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Habitual reappraisal in context: peer victimisation moderates its association with physiological reactivity to social stress

Kara A. Christensen[a], **Amelia Aldao**[a], **Margaret A. Sheridan**[b,c], and **Katie A. McLaughlin**[d]

[a]Department of Psychology, The Ohio State University, Columbus, OH, USA

[b]Division of Developmental Medicine, Boston Children's Hospital, USA

[c]Department of Pediatrics, Harvard Medical School, Boston, WA, USA

[d]Department of Psychology, University of Washington, Seattle, WA, USA

Abstract

Although the emotion regulation strategy of reappraisal has been associated with adaptive outcomes, there is a growing evidence that it may not be adaptive in all contexts. In the present study, adolescents reported their use of habitual reappraisal and their experiences with peer victimisation, a chronic stressor that is associated with reduced well-being in this population. We examined how these variables predicted physiological reactivity (vagal withdrawal and changes in pre-ejection period) during a social stressor (i.e., Trier Social Stress Task). In line with previous research, at high levels of victimisation, habitual reappraisal predicted adaptive physiological reactivity (i.e., greater vagal withdrawal). Conversely, at low levels of victimisation, habitual reappraisal predicted maladaptive physiological reactivity (i.e., blunted vagal withdrawal). These findings were specific to parasympathetic reactivity. They suggest that habitual reappraisal may exert different effects on parasympathetic reactivity depending on the presence of stressors, and highlight the importance of examining the role of contextual factors in determining the adaptiveness of emotion regulation strategies.

Keywords

Reappraisal; peer victimisation; vagal withdrawal; pre-ejection period; context

Introduction

A strategy for regulating emotions that has received a great deal of attention in the literature is reappraisal (Gross, 1998). It involves changing how one interprets an emotion and/or the situations that give rise to it in order to modify its onset, duration, and/or intensity. For example, when being teased by a group of peers, a teenager might seek to reduce his sadness by reminding himself that he will soon be graduating and that he will be able to make new friends in college. Reappraisal has frequently been conceptualised as an adaptive emotion regulation strategy that is effective at modulating emotional responses (e.g., Gross, 2015).

CONTACT: Amelia Aldao, aldao.1@osu.edu.

Consistent with this notion, recent meta-analytic work suggests that its habitual use is associated with effective modulation of affect (e.g., Webb, Miles, & Sheeran, 2012) and good mental health outcomes (e.g., Aldao, Nolen-Hoeksema, & Schweizer, 2010).

However, recent work suggests that this strategy may not serve a uniformly adaptive function across all contexts (e.g., Aldao, 2013). A recent study found that perceptions of control over stressors may, in fact, moderate the association between the ability to implement this regulation strategy and the experience of good mental health (Troy, Shallcross, & Mauss, 2013). Specifically, in participants who reported encountering uncontrollable stressors within the previous 18 months, reappraisal ability—as measured by reductions in self-reported negative affect while watching an emotionally evocative film clip—was associated with *lower* levels of depression symptoms. Conversely, in participants who experienced controllable stressors, reappraisal ability was associated with *higher* levels of depression symptoms. Such findings suggest that when stressors cannot be controlled, focussing on modifying emotions (rather than the stressors) might be particularly adaptive (see coping literature; e.g., Lazarus & Folkman, 1984). When stressors can be controlled, however, modifying emotions through reappraisal may inhibit the enactment of behaviours to remove the stressor, thus resulting in decreased adaptation.

In this study, we sought to build upon this previous work on contextual determinants of the correlates and consequences of reappraisal in two critical ways. First, we focused on the growing literature on reappraisal in adolescence, a time marked by the initiation of more frequent and effective reappraisal compared to childhood (e.g., Silvers, McRae, Gross, Remy, & Ochsner, 2012). We also aimed to examine a developmentally relevant stressor that plays a major role in mental health and well-being in this population: peer victimisation (e.g., Low et al., 2012). Indeed, recent work suggests that approximately 1 in 6 adolescents are victimised by their peers (e.g., Nansel et al., 2001) and that victimisation is associated with the development and maintenance of various forms of psychopathology, including both internalising and externalising problems (see meta-analysis in Reijntjes et al., 2011; Reijntjes, Kamphuis, Prinzie, & Telch, 2010). Morever, peer victimisation in adolescents has been shown to longitudinally predict higher levels of emotion dysregulation, dysregulated emotion expression, and higher levels of rumination (e.g., McLaughlin, Hatzenbuehler, & Hilt, 2009).

Second, we examined reappraisal in relation to dysregulated physiological responses to stress since this constitutes an important vulnerability factor for the development of internalising and externalising disorders in childhood (Graziano & Derefinko, 2013). Given the interpersonal nature of peer victimisation, we focussed on physiological reactivity to a stressful socio-evaluative interaction. Specifically, we administered the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993), which consists of delivering a speech and conducting a math task in front of an audience (e.g., Gunnar, Frenn, Wewerka, & Van Ryzin, 2009). The TSST has been associated with differential outcomes in physiological and affective responses across a broad range of psychopathology and is one of the most reliable methods of eliciting physiological stress responses (Dickerson & Kemeny, 2004).

We examined physiological reactivity to the TSST in both the parasympathetic and sympathetic branches of the autonomic nervous system. We assessed parasympathetic reactivity by measuring changes in respiratory sinus arrhythmia (RSA), which reflects rapid modulation of heart rate by the vagus nerve in response to environmental demands (e.g., Porges, 2007; Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012). Increased vagal withdrawal has been linked to adaptive functioning in a number of domains. For example, it has been associated with the deployment of high levels of cognitive effort (e.g., Duschek, Muckenthaler, Werner, & Reyes del Paso, 2009), the ability to effectively regulate emotions (as reviewed by Thompson, Lewis, & Calkins, 2008), and good mental health (i.e., low levels of externalising and internalising symptoms; e.g., Graziano & Derefinko, 2013), and better academic functioning (e.g., Graziano & Derefinko, 2013). It is worth noting, however, that some studies have found that increased vagal withdrawal is associated with increased internalising psychopathology (e.g., Boyce, 2001). Thus, there is some amount of heterogeneity in the link between vagal withdrawal and adaptive functioning.

