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Adversity and Visual Working Memory: The Role of Lifetime Adversity When Shaping Visual Working Memory in Emotional Recall

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ABSTRACT

Prior research has suggested that adversity is linked to cognitive impairments, including reduced memory, attention, and decision-making abilities. There has also been evidence of negativity biases in memory, where humans tend to allocate more attention and remember negative information more vividly than other forms of emotional stimuli. Data was collected from students (ages 19-31) at the University of California, Riverside in an upper-division psychology laboratory course through an online Google Form. Participants were split into different sections of which included general demographic information (age/gender); their recall across three trials of positive, negative, and neutral words pulled from the Affective Norms for English Words (ANEW) database; and their responses to the Stress and Adversity Inventory Screener for Adults (STRAIN). No correlation was found between adversity and overall recall performance. There was also no correlation between adversity scores and any of the emotional stimuli separately. An ANOVA found that emotional tone significantly affected recall performance, with a Post-Hoc Analysis revealing specifically that negative word recall was the lowest overall, while neutral was highest. However, there was no significant effect of emotional tone on levels of adversity. In support of the alternative hypotheses, emotional tones did have a significant effect on how frequently a valenced word was recalled. However, there was insufficient evidence to support our main hypothesis and no evidence to reject the null hypothesis, suggesting that there is no relationship between adversity and memory performance.

KEYWORDS: visual working memory, lifetime adversity, emotional valence, negativity bias, recall performance, STRAIN inventory, cognitive processing.

FACULTY MENTOR - Dr. Weiwei Zhang, Department of Psychology



Dr. Zhang joined UCR's Department of Psychology in 2012. The Zhang Lab uses cognitive neuroscience methods to research perception, attention, memory, and higher cognition in healthy and clinical populations. His work is funded by the National Institute of Mental Health (NIMH) and National Institute on Aging (NIA).



**CARISSA
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Carissa is a psychology student at UCR and an incoming Psy.D. student at the University of La Verne with research interests in self/social stigma, clinician bias, and cultural competency. She is a Chancellor's Research Fellow and conducts research on how adversity and emotional regulation strategies influence visual working memory. Her long-term goal is to pursue a career in clinical psychology that integrates research, mentorship, and evidence-based mental health care.



RISHITHA KONA

Rishitha is double majoring in Psychology and Business Administration at UCR. She serves as a research assistant in Weiwei Zhang's CONPAM Lab, where she has contributed to research examining facial recognition, handgrip strength's link to leadership qualities, and adversity's relationship with visual working memory. Her academic interests center on cognitive psychology and the intersection of psychology and business. Following graduation, she will continue her education by earning an M.S. in Applied Psychology at the University of Southern California.

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INTRODUCTION

Understanding how perception interacts with cognition remains one of the most intriguing and underexplored areas in cognitive science. Recent research has begun to shed light on these processes, particularly visual working memory (VWM), a sophisticated cognitive system that temporarily stores and manipulates visual information. Landmark work by Luck and Vogel (1997), employing a change detection paradigm, demonstrated that VWM stores integrated objects rather than isolated features, catalyzing a surge of research into the mechanisms and boundaries of VWM. Building on this, Bays and Husain (2008) showed that VWM capacity is flexible, with allocation varying according to task demands, and that attention modulates the precision of memory representations. As El-Hage et al. (2006) note, working memory forms a crucial link between perception and controlled action. However, the specific ways in which life experiences, particularly adversity, shape the dynamics of VWM remain insufficiently understood. The present study is motivated by the need to clarify this relationship: it systematically investigates how lifetime adversity influences the allocation of attention and recall during VWM tasks involving emotionally valenced stimuli. By doing so, the study aims to advance our understanding of how emotional relevance and life experience shape core cognitive processes, with implications for education, occupational performance, and well-being.

The influence of adversity and trauma on memory remains a critical frontier in cognitive science. Levens et al. (2016) found that distant adversity can enhance working memory performance. In contrast, recent adversity tends to impair it, underscoring the complex and dynamic effects of life experiences on cognitive functioning. While these findings illuminate the importance of emotional context, they fall short of clarifying how the degree of adverse experiences shapes future memory processes. Most previous research has focused on the impact of acute emotional states on immediate visual memory, often overlooking critical individual differences, such as cognitive ability and attentional capacity. Studies on adversity typically emphasize long-term memory or focus narrowly on childhood experiences, leaving adult and lifetime adversity underexplored. This study is motivated by the emerging

possibility that lifetime adversity plays a more significant and nuanced role in shaping the emotional dynamics of VWM than previously recognized.

