Reward prospect improves inhibitory control in female university students with a history of childhood sexual and physical abuse

Kiyar, Meltem; Lommen, Miriam J. J.; Krebs, Ruth M.; Daniels, Judith K.; Mueller, Sven C.

Published in:
Journal of Behavior Therapy and Experimental Psychiatry

DOI:
10.1016/j.jbtep.2020.101629

Publication date:
2021

Journal of Behavior Therapy and Experimental Psychiatry 71 (2021) 101629

Contents lists available at ScienceDirect

Journal of Behavior Therapy and Experimental Psychiatry

journal homepage: www.elsevier.com/locate/jbtep

Reward prospect improves inhibitory control in female university students with a history of childhood sexual and physical abuse

Meltem Kiyar [a], Miriam J.J. Lommen [b], Ruth M. Krebs [c], Judith K. Daniels [b], Sven C. Mueller [a,d,*]

[a] Department of Experimental Clinical and Health Psychology, Ghent University, Belgium
[b] Department of Clinical Psychology and Experimental Psychopathology, University of Groningen, the Netherlands
[c] Department of Experimental Psychology, Ghent University, Belgium
[d] Department of Personality, Psychological Assessment and Treatment, University of Deusto, Bilbao, Spain

ARTICLE INFO

Keywords:
Abuse
Maltreatment
Neglect
RDoC
Cognitive control
Reward

ABSTRACT

Background and objectives: Childhood abuse and neglect increase the risk for psychiatric disorders (e.g., depression and anxiety) during adulthood and have been associated with deficits in cognitive control. The specific mechanisms underlying these cognitive control deficits are still unknown.
Methods: This study examined the expectation for reward to improve inhibitory control in young women (ages 18–35 years) with a history of childhood sexual and/or physical abuse (AG, N = 28), childhood emotional and/or physical neglect (NG, N = 30), or unaffected comparison women (HC, N = 40). They completed a previously validated rewarded (color-word) Stroop task and filled out questionnaires on depression, anxiety, and resilience.
Results: Surprisingly, a significant group by reward interaction revealed larger performance benefits under reward prospect (relative to no-reward) for the AG group relative to both the NG and HC groups.
Limitations: A small sample size limiting generalizability.
Conclusions: These results demonstrate sensitivity of abused subjects to reward in modulating cognitive control and might aid in discussing whether using reward schedules during therapeutic interventions could be effective.

1. Introduction

Childhood maltreatment and the resulting social and public health problems continues to be a major problem (Gilbert et al., 2009). Specifically, a meta-analytic examination revealed that, globally, around 7.6% of boys and 18% girls experience sexual abuse (e.g. intercourse and/or fondling of genitals directly or through clothes), with 22.6% of children experiencing physical abuse (i.e. an injury inflicted on the child via various non-accidental means), and 18% of children are neglected (e.g. ignorance of the child's needs for affection)(Stoltenborgh, Bakermans-Kranenburg, Alink, & van Ijzendoorn, 2015). While many youth who were exposed to maltreatment remain resilient throughout adulthood (Yoon et al., 2019), childhood maltreatment is associated with 1) developing psychiatric disorders such as post-traumatic stress disorder (PTSD), depression, and anxiety (McCrory & Viding, 2015), 2) deficits in psychosocial development (Cracco et al., 2020; Hudson et al., 2020; Nelson et al., 2002), 3) altered neuro-cognitive development (Hart & Rubia, 2012) and 4) deficits in the anticipation and processing of rewards (Dillon et al., 2009; Mueller et al., 2012). Potentially, these alterations in psycho-social development, impaired cognitive control, and reward processing might interact and maintain each other. While the severity of the maltreatment experience appears to play a key role (Cicchetti & Manly, 2001), it is not yet fully established to what extent these alterations are differentially associated with the type of maltreatment experience, i.e. sexual or physical abuse vs. emotional abuse or neglect (Kavanaugh, Dupont-Frechette, Jerskey, & Holler, 2017; Su, D'Arcy, Yuan, & Meng, 2019).

