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A Multimodal Assessment of Disgust in Response to Traumatic Event Reminders Among Adolescents

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Abstract

The majority of youth will report traumatic event exposure by the time they reach adulthood. Research suggests exposure to such events is linked to myriad negative outcomes. Not all traumatic events are alike, however; evidence suggests that, compared to non-interpersonal events, interpersonal events in which another person intentionally perpetrates harm are linked to elevations in the likelihood of negative outcomes, including posttraumatic stress disorder (PTSD). One reason for this discrepancy is that interpersonal traumatic events may elicit greater levels of disgust. However, this is a very under-developed research base, no study has examined this question among youth. The current study aimed to address this gap in the literature by comparing adolescents with differing types of traumatic event exposure (i.e., interpersonal vs. non-interpersonal) in terms of self-reported, behavioral, and physiological indicators of disgust elicited by trauma reminders presented during a script-driven imagery procedure. In contrast to hypotheses, adolescents exposed to reminders of their interpersonal traumatic event did not report greater self-reported, behavioral, or physiological disgust compared to those exposed to reminders of their non-interpersonal traumatic event. Findings are discussed in terms of theoretical and methodological implications for future work in the area.

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The majority of youth (~70%) will experience a traumatic event by the time they reach 16 years of age (Copeland, Keeler, Angold, & Costello, 2007). Exposure to such events is a risk factor for subsequent psychopathology (Liu et al., 2017) in addition to an array of negative outcomes including substance use (McLaughlin et al., 2013), increased aggression (Shields & Cicchetti, 1998), and suicidal behavior (Ford, Hartman, Hawke, & Chapman, 2008). Although most adolescents who experience a traumatic event eventually recover, identifying factors that help us better understand who is at increased risk for deleterious outcomes remains important. One factor implicated in post-trauma health is the type of traumatic event to which one is exposed, with interpersonal traumatic events being especially pernicious (Trickey, Siddaway, Meiser-Stedman, & Field, 2012). This may be due, at least in part, to increased disgust as a function of exposure to these types of events. The current study aims to extend the existing literature by comparing disgust reactivity in response to reminders of interpersonal versus non-interpersonal traumatic events among adolescents.

Traumatic Event Type

Interpersonal traumas (IPT) are traumatic events that involve the intentional infliction of harm by another human being (McLaughlin et al., 2013). Recent work suggests experiencing an IPT is associated with greater risk of negative outcomes compared to individuals who experience a non-interpersonal trauma (non-IPT) such as a vehicle accident or natural disaster. Indeed, several studies demonstrate increased rates of aggression (Bynion et al., 2017; Kisiel et al., 2014), suicidal behavior (Ford et al., 2008), substance use (Edgardh & Ormstad, 2000), and PTSD (McLaughlin et al., 2013) among youth who have experienced at least one IPT compared to those exposed to non-interpersonal traumatic events. One perspective on the particularly insidious effects of exposure to interpersonal traumatic events is that such experiences violate social sanctions for human behavior and disrupt adaptive social bonding processes (Charuvastra & Cloitre, 2008).

Another important perspective regarding the sequelae of IPTs pertains to the role of peri- and posttraumatic emotional responding (Foa & Rothbaum, 1998). Although previous work has focused on fear as a primary emotion of interest in this domain, recent work highlights the role of disgust. For instance, research suggests both youth (Feldner, Frala, Badour, Leen-Feldner, & Olatunji, 2010) and adults (Badour, Feldner, Babson, Blumenthal, & Dutton, 2013) with a history of sexual assault report greater feelings of disgust compared to those exposed to other traumatic event types, even after accounting for variance attributable to other emotions like anxiety or sadness (Amstadter & Vernon, 2008). These data underscore the importance of evaluating disgust in the context of IPT.

Disgust

The conceptual foundations for the current investigation are based on theoretical perspectives that define emotions as discrete affective states elicited by specific stimuli in the environment, theoretically aimed at optimizing survival (Darwin, 1872). Emotions can be measured via subjective self-report, behavioral responding, and physiological reactivity (Lang, 1979), and there are basic, universal emotions reflecting distinct states (e.g., happiness; Keil & Miskovic, 2015; Olatunji & Sawchuk, 2005). Disgust is conceptualized as one of the basic universal emotions, possessing overlapping as well as distinguishing characteristics compared to other basic emotions, such as fear and anger. Like fear and anger, disgust is linked to an unpleasant emotion state, thought to serve as a protective mechanism by facilitating avoidance of stimuli that may be harmful to the organism (Rozin, Markwith, & McCauley, 1994). Disgust is also linked to activation of the parasympathetic nervous system (PNS) whereas other basic emotions (e.g., anger, fear, anxiety) are associated with activation of the sympathetic nervous system (SNS; Levenson, 1992). Although the literature is relatively small, laboratory-based work suggests physiological correlates of disgust-related responding include decreased heart rate and increased salivation (Carlson, 1994; Levenson, Ekman, & Friesen, 1990). In terms of behavioral reactivity, disgust-relevant facial expressions involve engagement of the levator labii and lateral frontalis muscles (muscles below the left eye and above the left eyebrow; Orr & Roth, 2000; Fridlund & Cacioppo, 1986). Additionally, disgust-related stimuli typically elicit an avoidant response (Izard, 2007), which can be either active (pushing the disgust-related stimulus away) or passive (trying to escape from the disgust-related stimulus).

