The impact of childhood maltreatment on adaptive emotion regulation strategies

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ABSTRACT

Objective: Childhood maltreatment is a potent known risk factor for psychopathology, accounting for nearly 30% of the risk for mental illness in adulthood. One mechanism by which maltreatment contributes to psychopathology is through impairments in emotion regulation. However, the impact of childhood maltreatment on adaptive regulation strategies remains unclear, particularly across positive and negative emotions.

Methods: Using Mechanical Turk, we recruited a cross-sectional sample of 207 adults (21–69 years) with and without childhood maltreatment exposure to complete an emotion regulation task where they were shown positive and negative emotional pictures and were instructed to reappraise or accept their emotions, alongside a non-instruction comparison condition. Participants rated their emotional intensity following each image, as well as perceived effectiveness of each strategy at the end of each block. We first investigated the impact of image valence and strategy use on the intensity of post-image emotions, followed by interacting both maltreatment exposure and severity with valence and strategy.

Findings: Surprisingly, maltreated individuals showed significantly higher emotional intensity compared to non-maltreated individuals, specifically toward positive images ($F(2,194.6) = 5.01$, $p < 0.01$). When examining strategy, the use of acceptance to regulate negative emotions was equally effective across all levels of maltreatment severity ($F(2,194.6) = 15.93$, $p < 0.001$), while reappraisal was effective only at lower maltreatment levels.

Conclusion: These findings suggest that experiences of childhood maltreatment exert differential impacts on the ability to regulate positive and negative emotions using key adaptive regulation strategies, which has implications for both psychopathology risk and treatment interventions.

1. Introduction

Childhood maltreatment is a potent known risk factor for psychopathology, accounting for nearly 30% of the risk for mental illness in adulthood (Green et al., 2010). One mechanism by which maltreatment contributes to psychopathology is through impairments in

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emotion regulation (Kim-Spoon et al., 2013), or the ability to modulate the experience of positive or negative emotions (Gross, 1998). Maltreatment exposure during childhood has been linked to maladaptive impairments in emotion regulation throughout one's life, including utilization of fewer emotion regulation strategies, greater non-acceptance toward one's emotions, and weaker clarity of one's emotions (Gratz & Roemer, 2004). Furthermore, maltreatment has been associated with greater use of maladaptive strategies during adulthood including suppression and rumination, which in turn mediate general psychopathology risk (Weissman et al., 2019). In contrast, adaptive emotion regulation strategies, such as acceptance, reappraisal, and problem solving, are associated with enhanced positive emotions, reduced reactivity to stressful and emotional stimuli, and better mental health outcomes (Aldao et al., 2010). However, while the relationship between maltreatment and maladaptive emotion regulation strategies has received ample study, little remains understood about how childhood maltreatment influences the use of *adaptive* emotion regulation strategies.

Further exploration of adaptive emotion regulation strategies, particularly reappraisal and acceptance, are important due to their demonstrated effectiveness within therapeutic approaches such as Cognitive Behavioral Therapy, Dialectical Behavior Therapy (Linehan, 1993) and Acceptance and Commitment Therapy (ACT; Hayes et al., 2006). Reappraisal is typically described as reinterpreting an emotional situation to create a more neutral perspective (Gross, 1998). As a regulation strategy, it appears to be effective in reducing negative emotions, increasing positive emotions, and reducing physiological reactions to emotional stimuli, though it can also be used to keep positive emotions in check to avoid the development of manic symptoms (Painter et al., 2019). In comparison, acceptance, which stems out of Eastern philosophy, has been incorporated into therapeutic interventions such as mindful-based stress reduction (Kabat-Zinn, 1994). When engaging in acceptance, there is an emphasis on non-judgmental acceptance of emotions and the accompanying thoughts, feelings, and sensations (Aldao et al., 2010). In the only study to directly compare these strategies in the context of positive and negative emotions, reappraisal appeared to result in a greater reduction of negative emotions and greater increases in positive emotions, but required more effort compared to acceptance (Troy et al., 2018). However, the study did not have a non-instruction control condition, limiting the ability to form definitive interpretations comparing the two strategies. Furthermore, no studies have examined the impact of childhood maltreatment on the comparative use and effectiveness of these strategies. This study's inclusion of positive emotions is particularly novel, as few studies explore the specific changes that occur in positive emotionality.

The role of positive emotion regulation represents another critical knowledge gap in understanding the relationship between childhood maltreatment and psychopathology risk. Despite the importance of both positive and negative emotions, the majority of research on childhood maltreatment and psychopathology risk has focused solely on negative emotions (Waugh, 2020). For instance,

Table 1
Participant demographics and clinical characteristics.

