum of correctly identified old and correctly identified new faces out of the 60 faces that were presented. Source memory accuracy was coded by adding up the number of correctly identified background colors from the faces identified as old in the recognition task. Scores were split into a threat and safety variable based on the background color of the threat to which the participant had been assigned.

For all surveys, items designated to be reverse-coded via the scoring literature were reverse-coded prior to analysis**.** The Childhood Trauma Questionnaire (CTQ) was divided into Emotional Abuse, Physical Abuse, Sexual Abuse, Emotional Neglect, and Physical Neglect each with five items. These scores were separately summed to create a score for each dimension.

Scores range from 5 to 25, with higher scores explaining higher levels of childhood trauma. The Adverse Childhood Experiences Questionnaire (ACE-Q) was composed of ten questions and responses of "Yes" were added to create a composite score. Scores range from 0 to 10, with higher scores indicating higher levels of household dysfunction experiences. The Short Grit Scale (GRIT-S) is composed of two scales, consistency of interest and perseverance of effort each with four items, which were summed and divided by four. A total grit score was computed by taking the average of the two subscales. Scores could range from 1 to 5, with higher scores indicating higher overall levels of grit.

Data Transformation

After examining the distribution of responses for skewness and possible outliers, physical abuse and sexual abuse were log-transformed, and outliers were replaced for the log of physical and sexual abuse, with scores at three standard deviations above the mean. Physical neglect outliers were also replaced with scores at three standard deviations above the mean. Emotional abuse, emotional neglect, and household dysfunction were not transformed.

See Table 2 for all descriptive statistics. All analyses were conducted using SPSS 28. In accordance with the literature on cognitive tasks, participants who performed at an accuracy rating of less than 60% on the item memory task were excluded from analysis due to the forced choice nature of this task and choosing a cutoff that is just above performing at chance. In this instance, the accuracy rating was calculated as the overall accuracy during the recognition task, the number of faces correctly identified as old plus the number of faces correctly identified as new.

Repeated-Measures ANCOVA

Two repeated-measures ANCOVAs were conducted to test whether adverse childhood experiences influenced performance on item and source memory accuracy based on threat and safety conditions. The first was with item memory accuracy as the dependent variable, and the second was with source memory accuracy as the dependent variable. The covariates entered for both repeated-measures ANCOVAs were emotional abuse, physical abuse, sexual abuse, emotional neglect, physical neglect, household dysfunction, and grit. For the following analyses, the alpha level was set at .05, such that null hypotheses were rejected for p-levels less than .05 and designated p-values between .05 and .1 as trending towards significance.

The first repeated-measures ANCOVA for item memory accuracy revealed main effects for Encoding Condition, F (1, 123) = 5.066, p = .026, η_{p2} = .04, such that accuracy for item memory was higher in the safety condition (M = 13.86, SD = 2.60) than the threat condition (M = 13.3, SD = 2.60; see Figure 1 for item memory accuracy means for the threat and safety conditions). Physical Neglect was a significant covariate in the model, F (1, 123) = 3.95, p = .049, η_{p2} = .03, and Sexual Abuse approached significance, F (1, 123) = 2.867, p = .093, η_{p2} = .03. To further support the direction of the effect of physical neglect on overall item memory accuracy, a Pearson's correlation was conducted on these variables. This revealed a positive correlation approaching significance between item memory accuracy and physical neglect, r = .159, p = .070.

In addition, the analysis revealed a Sexual Abuse x Encoding Condition interaction, F (1, 123) = 5.397, p = .022, .05, η_{p2} = .04, such that the difference in item memory accuracy for threat versus safety stimuli differs depending on sexual abuse level. To determine the direction of the effect of sexual abuse on item memory accuracy between the conditions, Spearman's correlation was conducted on these variables. It revealed a significant positive correlation

between item memory accuracy in the threat condition and sexual abuse, $r = .174$, $p = .047$, such that higher levels of sexual abuse predicted better item memory in the threat condition. Trending towards significance was a Grit x Encoding Condition interaction, F (1, 123) = 2.945, $p = .089$, such that item memory accuracy for threat versus safety stimuli differed depending on grit level.

There were no further significant findings with item memory accuracy with emotional abuse, physical abuse, emotional neglect, or household dysfunction.

The second repeated-measures ANCOVA for source memory accuracy revealed a main effect for Encoding Condition, F (1, 123) = 3.905, $p = .05$, $\eta_{p2} = .03$, such that accuracy for source memory was higher in the safety condition ($M = 7.19$, $SD = 2.43$) than the threat condition ($M = 7.14$, $SD = 2.31$; see Figure 2 for source memory accuracy means for the threat and safety conditions). Grit approached significance as a covariate, F (1, 123) = 2.841, $p = .094$, such that there is a positive relationship between grit levels and overall source memory accuracy.

In addition, the analyses revealed a significant Emotional Abuse x Encoding Condition interaction, F (1, 123) = 4.624, $p = .033$, $\eta_{p2} = .036$, such that the difference in source memory accuracy for threat versus safety stimuli differed depending on emotional abuse level. To determine the direction of the effect of emotional abuse on source memory accuracy between the conditions, a Pearson's correlation was conducted on these variables. There was no significant correlation between emotional abuse and source memory accuracy in either the threat $r = .072$, $p = .412$, or safety condition, $r = .154$, $p = .079$.

There were no further significant differences with source memory accuracy in the threat and safety conditions with the covariates of sexual abuse, physical abuse, emotional neglect, physical neglect, or household dysfunction.