Self-regulatory control (or cognitive control) is fundamental to goal-directed behavior and decision-making (Diamond, 2013). In healthy adults, being able to anticipate reward improves cognitive control and goal-directed behavior (Braver et al., 2014). This effect holds across different cognitive control functions including response inhibition (Herrera et al., 2019), conflict resolution (Krebs, Boehler, & Woldorff, 2010; Padmala & Pessoa, 2011), as well as working memory (Jimura, Locke, & Braver, 2010; Locke & Braver, 2008). One commonly used conflict resolution task is the Stroop task, in which participants have to name the ink color of a color word, while ignoring its semantic meaning (e.g., the word red printed in blue font)(Stroop, 1935). In a modified

* Corresponding author. Department of Experimental Clinical and Health Psychology, Ghent University, Henri Dunantlaan 2, 9000, Ghent, Belgium.
E-mail address: sven.mueller@ugent.be (S.C. Mueller).

https://doi.org/10.1016/j.jbtep.2020.101629
Received 24 September 2019; Received in revised form 6 October 2020; Accepted 4 November 2020
Available online 7 November 2020
0005-7916/

version of this task, Krebs et al. (2010) additionally associated correct responses to two specific ink colors with reward, while the other two colors were never related to rewarding outcomes. The irrelevant word meanings could be neutral (an additional color word that was not overlapping with any on the ink colors), congruent (the word "red" written in red font), or incongruent (the word "red" written in yellow font). Their (Krebs et al., 2010) findings revealed that healthy adults responded faster in trials featuring reward prospect ink colors as compared to no-reward ink colors (relevant reward information), which is consistent with the commonly observed reward benefit in task performance. Interestingly, incongruent trials that featured reward-related word meanings (irrelevant reward information) resulted in increased interference, potentially due to increased stimulus saliency. Taken together, these findings suggest that reward can improve cognitive control in healthy participants, a critical aspect in goal-directed autonomous behavior, but can also impair performance if reward information is not in-line with the task goal (Braver et al., 2014; Krebs, Hopf, & Boehler, 2016).

By comparison, deficits in reward processing (e.g., decreased motivation and/or anticipation of reward) have been documented in maltreated populations (Dillon et al., 2009; Guyer et al., 2006) thus casting doubt on whether reward can be used to boost cognitive control in this cohort. Surprisingly little research has directly examined whether, despite the general deficits in reward processing, persons who have been maltreated during childhood can still sufficiently process reward to facilitate cognitive control later in life. In one study on early-life stress, adopted adolescents (relative to adolescents residing with their biological parents) failed to exhibit monetary incentive related enhancement during inhibitory control (Mueller et al., 2012). However, while most available studies examined maltreatment in general without dividing the sample into subgroups (Aas et al., 2011; Kaczmarczyk, Wingenfeld, Kuehl, Otte, & Hinkelmann, 2018; Majer, Nater, Lin, Capuron, & Reeves, 2010; Miller et al., 2015), a few experimental studies have been able to demonstrate differences in outcome depending on the type of experienced maltreatment (Cowell, Cicchetti, Rogosch, & Toth, 2015; Cromheeke, Herpoel, & Mueller, 2014; Shipman, Edwards, Brown, Swisher, & Jennings, 2005).

Recently, researchers have proposed a new model, in which abuse types have differential impact on cognitive-affective processes. Their model (Sheridan, Peverill, Finn, & McLaughlin, 2017) suggests that while experience of abuse types (sexual/physical abuse) could be lumped into a 'threat' category supposedly increasing perception of threat and altering emotion recognition and regulation, experience of neglect could be associated with 'deprivation' that disrupts cognitive development including executive functions and learning and memory processes. However, data are presently contentious due to a scarcity of studies. Directly comparing abused vs. neglected youths (10–18 years of age) revealed larger impact on underlying neurobiology in the previously abused cohort (relative to neglect) during an emotional Stroop task (Blair et al., 2019). By contrast, neuropsychological studies contradict this hypothesis, finding that sexual abuse also appears to influence the critical developmental functions such as language and memory (De Bellis, Woolley, & Hooper, 2013) or executive functions (Cecil, Viding, McCrory, & Gregory, 2015), hypothesized to be impacted by neglect. Being somewhat in-between, sexually and physically abused women but not women who experienced other stressors showed detrimental performance during a working memory task, but only in an emotional condition (happy faces) (Cromheeke et al., 2014). These findings suggest that closer scrutiny of maltreatment type, and specifically between abuse types and neglect on affective function within the context of cognitive control is warranted.