The word disgust literally means “distaste,” which originates from the gustatory response designed to protect the organism from ingesting toxic or poisonous substances (Rozin & Fallon, 1987). However, disgust extends beyond merely ingestion of contaminants and can be more broadly defined by revulsion elicited by, or contact with, an offensive item (Angyal, 1941). Thus, there is a relatively wide range of potential disgust elicitors, which theorists have categorized in several different ways. For instance, McKay (2017) describes three broad dimensions of disgust elicitors; core disgust (elictors linked to food, body products, and insects/animals), contamination disgust (elicitors linked primarily to sex), and animal-reminder disgust (elicitors linked to death or body-envelope violations). In their four-factor model, Rozin and colleagues (2000) similarly discuss core and animal-reminder categories of disgust elicitors, but also interpersonal (e.g., rapists), and socio–moral disgust (e.g., child abuse) elicitors (with some overlap in the latter two domains). Another perspective categorizes disgust into two clusters (primary and complex; Marzillier & Davey, 2004). The primary cluster characterizes disgust as 'fear of ingestion' (e.g., poison), while the complex cluster encompasses social behaviors that are considered to be a 'moral transgression' (e.g., rape). To the extent that purposeful acts of harm by others (including interpersonal traumatic events) reflect such moral transgressions, they may be linked with elevated disgust, although this question has not been addressed outside the context of sexual assault trauma among youth (e.g., Feldner et al., 2010).

It is important to study the nature, manifestation, and clinical implications of disgust among youth because evidence suggests it changes across development, in part as a function of associative learning processes (Olatunji & Sawchuck, 2005). Indeed, behavioral responses to disgust-related stimuli (e.g., food, spiders) can be learned via direct, vicarious, lexical, and operant conditioning experiences (Davey, Forster, & Matthew, 1993; Fallon, Rozin, & Pliner, 1984; Muris et al., 2009; Webb & Davey, 1992). As a result, across development, the range of stimuli that can elicit disgust increases (e.g., a toddler's response to putting dirty objects in their mouth is often distinct from that of a child or adolescent). Rozin and Fallon (1987) further suggest that children younger than 8 years old may be less likely to report feelings of disgust in response to moral violations than they are with other disgust elicitors (e.g., foul odors/tastes). Although empirical work in the area is scant, it stands to reason that multiple factors (e.g., accumulating learning experiences; cognitive development) play a role in a child's emerging ability to experience disgust in response to more subtle or culturally-bound disgust elicitors (e.g., finding a civic leader who has engaged in selfish or non-violent criminal behavior to be morally disgusting).

Finally, disgust is increasingly recognized as a critical emotion to study in the context of psychopathology; available data suggest disgust may play a role in a wide range of clinical problems, including obsessive compulsive disorder, specific phobias, eating disorders, depression, and PTSD (Badour, Ojserkis, McKay, & Feldner, 2014; McKay, 2017). Further, it appears more resistant to inhibitory learning processes than fear (e.g., Smits, Telch, & Randall, 2002), meaning disgust-relevant learned associations may be particularly difficult to extinguish. Thus, as discussed above, disgust elicited by interpersonal traumatic events like sexual assault may be implicated in the greater likelihood of problems following these events compared to non-interpersonal traumatic events. Nonetheless, disgust remains one of the most understudied basic emotions (McKay, 2017; McNally, 2002) and is examined even less so among children and adolescents. In terms of clinical outcomes, very little work has examined disgust among youth generally, or in the context of traumatic event exposure specifically, and no work has evaluated disgust in response to traumatic event reminders among youth in the laboratory. This relative degree of neglect is unfortunate, given the availability of ideographic script-driven imagery procedures, which represent a powerful method for evaluating real-time emotion reactivity among individuals with a history of traumatic event exposure.

Script-Driven Imagery Procedure. Script-driven imagery procedures involve having the participant write down memories of a traumatic event, converting written responses into a standardized 30s idiographic audio recording, and later presenting audio recordings of these written scripts as a traumatic event reminder. This approach allows for evaluation of affective, behavioral, and physiological reactivity to trauma cues in a controlled laboratory setting (Pitman Orr, Forgue, de Jong, & Claiborn, 1987). Such procedures have been widely used with adults, and findings suggest adults with PTSD report significantly greater negative affectivity (e.g., disgust, fear) and physiological reactivity in response to reminders of traumatic events via script-driven imagery procedures compared to individuals without a trauma history and/or PTSD

(Badour & Feldner, 2016; Lanius et al., 2002; McNally et al., 2004; McTeague et al., 2010; Ramón et al., 2006). Only one published study to date has utilized the script-driven imagery procedure with youth. Kirsch and colleagues (2015) examined changes in anxiety and physiological arousal (i.e., facial electromyography [EMG]) in response to a script-driven imagery procedure among a sample of trauma exposed youth (6 -17 years). As expected, adolescents with PTSD responded with significantly greater self-reported anxiety and physiological reactivity in response to their idiographic traumatic event script compared to those without PTSD. To the best of our knowledge, no work has evaluated disgust among youth in this context.

Current Study

With this background, the overarching goal of the current study was to carefully examine the role of trauma type (IPT vs. non-IPT) as it relates to disgust elicited by traumatic event reminders among adolescents during a script-driven imagery procedure. Several hypotheses guided this investigation. First, because the existing literature consists of a single study, we provided a conceptual replication of prior work (e.g., Kirsch, Wilhelm, & Godlbeck, 2015); increased negative affectivity (i.e., anxiety, disgust, distress, and fear) for post-traumatic script compared to post-neutral and baseline ratings was expected across the entire sample. Comparison of negative affect ratings across the entire sample also served as a manipulation check prior to the examination of between group differences. Further, empirical evidence suggests that trauma-related disgust may be elevated among individuals with an IPT history. Therefore, it was also hypothesized that, compared to those with a non-IPT history, participants who report an IPT as their most salient traumatic event will self-report elevated disgust following the trauma-related script presentation compared to the neutral script as well as baseline.

Following Kirsch and colleagues, this was indexed via script contrast (defined as the difference between post-neutral ratings subtracted from post-traumatic event script ratings) and script reactivity (defined as the differences in baseline ratings subtracted from post-traumatic event script ratings). Third, due to the physiological reactivity to disgust-related stimuli and its association with activation of the PNS (Levenson, Ekman, & Friesen, 1990), it was hypothesized that participants in the IPT group will evidence decreased heart rate as measured by script contrast and script reactivity compared to the non-IPT group. Finally, in terms of behavioral responding, compared to the non-IPT group, youth in the non-IPT group will display greater levels of script contrast and script reactivity in disgust-relevant facial expressions as indexed by activity in the levator labii and lateral frontalis muscle (measured using facial EMG).