Moderation Analysis

Given the differences in item memory accuracy between conditions for sexual abuse, I conducted a moderation analysis examining whether grit could be a moderator of the relationship between sexual abuse and item memory accuracy in the threat and safety conditions. The PROCESS SPSS macro was used to analyze the data (Hayes, 2022). Altogether, 12.27% of the variability in item memory performance in the threat condition was predicted by the variables in the model, $R^2 = 0.1227$, $F(3, 127) = 5.9194$, $p < .001$. Table 3 displays the unstandardized regression coefficients. The interaction effect was statistically significant ($p = .049$), indicating that grit moderated the effect of sexual abuse on item memory accuracy in the threat condition. The results demonstrated a relationship between sexual abuse scores and item memory accuracy; higher item memory accuracy in the threat condition is observed in participants who experienced greater sexual abuse and is stronger for individuals who are higher in grit. This moderating effect is shown in Figure 3, and the statistical model is shown in Figure 4. Table 4 represents the conditional effects of the focal predictor (sexual abuse) at three values of the moderator (grit).

Discussion

This study aimed to examine grit as a psychological construct that may mitigate the impact of childhood adversity on item and source memory accuracy. Drawing on trauma theory and outcomes associated with grit, exploring the protective factors of grit on item and source memory accuracy in populations with adverse childhood experiences has theoretical, empirical, and clinical importance. For example, theoretically, this research extends trauma theory to item and source memory, which appear to be dependent upon context and practically can inform a more nuanced and personalized approach to supporting cognitive well-being in individuals with a history of childhood adversity.

The results supported my hypothesis that there will be better item and source memory accuracy in the safety condition compared to the threat condition. Participants did exhibit better memory performance in the safety condition compared to the threat condition, suggesting that the emotional context influenced memory retrieval. This finding aligns with previous research highlighting the impact of emotional arousal on memory encoding and retrieval processes (Herzog & Schmahl, 2018; Schellhaas et al., 2022).

In addition, I predicted that participants who have experienced higher levels of abuse and household dysfunction would have better item and source memory in the threatening condition compared to the safety condition. There was partial support for this hypothesis. Participants who experienced higher levels of sexual abuse were more accurate at item memory (recognizing 'old' and 'new' faces) in the threatening condition but not the safety condition. However, there was no effect of sexual abuse on source memory accuracy (background color of correctly identified 'old' faces). The partial support for the hypothesis suggests that there may be a complex relationship between the severity of sexual abuse experienced and memory processes, particularly in response to threatening stimuli. Therefore, this finding may hint at a potential interaction between trauma history and the emotional context of memory tasks. One possible explanation could be that individuals who have experienced severe sexual abuse may have heightened sensitivity to threatening cues, leading to enhanced vigilance and attention to relevant stimuli in threatening contexts. This heightened vigilance might result in improved item memory for faces in threatening situations compared to safe environments. However, the absence of an effect of sexual abuse on source memory accuracy suggests that the impact of trauma on memory processes may be specific to certain aspects of memory or certain contextual factors. Overall, these findings underscore the importance of considering individual differences, such as trauma

history, and situational factors when studying memory processes, as they can interact in complex ways to influence cognitive functioning.

In addition, source memory accuracy for threat versus safety conditions differs depending upon emotional abuse level. This trend implies that emotional abuse history might influence memory processes differently depending on the emotional context, with greater sensitivity to safety than threat cues in individuals with a history of emotional abuse.

However, there was no effect of emotional abuse on item memory accuracy between conditions, nor did physical abuse affect item or source memory by condition. The absence of an effect of emotional abuse on item memory accuracy between conditions, as well as the lack of impact of physical abuse on item or source memory by condition, suggests that these types of abuse may not directly influence memory processes in response to different emotional contexts. This finding implies that while emotional and physical abuse may have significant effects on other cognitive and emotional functions, they might not specifically affect memory performance in response to varying levels of threat or safety cues. One possible explanation for this discrepancy could be the differential impact of emotional arousal on item versus source memory processes.

My third hypothesis predicted that those who experience higher levels of neglect would have lower accuracy in item and source memory across threat and safety conditions. There was partial support for this with an effect on overall item memory for those who had experienced physical neglect. However, contrary to the hypothesis, there was no effect of emotional neglect on item and source memory and no effect of physical neglect on source memory. This suggests that neglect-related experiences did not significantly influence memory performance in different emotional contexts. This result does not fit with those from the Schellhass et al. (2022), which

found enhanced item and source memory in their safety condition. While previous research also finds deficits in long-term memory and visual episodic memory for people who have experienced neglect, these deficits may be more closely related to autobiographical memories. However, considering these results are specific to one study, it provides a path for future research to explore the type and context of memory deficits more fully for those who experienced neglect.

Lastly, I predicted better overall item and source memory task performance for individuals with higher levels of grit compared to those with lower levels of grit in both threat and safety conditions. Additionally, individuals with greater exposure to adverse experiences yet with higher levels of grit will have better memory accuracy in both conditions compared to those with low grit. Grit was found to be a moderator in the relationship between sexual abuse and item memory accuracy in the threat condition. This suggests that grit may play a protective role, specifically in the encoding and retrieval of item-specific details in threatening situations. The lack of significant moderation effects for other types of adverse experiences indicates the need for further exploration of the differential impact of grit on memory processes. This finding could also be explained based on the complex and intensive experiences that surround sexual abuse, leading individuals to be extremely hypervigilant when expecting a threat and even further when facial stimuli are being presented.

