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Impacts of Acute Psychological Stress on the Emotions of Individuals with Early Life Stress

ABSTRACT

Objective: The study aimed to evaluate negative and positive emotional responses to acute psychological stress in individuals with early life stress (ELS).

Methods: One hundred sixty-one participants from the Birmingham community in Alabama completed the study and were stratified into 2 groups based on measurements of ELS using the Childhood Trauma Questionnaire and a confirmatory clinical interview. Acute psychological stress, that is, the Trier Social Stress Test (TSST), was administered, and emotional responses were measured using the Visual Analogue Scale. Comparisons utilized chi-square for categorical variables and *t*-test for continuous variables. Analysis of covariance (ANCOVA) was applied to compare the 2 groups after controlling for confounding variables. Stepwise multiple linear regression analysis was used to investigate predictive power of variables for emotional responses to the TSST.

Results: Participants with ELS experienced less pleasantness at the baseline (P = .02), and 1 minute (P = .04), but not 90 minutes time points compared to the non-ELS group. Participants in the ELS group also reported higher anxiety at baseline (P = .003), and 90 minutes (P = .04) post-TSST. Data analysis showed the effect of time on emotional responses during the TSST. Different emotional responses, including pleasantness, anxiety, fatigue, and vigor, were able to be predicted by ELS severity.

Conclusion: Our data demonstrates that individuals with ELS presented different positive and negative emotional responses when exposed to acute psychological stress. Our findings may be useful for clinicians who work with individuals with ELS. Our findings also highlight the importance of recognizing emotional responses and of building up resilience in response to acute stress.

Keywords: Acute psychological stress, early life stress, emotional response, positive, negative

Introduction

Early life stress (ELS) due to childhood abuse and/or neglect includes any form of physical, sexual, or emotional abuse or neglect experienced by a developing child.[1] In 2012, the Department of Health and Human Services reported 3.4 million referrals to child protective services in the United States.[1,2] Among these reports, 78.3% were of neglect, 18.3% were of physical abuse, and 9.3% were of sexual abuse. These numbers may be deflated, as child abuse is severely under-reported.[1] The effects of these events can transgress into adulthood and manifest as physical or psychological problems.[3] Growing evidence suggests that ELS disrupts developmental processes and magnifies risk for health consequences later in life. For example, studies have shown that ELS can increase the risk of developing psychiatric disorders, including personality disorders, psychosis, suicidality, and post-traumatic stress disorder, later in life.[2-5] In addition, ELS also increases the risk for cardiovascular diseases and other medical disorders in adulthood.[6,7] Although most studies indicate associations between ELS and a variety of disorders, the underlying mechanisms remain to be defined.

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People face many stressors in everyday life. Individuals could have different emotional responses to the same or similar stressors, including acute psychological stress.[8] Inconsistent findings were reported in individuals with ELS to stress in previous studies. Though many studies have found blunted stress responses in ELS participants, some have found that ELS participants can demonstrate heightened stress responses as ELS severity increases.[9-12] However, the stress responses referred to in these studies usually exclusively describe physiological measures, such as cortisol or adrenocorticotropic hormone baseline-to-peak changes. In contrast, self-perceived psychological measures of the participants' stress responses are often not considered.[13] There is strong evidence linking psychological stress to disease risk; however, psychological stress has not been included as often as it should be in models of health.[14] Considering the many ways cognitive and emotional processes can affect the physiological pathways that are influenced by stress,[13] it is critical that perceived psychological measures are considered in the context of stress response. Epidemiological studies showed that perceiving stress over long periods of time, such as ELS, was associated with worse mental and physical health.[15] Due to the limited information regarding how ELS affects the self-perceived stress responses of adults, this paper aimed to examine that more closely. This study was designed to investigate negative and positive self-perceived emotional responses to acute psychological stress in people with ELS in contrast to people without ELS. We hypothesize that compared with people without ELS, individuals with ELS will present with different emotional responses in both positive and negative emotions.

Methods

Participants

Two hundred forty-seven participants were screened and recruited from the community of Birmingham, Alabama, and 161 participants completed the study for data analysis. The study's protocol was approved by the University of Alabama at Birmingham's Institutional Review Board (Approval No: 141006007; Date: 2/24/2015), and written informed consent was obtained from all participants before any procedures. Participants were between 19 and 60 years of age. Participants had no significant history of psychosis, bipolar disorder, or substance use disorder within the last 12 months before they consented. Participants did not have endocrine, unstable cardiovascular, or inflammatory diseases.