The central aim of this study is to determine how lifetime adversity influences the recall of emotionally valenced stimuli during VWM tasks. Gaining a clearer understanding of how adversity shapes cognition has critical implications for educational achievement, occupational performance, and overall well-being. Based on previous literature, two primary hypotheses were formulated: the main hypothesis predicts that individuals with higher lifetime adversity will exhibit a recall bias toward negative words, remembering more negative than positive or neutral words, consistent with the negativity bias framework (Levens et al., 2016). The null hypothesis is that there will be no significant association between adversity scores and recall performance across emotional valences. This study also explores the alternative possibility that higher adversity is associated with poorer recall across all categories, reflecting the inhibitory effects of trauma and stress, as documented by Ji and Wang (2018). Notably, our design improves on past studies by examining differences across valences rather than focusing solely on overall recall or limited emotional categories.

METHODOLOGY

Participants

Participants were undergraduate students at the University of California, Riverside, enrolled in an upper-division psychology laboratory course, ensuring a similar educational background. The sample was very small ($N=18$; both males and females aged 19 to 31), which limits the generalizability and statistical power of the findings and should be considered when interpreting results. This limitation is acknowledged up front to promote transparency and rigor. Participants voluntarily completed the study in a classroom setting through a digital survey accessed by a link or QR code. All participants provided informed consent before participating and were debriefed afterward, in accordance with ethical guidelines. This classroom-based study was reviewed for ethical compliance and approved by the course instructor, in line with university IRB policies for minimal-risk educational research.

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Materials

A digital form, accessible via link or QR code, was used to collect participant age and sex and to present task instructions. To assess the impact of emotional valence on VWM, participants viewed lists of positive, neutral, and negative words selected from the Affective Norms for English Words (ANEW) database (Bradley et al., 1999). Words were chosen based on valence ratings (1 = unhappy; 9 = happy) to ensure consistent emotional impact: positive ($\geq \sim 7$), negative ($\leq \sim 3$), and neutral (≈ 5).

The stimuli consisted of three blocks of 12 words (see Appendix A), each containing four words per valence category in randomized order. During the encoding phase, a PowerPoint presentation displayed each word for 1 second, with a 1-second fade. In the retrieval phase, participants had two minutes to recall and report words via the digital form after each block. Recall was scored by counting only correct words that matched the presented list exactly and were written in the correct tense; extraneous or incorrectly recalled words were excluded. Emotional categories were analyzed separately to identify valence-specific effects.

Adversity Assessment

Following the memory tasks, participants were invited to anonymously complete the Stress and Adversity Inventory Screener for Adults (STRAIN) (Slavich, 2022). While the original STRAIN contains 220 items, this study used the 20-item shortened version (see Appendix B) to quantify the total number of lifetime stressors.

Responses were scored dichotomously (1 = “YES,” 0 = “NO”), with a “DECLINE TO STATE” (0) option for sensitive questions. Higher total scores indicate greater adversity; individuals with high “Decline” rates were excluded from the final analysis. This screening was administered after the primary memory task to minimize biases toward negative information arising from a priming effect triggered by the survey content. Participants were explicitly informed that this portion was optional and confidential.

Procedures

Prior to starting the experiment, participants provided informed consent and completed a digital demographic

form. They were then given specific instructions for the memory task:

“In this next part, you will be presented with a series of 12 random words, one at a time for one second. After the last word, the screen will tell you to list as many words as you can remember. At this time, you may click ‘next’ on your form. You will have two minutes to write. When the timer goes off, click next once more. Please do not continue on until prompted to do so.”

This process consisted of three trials with identical parameters but different words to ensure data consistency. Following the memory tasks, researchers explained the purpose of the STRAIN survey, the full scope of the study, and the reason for the initial omission of the survey details. Participants then completed the STRAIN assessment with renewed assurances of anonymity and the option to decline sensitive questions.