The findings corroborate previous research demonstrating the influence of emotional arousal and adverse childhood experiences on memory performance. The differential effects observed for specific types of abuse and neglect align with theoretical frameworks emphasizing the role of emotional salience and cognitive appraisal in memory formation. Additionally, the moderating effect of grit on the relationship between sexual abuse and item memory accuracy

supports theories suggesting that individual traits can mitigate or perhaps protect the negative impact of adverse experiences on cognitive functioning.

This research further contributes to the existing literature by providing nuanced insights into the interplay between adverse childhood experiences, individual traits, and memory processes. The findings highlight the importance of considering the specific nature of adverse experiences and individual differences when examining memory outcomes. Moreover, the identification of grit as a potential protective factor in memory performance underscores the relevance of non-cognitive traits in buffering against the detrimental effects of trauma. Our findings align with theoretical perspectives emphasizing the interaction between individual characteristics, such as personality traits, environmental factors, and childhood experiences, in shaping cognitive functioning. Furthermore, our results extend previous research by demonstrating the differential impact of specific adverse childhood experiences on memory accuracy, underscoring the heterogeneity of developmental risk factors and their implications for cognitive outcomes. By integrating findings from diverse domains, including developmental psychology, cognitive neuroscience, and personality psychology, our study contributes to a comprehensive understanding of the complex interplay between psychological factors and memory processes.

Limitations and Future Directions

Despite this study's insights, several limitations should be acknowledged. It may be possible that the sound in the threatening condition did not sufficiently convey the threat level necessary for creating emotional differences between the conditions. This may have been compounded by participant crosstalk as data collection progressed. Future research should

investigate alternative methods to creating threatening situations that are still not harmful to participants.

Furthermore, the generalizability of our findings may be limited by the sample characteristics, which predominantly comprised individuals from a specific demographic or nonclinical population. Future research should strive for greater diversity in participant demographics to ensure the robustness and generalizability of findings. Moreover, using a single assessment tool for measuring childhood adversity may overlook nuances in participants' experiences, necessitating a more comprehensive assessment approach.

Finally, while our study focused on memory accuracy as a key outcome measure, future research could explore additional cognitive domains, such as executive function or attentional control, to provide a more holistic understanding of the impact of childhood adversity on cognitive functioning. To add, as grit has been recently described as a measure of intelligence and has been thought to be a predictor of educational achievement (Duckworth et al., 2007), grit may be thought of by participants in solely cognitive domains. If thought of as a trait outside of educational settings and in a broader sense, perhaps we would see more findings with grit as a protective factor against lifetime adversity. Despite these limitations, our study underscores the importance of grit and adaptive coping strategies in mitigating the adverse effects of childhood adversity on cognitive well-being.

Conclusion

The present study employed a comprehensive analysis to investigate the influence of various covariates on multiple dependent variables related to memory accuracy. Our findings suggest that certain childhood adversities, such as emotional abuse and sexual abuse, exert significant effects on item and source memory accuracy, particularly in threatening situations.

Moreover, grit emerged as a noteworthy protective factor, indicating that individuals with higher levels of grit exhibit enhanced item accuracy under threat conditions. While the impact of grit did not reach statistical significance across all measures, its role in mitigating the effects of childhood adversity on memory accuracy warrants further exploration.

Grounded in theoretical frameworks emphasizing grit as a crucial factor in cognitive resilience, this study contributes to the growing body of literature elucidating the mechanisms underlying adaptive coping strategies. By elucidating the complex interplay between childhood adversity and cognitive functioning, our findings underscore the importance of developing targeted interventions aimed at bolstering grit in at-risk populations. Moreover, our results highlight the need for personalized approaches to cognitive well-being, taking into account individual differences in coping mechanisms and childhood adversity levels.

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Table 1

Demographics

Variable	*N* = 131	Overall Sample
Age		
	Range	18 - 54
	Mean	21.40
	Standard Deviation	5.83
Gender		
	Female	106 (80.9%)
	Male	23 (17.6%)
	Other	2 (1.6%)
Race/Ethnicity		
	White	72 (55%)
	Black/African American	13 (9.9%)
	Asian/Asian American	12 (9.2%)
	Middle Eastern or North African	1 (.8%)
	Hispanic Latino or Spanish Origin	26 (19.8%)
	Biracial/Multiracial	3 (2.3%)
	Other	4 (3.1%)
Socioeconomic Status		
	Upper Class	4 (3.1%)
	Upper Middle Class	53 (40.5%)
	Lower Middle Class	45 (34.4%)

Upper Lower Class	14 (10.7%)
Lower Class	9 (6.9%)
Unknown	6 (4.6%)
Major	
Psychology	69 (52.7%)
Other	62 (47.3%)
Mental Disorder Diagnosis	
Yes	41 (31.3%)
No	90 (68.7%)
Taking Medication for Mental Health Diagnosis	
Yes	17 (13%)
No	24 (18.3%)
Alcohol Use	
0 Days	87 (66.4%)
1 Day	32 (24.4%)
2 Days	6 (4.6%)
3 Days	3 (2.3%)
4 Days	2 (1.5%)
7 Days	1 (.8%)
Tobacco Use	
Yes	12 (9.2%)
No	119 (90.8%)
Manipulation Check	

Not Threatened At All	41 (31.3%)
Slightly Threatened	29 (22.1%)
Somewhat Threatened	16 (12.2%)
Neutral	10 (7.6%)
Moderately Threatened	20 (15.3%)
Very Threatened	8 (6.1%)
Extremely Threatened	7 (5.3%)