Germane to this investigation, recent work suggests that vagal withdrawal might be particularly sensitive to social performance in children and adolescents. For example, in a laboratory study of interpersonal stressors, children whose parents were experiencing high levels of marital conflict were less likely to exhibit externalising symptoms if they had high vagal withdrawal (Obradović, Bush, & Boyce, 2011). In another study examining physiological responses to peer-evaluative stress, social competence was associated with greater vagal withdrawal, but only in adolescents who reported less use of engaged coping (i.e., reappraisal) during the laboratory stressor (Erath & Tu, 2013). Similarly, in a study of social exclusion, anxious children exhibited blunted vagal withdrawal during a task in which they were socially excluded relative to non-anxious children (Gazelle & Druhen, 2009). Thus, increased vagal withdrawal has been associated with more adaptive outcomes in the context of social stressors in these populations. Therefore, in light of the literature associating greater vagal withdrawal in children and adolescents to more adaptive social outcomes (e.g., Erath & Tu, 2013; Graziano & Derefinko, 2013) and decreased psychopathology (e.g., Gazelle & Druhan, 2009; Obradović et al., 2011), we conceptualise greater vagal withdrawal to this socio-evaluative task as representing an adaptive pattern of physiological reactivity.

We also assessed sympathetic responses by calculating pre-ejection period (PEP), which is the time period between ventricular depolarisation and the opening of the aortic valve (Newlin & Levenson, 1979). Decreases in PEP reflect *increased* sympathetic activity, while increases in PEP indicate *decreased* sympathetic activity (e.g., Beauchaine et al., 2013). Importantly, blunted PEP responses to reward have been associated with externalising behaviours (Beauchaine et al., 2013). Germane to the present investigation, in one computerised social exclusion study, young adults (mean age = 21.3) took part in a 5-min online chat discussion in which they either were included in or excluded from a prescripted chat between two computer-controlled participants (Newman, 2014). In response to exclusion, participants with greater histories of peer victimisation showed blunted sympathetic reactivity (i.e., a smaller decrease in PEP) than those with no history of victimisation. Interestingly, there were no effects of condition or historical victimisation on changes in vagal withdrawal, suggesting that dysregulated physiological reactivity during

the social interaction task was specific to the sympathetic and not the parasympathetic system.

In the current investigation, we examined whether chronic peer victimisation moderated the association between the habitual use of reappraisal and both sympathetic and parasympathetic reactivity to a social stressor. In light of previous work suggesting that reappraisal is associated with adaptive outcomes when stressors are uncontrollable and less adaptive outcomes when stressors are controllable (e.g., Troy et al., 2013), we expected that for those participants reporting elevated peer victimisation (i.e., high levels of an uncontrollable stressor), habitual reappraisal would be associated with adaptive physiological reactivity (i.e., greater vagal withdrawal and PEP decreases; Beauchaine et al., 2013; Porges, 2007; Thayer et al., 2012). Conversely, we predicted that for those reporting low levels of peer victimisation (i.e., low levels of an uncontrollable stressor), habitual reappraisal would be linked to maladaptive physiological reactivity (i.e., blunted vagal withdrawal and PEP decreases).

Given that peer victimisation is a multi-faceted process that spans overt victimisation (e.g., physical violence), relational victimisation (e.g., social exclusion), and reputational victimisation (e.g., spreading rumours; Prinstein, Boergers, & Vernberg, 2001), we examined each type as a separate factor that might differentially moderate the relationship between habitual reappraisal and adaptive physiological reactivity to the social stressor. In light of work suggesting that those adolescents who experience multiple types of victimisation are at the greatest risk for developing difficulties (Prinstein et al., 2001), we also created a total victimisation score. Given that previous research has not examined different facets (or number of facets) of peer victimisation in relation to vagal withdrawal and PEP decreases, we did not have a priori hypotheses regarding differences among them.

Method

Sample

We report how we determined our sample size, all data exclusions, all manipulations, and all measures specific to this investigation of emotion regulation and peer victimisation in relation to the socio-evaluative task (TSST). A diverse community-based sample of 169 adolescents aged 13–17 was recruited for participation in a study examining childhood adversity and stress reactivity from schools, after-school programmes, medical clinics, and the general community in the Boston, MA area between July 2010 and November 2012. The current study presents findings from one of the tasks in this laboratory-based longitudinal study, which additionally assessed response to a frustration task, stressful life events, exposure to trauma, and psychopathology. Other studies examining reappraisal (e.g., Troy et al., 2012) have examined the presence of global stressors; therefore, we sought to advance the literature by selecting an acute psychosocial stressor, namely the TSST. We were interested in examining variables that would map more closely onto the interpersonal and evaluative nature of the TSST. Consequently, we identified peer victimisation as the most promising measure to examine in relationship to reappraisal. This sample was 56.0% female (n = 94) with a mean age of 14.9 years (SD = 1.36). Our sample was 40.8% White (n = 69), 18.3% Black (n = 31), 17.8% Hispanic (n = 30), 7.7% Asian (n = 13), and 14.8% Biracial or

other (n = 25). The final analytic sample consisted of 158 participants. Eleven adolescents were dropped from the final data analysis. Reasons for exclusion included medication usage known to influence cardiovascular functioning (n = 4), equipment malfunction (n = 8), heart murmur (n = 1), severe cognitive impairment (n = 1), and pervasive developmental disorder (n = 1). All procedures were approved by the Institutional Review Boards at Harvard University and Boston Children's Hospital.

Self-report measures

We administered the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski, Kraaij, & Spinhoven, 2001), which consists of 36 questions that measure nine coping strategies (acceptance, blaming others, catastrophising, positive reappraisal, positive refocusing, putting into perspective, refocus on planning, rumination, self-blame) that may be used in response to negative life events. Questions are rated on a 5-point scale. Subscale scores are obtained by summing the component items. The CERQ subscales all show good internal reliability (α = .79–.88 in this sample).