Method

Participants

The sample included 60 adolescents (30 males) between the ages of 10 and 17 years (M_{age} = 14.42, SD = 2.21) and enrolled in 4th through 11th grade. Recruitment efforts consisted of sustained community-based efforts, including flyering and advertising on local public radio. Adolescents who participated in the current study received monetary compensation of $40 for approximately 3 hours of their time. Participants were primarily Caucasian (73.3%); followed by 15% “multiple race”, 5% African American, 3.3% American Indian, and 1.7% “other”. These demographics are representative of the local community. Further, the majority (65%) of parents in the current study reported at least some college education and 15% who reported having completed graduate school. See Table 1 for descriptive statistics of demographic variables.

Measures

Self-Report Negative Affect. All negative affect variables in response to reminders of a neutral and traumatic event were assessed using a single self-report item from the well-established Subjective Units of Distress scales (SUDs; Wolpe, 1958). Participants were asked to report current levels anxiety (SUDs-A), disgust (SUDs-D), distress (SUDs-Dist), and fear (SUDs-F) on a visual analog scale ranging from 0 to 100. This single-item rating for each emotion was employed six times throughout the study. This approach has been employed in multiple laboratory-based studies including among those utilizing a script-driven imagery procedure (Pitman et al., 1987).

Traumatic Event History. The *Clinician-Administered PTSD Scale, Child and Adolescent Version* (CAPS-CA; Nader et al., 1996), a structured clinical interview, was used to assess adolescents' history of exposure to traumatic events, including their most salient traumatic event. Traumatic event exposure was assessed by a life event checklist comprised of 19 common interpersonal and non-interpersonal traumatic events (e.g., sexual assault, natural disaster). The CAPS-CA also includes 33 items, which youth rate in relation to their most salient traumatic event. These map onto three posttraumatic stress symptom clusters (i.e., numbing/ avoidance, arousal, re-experiencing) which align with PTSD diagnosis criteria according to the DSM-IV-TR (APA, 2000). The CAPS-CA is a modified version of the original adult version, adapted to be developmentally appropriate for use among youth. It has demonstrated excellent validity and reliability (Weathers, Keane, & Davidson, 2001) in addition to high inter-rater reliability (r = 0.95- 0.99), and internal consistency (α = 0.90; Harrington, 2008). In order to ensure mastery of the CAPS-CA interview administration, the PI completed training presented by a certified trainer (Dr. Jennifer Price) at the Laureate Institute for Brain Research in Tulsa, Oklahoma. Additional training included further considerations when administering structured interviews with adolescents and a detailed overview of the interview provided by Dr. Leen-Feldner. All interviews were recorded, and a review of a random selection of tapes by a blind rater resulted in 100% diagnostic agreement.

Physiological Responding. Physiological data were obtained using a BIOPAC MP 150 data acquisition system (BIOPAC systems Inc.; Goleta, CA: USA), which uses Acq*Knowledge* 4 software. For the purpose of the current study, a single-channel biopotential electrocardiogram amplifier (ECG100C) was used to measure heart rate as well as two channels of biopotential electromyogram amplifiers (EMG100C) in order to measure facial EMG (BIOPAC Systems Inc., n.d.). In regard to heart rate measurement, disposable Ag/AgCl electrodes were placed just below the participant's lower left rib and right collar bone. This method is consistent with recommended guidelines (Berntson, Quigley, & Lozano, 2007). In order to acquire face muscle movement, two disposable Ag/AgCl electrodes were placed on the levator labii (below the left eye) and on the lateral frontalis (above the left eyebrow), which are facial regions associated with disgust responding specifically (Orr & Roth, 2000; Fridlund & Cacioppo, 1986). Placement of the facial EMG electrodes were based on previous work indicating these regions of facial activity are specific to disgust (Orr & Roth, 2000) and serve as a promising behavioral index of disgust reactivity (Vrana, 1993). Indices of physiological reactivity were measured throughout the duration of the script-driven imagery procedure.

Trait Vividness of Imagery. In order to assess each participant's ability to vividly imagine their idiographic reminder of a neutral and traumatic event, participants were administered the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973) after having completed the script-driven imagery procedure. The VVIQ is a 16-item scale commonly used in adult imagery research to measure individual differences in vividness of visual imagery. After participants were instructed to visualize several images they were asked to rate the vividness of those images on a scale from 0 (*perfectly clear and as vivid as normal vision*) to 5 (*no image at all, you only "know" that you are thinking of the object*). The VVIQ evidences good test-retest reliability (r = 0.74) and high internal consistency (current sample r = .88; Allbutt, Ling, Rowley, & Shafiullah, 2011; McKelvie, 1995). VVIQ scores were used to determine whether there was a significant difference in imagery vividness between groups in order to evaluate vividness as a potential covariate.

Procedure

Parents who were interested in having their child participate in the current study contacted the Arkansas Interdisciplinary Sciences Laboratory located at the University of Arkansas. A telephone screener was then administered to adolescents in order to determine eligibility. During the screener, verbal consent to participate in the research study was obtained from both the parent and child; adolescents that met inclusion criteria were then invited to the lab. Upon arrival to the lab, written informed consent and assent for both the child and the parent's participation was obtained. Adolescents were asked to complete a series of tasks including a structured interview with the primary investigator, a battery of questionnaires including those described above, and the script-driven imagery procedure.