Table 2

Descriptive Statistics of Item and Source Memory and Questionnaires

Measure	*N* = 131	*M (SD)*
Item Memory Threat Condition		13.34 (2.61)
Item Memory Safety Condition		13.86 (2.61)
Source Memory Threat Condition		7.15 (2.32)
Source Memory Safety Condition		7.20 (2.43)
Emotional Abuse		10.78 (4.84)
Physical Abuse		7.09 (3.31)
Sexual Abuse		6.86 (4.38)
Emotional Neglect		10.36 (4.41)
Physical Neglect		7.17 (3.01)
Household Dysfunction		1.80 (1.86)
Depression and Anxiety		4.93 (3.41)
Grit		3.26 (.69)
Conscientiousness		15.73 (2.81)
Neuroticism		14.32 (3.73)

Table 3

Summary of Moderated Regression Analysis Predicting Item Memory Threat Accuracy

	B	*t*	*p*	95% CI	
				Low	Up
Constant	15.661	3.738	.000	7.371	23.951
Grit (W)	-1.586	-1.218	.226	-4.164	.992
Sexual Abuse (X)	-2.761	-1.293	.198	-6.986	1.465
W * X	1.336	1.987	.049	.0052	2.666

Table 4

Conditional Effects of Sexual Abuse

Grit	Effect	SE	*t*	*p*	95% CI	
					Low	Up
- 1 *SD*	.579	.655	.884	.379	-.717	1.874
Mean	1.413	.528	2.676	.008	.368	2.458
+1 *SD*	2.582	.814	3.172	.002	.971	4.193