Given that the CERQ does not contain a variable that assesses the multi-faceted nature of reappraisal (e.g., McRae, Ciesielski, & Gross, 2012), we created a reappraisal composite score by standardising and then averaging the refocus on planning, positive refocusing, positive reappraisal, and putting into perspective subscale scores (α = .83).

We assessed peer victimisation using the Revised Peer Experiences Questionnaire (Prinstein et al., 2001), which contains 18 items that measure overt, relational, and reputational victimisation. Participants rated responses on a 5-point scale, with higher scores representing greater victimisation. The original and revised measure has demonstrated good test–retest reliability, internal consistency, and convergent validity (Prinstein et al., 2001).

Participants rated the degree of threat experienced during the task using a measure of cognitive appraisal utilised in studies of challenge and threat (Jamieson, Nock, & Mendes, 2012). Item wording was modified from pre-task to post-task to reflect anticipated and experienced threat. Participants rated each item on a 7-point scale. Items representing situational demands (e.g., "*The upcoming task is difficult*") demonstrated good internal reliability (α = .77).

Physiological reactivity

Electrocardiogram (ECG) recordings were obtained with a Biopac ECG amplifier (Goleta, CA) using a modified Lead II configuration. Cardiac impedance recordings were obtained with a Bio-Impedance Technology model HIC-2500 impedance cardiograph (Chapel Hill, NC). One pair of mylar tapes encircled the neck and another pair encircled the torso. A continuous 500 μA AC 95 kHz current was passed through the two outer electrodes, and basal thoracic impedance ($z0$) and the first derivative of basal impedance (dz/dt) was measured from the inner electrodes. A Biopac MP150 integrated the ECG and impedance cardiography (ICG) signals, sampled at 1.0 kHz, using Acqknowledge software.

ECG and ICG data were scored by raters blinded to victimisation status. Signals were averaged into 1-min epochs using Mindware Software (Mindware Technologies, Gahanna,

OH). RSA was calculated from the interbeat interval time series using spectral analysis. We used the high frequency band 0.12–0.40 Hz and controlled for respiration rate (e.g., Berntson et al., 1997). To ensure accurate placement of the B point in the ICG data, two independent raters were used and SV differences of more than 5% (present in 8.2% of minutes scored) were reviewed and adjudicated by one of the authors (KM). PEP was calculated based on the ECG and ICG signals. The Q-onset in the ECG was placed using a validated automated scoring algorithm that was visually inspected to ensure accurate placement and adjusted if needed.

Procedure

Participants first completed a five minute resting physiology baseline in which they were instructed to sit quietly without moving. They then completed questionnaire and interview measures assessing peer victimisation and emotion regulation. The parent or guardian who attended the session provided informed consent and adolescents provided assent. Participants next completed the Trier Social Stress Task (Kirschbaum et al., 1993) while undergoing continuous physiological recording (ECG and ICG). The TSST consists of three phases—speech preparation, speech, and mathematics. Participants were told that they would be giving the speech in front of a panel of trained judges who would rate their performance. The speech topic provided was idiographic and interpersonal in nature; specifically, participants were asked to discuss the qualities of a good friend and the qualities they felt they personally did or did not possess. Then, they delivered the speech for five minutes in front of two evaluators, who were trained to give neutral or mildly negative feedback (e.g., displaying disinterest). Next, participants completed the mathematics portion in which they were asked to count backwards by seven from a three-digit number for five minutes. If participants made a mistake, they were stopped and asked to start again. Participants rated their assessment of threat pre-speech, post-speech, and post-math.

We calculated vagal withdrawal and PEP decreases by subtracting baseline from values from each period of the TSST. Thus, more negative values indicate greater vagal withdrawal (i.e., decreased parasympathetic activity) and greater decreases in PEP (i.e., increased sympathetic activity). Due to strong habituation during the task, we used only the first minute of each period and the baseline, which is standard practice (e.g., Jamieson et al., 2012). This resulted in three sets of variables: speech preparation reactivity, speech reactivity, and mathematics reactivity for vagal withdrawal and PEP decreases.

Statistical analysis

We examined interactions between peer victimisation and reappraisal predicting vagal withdrawal and PEP changes to the TSST. First, we examined all emotion regulation and peer victimisation variables for normality and transformed those with skew > 2 (i.e., positive refocusing and refocus on planning subscales and all peer victimisation variables). Next, we created interaction terms between each of the peer victimisation variables (i.e., total, overt, relational, and reputational) and habitual reappraisal. We then conducted regressions entering in the main effect terms for peer victimisation and habitual reappraisal as well as the interaction. We probed significant interactions with the PROCESS macro to identify

where regions of significance begin by percentiles of the moderator (Hayes, 2013). We ran 10,000 bias-corrected bootstraps.

Results

Descriptive statistics

Participants in this study reported their experiences with peer victimisation, habitual usage of reappraisal, and demographic information. We report these data and descriptives for the physiological reactivity variables in Table 1.

Manipulation checks

We examined subjective ratings of threat pre-speech, post-speech, and post-mathematics in order to confirm stress elicitation. We corrected for multiple comparisons by setting α at .05/3 = .017. We found a significant difference among all three ratings, such that perceived threat increased following the speech and math tasks relative to ratings before the TSST began, $t(146) = 10.507$, $p < .001$, and $t(142) = 4.195$, $p < .001$, respectively. In addition, the speech task was rated as more threatening than math, $t(145) = 2.979$, $p = .003$.

We examined the degree of vagal withdrawal by testing the difference scores created from the TSST (i.e., speech preparation, speech, and math) against zero. We corrected for multiple comparisons by setting α at $p = .05/3 = .017$. All three difference scores were significantly smaller than zero: speech preparation, $t(149) = -2.449$, $p = .015$; speech, $t(149) = -6.283$, $p < .001$; and math, $t(147) = -4.261$, $p < .001$. This suggests that the task resulted in vagal withdrawal (i.e., decreased parasympathetic activity).

Finally, we examined PEP changes during each task segment, correcting for multiple comparisons by setting α at $p = .05/3 = .017$. All three difference scores were significantly less than zero: preparation, $t(151) = -9.438$, $p < .001$; speech, $t(150) = -13.865$, $p < .001$; and math, $t(148) = -11.691$, $p < .001$. This suggests that the task resulted in increased sympathetic activity.