Assessment of Early Life Stress

ELS was assessed using the Childhood Trauma Questionnaire Short Form, a widely used self-reported questionnaire with good reliability and validity (reliability coefficient is .95 for the total scale).[16-20] The measure has 5 sub-scales comprised of 5 questions each that assess ELS in the areas of physical neglect, emotional neglect, emotional abuse, physical abuse, and sexual abuse. Subjects rate statements about childhood experiences on a 5-point scale ("never true" to "very often true").[16,19,20] Cut-off scores are ≥8 for physical neglect, ≥8 for physical abuse, ≥8 for sexual abuse, ≥10 for emotional abuse, ≥15 for emotional neglect, or ≥35 for Childhood Trauma Questionnaire total score.[16,19,20]

Participants in the ELS group met at least one of the above criteria. The presence and severity of ELS were also confirmed by a clinical interview with study staff. Group assignment for participants was done via a consensus conference with study staff. The method of combining a screening questionnaire, that is, Childhood Trauma Questionnaire, followed by a confirmatory interview is considered a highly rigorous approach to quantifying ELS.[21] ELS and non-ELS groups were formed through the validated questionnaire cutoffs and confirmed through interviews. Total ELS severity refers to the total questionnaire score, also known as the Childhood Trauma Questionnaire (CTQ) total score, and reflects the severity of early life stress the participant experienced in childhood. The CTQ was performed during the participant's first visit to the laboratory.

Acute Psychological Stress Test

Acute psychological stress was created using the Trier Social Stress Test (TSST), a well-validated and standardized laboratory psychological stress procedure that was performed on the participant's second visit.[22,23] This second visit was scheduled within a week following the participant's first visit. The entire procedure consists of a baseline period, followed by the TSST component, and ends with a resting period (Figure. 1). The TSST component includes a speech and an arithmetic test (Figure. 1). Each participant was instructed to report to the laboratory between 12:30 PM and 1:00 PM to begin the TSST. Caffeine-containing beverages and alcohol consumption were not allowed for 24 hours prior to the test.

Upon arrival, participants were made to wait for 20 minutes. Then, instructions were given for the start of the TSST component, which aimed to induce acute psychological stress in the participants. First, subjects were given 10 minutes to prepare a 5-minute free speech for a job interview, which they presented in a simulated recorded interview conducted by 2-3 male and female interviewers in front of a video camera. The interviewers, usually in white laboratory coats, then instruct the participants to complete a 5-minute mental arithmetic task. Participants were asked to subtract 13 sequentially from 1022 and to start over from 1022 if any mistakes were made during the 5-minute period. Finally, participants rested in a quiet area without interruption for 90 minutes after the end of the TSST. After the entire procedure was completed, participants were informed that the test was indeed not video recorded.

Measuring Emotional Response

Emotional responses of the participants were measured from the beginning of their visit up to 90 minutes after completing the TSST component (Figure. 1). Participants were asked to rate their emotions using the visual analog scale (VAS). The emotions rated on this scale included pleasantness, vigor, relaxation, irritation, fatigue, and anxiety. The VAS has been used in previous studies employing the TSST and has proven useful in measuring acute emotional responses.[24-26] It consists of a series of 100-mm horizontal lines each labeled with an adjective (e.g., anxiety and irritability). The left end of each line is labeled "not at all" (0) and the right "extremely" (10).

MAIN POINTS

- *People with early life stress present different positive and negative emotional responses when exposed to acute psychological stress.*
- *Our findings suggest that clinicians who work with individuals with ELS should offer individualized services.*
- *Our findings also highlight the importance of recognizing emotional responses and building up resilience in response to acute stress.*

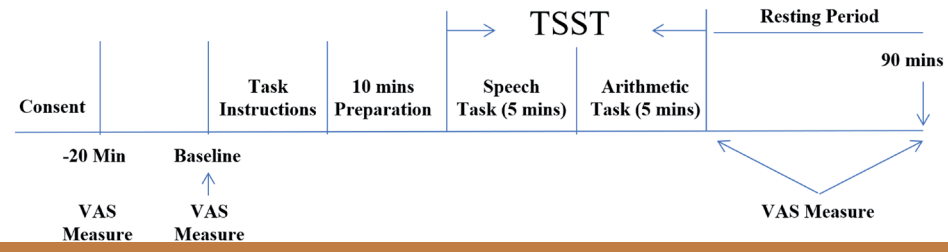

Figure 1. Experimental protocol of the trier social stress test (TSST). VAS, visual analog scale.