	Maltreated ($N = 148$)	Non-maltreated ($N = 52$)
Gender		
Male	31	82
Female	20	65
Prefer not say	1	1
Age range		
18–29	75	10
30–39	54	25
40–49	10	5
50–59	4	10
60+	1	2
Race		
White	74	40
Black	6	6
American Indian or Alaskan Native	3	0
Latinx	3	1
Asian or Pacific Islander	58	3
Mixed race	3	1
Prefer not say	1	1
Ethnicity		
Hispanic	22	2
Not Hispanic	118	49
Prefer not say	8	1
Income		
Below 20,000	21	3
20,000–29,999	24	8
30,001–49,999	35	18
50,00–74,999	27	12
75,000–99,999	11	6
100,000+	15	4
Prefer not say	6	1
Mean CTQ	44.76 (19–70)	16.09 (15–20)
Average BDI	42.1 (22–62)	25.84 (22–53)
Average STAI-Trait	53.29 (33–75)	45.03 (35–57)

Note. Participants were categorized as maltreated-exposed if they scored above "minimal" on any one of the three abuse subscales in the Childhood Trauma Questionnaire (CTQ; physical abuse $\geq$ 8, sexual abuse $\geq$ 6, emotional abuse $\geq$ 9).
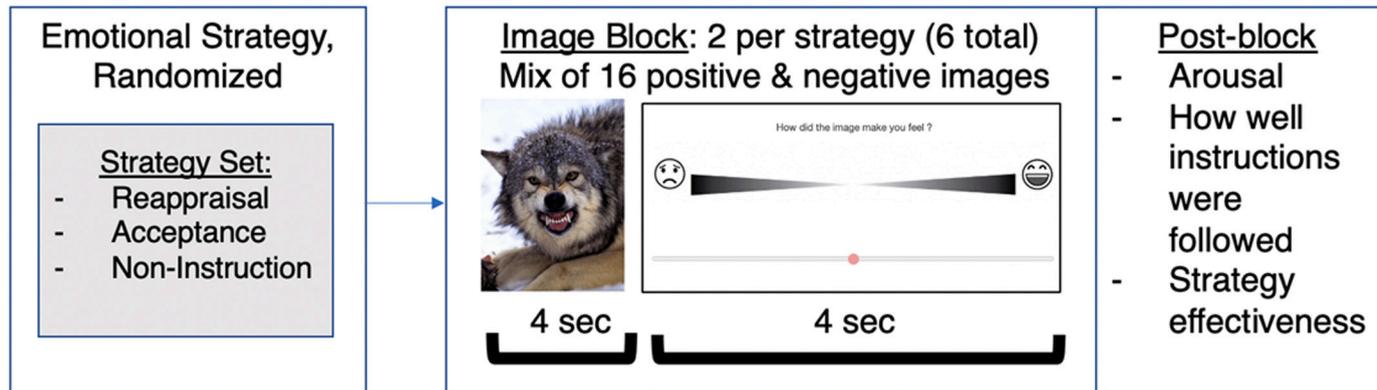
Fig. 1. Experimental task design.
During the emotion regulation task, participants were asked to engage in one of three strategies while observing a block of 16 mixed positive and negative images. Each strategy was implemented twice, for a total of 6 blocks. After each block, participants rated their level of arousal, how well they followed instructions, and perceived effectiveness of the strategy.

women who have experienced domestic violence exhibit greater rates of nonacceptance of positive emotions, greater impulsivity in response to emotions, and greater posttraumatic symptoms (Weiss et al., 2018). Furthermore, childhood maltreatment markedly increases risk for multiple disorders characterized by a limited ability to experience positive emotions including depression, anxiety, and posttraumatic stress disorder (PTSD). However, more work is needed to examine how early experiences of maltreatment can specifically influence both positive and negative emotion regulation. Here, examining the intersection of childhood maltreatment and positive emotions may lead to identifying novel therapeutic targets, potentially improving outcomes for victims of childhood maltreatment.

To date, no study has examined how experiences of childhood maltreatment affect the use of these key emotion regulation strategies, comparing acceptance and reappraisal, as well as its impact on both positive and negative emotion. In order to address these critical knowledge gaps, we conducted a study to explore the impact of childhood maltreatment on acceptance and reappraisal in adulthood, incorporating both positive and negative emotions along with a non-instruction comparison condition. We examined the effects of childhood maltreatment exposure (including neglect and abuse) on the effectiveness and perceived effort of these strategies. In conjunction with research indicating greater rates of emotional dysregulation following maltreatment and the broad impact of maltreatment on psychopathology risk, we hypothesized reappraisal would be more effective at modulating both positive and negative emotions, and that maltreatment experiences would be associated with greater intensity of emotional experience (compared to the non-instructed conditions).

2. Methods

2.1. Participant recruitment

All data was collected from 207 participants in a cross-sectional design, who were recruited through Amazon's Mechanical Turk and using Qualtrics to administer the task online. Inclusion criteria for this study were 18 years of age or older, English language fluency, and residence in the United States. Data was collected online over the course of two days in November of 2019. All study procedures were approved by the University of Wisconsin-Madison Health Sciences Institutional Review Board.