Relationships between baseline vagal activity, habitual reappraisal, and peer victimisation

Given that baseline vagal tone may serve as a bio-marker for flexible and adaptive emotional responding to environmental demands (e.g., Appelhans & Luecken, 2006; Thayer et al., 2012), we examined relationships between baseline vagal tone and our variables of interest to determine findings were not driven by differences in baseline vagal activity. We found that baseline vagal tone was not significantly associated with habitual reappraisal or any of the peer victimisation variables (all p's > .257). Further, when we predicted baseline vagal tone with habitual reappraisal, each peer victimisation subtype, and their interactions we observed no significant main effects or interactions (all p's > .265).

Habitual reappraisal and peer victimisation predicting vagal withdrawal

Speech preparation—Greater exposure to total, $b = .208$, $se = .100$, $p = .04$, relational, $b = .319$, $se = .156$, $p = .043$, and reputational victimisation, $b = .296$, $se = .148$, $p = .047$, was associated with blunted vagal withdrawal during speech preparation. We observed no main

effects of habitual reappraisal (all p's > .251), and no interactions between victimisation and reappraisal (all p's > .137).

Speech—None of the measures of peer victimisation were associated with vagal withdrawal during the speech (all p's > .329). Instead, habitual reappraisal predicted blunted vagal withdrawal in the models with total, $b = 1.045$, $se = .458$, $p = .024$, overt, $b = -.804$, $se = .383$, $p = .037$, and reputational victimisation, $b = .509$, $se = .257$, $p = .05$. Importantly, these main effects were qualified by two-way interactions between habitual reappraisal and victimisation. Interactions were significant for all measures of victimisation, including total, $b = -.374$, $se = .155$, $p = .017$, $R^2 = .204$, overt, $b = -1.322$, $se = .527$, $p = .013$, $R^2 = .207$, relational $b = -.455$, $se = .229$, $p = .049$, $R^2 = .166$, and reputational victimisation, $b = -.596$, $se = .223$, $p = .008$, $R^2 = .23$. We probed significant interactions using the Johnson–Neyman technique (Johnson & Fay, 1950) to identify regions of significance ($p \leq .05$; see Table 2 for the percentiles corresponding to each significant effect within each model). For participants who reported low levels of total victimisation, there was a positive association between habitual reappraisal and vagal reactivity, $b = .568$, $se = .288$, suggesting blunted withdrawal. For those who reported high levels of total victimisation, there was a negative marginal association between habitual reappraisal and vagal reactivity, $b = -.707$, $se = .358$, suggesting greater withdrawal (see Figure 1). Similar findings were observed for overt and reputational victimisation (see Table 2). No statistically significant transition points were observed for the interaction between reappraisal and relational victimisation.

Math—Peer victimisation did not predict vagal reactivity during math (all p's > .051); however, there were main effects of reappraisal in the model entering total $b = .982$, $se = .403$, $p = .016$, and relational victimisation, $b = 1.105$, $se = .455$, $p = .016$. These associations were qualified by two-way interactions between habitual reappraisal and total, $b = -.344$, $se = .136$, $p = .013$, $R^2 = .232$, and relational victimisation, $b = -.496$, $se = .201$, $p = .014$, $R^2 = .209$, in predicting vagal reactivity.

Among participants who reported low levels of victimisation, there was a positive association between habitual reappraisal and vagal reactivity for total victimisation, $b = .444$, $se = .225$, indicating that higher reappraisal was associated with blunted vagal withdrawal. The association between habitual reappraisal and vagal reactivity was negative among participants with high levels of total victimisation suggesting higher reappraisal was associated with greater vagal withdrawal $b = -.605$, $se = .306$ (see Figure 1). Similar findings were observed for relational victimisation (see Table 2).

Habitual reappraisal and peer victimisation predicting PEP decreases

Speech preparation—Higher levels of total victimisation, $b = 2.213$, $se = .883$, $p = .013$, overt, $b = 6.600$, $se = 2.970$, $p = .028$, relational, $b = 2.873$, $se = 1.371$, $p = .038$, and reputational victimisation, $b = 3.143$, $se = 1.323$, $p = .019$, were associated with PEP reactivity such that, greater victimisation predicted decreased reduction in PEP (i.e., blunted sympathetic reactivity). There were no main effects of habitual reappraisal on PEP reactivity (all p's > .062). The two-way interaction between habitual reappraisal and overt victimisation was significant, $b = -8.706$, $se = 3.810$, $p = .024$, $R^2 = .257$, but the Johnson–

Neyman technique revealed no statistically significant transition points within the range of the moderator (all *p*'s > .05). No other two-way interactions were significant (all *p*'s > .055).

Speech—There were no main effects of peer victimisation on PEP reactivity during the speech (all *p*'s > .054); however, there was a main effect of reappraisal predicting increased PEP decreases in the model when entering overt victimisation, $b = -6.219$, $se = 3.044$, $p = .043$. None of the two-way interactions were significant (all *p*'s > .063).

Math—There was a main effect of total, $b = 1.817$, $se = .829$, $p = .030$, and reputational victimisation, $b = 3.320$, $se = 1.230$, $p = .008$, on PEP reactivity, such that higher victimisation was associated with reduced PEP decreases. There were no main effects of habitual reappraisal on PEP reactivity during math (all *p*'s > .109) or significant two-way interactions (all *p*'s > .071).

Discussion

The study is the first to investigate how habitual usage of reappraisal interacts with a chronic stressor, peer victimisation, to predict physiological reactivity to a laboratory-based stressor in adolescents. As such, it represents an important development in our understanding of how emotion regulation strategies may be associated with different outcomes depending on context. Specifically, we found that peer victimisation (i.e., an uncontrollable stressor) moderated the association between habitual use of reappraisal and vagal withdrawal in response to a socio-evaluative stressor. In adolescents experiencing high levels of peer victimisation, habitual reappraisal was associated with greater vagal withdrawal—generally considered an adaptive response to socio-evaluative threats (e.g., Porges, 2007)—whereas in participants experiencing low levels of victimisation, habitual reappraisal was associated with blunted vagal withdrawal—usually conceptualised as a maladaptive response to socio-evaluative threats (Graziano & Derefinko, 2013; Obradović et al., 2011). These findings are aligned with those by Troy et al. (2013), who found that when adults encountered uncontrollable stressors, their ability to use reappraisal was also associated with adaptive outcomes (i.e., fewer depression symptoms). Conversely, when stressors were controllable, reappraisal ability was linked to maladaptive outcomes (i.e., more depression symptoms). Thus, our study provides further support for the notion that reappraisal might be most adaptive when stressors are outside of one's control.