Emotional Awareness Training. Participants were asked to identify, understand, and provide examples of nine specific emotions (i.e., happy, sad, excited, anxious, disgusted, surprised, angry, worried and relaxed). Both positive and negative words were used in order to avoid priming effects (e.g., bias toward negative emotional responses). First, participants were asked to match a given emotion with the appropriate facial expression. Next, participants listened to standardized definitions of each emotion and were asked to provide a personal example of a time they have experienced that specific emotion. Finally, a brief 4-item emotional understanding post-test was administered to ensure emotional training effectiveness. Of the entire sample, only one participant made one incorrect response. Here, the correct response was provided and further explained to the participant, until understanding was affirmed.

Response to Imagery Training. In order to increase script-driven imagery effectiveness, all participants received standardized imagery training. Participants were asked to sit and relax while they listened to an audio recording designed to help vividly imagine three scenes as if they were really happening.

Script-Driven Imagery Procedure. All participants were administered an idiographic neutral script-driven imagery procedure prior to receiving a trauma-related script-driven imagery procedure in order to compare differences in physiological reactivity from a non-emotional script to those elicited by a trauma reminder. Individualized scripts were obtained for each participant. In order to generate a neutral script (e.g., one which does not elicit positive or negative affect) participants were provided with a list of neutral events (e.g., brushing your teeth, listening to music) to choose from. The trauma-related script was derived from the most salient traumatic event reported by the participant during the CAPS-CA interview. In line with prior published procedures, a list of bodily sensations (e.g., sweaty palms, racing heart; Pitman et al., 1987) was presented when developing the trauma script. Participants were asked to circle all of the bodily sensations that occurred at the time they experienced their most salient traumatic event. The PI worked collaboratively with the participant to develop standardized scripts then used to create 30-second audio recordings of each event. Following script development, participants were fitted with BIOPAC physiological monitoring equipment to measure heart rate, skin conductance and face muscle movements during the procedure. Finally, standardized audio instructions for the script procedure began with a five-minute relaxation period to ensure accurate baseline readings.

Data Analytic Approach

Data were categorized into two mutually exclusive groups based on self-reported index trauma type (i.e., IPT vs. non-IPT). This categorization process was based upon existing approaches (Iverson et al., 2014; McLaughlin, et al., 2013) that include discrete IPT (e.g., being kidnapped, physically assaulted, sexually assaulted) and non-IPT (e.g., natural disaster, accidental injury, car accident) categories. Trauma groups were coded by two trained research assistants, with any disputes settled by the PI. Training consisted of completion of a structured reading program on the nature and consequences of traumatic event exposure. Next, coders were provided with a standardized definition of interpersonal trauma and practiced categorizing traumatic events (identified in the structured readings) as interpersonal or non-interpersonal. As a result, high inter-rater reliability (Intraclass correlation coefficient [ICC] .97%) was obtained across raters with only two discordant cases out of the sixty coded trauma types.

The data analytic approach followed Kirsch and colleagues (2015) in which group differences of script contrast and script reactivity were examined for all but the first hypothesis. Script contrast was examined by subtracting self-reported and physiological responding to the neutral script from the traumatic event script whereas script reactivity was examined by subtracting baseline responding from the traumatic event script. In order to address the first hypothesis, paired-samples *t*-tests were conducted to examine overall differences between post-trauma script ratings compared to post-neutral script ratings for each of the SUDs variables (i.e., anxiety, disgust, distress and fear) as well as post-trauma script ratings compared to baseline ratings. To address the remaining hypotheses, group (i.e., IPT vs. non-IPT) served as the predictor variable for independent-samples *t*-tests in order to examine differences in script contrast and script reactivity for self-report disgust and physiological responding between groups.

Results

Preliminary Analyses

Prior to hypothesis testing, all data were inspected for outliers, violation of statistical assumptions (e.g., normality), and problematic signals (e.g., poor signal due to excessive movement, recording noise). In terms of self-report outcomes, all SUDs scores (i.e., anxiety, disgust, distress, and fear) violated assumptions of normality and homogeneity therefore, as recommended, a square root transformation was computed. All other relevant variables met assumptions. Physiological data were visually inspected for artifacts (e.g., poor signal, excessive movement). Data for four cases were excluded due to the magnitude of problematic signals. All other recorded segments with problematic signals were retained due to the minimal amount of continuous data (< 1.5 seconds) that were removed. Other missing physiological data were due to the inability to acquire data as a result of computer software issues or participant attire. As suggested, heart rate was converted to beats per minutes and was calculated using raw electrocardiogram data (Berntson et al., 2007; Porges & Byrne, 1992).

Descriptive analyses were next conducted. Means and standard deviations for all relevant variables as a function of group (i.e., IPT, non-IPT) as well as the overall sample are presented in Table 2. Scores on the VVIQ-A as well as age were not statistically significantly different between groups [$t(48) = -1.27$, $p = .266$; $t(53) = -.952$, $p = .345$, respectively] and therefore were not used as covariates. Further, as shown in Table 3, zero-order correlation analyses indicated that age was not significantly related to the primary predictor or any outcome variables. Finally, it merits mention that Kirsch and colleagues (2015) examined group differences (trauma control versus PTSD) in baseline responding and found the PTSD group evidenced higher self-reported negative affect (i.e., anxiety), but not physiological responding. A similar pattern was observed here, with the IPT group evidencing significantly elevated baseline disgust ($M = 11.04$, $SD = 18.09$) compared to the non-IPT group ($M = 6.69$, $SD = 13.66$; [$t(33.53) = -2.07$, $p = .045$]). In terms of heart rate and facial EMG reactivity, there were no significant group differences in baseline responding.

Primary Analyses

In order to address the first hypothesis, a paired-samples *t*-test was first conducted to examine differences between post-neutral and post-traumatic event script ratings for each SUDs indicator of negative affect (i.e., anxiety, disgust, distress, and fear; See Table 4 for means and inferential statistics). Results indicated that, for the entire sample, post-traumatic script SUDs ratings were significantly greater ($p < .001$) than post-neutral script SUDs ratings for each indicator of negative affect. In regard to differences between baseline and post-traumatic event script ratings, results indicated that, with the exception of anxiety ratings, all other SUDs ratings (i.e., disgust, distress, and fear) were significantly greater ($p < .001$) than baseline ratings.