Examination of maltreatment types arguably bears clinical relevance as it may aid in deciding whether adopting reward schedules during therapeutic intervention may be effective and facilitate therapeutic progress. Jankowski et al. (2017) documented that an intervention based on positive reinforcement, relative to care as usual, in foster youths altered the neural correlates underlying inhibitory control. Whilst promising, their sample size was very small and it is unclear whether the findings may have been driven by a subgroup, given the high overlap of maltreatment types in their cohort. Here, characterization of participants along the Research Domain Criteria (RDoC) ("positive valence system and motivational processing") (Insel et al., 2010) appears relevant to elucidate to what extent reward-based interventions may benefit all individuals with maltreatment experience or only specific subgroups.

Therefore, this study examined the extent to which reward prospect might influence cognitive control in young women with a history of 1) childhood sexual and/or physical abuse (AG), 2) emotional and/or physical neglect (NG), or 3) in unaffected comparisons (HC) using a previously validated rewarded Stroop task (Krebs et al., 2010). We used this task in order to assess the effect of relevant reward information (reward vs. no-reward ink colors), as well as the effect of irrelevant reward information (reward-related vs. reward-unrelated word meanings) in incongruent trials. While the former typically promotes cognitive control in-line with the task goal, the latter provides an index for more low-level processes related to stimulus saliency that can bypass cognitive control and lead to performance detriments (Krebs et al., 2016). Based on previous findings (Colvert et al., 2008; Cromheeke et al., 2014; Dillon et al., 2009; Mueller et al., 2012) we predicted that young women with a history of abuse would 1) display general performance deficits (slower reaction times and lower rates of accuracy regardless of reward) relative to the neglect and healthy comparison groups and 2) show a particular lack of reward-induced performance benefits. With regard to the effect of irrelevant reward information, we had no clear prediction given that these effects are assumed to rely on more low-level processing, which is virtually unexplored in this cohort.

2. Method

2.1. Participants

Twenty-eight women in the abuse (AG) group (mean age, M_{age} = 21.61, SD = 2.53), 30 women in the neglect (NG) group (M_{age} = 21.23, SD = 3.5), and 40 women in the healthy comparison (HC) group (M_{age} = 21.05, SD = 3.04) volunteered. Women were predominantly of Caucasian ethnicity, with 8 participants being from other countries. The groups were well-matched for age χ^2 (24, N = 98) = 24.65, p = .42), depression ($F_{(2,95)}$ = 2.20, p = .12), resilience ($F_{(2,95)}$ = 0.44, p = .65) and state anxiety ($F_{(2,95)}$ = 1.37, p = .26), but differed in trait anxiety $F_{(2,95)}$ = 3.45, p < .05 (Table 1). Post-hoc tests indicated that the NG group scored higher on trait anxiety than the HC group (p = .009). Therefore, this variable was added as a covariate of no interest to all analyses. Participants were recruited during first-year online screening, in which they could voluntarily complete the Childhood Trauma Questionnaire Short Form (CTQ-SF; Bernstein et al., 1994). CTQ-SF responses

Table 1
Demographic information, mean scores and standard deviation on the measures of anxiety *(STAI), depression (BDI-II) and resilience score.*

Variable	Abuse group(AG) (n = 28)	Neglect group(NG) (n = 30)	Comparison group(HC)(n = 40)	*P* value	Effect size η_p^2
Age	21.61 (2.53)	21.23 (3.5)	21.05 (3.04)	.76	.01
Depression	11.04 (11.37)	13.30 (9.9)	8.13 (9.86)	.12	.04
State anxiety	38.71 (10.91)	41.07 (8.78)	37.28 (8.94)	.26	.03
Trait anxiety	46.93 (9.29)	49.63 (8.17)	44.15 (8.6)	**<.05**	.07
Resilience[a]	133 (19.37)	128.97 (15.19)	131.75 (16.32)	.65	.01

Note. [a]*t*-scores are used.

were used to contact and invite students for participation and to create the AG, NG, and HC groups. Following Walker et al. (1999), the following cut-off scores were used: for the AG group women needed to score > 8 points on sexual abuse or physical abuse scale; for the NG group women needed to score > 15 on the emotional neglect or > 8 points on the physical neglect scale and HC participants needed to score less than any of these thresholds on the respective scales. Participants received either monetary compensation (15 euros) or monetary compensation and course credit (course credit and 5 euros). All participants provided written informed consent and ethical approval was granted by both the ethical committees of the Faculty of Psychology and Educational Sciences (Ghent, Belgium) and of the Faculty of Behavioural and Social Sciences (Groningen, the Netherlands).