However, it remains unclear why an emotion regulation strategy typically thought as adaptive is associated with detrimental outcomes when people are experiencing moderate stressors (as in this study) or when they experience stressors that are controllable (as in Troy et al., 2013). One possibility is that when the amount and type of stress experienced by an individual is manageable, the utilisation of reappraisal might not be necessary (see Lazarus & Folkman, 1984). Reappraisal may thus be an inappropriate use of cognitive resources that could be better devoted to changing behaviour. In order to test this notion, it will be important to administer cognitive depletion tasks following the use of reappraisal in low versus high stress situations (e.g., Sheppes & Meiran, 2008). If the use of this strategy in low stress situations is, indeed, associated with excessive use of cognitive resources, we would expect it to produce greater depletion than when used in high stress situations. In addition, it

is possible that the habitual use of reappraisal might also reflect people's higher vigilance for potential threats that may require regulation. That is, these individuals might be frequent reappraisers because they are constantly looking for threats in the environment to reappraise. To test this idea, it would be useful to examine whether habitual reappraisal is linked to greater threat detection in the environment (e.g., by utilising tasks assessing orientation towards threatening faces or social threat stimuli).

Another possibility is that, in such low stress contexts, high levels of reappraisal might actually resemble a perseverative thought process akin to worry or rumination. Thus, although individuals may think that they are actively addressing the stressor, they might actually be engaging in a cycle of perseverative thought that leads to emotional avoidance and interferes with taking action (e.g., Borkovec, Alcaine, & Behar, 2004). In other words, such reappraisal of mild stressors may actually represent an avoidance of emotional experience, whereby individuals might be overusing this strategy as a way to cognitively distance themselves from emotional experiences. In this vein, it will be important for future investigations to identify the extent to which reappraisal might be serving an avoidant function. One way of doing so will be by asking participants to write or say out loud their thought processes and code them for approach versus avoidance tendencies. Another way would be coding behavioural indicators of avoidance (e.g., reduced eye contact, laid back body posture).

The literature contains mixed findings regarding the associations between vagal withdrawal and indices of adaptive functioning. Vagal withdrawal may be used to index a range of processes including flexible emotional responding, cognitive engagement, and attentional processes (e.g., Porges, 2007; Thayer et al., 2012; Thompson et al., 2008). As such, it can be difficult to determine under which circumstances and for whom increased vagal withdrawal would indicate more adaptive functioning. Indeed, some studies have found that greater vagal withdrawal to task stressors was associated with increased internalising psychopathology (e.g., Boyce, 2001) and others have found non-significant associations (e.g., Eisenberg et al., 2012). In light of this, it is important to consider these findings to be preliminary in our understanding of what constitutes adaptive physiological responses.

Similarly, although blunted vagal withdrawal has been associated with detrimental outcomes (e.g., Graziano & Derefinko, 2013), it is certainly possible that among those individuals with histories of low peer victimisation, blunted vagal withdrawal may not necessarily constitute a maladaptive physiological response. Given that blunted vagal withdrawal may also represent decreased cognitive engagement with environmental stressors, those in this group who are skilled at reappraisal may be more emotionally regulated and thus not have construed the TSST as an intense stressor. Thus, when there is no acute environmental threat, reduced cognitive effort or attention, and by extension, blunted vagal withdrawal, may be an appropriate response. Consequently, performing detailed assessments of cognitive appraisals and in-the-moment usage of reappraisal will be critical in future research for determining how participants interpret and respond to the interpersonal stress.

Finally, an important point to consider as research in this area continues to grow is the importance of examining the nuances in the relation between vagal withdrawal and adaptive

functioning. In this respect, a series of recent studies have shown that resting vagal tone has a quadratic relationship with adaptation, such that individuals with either very low or very high levels of resting vagal tone report the highest levels of psychopathology and lowest levels of quality of life (e.g., Kogan, Gruber, Shallcross, Ford, & Mauss, 2013, 2014). In this respect, it will be important for future work to test non-linear associations between vagal withdrawal and adaptive functioning. Moreover, recent work has shown that interactions between resting vagal tone and vagal withdrawal may predict mental health outcomes (e.g., Yaroslavsky, Bylsma, Rottenberg, & Kovacs, 2013). As such, it will be important to model how the link between vagal withdrawal and adaptive outcomes might vary as a function of the levels of resting vagal tone.

Although peer victimisation was associated with blunted sympathetic reactivity during the speech preparation portion of the task (replicating Newman, 2014), it did not moderate the association between reappraisal and such reactivity. This suggests that the moderating effect of chronic social stress on the association between reappraisal and physiological reactivity might have some degree of specificity with regard to the parasympathetic nervous system. This pattern can be interpreted in light of Porges' polyvagal theory, which emphasises the strong link between vagal activity and social engagement (Porges, 2007). Specifically, polyvagal theory suggests that vagal activity increases during threat scenarios and is withdrawn in response to social engagements. Further supporting these divergent findings, PEP has been found to index reward responses (e.g., Beauchaine et al., 2013) and as such, its role in non-reward-based social interactions might be quite limited. One way of shedding further light onto these findings will be to examine chronic stress, reappraisal, and RSA and PEP reactivity in the context of tasks that vary in their level of both (1) social engagement, and (2) availability of rewards.