In order to examine the second hypothesis, an independent-samples *t*-test was performed to evaluate whether script contrast for SUDs-D ratings and script reactivity differed as a function of group. Results indicated that script contrast for SUDs-D ratings were not statistically significantly different between groups ($t(53) = -1.77$, $p = .083$), although the IPT group did display greater SUDs-D script contrast ratings ($M = 20.40$, SD = 29.29) compared to the non-IPT group ($M = 16.25$, SD = 28.04). A similar pattern emerged in regard to script reactivity. Although non-significant ($t(53) = -1.68$, $p = .098$), results indicated that the IPT group displayed greater script reactivity for SUDs-D ratings (*M* =13.14, SD = 21.68) compared to the non-IPT group (*M* = 4.92, SD = 13.83).

To address the third hypothesis, an independent-samples *t*-test was conducted in order to determine whether there were significant group differences in levels of script contrast for HR. Contrary to hypotheses, script contrast for HR was slightly higher for the IPT group (*M* = 3.79, SD = 5.86) than for the non-IPT group (*M* = 2.77, *SD* = 6.18), however, differences did not reach statistical significance [$t(45) = -.584$, $p = .562$]. Similarly, there were no statistically significant group differences in regard to script reactivity [$t(45) = .094$, $p = .925$]. Please see Table 2 for means.

In order to examine group differences in levels of script contrast for frontalis and levator facial EMG, two separate independent-samples *t*-tests were conducted. Contrary to predictions, there were no significant between group differences in levels of script contrast for frontalis facial EMG [$t\ (46) = 1.17$, $p = .246$] or for script reactivity [$t\ (47) = .513$, $p = .610$]. Similarly, for activity indexed via the levator facial EMG, there were no significant between group differences in levels of script contrast [$t\ (49) = .823$, $p = .414$] or levels of script reactivity [$t\ (49) = .101$, $p = .317$]. Means are presented in Table 2.

Discussion

Exposure to interpersonal traumatic events is associated with more deleterious outcomes compared to non-interpersonal traumatic events; one contributing factor for this association involves the level of peri-and post-traumatic emotional responding. Empirical evidence suggests experiencing an IPT is associated with elevated trauma-related disgust (Badour et al., 2013; Fairbrother & Rachman, 2004) and may be responsible in part for the onset and maintenance of subsequent psychopathology. The current study aimed to conceptually replicate prior work evaluating the use of script-driven imagery (Kirsch et al., 2015) and expand on prior work by examining multi-modal disgust reactivity in response to ideographic reminders as a function of trauma type among youth. Results suggest ideographic scripts are a useful tool in eliciting post-traumatic emotional responding in adolescents. With regard to hypothesized relations between IPT exposure and disgust, no significant effects were observed in the current study.

First, in relation to self-reported negative affect (i.e., anxiety, disgust, distress, and fear), findings were consistent with hypotheses and prior work (Kirsch et al., 2015). Specifically, the overall pattern of findings for within-subjects' analyses indicated increased subjective ratings of negative affect for the post-traumatic event script relative to baseline and post-neutral script ratings. These findings also fit with laboratory-based adult work, indicating elevated negative affect in response to trauma cues (Pitman et al., 1987). At a broad level, the current observations accord with theory and research on PTSD indicating that encounters with internal and external reminders of one's traumatic event are upsetting (Pynoos et al., 1999) and may contribute to pathological avoidance behavior characteristic of the disorder (Gilboa-Schechtman & Foa, 2001). From a pragmatic perspective, the current pattern of findings suggests script-driven imagery procedures effectively elicit post-traumatic negative affect among youth with a history of exposure to a traumatic event. With this safe and inexpensive protocol, researchers are poised to address a number of pressing questions in the literature, including characterizing psychophysiological reactivity in response to trauma reminders, evaluating developmental differences and change posttraumatic symptom trajectories, and discerning key individual difference variables (e.g., emotion regulation skills; distress tolerance) that influence trauma-cue driven reactivity (e.g., Cloitre et al., 2009; Pynoos et al., 1999; Shipman, Edwards, Brown, Swisher, & Jennings, 2005).

Second, and in contrast to expectations, no significant group differences in self-reported disgust ratings indexed via script contrast or script reactivity were found. This pattern of results is surprising, given empirical and theoretical work linking disgust to experiences of interpersonal trauma (e.g., Badour & Feldner, 2013). One possibility is that there are individual (e.g., disgust sensitivity) as well as developmental differences in the subjective experience of disgust in response to trauma cue reminders (Haidt et al., 1997; Ong, Mullette-Gillman, Kwok, & Ling, 2014). For instance, previous work exposing children to disgusting stimuli suggests that youth below the age of eight years generally do not interpret certain stimuli as disgusting; however, children later learn to interpret and avoid certain social and interpersonal interactions key social agents (e.g., parents) may consider disgusting (Rozin & Fallon, 1987). Disgust in response to interpersonal trauma cues may not emerge until even later, in adolescence or early adulthood, when neurobiological systems that subserve social-affective functioning are fully developed (Crone & Dahl, 2012). Prospective work is needed to evaluate potential developmental changes in the subjective experience of disgust, particularly in response to interpersonal trauma cues. In contrast, methodological issues may be at play in the observed pattern of results. One concern pertains to how disgust was explained to participants in the current study. Prior to the script procedure, participants were instructed to listen to an emotional training audio recording during which definitions of several emotions and an example of each were provided. Disgust was described as something "*icky or gross*" and an example of when someone might feel disgusted involved playing in the dirt or with a worm. This definition may better align with elicitors in certain domains of disgust, such as core disgust (e.g., insects, animals, food, body products), as opposed to the type of disgust elicited during an interpersonal traumatic event (McKay, 2017). The focus on core types of disgust-related stimuli (e.g., playing with a worm) in the emotion training may have decreased the likelihood that adolescents would report the type of (moral) disgust elicited by the trauma cue reminders. Incorporating emotion training procedures that include specifiers pertinent to other disgust domains, including body envelope violation or violations of sexual norms, will be an important area for future research.