Statistical Analyses

Responses to the STRAIN were aggregated to reflect adversity levels, and the quantity of words recalled (by category and total) was calculated. The selection of these variables and analyses was designed to isolate the impact of lifetime adversity on recall performance across emotional valences and to control for potential confounds, such as overall recall ability. To examine the relationship between lifetime adversity and emotional recall, five variables were included: 1) adversity score (0–20), 2) positive words recalled (0–12), 3) negative words recalled (0–12), 4) neutral words recalled (0–12), and 5) total words recalled (0–36). Recalled words were adjusted to the maximum total correct; words not on the list or in incorrect tenses were excluded. This approach enabled a nuanced analysis of if adversity influences not only total recall but also preferential recall of specific emotional categories.

Correlation Analysis. A Pearson correlation coefficient (r) was used to assess the strength and direction of the relationship between adversity scores and the recall of positive, negative, and neutral words. Pearson’s correlation was chosen for its effectiveness in evaluating linear relationships between continuous variables in small samples. Significance was evaluated using a two-tailed test ($\alpha = 0.05$).

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Group Comparisons. To observe differences in word recall and adversity, mean totals were compared using a Repeated Measures ANOVA (two-tailed, $\alpha = 0.05$). A repeated-measures ANOVA was selected because it allows comparisons of recall rates within subjects across emotional valence, increasing statistical power, and controlling for individual differences. To convert adversity from a continuous to a discrete variable, a median split created high (score >5) and low (score ≤ 5) groups, each containing 9 participants. The first ANOVA measured the main effects of emotional tones on recall; a second iteration included adversity level as a between-subjects factor to determine whether adversity modulated the effect of emotional tone on recall.

RESULTS

Descriptive statistics (Table 1) were conducted to identify trends in recall performance across emotional valences. Table 1 summarizes the mean recall scores for positive, negative, and neutral words, showing that participants recalled more neutral words than either positive or negative words. The descriptive statistics helped contextualize the subsequent inferential analysis of average positive words.

A repeated-measures ANOVA revealed a significant difference in recall rates by emotional tone; neutral words were recalled most ($M = 7.06$), negative words least ($M = 6.56$), with negative recall significantly lower than both positive ($p = 0.008$) and neutral ($p = 0.008$), and no difference between positive and neutral recall ($p > 0.05$).

Correlation analyses showed no significant relationship between adversity score and recall of negative ($r = -0.38$, $p = 0.12$), positive ($r = -0.31$, $p = 0.22$), neutral ($r = 0.07$, $p = 0.79$), or total words ($r = -0.38$, $p = 0.12$); thus, adversity score was not correlated with recall for any emotional valence (all $p > 0.05$).

An additional repeated-measures ANOVA including adversity level as a between-subjects factor found no significant interaction between adversity level and recall of positive, negative, or neutral words ($F(1,16) = 0.694$, $p = 0.417$); thus, adversity did not affect the pattern of recall across emotional tones.

Descriptive Statistics ▼						
	Valid	Mean	Std. Deviation	Range	Minimum	Maximum
Negative recall	18	5.056	1.798	6.000	2.000	8.000
Positive recall	18	6.556	1.653	6.000	4.000	10.000
Neutral recall	18	7.056	2.313	8.000	3.000	11.000
Total Correct Recall	18	18.611	3.806	13.000	13.000	26.000
Adversity Score	18	6.444	4.342	13.000	2.000	15.000

Table 1

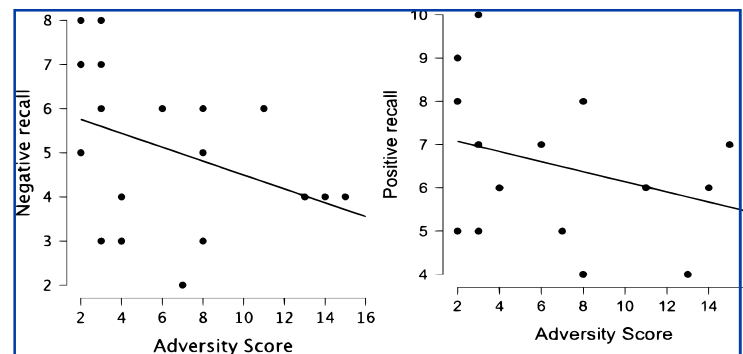


Figure 1. Mean Recall Scores vs Emotional Tone.