Figure 1

Mean Differences in Item Memory Accuracy by Condition

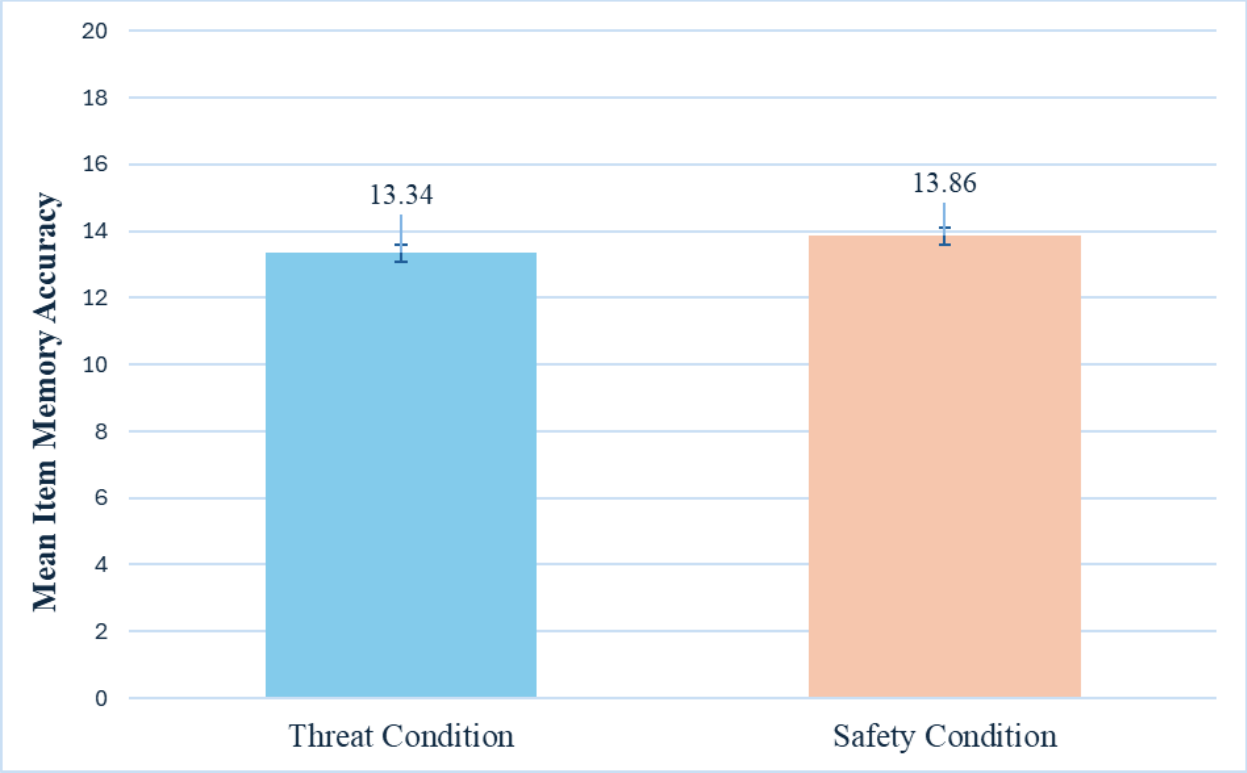


Figure 2

Mean Differences in Source Memory Accuracy by Condition

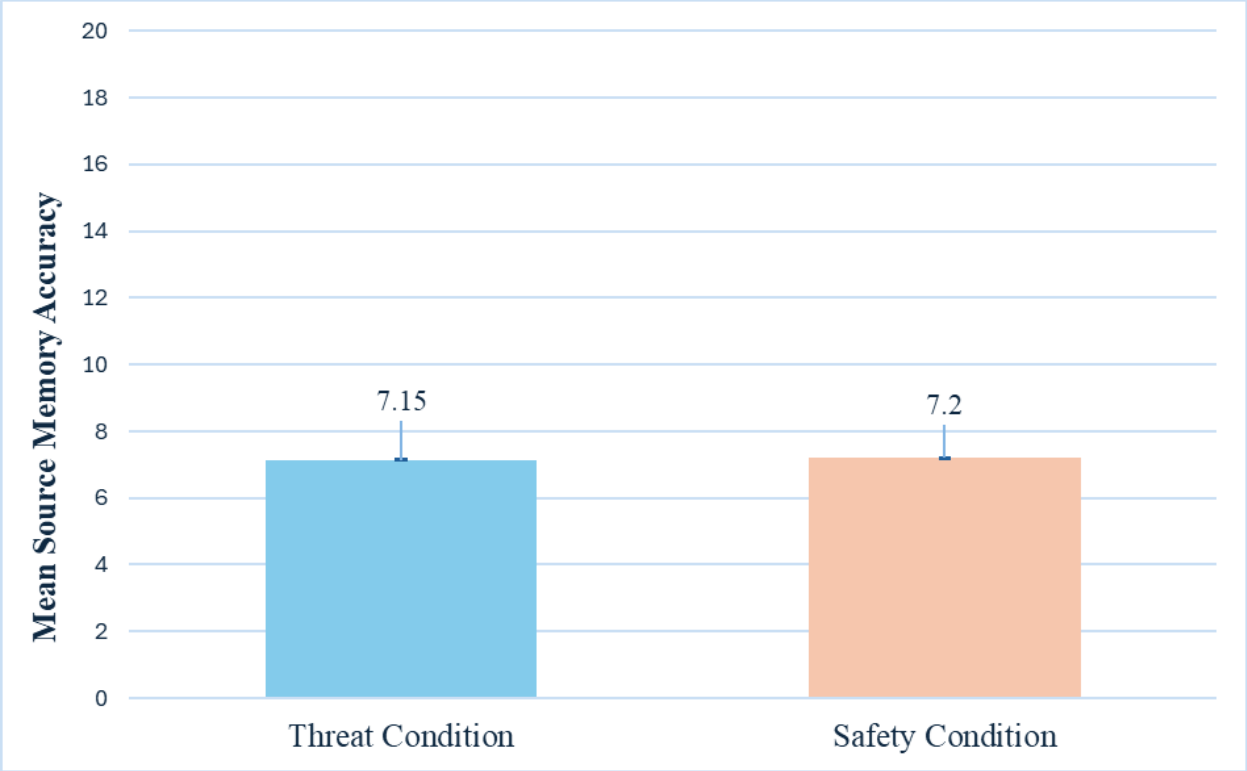


Figure 3

Moderation Analysis Plot

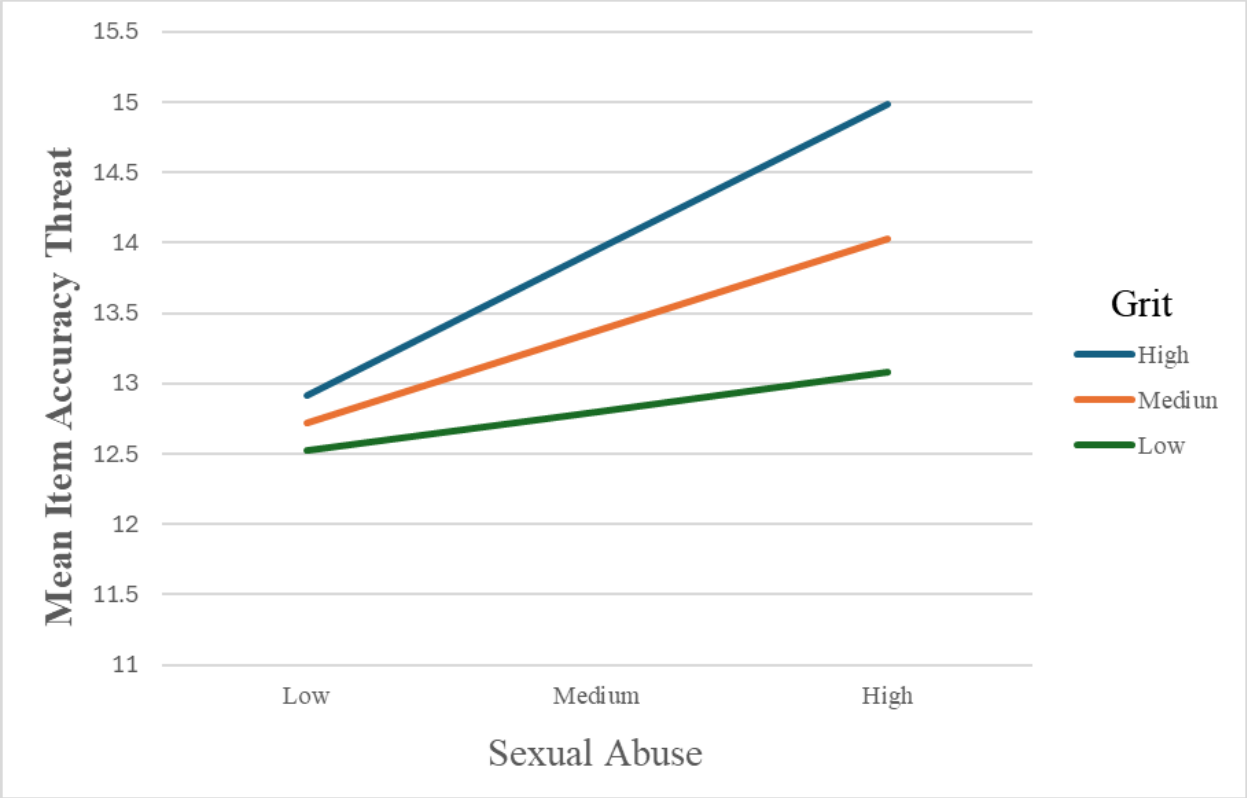
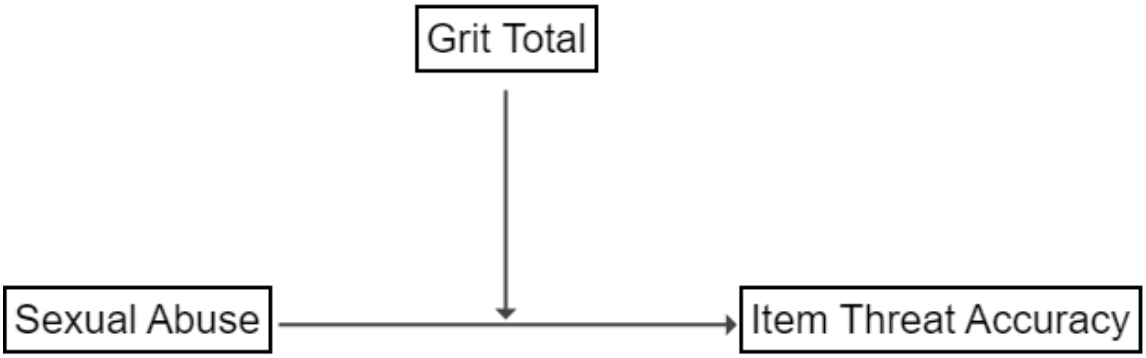