Two additional methodological considerations may also pertain to the observed null effects in terms of self-reported disgust. First, the current study was potentially underpowered to detect effects. Previous work examining multi-modal responding to a trauma reminder suggests a medium effect size (r = .4) for both self-report and physiological indices (Kirsch et al., 2015; McNally et al., 2004). Although the sample size for each group was similar to prior work (Feldner et al., 2010; Kirsch et al., 2015), a post-hoc power analysis was conducted using *G*Power* (Erdfelder, Faul, & Buchner, 1996). Results indicated that the current study was powered to detect an observed effect size of d = .14, with power (1 - β) set at 0.80 (α = .05; two-tailed). This effect size is small, suggesting a larger sample size may have yielded findings more consistent with hypothesized effects (Ferguson, 2009; Rosenthal, 1984). Second, it is also possible that the index events, while interpersonal in nature, were not as intense as the types of traumatic events typically studied in this literature (e.g., sexual assault, kidnapping; Kisiel et al., 2013). Indeed, ratings of disgust only increased by approximately 13 points (on a scale of 0-100) from baseline to post-traumatic event script in the IPT group. However, it is also worth noting that, although not statistically significant, means were in the expected direction, with the IPT group evidencing greater disgust contrast and reactivity than the non-IPT group. This is consistent with theory and research in the area (Badour et al., 2011; Dalgleish & Power, 2004; Rachman, 2004), and underscores the importance of addressing the methodological concerns of the current study in future work. For instance, addressing study hypotheses in a larger sample with clinically-relevant levels of posttraumatic stress or exposure to more intense interpersonal traumatic events may render results more consistent with the theorized association between IPT and disgust. Further, the laboratory-based design of the current study is limited in terms of ecological validity. Future work may usefully utilize tools like ecological momentary sampling to evaluate linkages between interpersonal trauma and disgust in more real-life settings.

With regard to physiological response to the script driven imagery procedure, prior work suggests that physiological responding to disgust-related stimuli is characterized by a decrease in heart rate (Gross & Levenson 1993; Olatunji & Sawchuk, 2005); however, findings are somewhat inconsistent (Olatunji, Haidt, McKay, & David, 2008) and there is little work examining this association among youth (Kunzmann, Kupperbusch, & Levenson, 2005). In the current study, there were no significant differences in heart rate script contrast or reactivity between participants presented with reminders of an IPT compared to those with a non-IPT. Findings in the current study are similar to those found by Kirsch and colleagues (2015), with comparable baseline heart rate across the entire sample as well as non-significant baseline and post-trauma script differences between a group with PTSD compared to a trauma control. These data converge to suggest that presentation of trauma-related cues to youth may not cause the types of changes in sympathetic response observed in some prior (adult) work. However, power is potentially an issue here too; problematic signaling led to the elimination of four cases in addition to pairwise comparisons which resulted in variability of missing data for various reasons (e.g., allergies, attire). Alternatively, it is possible that the content of the script did not capture enough of the disgusting aspects of the trauma reminder specifically, making it difficult to detect physiological responding associated with disgust versus negative affect more broadly. Consistent with prior work, future studies should consider using a script-driven imagery procedure where scripts are constructed to reflect specific types of trauma reminders (i.e., disgust-focused vs. fear-focused scripts; Badour & Feldner, 2016). This approach would provide a better understanding of the circumscribed role of disgust in trauma-cue-driven responding. This is a daunting methodological challenge, as several emotions can be experienced simultaneously, and it may not be possible to elicit some emotions, including disgust, in the absence of others (e.g., fear; Chapman & Anderson, 2013; Salerno & Hagene, 2013). Continued innovation in this area is needed in order to profile patterns of autonomic response across discrete emotions.

Lastly, muscle activity indexed via facial EMG is suggested to be associated with discrete emotions, such as fear and disgust (Olatunji & Sawhcuck, 2005), although the extant empirical literature on emotion and psychophysiology is inconsistent (Barrett, 2006). Specifically, greater muscle tension of the levator labii corresponds with facial expressions in response to the presentation of disgust stimuli whereas greater activity of the frontalis corresponds with disgust as well as other negative emotions such as fear and anger (Vrana, 1993). However, only one study has examined facial EMG activity in response to ideographic reminders among youth (Kirsch et al., 2015). Consistent with these findings, no differences in facial EMG activity between groups were observed in the current study. These findings fit with prior work suggesting autonomic measures cannot reliably distinguish discrete emotions beyond the ability to consistently distinguish between positive and negative affect more broadly (Cacioppo, Berntson, Larsen, Poehlman, & Ito, 2000; also see Quigley, Lindquist, & Barrett, 2014). It is also possible that methodological issues specific to the current study may have limited our ability to detect significant group differences. For instance, it is possible that the use of audio recorded reminders as the stimulus presentation requires sampling at a higher sampling rate (e.g., 200hz) whereas the sampling rate in the current study was set at 100hz. This rate was selected because it is accords with previous work and has the benefit of accurately detecting and classifying variations in face muscle activity while reducing data processing and memory storage (Blumenthal et al., 2005; Fridlund & Caciappo, 1986; Li, Li, Yu, & Geng, 2011). Nonetheless, depending on the type of stimuli presentation (e.g., video, images, audio), higher sampling rates may optimize the ability to detect gross face muscle movement and should be considered in future work (Roddy, Stewart, & Barnes-Holmes, 2011; Varcin, Bailey, & Henry, 2010).