We found no differences among the types of victimisation for the speech portion of the task, which suggests that the mere experience of bullying can have a strong impact on physiological response, regardless of its type. This is consistent with previous work showing strong effects of relational victimisation on mental health and physiology (e.g., McLaughlin et al., 2009; Prinstein et al., 2001). For the mathematics portion of the TSST, only relational and total victimisation interacted with reappraisal to predict vagal withdrawal. One possible explanation is that the math portion of the TSST, while potentially stressful, does not require disclosure of personal information in the same ways as the speech task. As such, it might not have activated the same degree of threat to self and indeed, the perceived threat ratings for the math were lower than for the speech in this study. When a stressor is less personally threatening, it is possible that maladaptive responses are only seen among those individuals who are most sensitive to that particular domain stress, potentially as a function of prior salient evaluative experiences (i.e., adolescents who are more vulnerable because of higher levels of victimisation or greater experiences with relational aggression).

In a similar vein, when predicting vagal withdrawal for speech preparation, we only found a main effect of peer victimisation, such that increased victimisation was associated with blunted withdrawal. The lack of a significant interaction with reappraisal could be explained by the fact that participants ranked this portion of the task as the least threatening. This again suggests that these interactive effects between victimisation status and reappraisal may be

more likely to appear during situations that are more emotionally salient and require greater regulation. Future research should examine whether the degree to which the experimental task models victimisation experiences interacts with reappraisal (and other ER strategies) to predict maladaptive outcomes. Future work may seek to use stressors that more directly map on to peer victimisation experiences (e.g., social exclusion tasks, negative peer evaluation) and thus provide greater external validity by modelling the environmental stressors these adolescents experience in their daily lives.

This study had a number of limitations that warrant further discussion. First, its observational design precluded the testing of causal relations between use of reappraisal, peer victimisation, and physiological reactivity. Future work may seek to experimentally manipulate the use of reappraisal, particularly task-relevant state-level reappraisal. Additionally, in this study, we utilised a composite measure of reappraisal. Given that reappraisal is a multi-faceted construct (e.g., McRae et al., 2012), it would be of interest for future studies to examine if the types of reappraisal may differentially interact with peer victimisation when predicting physiological or subjective outcomes (e.g., threat appraisals, self-reported emotion). Second, while the size and diversity of the sample are strengths of this study, there were fewer adolescents who were at the upper-ranges of victimisation exposure. This restriction of range might have accounted for the somewhat weaker findings at high levels of victimisation. Consequently, oversampling children high in peer victimisation will be essential to shed more light onto adaptive and maladaptive patterns of reactivity in this vulnerable population.

The findings from this investigation constitute an important step in the development of a more sophisticated understanding of how peer victimisation might provide a context that influences the experience and regulation of emotions and stress reactivity. More broadly, these findings lend support to the growing literature on examining the contextual determinants of emotion regulation and mental health (e.g., Aldao, 2013). It is our hope that future work in this area continues to examine how the interplay between exposure to different types of stressors and use of specific emotion regulation styles influences mental health over time.

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References

Aldao A. The future of emotion regulation research: Capturing context. Perspectives on Psychological Science. 2013; 8(2):155–172. DOI: 10.1177/1745691612459518 [PubMed: 26172497]

Aldao A, Nolen-Hoeksema S, Schweizer S. Emotion-regulation strategies across psychopathology: A meta-analytic review. Clinical Psychology Review. 2010; 30(2):217–237. DOI: 10.1016/j.cpr.2009.11.004 [PubMed: 20015584]

Appelhans BM, Luecken LJ. Heart rate variability as an index of regulated emotional responding. Review of General Psychology. 2006; 10(3):229–240. DOI: 10.1037/1089-2680.10.3.229

Beauchaine TP, Gatzke-Kopp L, Neuhaus E, Chipman J, Reid MJ, Webster-Stratton C. Sympathetic- and parasympathetic-linked cardiac function and prediction of externalizing behavior, emotion regulation, and prosocial behavior among preschoolers treated for ADHD. Journal of Consulting and Clinical Psychology. 2013; 81(3):481–493. DOI: 10.1037/a0032302 [PubMed: 23544677]

Berntson GG, Thomas Bigger J, Eckberg DL, Grossman P, Kaufmann PG, Malik M, … Van Der Molen MW. Heart rate variability: Origins, methods, and interpretive caveats. Psychophysiology. 1997; 34(6):623–648. DOI: 10.1111/j.1469-8986.1997.tb02140.x [PubMed: 9401419]

Borkovec, T.; Alcaine, O.; Behar, E. Avoidance theory of worry and generalized anxiety disorder. In: Heimberg, RG.; Turk, CL.; Mennin, DS., editors. Generalized anxiety disorder: Advances in research and practice. New York: Guilford Press; 2004. p. 77-108.

Boyce WT. Autonomic reactivity and psychopathology in middle childhood. The British Journal of Psychiatry. 2001; 179(2):144–150. DOI: 10.1192/bjp.179.2.144 [PubMed: 11483476]

Dickerson SS, Kemeny ME. Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. Psychological Bulletin. 2004; 130(3):355–391. DOI: 10.1037/0033-2909.130.3.355 [PubMed: 15122924]

Duschek S, Muckenthaler M, Werner N, Reyes del Paso GA. Relationships between features of autonomic cardiovascular control and cognitive performance. Biological Psychology. 2009; 81(2): 110–117. DOI: 10.1016/j.biopsycho.2009.03.003 [PubMed: 19428975]

Eisenberg N, Sulik MJ, Spinrad TL, Edwards A, Eggum ND, Liew J, … Hart D. Differential susceptibility and the early development of aggression: Interactive effects of respiratory sinus arrhythmia and environmental quality. Developmental Psychology. 2012; 48(3):755–768. DOI: 10.1037/a0026518 [PubMed: 22182294]

Erath SA, Tu KM. Peer stress in preadolescence: Linking physiological and coping responses with social competence. Journal of Research on Adolescence. 2013; 24(3):757–771. DOI: 10.1111/jora.12085

Garnefski N, Kraaij V, Spinhoven P. Negative life events, cognitive emotion regulation and emotional problems. Personality and Individual Differences. 2001; 30(8):1311–1327. DOI: 10.1016/S0191-8869(00)00113-6

Gazelle H, Druhen MJ. Anxious solitude and peer exclusion predict social helplessness, upset affect, and vagal regulation in response to behavioral rejection by a friend. Developmental Psychology. 2009; 45(4):1077–1096. DOI: 10.1037/a0016165 [PubMed: 19586181]

Graziano P, Derefinko K. Cardiac vagal control and children's adaptive functioning: A meta-analysis. Biological Psychology. 2013; 94(1):22–37. DOI: 10.1016/j.biopsycho.2013.04.011 [PubMed: 23648264]

Gross JJ. The emerging field of emotion regulation: An integrative review. Review of General Psychology. 1998; 2(3):271–299. DOI: 10.1037/1089-2680.2.3.271

Gross JJ. Emotion regulation: Current status and future prospects. Psychological Inquiry. 2015; 26(1): 1–26.