Figure 4

Moderation Model



Effect of sexual abuse on item memory accuracy in the threat condition as a function of grit

Appendix A

Self Assessment Manikin Manipulation Check

Bradley, M. M., & Lang, P. J. (1994b). Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry, 25*(1), 49–59. https://doi.org/10.1016/0005-7916(94)90063-9

Please respond to the following question based on how you felt during the memory task that you took during this study:

How threatened did you feel throughout the memory task after being told you would hear a loud noise when completing the task?

1 Not threatened at all

2 Slightly threatened

3 Somewhat threatened

4 Neutral

5 Moderately threatened

6 Very threatened

7 Extremely threatened

Please indicate which of the following icons best match how you felt during the portion of the task where you had the threat of hearing a loud noise.

1 Very Unpleasant  5 Very Pleasant

Appendix B

Item/Source *Memory Task Stimuli*

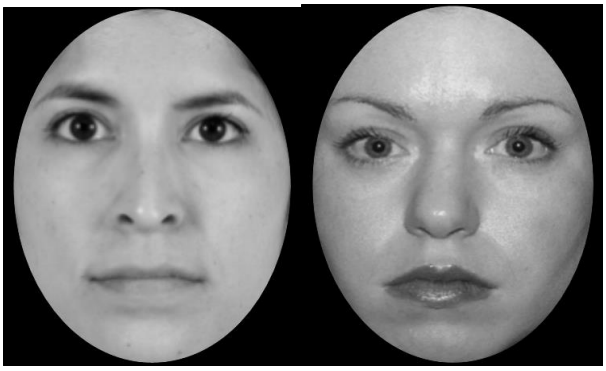
Schellhaas, S., Schmahl, C., & Bublatzky, F. (2022). Social threat and safety learning in individuals with adverse childhood experiences: Electrocortical evidence on face processing, recognition, and working memory. *European Journal of Psychotraumatology*, *13*(2). https://doi.org/10.1080/20008066.2022.2135195

Male Faces Presented during Encoding Phase:

Female Faces Presented during Encoding Phase:

Male Foil Faces:

Female Foil Faces:



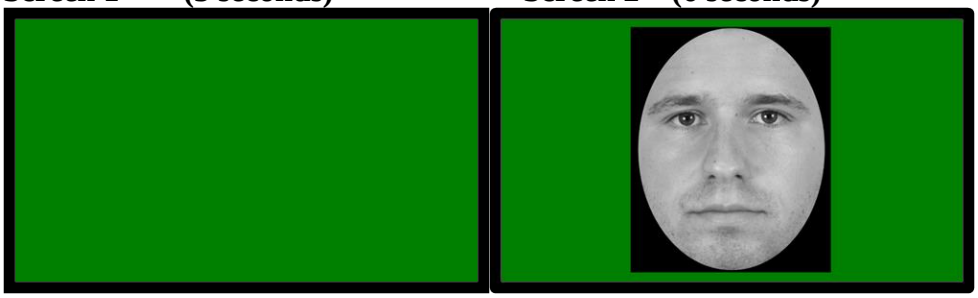
Appendix C

Item/Source *Memory Task*

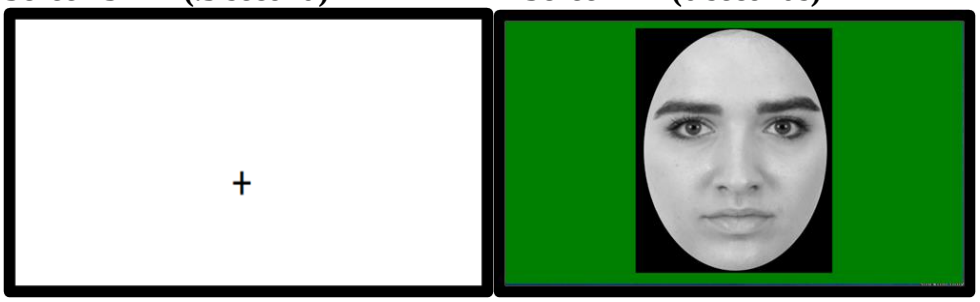
Schellhaas, S., Schmahl, C., & Bublatzky, F. (2022). Social threat and safety learning in individuals with adverse childhood experiences: Electrocortical evidence on face processing, recognition, and working memory. *European Journal of Psychotraumatology*, *13*(2). https://doi.org/10.1080/20008066.2022.2135195