(a) scatter plot of data; (b) bar plot of data means.

Depictions of a repeated-measures ANOVA showed a statistically significant difference in scores for emotional tones, $F(2, 34) = 6.314$, $p < 0.05$. ($p = 0.005$).

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Post Hoc Comparisons - Emotional Tone ▼

		Mean Difference	SE	t	Cohen's d	Phom
Positive	Neutral	-0.500	0.715	-0.699	-0.257	0.494
	Negative	1.500	0.430	3.491	0.772	0.008**
Neutral	Negative	2.000	0.577	3.464	1.030	0.008**

Table 2. Post-Hoc Differences between Stimuli Recall. Post Hoc comparisons revealed that negative stimuli were recalled significantly less than positive ($M = 6.556$, $p = 0.008$) and neutral ($M = 7.056$, $p = 0.008$).

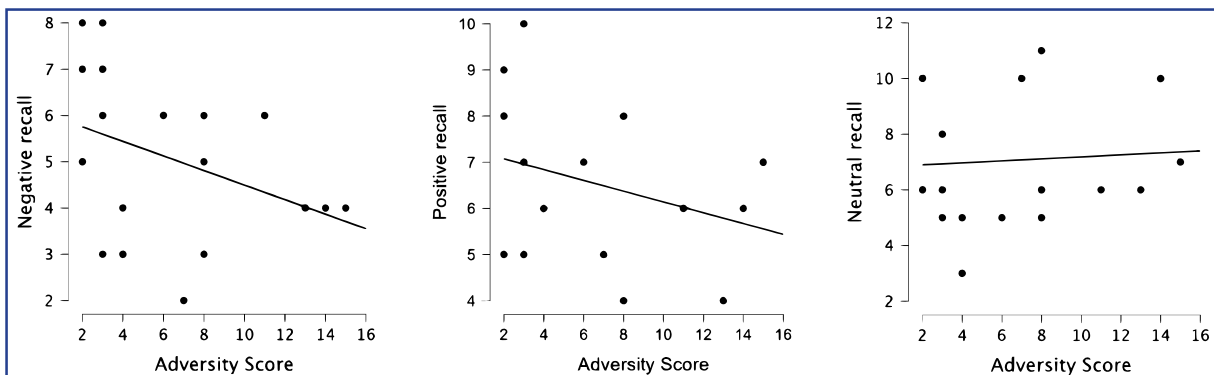


Figure 2. Correlation between STRAIN Scores and Recall of Each Stimulus. (a) STRAIN scores and negative word recall: Pearson's $r = -0.38$, $p = 0.12$ (weak, non-significant negative trend). (b) STRAIN scores and positive word recall: $r = -0.31$, $p = 0.22$ (weak, non-significant negative trend). (c) STRAIN scores and neutral word recall: $r = 0.07$, $p = 0.79$ (weak, non-significant positive trend).

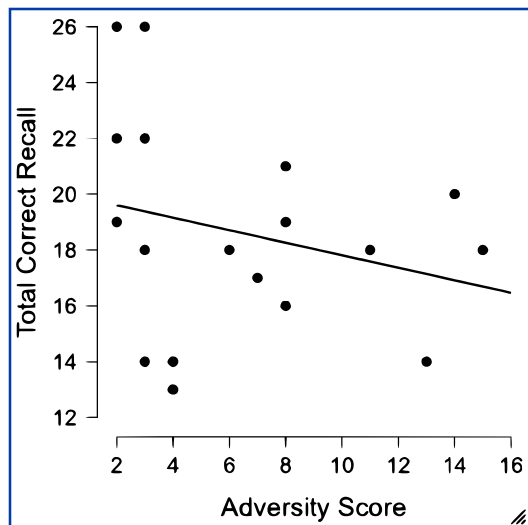


Figure 3. Correlation between STRAIN Scores and Total Correct Words Recalled. Relationship between the scores on the STRAIN and Total words correctly recalled. Pearson's r indicates a weak, non-significant negative trend, $r = -0.380$, $p = 0.120$.