Gunnar MR, Frenn K, Wewerka SS, Van Ryzin MJ. Moderate versus severe early life stress: Associations with stress reactivity and regulation in 10–12-year-old children. Psychoneuroendocrinology. 2009; 34(1):62–75. DOI: 10.1016/j.psyneuen.2008.08.013 [PubMed: 18835102]

Hayes, AF. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. 1. New York: The Guilford Press; 2013.

Jamieson JP, Nock MK, Mendes WB. Mind over matter: Reappraising arousal improves cardiovascular and cognitive responses to stress. Journal of Experimental Psychology. General. 2012; 141(3): 417–422. DOI: 10.1037/a0025719 [PubMed: 21942377]

Johnson PO, Fay LC. The Johnson-Neyman technique, its theory and application. Psychometrika. 1950; 15(4):349–367. DOI: 10.1007/BF02288864 [PubMed: 14797902]

Kirschbaum C, Pirke KM, Hellhammer DH. The Trier Social Stress Test—A tool for investigating psychobiological stress responses in a laboratory setting. Neuropsychobiology. 1993; 28(1–2):76–81. DOI: 10.1159/000119004 [PubMed: 8255414]

Kogan A, Gruber J, Shallcross AJ, Ford BQ, Mauss IB. Too much of a good thing? Cardiac vagal tone's nonlinear relationship with well-being. Emotion. 2013; 13(4):599–604. DOI: 10.1037/a0032725 [PubMed: 23731433]

Kogan A, Oveis C, Carr EW, Gruber J, Mauss IB, Shallcross A, … Keltner D. Vagal activity is quadratically related to prosocial traits, prosocial emotions, and observer perceptions of prosociality. Journal of Personality and Social Psychology. 2014; 107(6):1051–1063. DOI: 10.1037/a0037509 [PubMed: 25243414]

Lazarus, RS.; Folkman, S. Stress, appraisal, and coping. New York: Springer; 1984.

Low NC, Dugas E, O'Loughlin E, Rodriguez D, Contreras G, Chaiton M, O'Loughlin J. Common stressful life events and difficulties are associated with mental health symptoms and substance use in young adolescents. BMC Psychiatry. 2012; 12(1):116–125. DOI: 10.1186/1471-244X-12-116 [PubMed: 22900789]

McLaughlin KA, Hatzenbuehler ML, Hilt LM. Emotion dysregulation as a mechanism linking peer victimization to internalizing symptoms in adolescents. Journal of Consulting and Clinical Psychology. 2009; 77(5):894–904. DOI: 10.1037/a0015760 [PubMed: 19803569]

McRae K, Ciesielski B, Gross JJ. Unpacking cognitive reappraisal: Goals, tactics, and outcomes. Emotion. 2012; 12(2):250–255. DOI: 10.1037/a0026351 [PubMed: 22148990]

Nansel TR, Overpeck M, Pilla RS, Ruan W, Simons-Morton B, Scheidt P. Bullying behaviors among us youth: Prevalence and association with psychosocial adjustment. JAMA. 2001; 285(16):2094–2100. DOI: 10.1001/jama.285.16.2094 [PubMed: 11311098]

Newlin DB, Levenson RW. Pre-ejection period: Measuring beta-adrenergic influences upon the heart. Psychophysiology. 1979; 16(6):546–552. DOI: 10.1111/j.1469-8986.1979.tb01519.x [PubMed: 229507]

Newman ML. Here we go again: Bullying history and cardiovascular responses to social exclusion. Physiology & Behavior. 2014; 133:76–80. DOI: 10.1016/j.physbeh.2014.05.014 [PubMed: 24858188]

Obradović J, Bush NR, Boyce WT. The interactive effect of marital conflict and stress reactivity on externalizing and internalizing symptoms: The role of laboratory stressors. Development and Psychopathology. 2011; 23(1):101–114. DOI: 10.1017/S0954579410000672 [PubMed: 21262042]

Porges SW. The polyvagal perspective. Biological Psychology. 2007; 74(2):116–143. DOI: 10.1016/j.biopsycho.2006.06.009 [PubMed: 17049418]

Prinstein MJ, Boergers J, Vernberg EM. Overt and relational aggression in adolescents: Social-psychological adjustment of aggressors and victims. Journal of Clinical Child & Adolescent Psychology. 2001; 30(4):479–491. DOI: 10.1207/S15374424JCCP3004_05

Reijntjes A, Kamphuis JH, Prinzie P, Boelen PA, van der Schoot M, Telch MJ. Prospective linkages between peer victimization and externalizing problems in children: A meta-analysis. Aggressive Behavior. 2011; 37(3):215–222. DOI: 10.1002/ab.20374 [PubMed: 21433031]

Reijntjes A, Kamphuis JH, Prinzie P, Telch MJ. Peer victimization and internalizing problems in children: A meta-analysis of longitudinal studies. Child Abuse & Neglect. 2010; 34(4):244–252. DOI: 10.1016/j.chiabu.2009.07.009 [PubMed: 20304490]

Sheppes G, Meiran N. Divergent cognitive costs for online forms of reappraisal and distraction. Emotion. 2008; 8(6):870–874. DOI: 10.1037/a0013711 [PubMed: 19102598]

Silvers JA, McRae KED, Gross JJ, Remy KA, Ochsner KN. Age-related differences in emotional reactivity, regulation, and rejection sensitivity in adolescence. Emotion. 2012; 12(6):1235–1247. DOI: 10.1037/a0028297 [PubMed: 22642356]