2.2. Trauma and clinical measures

Participant demographics are summarized in Table 1. Participants provided information about maltreatment experiences during childhood using the *Childhood Trauma Questionnaire* (CTQ; Bernstein et al., 2003). We used the standard cutoff scores on the CTQ subscales to determine if a participant has been exposed to a specific form of maltreatment: physical abuse if the subscale had a total of 8 or above, sexual abuse if the subscale had a total of 6 or above, and emotional abuse if the subscale had a score of 9 or above. The physical and sexual subscales were combined into a "CTQ Abuse" score. If a subject qualified for any of the three, they were classified as abuse-exposed. Neglect exposure was separately classified using the same procedure. CTQ cutoff scores for neglect subscales were determined using the following scores: emotional neglect if the subscale had a score of 10 or above, and physical neglect if the subscale had a total of 8 or above. If a subject qualified for either form of neglect, they were classified as neglect-exposed.

Finally, participants reported their level of awareness of bodily sensations, associated mental states, and bodily perceptions using the *Multidimensional Assessment of Interoceptive Awareness* (Mehling et al., 2012), and their depression and anxiety severity using the *Beck Depression Inventory* (BDI; Beck et al., 1996), and *State-Trait Anxiety Inventory* (STAI; Marteau & Bekker, 1992).

2.3. Emotional strategies task

The task was a modified version of the paradigm described by Dan-Glauser and Gross (2015). See Fig. 1 for visual representation of the task. Participants were provided in-depth details regarding how to implement each emotion regulation strategy and practiced each strategy prior to beginning the task. Instructions for acceptance strategies were adapted from Ellard et al. (2017), the reappraisal strategies were adapted from Goldin et al. (2019), and the no-instruction trial, was adapted from Ellard et al. (2017). Specific language for each block of instructions is located in Supplemental materials.

In a pseudo-randomized design, images were presented in 6 blocks. At the start of each block, participants were instructed to engage in one of three emotion strategies: acceptance, reappraisal, or a non-instructed strategy. Block assignment of strategy instructions was pseudo-randomized, with participants randomly assigned an order in which to apply each strategy for the first three blocks, which was repeated in the last three blocks. This pseudo-randomization was implemented to improve generalizability and reduce bias should a static set of images be only associated with a single strategy. At the end of each block, participants were asked to rate their level of arousal using a 7-point *Self-Assessment Manikin* scale (Bradley & Lang, 1994). Participants were also asked questions about how well they followed the instructions and how effective they through the strategy was for them using a 5-point Likert scale ranging from "Extremely well/effective" to "Not well/effective at all".

Within each block 16 unique images were selected across both negative and positive valences and presented randomly for 4 s each. Following each image, participants were asked to rate their emotional experience using a modified version of an *Affective Slider* (Betella & Verschure, 2016), where they were asked "How did the image make you feel?" and responded on a continuous slider ranging from a frowning face to a smiling face. The slider translated to a continuous score ranging from a score of 0 (extremely negative) to 100 (extremely positive), with 50 representing a neutral rating. Participants were provided 5 s to rate each image. These ratings were primarily used as the outcome variables in analyses. Statistically, we designed the task to have 32 items per strategy, extending past the

20 minimum suggested by Brauer and Curtin (2018). We also followed their recommendations by having at least 200 subjects, which provided between 60 and 70 subjects per strategy analyzed.

2.4. Emotional strategies task stimuli

Images presented in the task were selected from the *Nencki Affective Picture System* (NAPS; Marchewka et al., 2014) due to the high image resolution and updated image content compared to the *International Affective Picture Set* (IAPS). The entire image set was re-normed for valence and arousal in an American population using Mechanical Turk in a previously unpublished project, increasing applicability of arousal and valence for the present study. A list of all NAPS images, with block groupings, and re-normed valence and arousal ratings can be found in the supplement (Table S1).

2.5. Statistical analyses

2.5.1. Image selection analyses
While selecting images from the greater NAPS image set, we attempted to find distinct valence and similar arousal ratings using the re-normed data collected in a separate study using Mechanical Turk, and a series of analyses were run in R. One set of linear models were run including all selected images, predicting valence and arousal ratings based on the valence category (positive or negative) as determined by the norming process. To compare valence and arousal ratings between blocks, a second set of linear models were run examining the effect of block grouping on the normed rating values.

2.5.2. Primary statistical analyses

2.5.2.1. Task validation analyses. All statistical analyses were completed in R (version 1.4.1717; R Programming Team, 2018) using RStudio (RStudio Team, 2012). Following data collection, 7 subjects missing 40% or more of the post-image ratings were omitted from analyses, leaving a total final sample of 200. As linear mixed effect modeling (LME) is fairly robust against missing data, no additional steps to rectify missing data were completed. A LME (v2.9.13; Bates et al., 2015) was used to first validate the task's successful induction of positive and negative affect. To do so, we examined the interaction of regulation strategy and image valence on emotional ratings for each individual image rating. Age and sex, centered around 0, were included as covariates in each model based on the literature indicating age-related changes in emotional experiences (Isaacowitz et al., 2017). The model also included the by-subject effects for the interaction between strategy and valence. We did not include a random intercept or lower-order random effects in the model in order to help with model convergence, following suggestions by Brauer and Curtin (2018), as the model would not converge correctly with the random intercept and lower-order random effects.