2.2. Experiment

The rewarded Stroop task was based on Krebs et al. (2010), and consisted of two phases: 1) During the training phase (n = 16 trials), participants were familiarized with the response mapping and the reward scheme in the absence of any interference. To this goal, participants responded to colored squares instead of Stroop color words. Here, correct responses to two out of four colors (e.g. blue and green) were associated with reward, while responses to the remaining colors (e.g., yellow and red) did not yield rewards. 2) During the task phase, capitalized color words were presented above a gray fixation point for 600 ms (see Fig. 1A). Again, fast and correct responses to two out of four ink colors were associated with reward. In addition, the word meanings could be neutral (an additional color word that was not overlapping with any on the ink colors), congruent (the word "red" written in red font), or incongruent (the word "red" written in yellow font) (see Fig. 1B). Importantly, the word meanings were entirely irrelevant for the task and were never predictive of reward, even if they referred to a reward-predicting ink color. Across participants, each of the four colors (i.e. red, yellow, blue and green) was equally often rewarded or not rewarded. Each accurate and fast response to rewarded ink colors was worth 1 point and participants could win up to approximately 70 points in each run, which corresponded to a maximum amount of 5 euros. Participants were encouraged to try and collect as many points as possible. However, in the end every participant received the full amount of 5 euros as a reward regardless of their actual performance. The experiment consisted of 512 stimuli in total, spread evenly across four runs (=128 stimuli per run). Each run included two breaks, after one third and after two thirds of the stimuli. Participants responded using the index and middle fingers of both hands on buttons on the keyboard. Specifically, keys on the keyboard were covered with white stickers ("A", "S", and "K", "L"). Stimulus-response assignments were counterbalanced across participants. Color-reward mappings were the same for training and task phase for each participant and counterbalanced across participants. Every trial was terminated by first response or maximal time out (1500 ms), which meant that the total duration of the experiment could not exceed 30 min (maximal 6 min per run). The Stroop task was conducted on a 15-inch PC laptop. The design resulted in eight main conditions (see Fig. 1B) formed by two experimental factors: Reward prospect (reward, no-reward) and Stroop congruency (congruent, incongruent, neutral), which are the basis for the primary analysis. Due to the fact that irrelevant word meanings could refer to reward or no-reward ink colors, incongruent trials were split, forming an additional factor for the secondary analysis, i.e., Reward-induced interference (incongruent reward-related, incongruent reward-unrelated). Hence, the analysis was focused on the effect of relevant reward information (reward vs. no-reward ink colors) in terms of general performance improvement as well as a potential reduction of interference. Moreover, we assessed the effect of irrelevant reward information in terms of reward-induced interference in incongruent trials (reward-related vs. reward-unrelated word meanings).

2.3. Questionnaires

Childhood Maltreatment Questionnaire (CTQ). The CTQ consists of 28 items which are ranked on 4-point scale with ranging options from 1, 'Never true' to 5, 'Very often true'. This questionnaire has a good test-retest reliability and high internal consistency (Cronbach's alpha in the current sample: α = 0.95) (Bernstein et al., 1994). Example questions to recruit the participants for the AG and NG groups were, respectively,