In addition to those already discussed, several limitations of the current study merit mention. First, groups which were categorized based on trauma history were not mutually exclusive, rather the most salient traumatic experience was used to distinguish between the IPT group and the non-IPT group. It is possible that participants in both groups had a history of IPT which may have influenced results. Future studies could address this issue by comparing mutually exclusive groups. However, due to the fact that the majority of adolescents are exposed to multiple traumatic events by the time they reach adulthood (Copeland et al., 2007), this approach may also limit generalizability. Indeed, repeated exposure to traumatic events (McLaughlin et al., 2013) and “complex” trauma (i.e., childhood trauma history comprised of multiple and chronic interpersonal traumas; van der Kolk et al. 2009) are associated with significantly greater problems compared to youth with exposure to a single traumatic event (Cloitre et al., 2009; D’Andrea, Ford, Stolbach, Spinazzola, & van der Kolk, 2012), including symptoms associated with greater affective and physiological dysregulation (Kisiel et al., 2013). Certainly, a more fine-grained approach toward categorizing groups based on trauma type is needed; measuring and statistically evaluating the influence of polytraumatization across groups defined by their most salient trauma may be an ideal approach. Second, other than the trauma being required to have taken place at least thirty days prior to the telephone screening, the amount of time elapsed since the traumatic event was allowed to vary across participants. Based on theoretical and empirical work suggesting most individuals experience a decrease in post-traumatic responding to reminders over time (McNally, Bryant, & Ehlers, 2003; Charuvastra & Cloitre, 2008), future work may benefit from setting clear time parameters as inclusion criteria (e.g., traumatic event exposure greater than 30 days and less than one year). Third, participants in the current sample were recruited via electronic and paper fliers, which may have resulted in a self-selection bias. For instance, fliers directed toward youth or their parents explicitly sought adolescents who had either been bullied or were exposed to a stressful event. Therefore, youth who were more comfortable discussing their traumatic experiences or were more encouraged by their parents may have been more likely to respond than parents or youth wishing to avoid such reminders. Recruitment strategies in which, for example, the salience of having to discuss one's traumatic event was attenuated (within the bounds of responsible conduct of human subjects research) might increase the generalizability of the sample.

These limitations notwithstanding, the current study is among the first to examine disgust in response to trauma cue presentation among youth with a history of interpersonal and non-interpersonal trauma. Importantly, findings indicated that the script-driven imagery procedure is an effective and safe tool for eliciting negative affect in response to trauma reminders among youth. Contrary to hypotheses however, there were no significant differences in disgust as a function of group indexed via self-report, physiological, or behavioral responding. Given theory and evidence suggesting disgust may play a role in elevated posttraumatic symptoms among individuals exposed to interpersonal trauma, along with the methodological limitations of the current study, the discussion includes a research agenda aimed at instigating further research in this important area.

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Appendix

Table 1

Descriptive Data for Parent and Child Demographic Variables and Theoretically Relevant Variables as a Function of Group

	Total (*N* = 60) *M* or *n* (*SD* or %)	IPV (*n* = 27) *M* or *n* (*SD* or %)	non-IPV (*n* = 28) *M* or *n* (*SD* or %)
Child			
Age	14.42 (2.21)	14.75 (2.16)	14.16 (2.37)
Gender (Male)	30 (50%)	14 (51.9%)	13 (46.4%)
Grade			
Fourth	3 (5%)	--	3 (10.7%)
Fifth	11 (18.3%)	6 (22.2%)	4 (14.3%)
Sixth	6 (10%)	1 (3.7%)	5 (17.9%)
Seventh	4 (6.7%)	2 (7.4%)	1 (3.6%)
Eighth	13 (21.7%)	8 (29.6%)	3 (10.7%)
Ninth	6 (10%)	2 (8%)	4 (14.3%)
Tenth	12 (20.0%)	5 (18.5%)	6 (21.4%)
Eleventh	5 (8.3%)	3 (11.1%)	2 (7.1%)
Race/Ethnicity*			
Caucasian	44 (73.3%)	19 (70.4%)	21 (75%)
Asian	--	--	--
African American	3 (5%)	3 (11.1%)	--
Multiple race	9 (15%)	2 (7.2%)	6 (21.4%)
Other	3 (5.1%)	2 (7.4%)	1 (3.6%)
Parent			
Age	42.40 (8.67)		
Relationship to child			
Biological mother	44 (73.3%)		
Step-mother	3 (5%)		
Biological grandmother	1 (1.7%)		
Biological father	7 (11.7%)		
Step father	1 (1.7%)		
Other	2 (3.3%)		
Race/Ethnicity*			
Caucasian	47 (78.3%)		
Asian	2(3.3%)		
African American	2 (3.3%)		
Multiple race	4 (6.7%)		
Other	3 (5.1%)		

Table 1 (continued)
Descriptive Data for Parent and Child Demographic Variables and Theoretically Relevant Variables as a Function of Group

	Total (N = 60) M or n (SD or %)	IPT (n = 27) M or n (SD or %)	non-IPT (n = 28) M or n (SD or %)
Annual Household Income			
< $20,000	17 (28.3%)		
$20,001 – $40k	13 (21.7%)		
$40,001 - $60k	13 (21.7%)		
>$60,001 - $70k	12 (20.0%)		
Marital Status			
Never Married	4 (6.7%)		
Married	37(61.7%)		
Divorced	13 (21.7%)		
Separated	4 (6.7%)		
Education			
High School	6 (10%)		
Some College	18 (30%)		
Completed College	18 (30%)		
Some Graduate School	3 (5%)		
Completed Graduate School	9 (15%)		

Note. *Race/ethnicity percentages do not sum to 100% because race/ethnicity categories were not mutually exclusive. IPV and non-IPV group sample size is based on pairwise comparisons; sum of groups does not total 60 due to missing data for the variable used to distinguish groups.