2.5.2.2. Abuse exposure analyses. Next, we examined the effect of childhood abuse on the use of strategies across valence. This model also allowed us to investigate the effect of abuse on emotional experience through the main effect of CTQ abuse used dichotomously. First, an LME was used to estimate the three-way interaction of regulation strategy, image valence, and abuse exposure. Here, abuse was dichotomously defined using the CTQ abuse cutoff scores described above, and all dichotomous variables were centered at 0. Age and sex were included as covariates, as well as the interaction of strategy and valence. A random intercept was included and random effects were restricted to just the interaction of strategy and valence to help with model convergence, following suggestions by Brauer and Curtin (2018).

To help decompose the effects further, we examined the effect of abuse exposure within each strategy, and the effect of strategy within abuse exposure, separately within each valence. This was accomplished by selecting trials of each strategy or abuse exposure individually, and running an LME predicting post-image rating from abuse exposure or strategy, controlling for age and sex, and including a by-subject intercept.

2.5.2.3. Abuse severity analyses. A second model then examined the effects of abuse severity, using the continuous CTQ abuse score. This model successfully converged with a random intercept and restricting the random effects to the interaction of strategy and valence.

2.5.2.4. Neglect exposure and severity analyses. Finally, an additional two models were run to separately estimate the impact of neglect, as measured by the CTQ. Similar to the models described above, one LME estimated the interaction using a dichotomous classification of neglect exposure, while the other used a continuous neglect severity score. To achieve model convergence, the random effect structures and covariates of the neglect severity was restricted to the random interaction of valence and instruction, while the neglect exposure mode included both a random intercept and random interaction of valence and instruction.

2.5.3. Post-hoc analyses
Within all significant effects involving abuse or neglect from the primary statistical analyses, we further examined whether there was a differential impact of specific forms of maltreatment. To do so, separate LME's were run to estimate the effect of dichotomous sexual abuse, physical abuse, emotional abuse, emotional neglect, and physical neglect exposure. Using the same model parameters described above, each LME included the three-way interaction of regulation strategy, valence condition, and maltreatment type, with

age and sex as covariates, and we included a random intercept and only the random effect of the interaction of image valence and emotion regulation strategy to simplify the model and improve model convergence, again following recommendations by Brauer and Curtin (2018). However, because the three specific forms of abuse were highly correlated (emotion and physical, $r = 0.83$; emotion and sexual, $r = 0.77$, sexual and physical, $r = 0.81$), we also included the other forms of abuse as covariates to determine if each form of abuse contributes uniquely.

2.5.3.1. Supplemental analyses. We also ran a series of analyses examining how maltreatment severity impacts the perceived strategy effectiveness, and separate analyses examining how depression and anxiety symptom severity relate to the post-image ratings. These are described in greater detail in the Supplemental materials section.

3. Results

3.1. Participant statistics

Out of the 207 subjects initially enrolled in the study, 200 remained after 7 were omitted from analyses due to missing data. Participants were primarily White (see Table 1) and Non-Hispanic, though a considerable number of subjects identifying as Asian American or Pacific Islander also completed study activities. Subjects were fairly balanced across males and females, with 56% identifying as male. Most subjects reported being under 40 years of age.

3.2. Image selection analyses

First, blocks were detected to be evenly balanced across both valence and arousal using data collected from a separate norming study (see Methods). Image block designation was not a significant predictor of either valence ($F(5,90) = 0.009$, $p = 1$) or arousal ($F(5,90) = 0.16$, $p = 0.98$). When separately examined within the positive and negative categories as determined by the normed ratings, there were again no significant effects of block for either positive or negative images across both arousal (negative, $F(5,42) = 0.038$, $p = 0.99$; positive, $F(5,42) = 1.3$, $p = 0.28$) and valence (negative, $F(5,42) = 0.34$, $p = 0.87$; positive, $F(5,42) = 0.3$, $p = 0.91$).

As expected, when modeling valence category on valence and arousal ratings across all images and blocks, no significant differences in arousal were detected ($F(1,94) = 1.092$, $p = 0.299$). However, there was a significant main effect of valence ($F(1,94) = 1027$, $p < 0.001$, partial eta = 0.92). This anticipated difference between positive and negative images confirmed previously-normed ratings, with positive images receiving higher ratings than negative images. Altogether, all subsequent analyses of valence differences across abuse and strategy were completed without concern of potential effects of arousal, so block order or designation was not included in
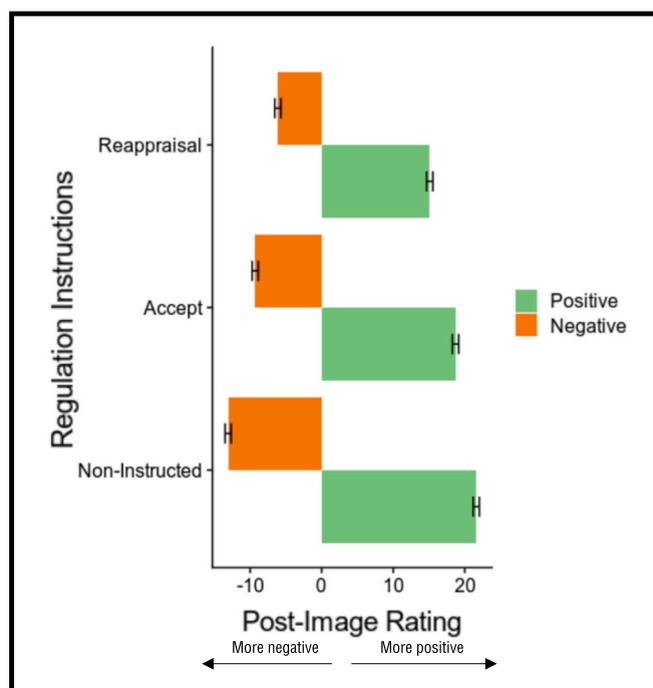