Participants were given the VAS to complete immediately upon arrival (20 minutes before the TSST time point), right before the TSST (baseline time point), 1 minute after the end of the TSST (1 minute time point), and 90 minutes after the end of the TSST (90-minute time point), as shown in Figure 1.

Statistical Analysis

All statistical analyses were performed using IBM SPSS version 26 (SPSS Inc., Armonk, NY, USA). All tests were 2-tailed with the significance level set at $P < .05$. Descriptive statistics of the data are presented with n (%) for categorical data, and for non-normalized variables (for non-parametric tests) are shown as mean rank, and for normalized variables (for parametric *t*-test) are shown as "mean ± SD." The Kolmogorov–Smirnov test was used to determine the normality of the interested variables. Chi-squared analysis was used for categorical data, while an independent samples *t*-test for age and non-parametric tests for CTQ total score and 5 subscale scores were used to detect the differences in continuous data (Table 1). ANCOVA was used to compare emotional responses between the 2 groups (ELS and non-ELS) at 4 time points after controlling for sex, age, employment, depression, education, and the baseline of each emotional response. Repeated measures analyses were conducted using all measures (20 minutes before the TSST, baseline, 1 minute, and 90 minutes after the end of the TSST) to capture a within-subjects contrast for the effect of time. Stepwise multiple linear regression analysis was used to identify the independent variables that best predicted emotional responses to the TSST, that is, 1 minute after the end of the TSST, in both the total sample and in individuals with ELS. Variables that may contribute to emotional responses to the TSST were entered into the model, including age, race, sex, employment status, education level, and CTQ.

Table 1. Participant Characteristics

Variable	Non-ELS	ELS	*P*-value
n	65	96	
Female	44 (67.7%)	57 (59.4%)	.323
Male	21 (32.3%)	39 (40.6%)	
White	28 (43.1%)	51 (53.1%)	.274
Black/African American	37 (56.9%)	43 (44.8%)	
Not employed	13 (20.3%)	39 (40.6%)	.021
Employed	51 (79.7%)	54 (56.3%)	
Non-MDD	44 (67.7%)	44 (45.8%)	.009
MDD	21 (32.3%)	52 (54.2%)	
Education (12+ years)	59 (90.8%)	70 (74.5%)	.040
Age	34.0 ± 10.5	39.4 ± 13.7	.012
CTQ total score	36.7	108.9	<.001
Physical neglect (PN)	47.6	101.8	<.001
Physical abuse (PA)	55.2	97.2	<.001
Sexual abuse (SA)	64.3	90.1	<.001
Emotional abuse (EA)	47.5	102.5	<.001
Emotional neglect (EN)	42.2	105.6	<.001

CTQ, childhood trauma questionnaire; ELS, early life stress; MDD, major depressive disorder.
Categorical data are presented with N (%), and continuous data in this table are presented as mean ± SD. PN, PA, SA, EA, and EN are all subtypes of ELS. Chi-squared analysis was used for categorical data, while an independent samples *t*-test for age (mean ± SD) and non-parametric tests for CTQ total score and 5 subscale scores (mean rank) were used to detect the differences between the 2 groups. Two participants did not report race, and 3 did not report employment status.

Results

Participant Characteristics

The characteristics of the 161 participants are presented in Table 1. The participants were stratified into a non-ELS group and an ELS group based on their Childhood Trauma Questionnaire total scores and/or subtype scores and a clinical confirmatory interview. There was no significant difference in race between the non-ELS and ELS groups. However, employment status, depression diagnosis, education, age, physical neglect, physical abuse, sexual abuse, emotional abuse, and emotional neglect differed. Compared to the non-ELS group, the ELS group had greater Childhood Trauma Questionnaire total scores (mean rank 36.7 vs. 111.0, $P < .001$). A greater percentage of participants in the ELS group experienced physical neglect (53.1%), physical abuse (60.4%), sexual abuse (34.4%), emotional abuse (58.3%), and emotional neglect (40.6%) when compared to the non-ELS group.