Table 2

Means and Standard Deviations for Covariates and Outcome Variables Separated by Group

	IPT	Non-IPT	Total
	M (*SD*)	*M* (*SD*)	*M* (*SD*)
Covariates			
VVIQ-A	2.06 (0.69)	1.85 (0.62)	1.98 (0.64)
Outcome Variables			
Script Reactivity			
ΔSUDs-D	13.14 (21.68)	4.92 (13.83)	8.55 (17.85)
Δ Heart Rate (bpm)	2.16 (6.04)	2.31 (4.93)	2.21 (5.21)
Δ EMG Frontalis (μV)	2.11 (7.21)	3.29 (8.63)	2.64 (7.75)
Δ EMG Levator (μV)	0.31 (1.92)	1.17 (3.78)	0.70 (2.94)
Script Contrast			
ΔSUDs-D	20.40 (29.29)	16.25 (28.04)	17.25 (27.81)
Δ Heart Rate (bpm)	3.79 (5.86)	2.77 (6.18)	3.27 (5.82)
Δ EMG Frontalis (μV)	0.67 (3.15)	2.76 (8.00)	1.72 (6.07)
Δ EMG Levator (μV)	0.25 (2.16)	0.78 (2.42)	0.49 (2.21)

Note. VVIQ-A = vividness of visual imagery; SUDs-D = disgust; bpm = beats per minute; μV = microvolts; EMG frontalis and levator = facial electromyography; Script Reactivity = post-trauma – post-neutral responding; Script Contrast = post-trauma – baseline responding; Δ = change scores.

Table 3

Zero-order Correlations Among Outcome Variables and Potential Covariates

Variable	1	2	3	4	5	6	7	8	9	10	*M*	(*SD*)
1. VVIQ-A	-	-.27*	- .17	.01	- .11	- .24	- .22	- .31*	- .21	.20	1.98	.64
2. SUDs-D Contrast	-	-	.88**	.21	.15	.10	.26	.11	.03	-.09	11.13	20.96
3. SUDs-D Reactivity	-	-	-	.29*	.14	.15	.34*	.05	- .00	- .12	8.55	17.85
4. HR Contrast	-	-	-	-	.69**	.04	.09	.18	.13	.04	3.27	5.82
5. HR Reactivity	-	-	-	-	-	.09	.09	.26	.22	.12	2.21	5.21
6. EMG-F Contrast	-	-	-	-	-	-	.90**	.44**	.59**	-.19	1.17	6.07
7. EMG-F Reactivity	-	-	-	-	-	-	-	.35*	.46**	-.23	2.64	7.75
8. EMG-L Contrast	-	-	-	-	-	-	-	-	.89**	.07	.49	2.21
9. EMG-L Reactivity	-	-	-	-	-	-	-	-	-	-.05	.70	2.94
10. Age	-	-	-	-	-	-	-	-	-	-	14.42	2.21

Note. VVIQ-A = ; SUDs-D Contrast = subjective disgust (post-trauma script – post-neutral script ratings); SUDs-D Reactivity = subjective disgust (post-trauma script – task baseline ratings); HR contrast = heart rate (post-trauma script – post-neutral responding); HR reactivity = heart rate (post-trauma script – baseline responding); EMG-F Contrast = frontalis facial EMG (post-trauma script – post-neutral responding); EMG-F Reactivity = frontalis facial EMG (post-trauma script – baseline responding); EMG-L Contrast = levator facial EMG (post-trauma script – post-neutral responding); EMG-L Reactivity = levator facial EMG (post-trauma script – baseline responding).

Table 4

Descriptive Statistics for Differences in Post-Trauma Script Ratings Among all SUDs Variables

	Post-Neutral Script *M (SD)*	Post-Trauma Script *M (SD)*	Mean Difference 95% CI	*t*	Baseline *M (SD)*	Mean Difference 95% CI	*t*
SUDs-A	15.76 (17.55)	26.98 (22.22)	-16.69, -5.74	-4.10**	21.97 (18.87)	-10.35, .254	-1.90
SUDs-D	4.03 (11.54)	15.17 (23.60)	-16.59, -5.67	-4.08**	6.69 (13.69)	-13.21, -3.90	-3.68*
SUDs-Dist	9.29 (15.76)	27.85 (29.19)	-25.78, -11.33	-5.14**	13.42 (17.60)	-21.56, -7.04	-3.94**
SUDs-F	8.61 (17.74)	25.86 (28.75)	-24.50, 10.00	-4.76**	12.63 (18.09)	-19.89, -6.58	-3.98**

Note: $N = 59$; CI = Confidence Interval; SUDS-A = Anxiety; SUDs-D = Disgust; SUDs-Dist = Distress; SUDs-F = Fear; results for baseline are compared to statistics provided for post-trauma script.

**$p < .001$, * $p = .001$

UNIVERSITY OF ARKANSAS

To:	Teah-Marie R Bynion BELL 4188
From:	Douglas James Adams, Chair IRB Committee
Date:	04/24/2018
Action:	**Expedited Approval**
Action Date:	04/24/2018
Protocol #:	1708004561R005
Study Title:	An Evaluation of the Validity of a Script-Driven Imagery Procedure among Adolescents
Expiration Date:	04/11/2019
Last Approval Date:	04/24/2018

The above-referenced protocol has been approved following expedited review by the IRB Committee that oversees research with human subjects.

If the research involves collaboration with another institution then the research cannot commence until the Committee receives written notification of approval from the collaborating institution's IRB.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date.

Protocols are approved for a maximum period of one year. You may not continue any research activity beyond the expiration date without Committee approval. Please submit continuation requests early enough to allow sufficient time for review. Failure to receive approval for continuation before the expiration date will result in the automatic suspension of the approval of this protocol. Information collected following suspension is unapproved research and cannot be reported or published as research data. If you do not wish continued approval, please notify the Committee of the study closure.

Adverse Events: Any serious or unexpected adverse event must be reported to the IRB Committee within 48 hours. All other adverse events should be reported within 10 working days.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, study personnel, or number of participants, please submit an amendment to the IRB. All changes must be approved by the IRB Committee before they can be initiated.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with the IRB Committee, original signed consent forms, and study data.

cc: Ellen Winifred Leen-Feldner, Investigator