Fig. 2. Task validation.
The emotional strategies task successfully induced positive and negative affect across regulation instruction, as measured by post-image emotional ratings. Brackets indicate standard error.
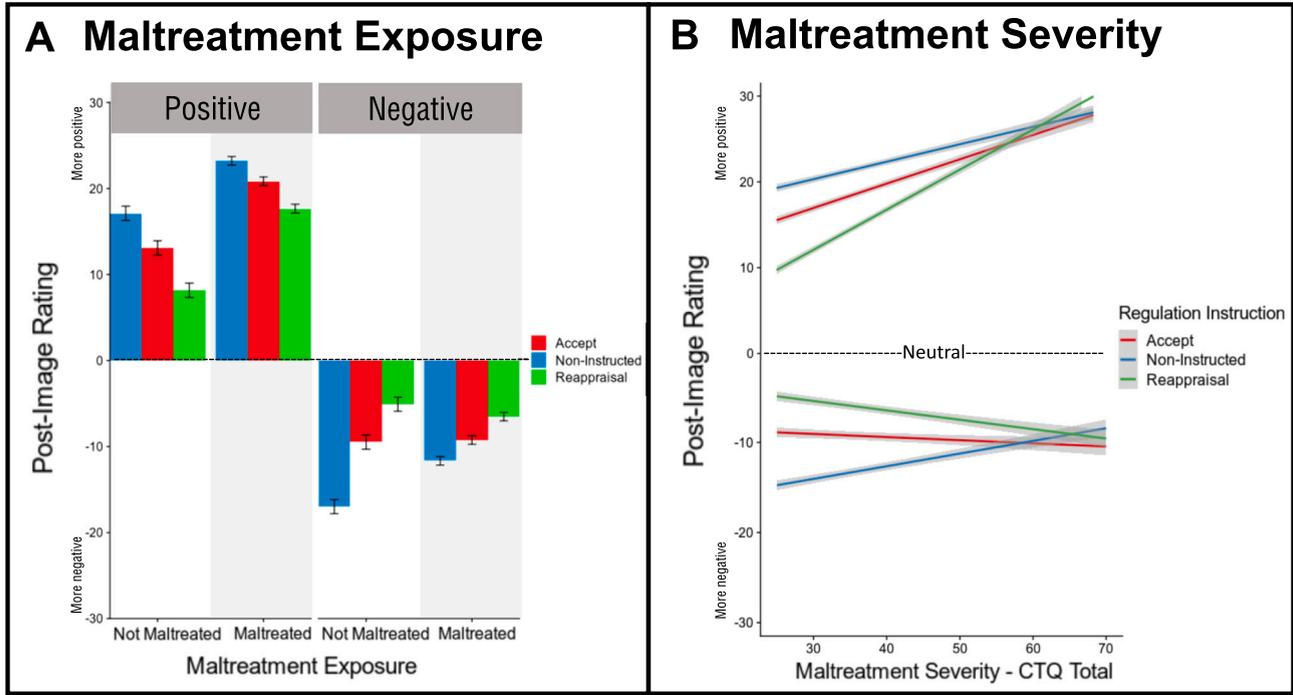
Fig. 3. Maltreatment analyses.
Effects of maltreatment exposure (Panel A) and maltreatment severity (Panel B) on post-image ratings during negative and positive images. Brackets indicate standard error.

future analyses.

3.3. Primary statistical analyses

3.3.1. Task validation analyses

When first examining the effectiveness of the task, we detected a significant interaction of valence and regulation strategy (Fig. 2; F (2,197.8) = 29.03, $p < 0.001$, $r^2 = 0.47$). Again, positive images received more extreme ratings than negative images across all trials. With respect to regulation strategy, as expected non-instruction trials had the most extreme ratings, reappraisal trials had the least extreme ratings, and acceptance trials had intermediate ratings. Results indicated that the interaction of acceptance and valence was significantly different than the interaction of both reappraisal trials with valence (F(5,204.5) = 16.99, $p < 0.001$) and the non-instruction and valence (F(5,204.1) = 31.51, $p < 0.001$). Here, reappraisal downregulated emotional intensity more than acceptance, non-instruction trails were less impactful than acceptance, and ratings were more extreme for all positive emotions than negative emotions.