Emotional Responses to Acute Psychological Stress Test

ANCOVA analysis indicated that compared with the non-ELS group, pleasantness was significantly lower at baseline (8.7 ± 1.8 vs. 7.5 ± 2.3, $P = .02$) and 1 minute (8.0 ± 2.2 vs. 6.6 ± 2.6, $P = .04$), but not at the 90 minutes (8.7 ± 1.8 vs. 7.7 ± 2.2, $P = .22$) time points in the ELS group

Table 2. Comparison of Emotional Responses at Different Time Points

Emotion	Time Point	Non-ELS Group (n = 65)	ELS Group (n = 96)	*P* value
Pleasantness	−20 minutes	8.52 ± 1.97	7.82 ± 2.06	.21
	Baseline	8.73 ± 1.76	7.51 ± 2.33	.02
	1 minute	7.98 ± 2.22	6.63 ± 2.61	.04
	90 minutes	8.74 ± 1.78	7.68 ± 2.21	.22
Anxiety	−20 minutes	1.42 ± 2.16	2.52 ± 2.87	.05
	Baseline	1.20 ± 1.95	2.96 ± 3.09	.00
	1 minute	2.14 ± 2.56	3.67 ± 3.21	.21
	90 minutes	0.78 ± 1.19	2.12 ± 2.61	.04

ELS, early life stress.

Table 3. Stepwise Linear Regression Analysis Predicting Emotional Responses

Dependent Variable	Total Sample (n = 161)			ELS (n = 96)		
	Significant Predictors	β	Adjusted R^2	Significant Predictors	β	Adjusted R^2
Pleasant	CTQ total score, race	9.4	0.25	CTQ total score, race	9.5	0.25
Anxiety	CTQ total score, employed	1.3	0.13	CTQ total score, employed	1.7	0.11
Fatigue	CTQ total score, sex	2.0	0.10	CTQ total score, sex, employed, education	2.4	0.20
Vigor	CTQ total score, sex, age, employed, education	6.0	0.22	CTQ total score, sex, age, race	4.9	0.28
Relax	None			None		
Irritation	None			None		

CTQ, childhood trauma questionnaire; ELS, early life stress.
Independent variables included age (years), race (0 = White, 1 = Black/African American), sex (1 = female, 2 = male), CTQ total score, employed (0 = unemployed, 1 = employed), and education level (0 = <12 years, 1 = ≥12 years). The *P* value for Anxiety in the ELS group is .08; otherwise, all other *P* values are <.05.

(Table 2). Participants in the ELS group also reported higher anxiety at baseline and 90 minutes post-TSST (Table 2). There were no significant differences in fatigue, vigor, irritation, and relaxation responses between the non-ELS and ELS groups at the different time points. A repeated-measures ANCOVA of 6 emotional responses across the 4 time points of the TSST demonstrated a significant effect of the time (F = 5.7-9.8, df = 3, all P values < .05), confirming the effectiveness of our acute psychological stress paradigm. There was no interaction between ELS and time using repeated-measures analyses. Stepwise multiple linear regression analysis among both the total sample and the ELS group only indicated that different emotional responses to the TSST (1 minute after the end of the TSST), including pleasantness, anxiety, fatigue, and vigor, were best predicted by some variables, such as CTQ total score, age, sex, race, employment status, and education level. CTQ total score was the only predictor that was entered in the regression model for 4 emotional responses. Relaxation and irritation were not predicted by any of these variables (Table 3).

Discussion

Our results showed that compared with people without ELS, people with ELS generally experienced different responses in both positive and negative emotions after exposure to the acute psychological test, that is, TSST. Repeated measures demonstrated the effects of time on emotional responses, and regression analysis showed that ELS severity, measured through CTQ total score, could predict some emotional responses, including pleasantness, anxiety, fatigue, and vigor to the TSST.

ELS increases the risk of developing early-onset of severe mood disorders. Because people with mood disorders experience difficulty with emotional control, they often utilize dysfunctional strategies to regulate their emotions.[27] Thus, treatments for mood disorders often include emotional therapies. Emotional therapies are techniques used to promote healthier emotional regulation, such as mindfulness-based cognitive therapy and acceptance and commitment therapy.[28] Well-defined emotional regulation strategies for negative emotions include cognitive reappraisal and expressive suppression. Cognitive reappraisal involves altering the way a person thinks about emotion-eliciting events, while expressive suppression involves altering the way an individual responds behaviorally to emotion-eliciting events.[29] Our results suggest that focusing on specific emotions when treating people with mood disorders who have experiences of ELS could be beneficial. When attempting cognitive reappraisal, for example, people with ELS could focus on reevaluating feelings of anxiety and fatigue, as these negative emotions were either worse in the ELS group or were best predicted by ELS severity. People with ELS can also utilize positive emotional regulation strategies such as ruminating on feelings of pleasantness and vigor, which were also predicted by ELS severity.[27]