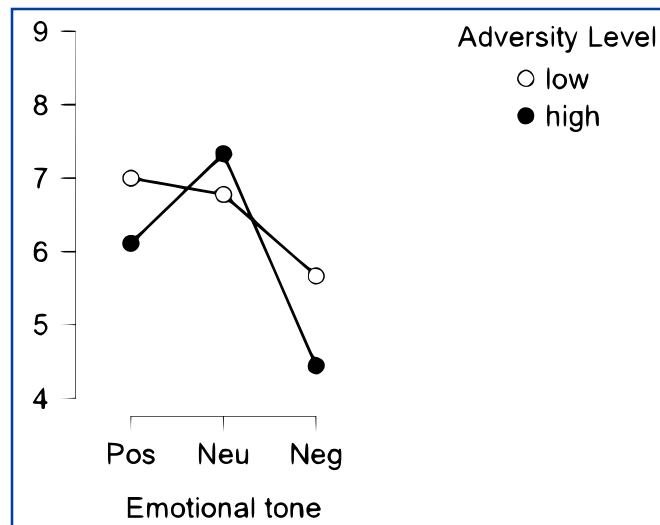


Figure 4. Main Effects of Emotional Tones and Interaction of Adversity Level. Repeated Measures ANOVA observing the effect of Adversity Level. No significant difference, $F(1,16) = 0.694$, $p > 0.05$.

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DISCUSSION

The main hypothesis, that individuals with higher adversity scores would recall more negative words, was not supported in this sample. Instead, the data best fit the null hypothesis, with no significant correlation between adversity and recall of emotionally valenced stimuli. However, recall performance did differ by emotional tone: neutral words were recalled most, and negative words least. One issue that complicates the interpretation of these findings is the small sample size, which reduced statistical power and may have masked subtle group differences. Additionally, the analytic decision to employ a median split for adversity, while facilitating categorical comparisons, may have limited the sensitivity to detect more nuanced, linear effects. Future studies should either treat adversity as a continuous variable or employ more advanced analytic models.

The connection between these results and the study hypotheses is clear: the lack of a relationship between adversity and recall refutes the initial expectation of a negativity bias among high-adversity participants. This outcome should be interpreted cautiously, given the methodological limitations, and underscores the need for replication with larger, more diverse samples and more refined analytic strategies. The finding that negative recall was lowest was unexpected and stands in contrast to prior research on negativity bias (Levens et al., 2016). One possible explanation is emotional avoidance: participants may have subconsciously avoided encoding or recalling negative words as a coping strategy. Alternatively, negative words might increase cognitive load or emotional interference, making them harder to encode and retrieve. These results partially align with Bays & Husain (2008), who argued that attention is preferentially allocated to information perceived as most relevant or least distressing.

A critical issue in this study is the limited control over confounding variables, such as baseline mood and individual differences in coping mechanisms or resilience. Additionally, the reliability of the recall scoring and the use of a short adversity screener may have affected measurement precision. These factors, along with the small sample size and analytic choices (median split), could have influenced the null findings. In contrast to prior studies such as El-Hage et

al. (2006) and Ji & Wang (2018), which found adversity impairs memory, our study did not reveal a significant association between adversity and recall, possibly due to these methodological constraints. Although a non-significant trend toward impaired recall with greater adversity was observed, further research is needed to clarify these relationships.

LIMITATIONS AND FUTURE RESEARCH

Our results must be interpreted in light of several limitations of the study. The small, convenience-based sample ($N = 18$) limits generalizability and increases the risk of Type II error. The correlational design precludes causal conclusions and reduces internal validity. Although some procedural details, such as timing and stimulus presentation, were explicitly controlled, other important aspects, including the reliability of measures, control of confounding variables (e.g., mood, baseline cognitive ability), and randomization procedures, require further development to ensure rigor. The use of a median split for adversity, while facilitating group comparisons, also presents limitations as previously noted.