Encoding Phase

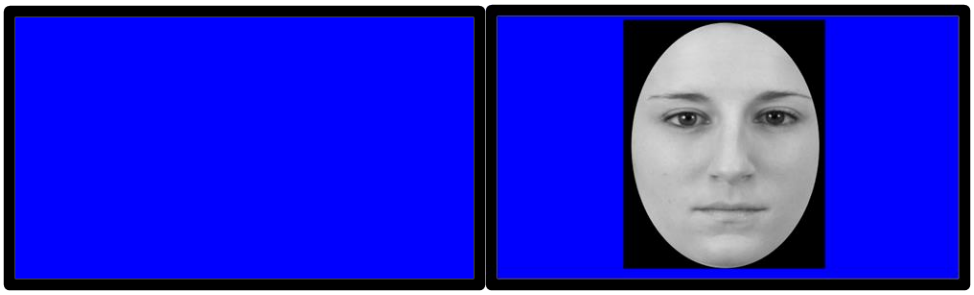
Screen 1 (3 seconds) **Screen 2 (6 seconds)**



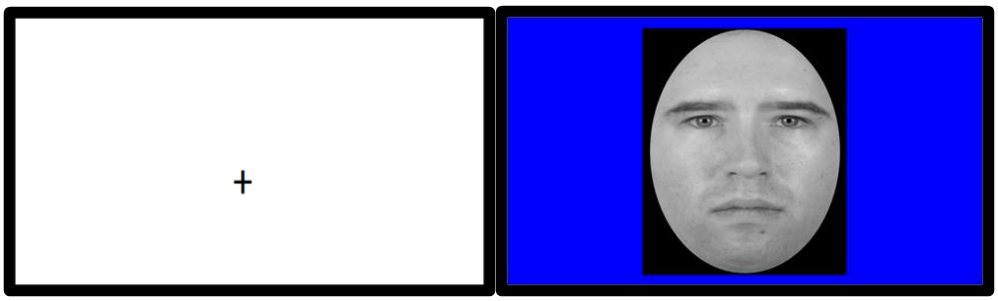
Screen 3 (.5 second) **Screen 4 (6 seconds)**



Screen 5 (3 seconds) **Screen 6 (6 seconds)**

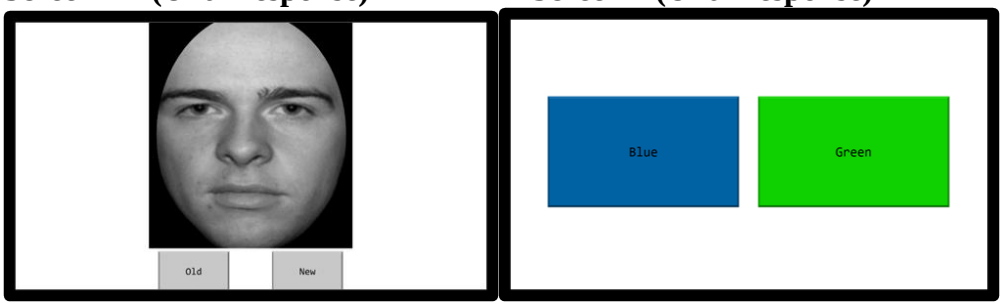


Screen 7 (.5 second) **Screen 8 (6 seconds)**

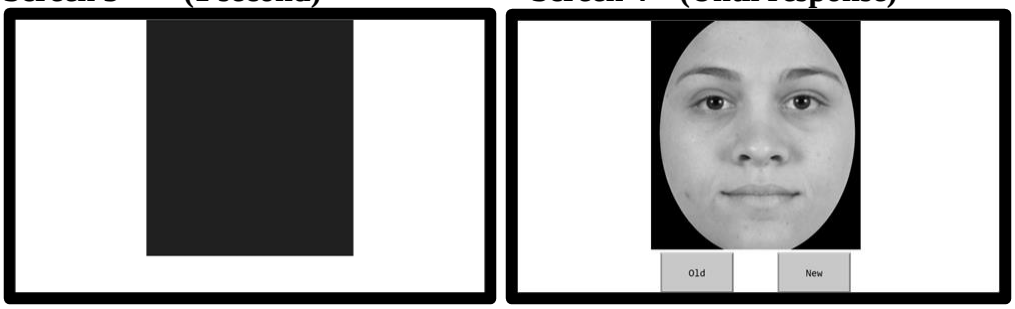


Recognition Phase - ***Old Choice***

Screen 1 (Until response) **Screen 2 (Until response)**

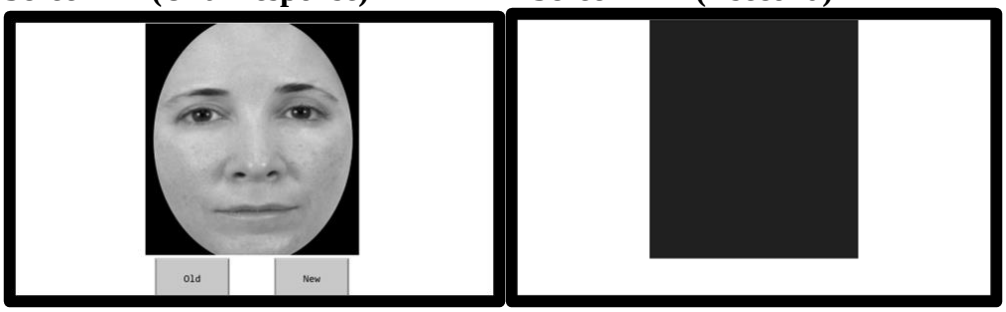


Screen 3 (1 second) **Screen 4 (Until response)**



Recognition Phase - ***New Choice***

Screen 1 (Until response) **Screen 2 (1 second)**



Screen 3 (Until response) **Screen 4 (1 second)**


Old
New

Appendix D

Adverse Childhood Experiences

The 28-item Child Trauma Questionnaire (CTQ-28)