3.3.2. Abuse exposure analyses

Next, we detected a significant interaction of abuse exposure, image valence, and emotion regulation strategy on emotional ratings, F(2,194.6) = 5.01, $p < 0.01$, $r^2 = 0.48$ (see Fig. 3). While we again found positive images rated higher and more extreme than negative images, within each valence there were significant interactions between abuse exposure and strategy (negative, F(2,197.21) = 11.47, $p < 0.001$; positive, F(2,196.82) = 11.57, $p < 0.001$). Within positive image trials, there was a significant effect of abuse exposure on emotional ratings for acceptance trials (F(1,192.55) = 16.44, $p < 0.001$), reappraisal trials (F(1,194.07) = 12.06, $p < 0.001$), and non-instruction trials (F(1,194.17) = 15.83, $p < 0.001$). Regardless of the strategy, those who experienced abuse rated positive images more extreme than those without an abuse history. Interestingly, when viewing negative images, there were no significant effects of abuse exposure on image rating within any of the strategies, while the effect of strategy remained similar to previous findings. However, in non-instructed trials of negative image, there was a trending difference between maltreated and non-maltreated individuals, F (1,194.13) = 3.1, $p = 0.07972$, where non-maltreated individuals showed more extreme ratings compared to their maltreated counterparts.

In addition, across positive valence trials, there was a significant effect of strategy for both maltreated (F(2,145.26) = 11.75, $p < 0.001$) and non-maltreated adults (F(2,49.99) = 15.05, $p < 0.001$). The same was true for negative trials, with significant effects of strategy on post-image rating for abused (F(2,145.7) = 7.74, $p < 0.001$) and non-abused (F(2,49.99) = 30.23, $p < 0.001$) individuals. These results indicate that similar strategy effects are present across emotional valence. Similar to the task validation findings, non-instruction trials had the most extreme ratings, acceptance had intermediate ratings, and reappraisal had the least extreme ratings. These support our hypothesis that acceptance will be less effective than reappraisal, and that those with a history of abuse exposure process positive images differently than non-maltreated individuals, but negative images are processed similarly regardless of abuse exposure. In addition, the emotion regulation strategy effects described above remained statistically significant regardless of abuse history or when the data were subset for valence (positive and abused, F(2,145.26) = 11.75, $p < 0.001$; positive and non-abused, F (2,49.99) = 15.05, $p < 0.001$; negative and abused, F(2,145.7) = 7.47, $p < 0.001$; negative and non-abused, F(2,49.99) = 30.23, $p < 0.001$).

3.3.3. Abuse severity analyses

We then examined the effect of childhood abuse *severity* across strategies and valence. We detected a significant three-way interaction of regulation strategy, image valence, and abuse severity, F(2,194.6) = 15.93, $p < 0.001$, $r^2 = 0.48$ (Fig. 3). Consistent with our previous findings, at lower levels of abuse the use of reappraisal strategies was associated with the least extreme emotional ratings, followed by acceptance strategies, and finally non-instruction trials were associated with the most extreme emotional ratings, across positive and negative images. At greater levels of abuse, any differences in emotional intensity based on strategy were no longer present.

3.3.4. Neglect exposure and severity analyses

Finally, in models investigating childhood neglect, we did not detect any significant three-way interactions for either neglect severity (F(2,195.1) = 0.64, $p = 0.53$) or dichotomous experience (F(2,194.2) = 1.01, $p = 0.37$). Therefore, all subsequent analyses of strategy effectiveness and sensitivity were examined solely using abuse experience and severity.

3.4. Post-hoc analyses

Here, we examined whether dichotomous experience of different forms of childhood abuse in driving the three-way interactions between abuse severity, image valence, and emotion regulation strategy. Here, we see that dichotomous experience of both childhood sexual abuse (F(2,195.7) = 13.73, $p < 0.001$), physical abuse (F(2,195.2) = 12.89, $p < 0.001$), and emotional abuse (F(2,194.7) = 6.22, $p < 0.01$) significantly predicted post-image ratings. When the models were run controlling for the other forms of abuse, we found the unique effect of sexual abuse (F(2,196.7) = 14.79, $p < 0.001$), emotional abuse (F(2,196.9) = 7.81, $p < 0.001$), and physical abuse (F (2,196.9) = 16.74, $p < 0.001$) remained significant.

Supplemental analyses indicated that increasing symptom severity for depression and anxiety were associated with increased intensity of positive emotions and reduced intensity of negative emotions (see Fig. S1). In addition, as maltreatment severity increased,

perceived strategy effectiveness also appeared to increase. However, at lower levels non-instruction was perceived as more effective than acceptance and reappraisal, while the latter two strategies equally increased in effectiveness as maltreatment severity increased (see Fig. S2). See Supplemental materials for a more detailed summary of results.

4. Discussion

In this study, we aimed to examine how a history of childhood maltreatment influences the experience of emotions and the use of specific emotion regulation strategies in a community sample of adults. We asked participants to view both positive and negative emotional images while practicing acceptance, reappraisal, or reacting without instruction, and to subsequently rate the strength of their emotions. We had two main hypotheses. We first predicted that reappraisal would be more effective at impacting emotions than acceptance, and also that abuse would be associated with more extreme ratings. We found full support for our first hypothesis, and partial support of our second hypothesis. To our knowledge, this is the first investigation of the distal effects of abuse on the use of specific adaptive emotion regulation strategies, while examining the effects in both positive and negative emotions.