To address these shortcomings, future research should increase sample size, use random sampling, rigorously control for confounding factors (e.g., mood, cognitive ability, prior trauma), and use validated and reliable measures. Greater procedural clarity, such as reporting inter-rater reliability for scoring recall or explicitly describing counterbalancing, would improve replicability. Studies could also build on Levens et al. (2016) by distinguishing between the effects of recent and distant adversity on VWM to illuminate the role of emotional resilience. Employing more granular adversity measures, such as the full STRAIN survey, would provide richer data. In addition, examining other domains of working memory (e.g., auditory) and considering long-term effects on memory consolidation through longitudinal designs could yield deeper insights. Finally, as the implications of adversity on cognitive functioning are only beginning to be understood, these lines of inquiry could support interventions for at-risk groups, inform cognitive training programs, and influence educational policy.

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In conclusion, investigating adversity and its effects on memory is essential for advancing our understanding of human cognition. Because adversity manifests in diverse forms and degrees of severity, appreciating its varied impact is critical. The current findings contribute to theory by challenging the assumption that high adversity is always linked to a negativity bias in memory; instead, the results suggest that emotional factors and individual coping strategies may override adversity-related biases under certain conditions. Practically, these results highlight the importance of considering emotional context and participant characteristics when designing memory interventions for populations with a history of adversity.

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APPENDIX A

Chosen Word Lists

Words were drawn from the Affective Norms for English Words (ANEW) database. Parameters for average word valence were added to ensure a more reliable positive/neutral/negative rating. On a scale of one to nine, negative words averaged a valence rating of $\lesssim 3$, neutral words averaged ≈ 5 , and positive words averaged $\gtrsim 7$. Random words within these parameters were chosen, and placed into randomizers to establish group and order within the group.

Words Categorized:

Group 1: Positive: Joyful, Peaceful, Loved, Grateful, Negative: Sad, Angry, Lonely, Stressed, Neutral: Table, Chair, Door, Book

Group 2: Positive: Happy, Cheerful, Delighted, Thrilled, Negative: Afraid, Guilty, Worried, Horrible, Neutral: Window, Pen, Clock, Floor

Group 3: Positive: Hopeful, Content, Ecstatic, Blissful, Negative: Depressed, Anxious, Frustrated, Terrible, Neutral: Paper, Wall, Roof, Street

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APPENDIX B

Stress and Adversity Inventory (STRAIN) Screener for Adults

The STRAIN survey used is the shortened 20-item version of the original 220-question assessment. This version is dichotomous with “YES”= 1 and “NO”= 0, the summation of the numerical responses are used to score adversity level, 0 pts being the minimum and 20 pts being the maximum. This survey has been modified in some wordings as well as given a third option of “DECLINE TO STATE” (“DECLINE”) with the value of 0.

STRAIN Assessment (modified)

Please indicate whether you experienced the situation at **any point during your lifetime...**

Question	Yes	No	DECLINE TO STATE
1) You experienced a difficult move that disrupted your daily life?			
2) You lived without enough space or privacy?			
3) You had difficulty paying for basic things in adulthood, such as food or rent?			
4) You were laid off or fired from a job?			
5) You had difficulty caring for a child (e.g., problems with childcare or paying for basic needs)?			
6) You had an immediate family member move out of the house for an upsetting reason?			
7) You experienced bullying (e.g., name calling, humiliation, rejection) during childhood?			
8) You separated from parent or caregiver for at least one month during childhood?			
9) You found out that a partner was unfaithful to you?			
10) You went through a divorce or serious relationship break-up?			
11) You had major legal problems with a partner or spouse (e.g., financial, custody issues)?			
12) You provided care for a close friend or family member who had a major health problem?			
13) You had a loved one with a mental illness (e.g., severe anxiety, depression, drug problem)?			
14) You had a friend or loved one who was abused (e.g., emotional, physical, or abuse)?			
15) A close friend or loved one passed away?			
16) Your parent(s) passed away?			
17) You experienced emotional abuse (e.g., invalidated, blamed, threatened, or humiliated)?			
18) You experienced physical abuse (e.g., bruised, hit, restrained, or physically harmed)?			
19) You were assaulted or attacked (e.g., someone tried to hurt, harass, or rape you)?			
20) You experienced ongoing sexual abuse (e.g., raped, molested, or unwanted sexual contact)?			
TOTAL (Sum of “Yes” responses)			