Adverse Childhood Experiences (ACEs) Assessment

Bernstein D., Fink L. (1998). Childhood Trauma Questionnaire. A Retrospective Self-Report Questionnaire and Manual. San Antonio, The Psychological Corporation

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., Koss, M. P., & Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. American Journal of Preventive Medicine,14(4), 245–258.

Scale

1 = Never true, 2 = Rarely true, 3 = Sometimes true, 4 = Often true, 5 = Very often true

Emotional abuse:

3. People in my family called me things like ‘‘stupid,’’ ‘‘lazy,’’ or ‘‘ugly.’’

8. I thought that my parents wished I had never been born.

14. I felt that someone in my family hated me.

18. People in my family said hurtful or insulting things to me.

25. I believe I was emotionally abused.

Physical abuse:

9. I got hit so hard by someone in my family that I had to see a doctor or go to the hospital.

11. People in my family hit me so hard that it left me with bruises or marks.

12. I was punished with a belt, a board, a cord, or some other hard object.

15. I believe that I was physically abused.

17. I got hit or beaten so badly that it was noticed by someone like a teacher, neighbor, or doctor.

Sexual abuse:

20. Someone tried to touch me in a sexual way or tried to make me touch them.

21. Someone threatened to hurt me or tell lies about me unless I did something sexual with them.

23. Someone tried to make me do sexual things or watch sexual things.

24. Someone molested me.

27. I believe that I was sexually abused.

Emotional neglect:

*5. There was someone in my family who helped me feel that I was important or special.

*7. I felt loved.

*13. People in my family looked out for each other.

*19. People in my family felt close to each other.

*28. My family was a source of strength and support.

Physical neglect:

1. I didn’t have enough to eat.

*2. I knew that there was someone to take care of me and protect me.

4. My parents were too drunk or high to take care of the family.

6. I had to wear dirty clothes.

*26. There was someone to take me to the doctor if I needed it.

Household Dysfunction:

1. Was your mother or stepmother often, or very often pushed, grabbed, slapped; or had something thrown at her? Sometimes, often, or very often kicked, bitten, hit with a fist or something hard? Ever threatened or hurt by a knife or gun or other weapon?

2. As a child, did you ever live with anyone who was a problem drinker or alcoholic or lived with anyone who used street drugs?

3. Was a household member ever depressed; mentally ill or sent to a mental hospital? Has a family member ever attempted suicide?

4. As a child, were your parents ever separated (didn't live together) or divorced?

5. Did a household member ever go to prison, or was constantly in and out of jail?

To compute CTQ clinical scale scores, fill in the blanks with item raw scores, then sum the item scores for each scale. All items with an asterisk (*) must be reverse coded before summing; 1=5, 2=4, 3=3, 4=2, 5=1. All clinical scales have a possible range of 5 to 25.

Emotional Abuse Cutoffs: None 8; Low 12; Moderate 15; Severe 16+

Physical Abuse Cutoffs: None 7; Low 9; Moderate 12; Severe 13+

Sexual Abuse Cutoffs: None 5; Low 7; Moderate 12; Severe 13+

Emotional Neglect Cutoffs: None 9; Low 14; Moderate 17; Severe 18+

Physical Neglect Cutoffs: None 7; Low 9; Moderate 12; Severe 13+

ACEs Questionnaire: A response of Yes for each question is summed to provide an overall ACE-Q score (out of 10). The higher the score, the more adverse childhood experiences the client has had and the higher the risk for social, mental, or other well-being problems. Scores of 4 or more are considered clinically significant.

Appendix E

Grit

Short Grit Scale (GRIT-S)

Duckworth, A.L, & Quinn, P.D. (2009). Development and validation of the Short Grit Scale (Grit- S). *Journal of Personality Assessment, 91,* 166–174.

Scale

1 = Very much like me, 2 = Mostly like me, 3 = Somewhat like me, 4 = Not much like me, 5 = Not like me at all

1. New ideas and projects sometimes distract me from previous ones*

2. Setbacks don’t discourage me

3. I have been obsessed with a certain idea or project for a short time but later lost interest*

4. I am a hard worker.

5. I often set a goal but later choose to pursue a different one*

6. I have difficulty maintaining my focus on projects that take more than a few months to complete*

7. I finish whatever I begin.

8. I am diligent.

Scoring:

For questions 2, 4, 7, and 8 assign the following points:

5 = Very much like me

4 = Mostly like me

3 = Somewhat like me

2 = Not much like me

1 = Not like me at all

For questions 1, 3, 5, and 6 assign the following points:

1 = Very much like me

2 = Mostly like me

3 = Somewhat like me

4 = Not much like me

5 = Not like me at all

Add up all the points and divide by 8. The lowest score on this scale is 1 (not at all gritty).

The maximum score on this scale is 5 (extremely gritty)