When examining overall task and strategy effects, we found that reappraisal showed the greatest effectiveness in decreasing emotional intensity rating compared to acceptance and non-instruction. Notably, this effect was seen across positive and negative images, and appeared regardless maltreatment exposure, supporting our first hypothesis. When examining whether the valence of emotional images interacts with regulation strategy use, we found that each of the emotional strategies had similar impact on the intensity of emotions regardless of whether the image was positive or negative. These findings support previous research by Boehme et al. (2019), Goldin et al. (2019), and Troy et al. (2018), where reappraisal was found to be more effective than acceptance in reducing the intensity of emotions. These findings also support the use of these strategies in managing not only negative emotions, but also reducing the intensity of positive emotions. This expands upon the current literature, as a majority of research focuses nearly exclusively on negative emotions. As proposed by Waugh (2020), examining positive emotions is important because of the lack of understanding in their role of psychopathology and treatment of mental disorders. As such, the current study continues this idea and expands the potential use of these strategies in therapeutic interventions across disorders involving dysregulation of positive emotions.

When comparing acceptance and reappraisal, the increased effectiveness of reappraisal could reflect an overall difference in strategy effectiveness. On the other hand, the observed differences may also reflect how these strategies uniquely affect the phases of the emotional experience as described in Gross' (1998) Process Model of emotion regulation. Building off of this model, Wolgast et al. (2011) proposed that while both reappraisal and acceptance exert some effect in the early stages of the emotional experience, acceptance may also play a role in response-focused elements of the emotional experience, also known as the emotion regulation process. By exerting less influence on the immediate and early emotion regulation processes of situation selection and situation modification (i.e., influencing emotions less than reappraisal), acceptance allows the user to non-judgmentally experience more of the emotion and therefore allowing them to experience the early aspects with less substantial distress. Then, by also influencing the later phases of emotion regulation via response modulation, it continues to keep the emotion at a manageable level, and may prevent subsequent extreme distress. This ability to act on multiple parts of the emotion regulation process across positive and negative emotions may make acceptance a strong fit for therapeutic interventions such as exposure therapy, response and prevention therapy, and narrative processing in trauma work. In comparison to reappraisal, which exerts its full impact on the initial aspect of the emotional experience process, acceptance exerts a more consistent, yet less intense, influence across the emotional experience process. This also falls in line with research that indicates that reappraisal requires more effort to implement, necessitating a large force of influence in a short period of time compared to a lower level of influence across time (Troy et al., 2018). However, additional research is needed to confirm and explore this explanation in greater depth, as our paradigm is unable to look at how these strategies influence the emotional experience across time.

Next, when examining the impact of childhood abuse on emotion regulation, we found a three-way interaction among abuse *exposure*, strategy, and valence. Surprisingly, for negative images we found trending differences for non-instruction trials, but no differences between groups for acceptance or reappraisal. For non-instruction trials, we found that abused individuals rated negative images as less extreme than their non-abused counterparts. This interaction is particularly interesting, as it may indicate that abused individuals default to automatically regulating their negative emotions. Alternatively, these results could provide evidence that both groups were equally effective in utilizing the specific emotion regulation strategies as instructed. This finding builds off of previous research, which has suggested that following abuse some dysfunction in emotion regulation of positive and negative emotions should occur (Berfield et al., 2021; Gratz & Roemer, 2004). One possible explanation for these findings could be the specific strategies included. In the present study, only adaptive strategies were investigated. Notably, prior work suggests increased use of maladaptive strategies following maltreatment (Weissman et al., 2019). However, it is possible that the adaptive strategies tested are less impacted by exposure to maltreatment alone when compared to maladaptive strategies such as rumination or suppression. Future studies would benefit from comparisons between alternative strategies across the adaptive and maladaptive spectrum, and could examine these effects in populations with more severe psychopathology.

Positive emotions, on the other hand, appeared to be processed differently for those with childhood abuse exposure compared to those who did not. Surprisingly, abused subjects rated positive images as more extreme than their non-abused counterparts irrespective of regulation strategy. One potential explanation for the overall difference in positive emotions comes from the known cognitive changes that occur following trauma and maltreatment such as abuse. Following maltreatment, individuals often develop biases toward recalling negative events (Vrijsen et al., 2017), and may even develop a negative cognitive bias toward their environment. Difficulty experiencing positive affect is characteristic of both major depressive disorder and PTSD, which are found in higher rates in trauma-exposed populations. This predisposition toward negative emotions and cognitions, coupled with the innate regulation

of negative emotions seen in this study, may leave some subjects unprepared or unpracticed to regulate their positive emotions, causing them to be experienced physiologically at more extreme levels. Future research should continue to explore the role that positive emotions play, and should examine the use of these strategies toward different emotional goals, such as increasing positive mood.