The ways to treat the adverse outcomes of ELS range from solely pharmacological to a combination of pharmacological and psychotherapeutic treatments.[30] These psychotherapeutic treatments can include emotional discourse, particularly the principle of abreaction, or encouraging patients to fully express their emotions connected to trauma. Most psychotherapeutic treatments, however, emphasize trauma-focused cognitive-behavioral techniques.[30,31] Given the results of our study, perhaps incorporating additional emotional regulation strategies into these techniques would be beneficial. Two emotions that could be focused on specifically are pleasantness and anxiety, which our study demonstrated were significantly different in people with ELS when compared to those without. This could include educating patients about their increased susceptibility to different emotional responses, particularly regarding pleasantness, relaxation, vigor, anxiety, fatigue, and irritation. Better education may prepare them mentally and even increase their acceptance of different emotional responses and resilience when they are exposed to acute stress. In addition, consistent with the literature, our study showed that adverse experiences, including ELS, are associated with lower education levels and unemployment status.[32,33] Thus, efforts to improve education and employment could help people with ELS cope with altered emotional responses in the face of acute stress.

Given that people with ELS are already at a heightened risk of developing psychiatric and medical disorders, different responses in both positive and negative emotions in people with ELS may further increase the risk for a variety of diseases and contribute to poorer treatment response.[2-5] Our regression analyses indicate that ELS is the best predictor for several emotions. Thus, improving screening for ELS might help detect ELS earlier and allow for timely prevention and interventions before full symptoms of disorders develop, leading to better treatment outcomes. In children and adolescents, these interventions could include addressing coping skills to acute psychological stress, which could aid in reducing the risk of diseases like depression. Other preventative services, like strengthening resilience factors, are also important during early development, as interventions earlier on are more likely to maximize stress resistance.[34] This can look like fostering close relationships with caring adults, improving social competence and openness to social support, and exposing oneself to manageable stress.[34] In the future, clinicians who determine that their patients have experienced ELS can encourage social support and prioritize the

development of other coping skills to help prevent the development of mood disorders or to lessen their severity. However, more research must be done to determine how to best treat patients with ELS to increase the efficacy of current treatment options.

Some caution may need to be taken when interpreting our findings. First, the Childhood Trauma Questionnaire, which was used to measure ELS, is a sensitive and validated self-reported questionnaire intended for adults to retrospectively report their childhood experiences, and the validity of adult retrospective reports of ELS is sometimes questioned.[17,35] However, the presence and severity of ELS were confirmed by a clinical interview with study staff and a board-certified psychiatrist. Group assignment for participants was done using both CTQ assessment and a confirmatory clinical interview. Second, our sample size does not allow us to further stratify ELS groups into subgroups, like people with physical abuse or sexual abuse. The sample size also does not allow us to characterize sex differences. Thus, future study is warranted to increase the sample size to examine whether people with different ELS experiences or of different genders exhibit differential emotional responses to acute psychological stress. Also, due to the study's reliance on self-reported measures, including physiological measures that correlate with various emotional responses may be an important area for future research.

In conclusion, individuals with ELS demonstrated different responses in both positive and negative emotions compared to people without ELS. Our results suggest that new targets for therapies in people with ELS should focus on both positive and negative feelings, including pleasantness and anxiety. In the future, these findings may help clinicians who work with people with ELS to educate their patients so they can better respond to acute stress and adopt healthy coping strategies to reduce the risks of psychiatric and medical disorders. For example, screening for ELS could be included in patient care, and clinicians could recognize ELS and offer a trauma-informed care approach. Doing so would minimize the chance of re-traumatizing patients when delivering evidence-based care.[36,37]

Availability of Data and Materials: *Available upon request.*

Ethics Committee Approval: *This study was approved by the Ethics Committee of University of Alabama at Birmingham (Approval No: 141006007; Date: 2/24/2015).*

Informed Consent: *Written consent was obtained from the patients/patient who agreed to take part in the study.*

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