Thayer JF, Åhs F, Fredrikson M, Sollers JJ III, Wager TD. A meta-analysis of heart rate variability and neuroimaging studies: Implications for heart rate variability as a marker of stress and health. Neuroscience & Biobehavioral Reviews. 2012; 36(2):747–756. DOI: 10.1016/j.neubiorev.2011.11.009 [PubMed: 22178086]

Thompson RA, Lewis MD, Calkins SD. Reassessing emotion regulation. Child Development Perspectives. 2008; 2(3):124–131. DOI: 10.1111/j.1750-8606.2008.00054.x

Troy AS, Shallcross AJ, Mauss IB. A person-by-situation approach to emotion regulation cognitive reappraisal can either help or hurt, depending on the context. Psychological Science. 2013; 24(12):2505–2514. DOI: 10.1177/0956797613496434 [PubMed: 24145331]

Webb TL, Miles E, Sheeran P. Dealing with feeling: A meta-analysis of the effectiveness of strategies derived from the process model of emotion regulation. Psychological Bulletin. 2012; 138(4):775–808. DOI: 10.1037/a0027600 [PubMed: 22582737]

Yaroslavsky I, Bylsma LM, Rottenberg J, Kovacs M. Combinations of resting RSA and RSA reactivity impact maladaptive mood repair and depression symptoms. Biological Psychology. 2013; 94(2): 272–281. DOI: 10.1016/j.biopsycho.2013.06.008 [PubMed: 23827087]

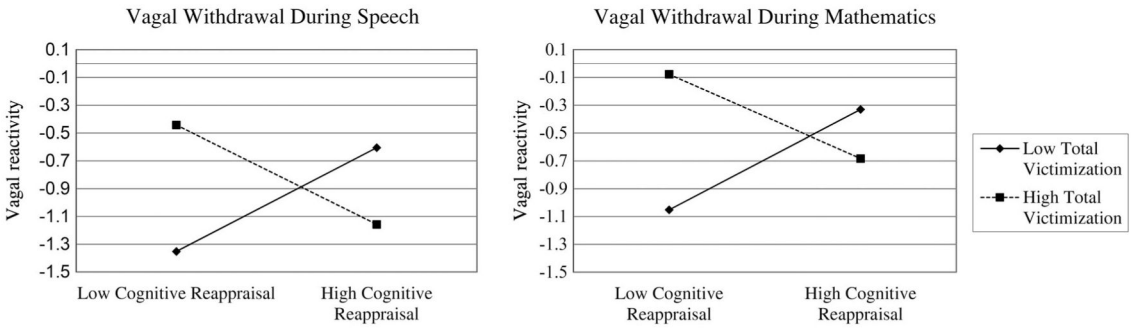

Figure 1.

Interactions between habitual reappraisal and total peer victimisation predicting vagal withdrawal.

Table 1

Study variables.

Variable	Mean	Standard deviation
Age (in years)	14.9	1.36
%Female	56	
%Caucasian	40.8	
Overt victimisation	1.696	2.254
Relational victimisation	4.222	3.476
Reputational victimisation	2.184	2.734
Total victimisation	8.101	7.195
Vagal withdrawal speech preparation	−.295	1.477
Vagal withdrawal speech	−.918	1.789
Vagal withdrawal mathematics	−.554	1.581
PEP decrease speech preparation	−10.162	13.275
PEP decrease speech	−16.339	14.481
PEP decrease mathematics	−11.794	12.314

Table 2

Unstandardised regression coefficients (*B*) predicting physiological reactivity with regions of significance percentiles.

	Vagal withdrawal				PEP decreases			
	Overt	**Relational**	**Reputational**	**Total**	**Overt**	**Relational**	**Reputational**	**Total**
Speech preparation reactivity								
Habitual reappraisal	−.341 (.318)	.298 (.451)	.257 (.223)	.381 (.403)	−5.181± (2.765)	7.133± (3.792)	.714 (1.929)	5.690± (3.375)
Peer victimisation	.549 (.338)	.319* (.156)	.296* (.148)	.208 (.100)	6.600* (2.970)	2.873* (1.371)	3.143* (1.323)	2.213* (.883)
Habitual reappraisal × PV	−.667 (.446)	−.116 (.196)	−.243 (.188)	−.117 (.134)	−8.706* (3.810)	−3.221± (1.668)	−.592 (1.653)	−1.979± (1.140)
Speech reactivity								
Habitual reappraisal	−.804* (.383)	1.00± (.518)	.509* (.257)	1.045* (.458)	−6.219* (3.044)	4.024 (4.201)	−1.109 (2.115)	2.830 (3.735)
Peer victimisation	.164 (.407)	.071 (.188)	.174 (.177)	.074 (.120)	6.025± (3.282)	1.575 (1.520)	2.821± (1.451)	1.712± (.977)
Habitual reappraisal × PV	−1.322* (.527)	−.455* (.229)	−.596** (.223)	−.374* (.155)	−7.871± (4.194)	−2.459 (1.848)	−.273 (1.813)	−1.495 (1.261)
Regions of significance percentiles								
Low; high	N.S.; 98.7	N.S.	45.3; 89.3	13.3; 93.3				
Mathematics reactivity								
Habitual reappraisal	−.405 (.342)	1.105* (.455)	.351 (.228)	.982* (.403)	−3.713 (2.614)	5.742 (3.556)	−.054 (1.783)	4.127 (3.159)
Peer victimisation	.353 (.364)	.096 (.165)	.309± (.157)	.125 (.106)	4.702± (2.825)	1.760 (1.290)	3.320** (1.230)	1.817* (.829)
Habitual reappraisal × PV	−.730 (.470)	−.496* (.201)	−.385± (.197)	−.344* (.136)	−5.402 (3.600)	−2.847± (1.564)	−.475 (1.532)	−1.639 (1.067)
Regions of significance percentiles								
Low; high		17.6; 96.6		23.6; 93.2				

± $p < .10$.

* $p < .05$.

** $p < .01$.