Examination of the *severity* of abuse provided additional nuanced information to the exposure findings above. Here, we found that at higher levels of abuse severity, the impact of strategies appears to converge, where strategies become equally impactful. However, we see different patterns within each valence. When the strategies are applied toward positive emotions, at higher levels of abuse we see a gradual increase in emotional intensity, which is consistent with the greater emotional experience observed in positive emotions across abuse-exposed participants. In comparison, when applied toward negative images, emotion intensity across strategies appeared to merge toward equal effectiveness, but rather than increasing in intensity they regressed toward the mean. This resulted in non-instruction trials becoming less effective and reappraisal strategies becoming more effective for negative images as abuse severity increased. Interestingly, acceptance was similarly effective when regulating negative images across the range of abuse severity. This finding provides evidence that acceptance may be more robust to negative valences in cases of abuse compared to other strategies and may also support the proposal by Wolgast et al. (2011). Here, if acceptance does influence emotions throughout the entire emotional process, it may prove more applicable to address the dysfunctions in emotion regulation that often accompany maltreatment and abuse (Gratz & Roemer, 2004). This could prove beneficial in treatment, as the lower impact of acceptance at lower maltreatment and abuse severity could prove useful for interventions such as exposure therapies, while still proving effective to help alleviate distress at higher levels of severity. Together, these results also provide partial support our second hypothesis that acceptance will be less effective than reappraisal, but only at lower levels of abuse severity.

In the future, research should further examine the relationship between differences in the use of these emotion regulation strategies and symptoms, as recent research has supported links between dysregulation between negative and positive emotions and post-traumatic symptoms (Simpson et al., 2021). Our supplemental findings indicate that while anxiety and depressive symptoms interact with image valences in unique ways, controlling for their unique effects did not influence the primary interactions. We found the interaction between abuse exposure, valence, and strategy effectiveness persisted even after controlling for the effects of depression and anxiety severity, which indicates that abuse has some unique influence on the experience and regulation of emotions, particularly positive emotions, in which emotions become more positive or extreme as severity increases.

A caveat of these findings is that PTSD symptoms, which were not measured in the current study, could exert unique influence beyond anxiety or depressive symptoms. One study that examined the use of these strategies on post-traumatic symptoms was Lee et al. (2015). They used factor analysis to examine how several emotion regulation strategies relate to a variety of PSTD symptom clusters. They found suppression and experiential avoidance were significantly associated with symptom clusters. They also found a significant positive association between acceptance and reexperiencing symptoms. While Lee et al.'s (2015) findings provide some conflicting results, they utilized self-report measures which may not have reflected the most accurate measure of acceptance. Further examination of research in this direction would benefit from the use of experiential and self-report measures.

Further exploration of these symptom relationships, particularly PTSD symptoms, in future research could substantially increase the clinical utility of these findings and their ability to inform treatment. In addition, future research would benefit by examining the effects of maltreatment exposure and severity, and its interaction with emotion regulation strategies such as acceptance proximal to maltreatment exposure. The present findings also indicate the pursuing research in positive emotions may prove beneficial, as positive emotions have a unique relationship with abuse. Because a majority of youth will experience maltreatment before 18 years of age (Lewis et al., 2019), examining these effects in closer proximity to the exposure may help identify earlier areas of intervention help to reduce or even prevent many of the lifelong effects of maltreatment.

While this study provides novel information about the relationship of childhood abuse to emotion regulation, it does have limitations. Due to task design, we are unable to determine if any of the results reported were due to overall emotional arousal during the task, as arousal ratings were captured only at the block level. However, we were able to determine that the blocks were not statistically different in ratings of arousal, which minimizes the probability that emotional arousal may be a potential confound. Finally, we are unable to determine what subjects were doing during the non-instruction trials as they were simply asked to do whatever felt most natural to them in the moment. This allowed subjects to potentially downregulate their emotions, suppress them, accept them, use reappraisal, or not use any form of regulation. Without knowledge of what subjects did during the non-instruction trials, the ability to interpret differences or non-differences among strategies is limited. A final limitation of the study is the method of recruitment through Amazon's Mechanical Turk. There are some concerns about the generalizability and difficulty representing the broader U.S. population (Buhrmester et al., 2018), however we opted to avoid heavily pre-screening our population to make it more inclusive in the hopes of a more generalizable sample. However, our sample demographics indicate this may not necessarily be the case. Our sample also consists of generally healthy individuals, which may influence these findings, and may differ if replicated in a more clinical sample. Examining these effects in a more clinical and trauma-exposed population would build upon many of the future directions and proposed mechanisms introduced in this paper.

Despite these limitations, this study provides important insights into the complex way that acceptance and reappraisal interact with positive and negative emotions and abuse history. The findings suggest that adults who experienced abuse experience positive images more intensely, and with increasing abuse severity they are equally effective at different emotion regulation strategies. In addition, it appears that acceptance is more robust to abuse severity, which may augur a broader utility of acceptance-based approaches in the treatment of abuse individuals.

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Declaration of competing interest

All listed authors have approved the manuscript for submission and report no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chiabu.2022.105494.

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