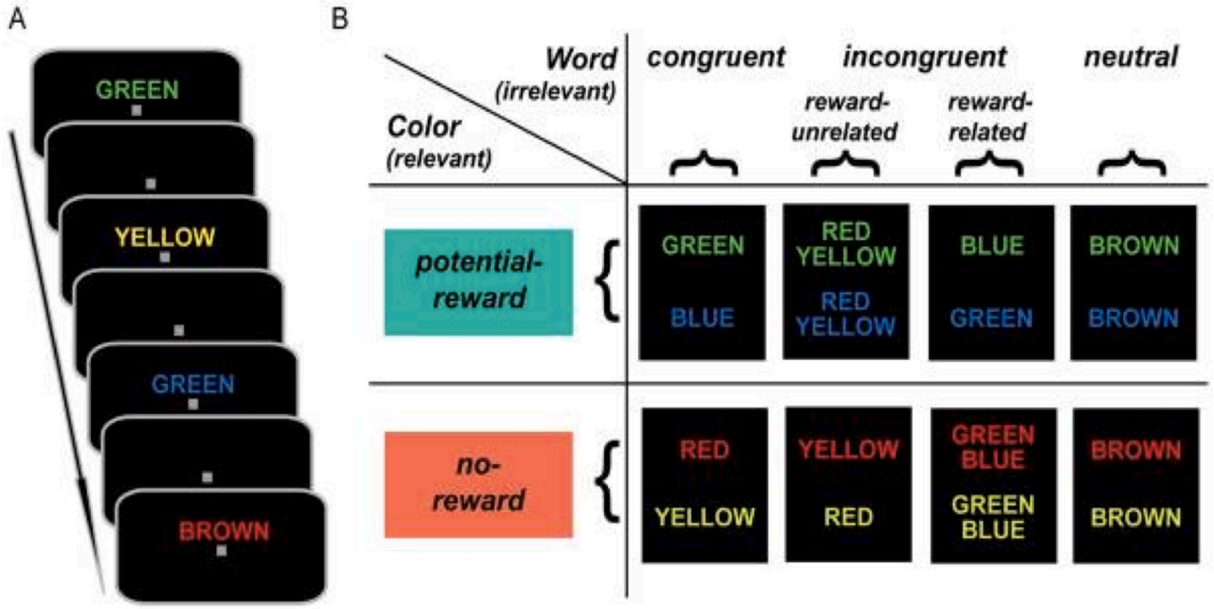

Fig. 1. (A) Subjects responded to the ink color (relevant dimension) of presented words (SOA: stimulus onset asynchrony). The figure on the left is merely an example of a possible set of four consecutive trials. (B) Counterbalanced across subjects, a subset of ink colors was associated with the potential of reward (potential-reward; e.g., green and blue), while the remaining ink colors were not (no-reward; e.g., red and yellow). The word meaning (irrelevant dimension) could be congruent, incongruent reward-unrelated, incongruent reward-related, or neutral with regard to the ink color. Original figure in Krebs et al. (2010), *Cognition, 117*(3), 341–347. With permission for reprint by Elsevier. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

1) "Someone tried to make me do sexual things or watch sexual things.", 2) "People in my family hit me so hard that it left me with bruises or marks.", and *3) "My parents were too drunk or high to take care of the family."*. The introduction of the questionnaire has been adjusted, as we were interested in early-life stress we asked the participants to take the age of before 15 years into account answering the questions. Participants for the HC group were only invited if they had scored below the threshold for any of the abuse and neglect items.

Anxiety. The State-Trait Anxiety Inventory (STAI) is a 40-item questionnaire rated on a 4-point Likert scale (e.g., from 1 *'Almost never'* to 4 *'Almost always'*), where higher scores indicate greater anxiety. One question of the state anxiety is, for example: *"I am presently worrying over possible misfortunes.". An example question of the trait anxiety is as follows: "I worry too much over something that really doesn't matter."*. The STAI has good internal consistency (Spielberger, Gorsuch, Vagg, & Jacobs, 1983), with current alpha = .82 for state anxiety and alpha = .87 for trait anxiety.

Depression. The Beck Depression Inventory (BDI-II (Beck, Steer, & Brown, 1996)) consists of 21 items of symptoms and attitudes. Each item has 4 to 5 self-evaluative statements, which are ranked on a 4-point scale (i.e. from 0 to 3) to reflect the range of severity of depression. Current α = 0.91.

Resilience. The Resilience Scale (RS), is a 25-item questionnaire scored on a 7-point scale with ranging options from 1, *'Disagree'* to 7, *'Agree'*. The RS has a high reliability and internal consistency (current α = 0.91), and respectable test-retest reliability (ranged from 0.67 to 0.90) (Portzky, Wagnild, De Bacquer, & Audenaert, 2010; Wagnild & Young, 1993).

2.4. Procedure

Participants came individually to one of the testing labs of the faculty and were informed about the general procedures of the study and were provided with a signed informed consent. Once participants had agreed to take part and had signed the informed consent, participants received detailed instructions regarding the behavioral task. In addition to the rewarded Stroop task, participants also completed an attentional bias task and an interoceptive awareness task (publication in preparation). Before starting the experimental trial, the familiarizing process with the response mapping and the reward scheme was practiced verbally and on the laptop. Firstly, there was an instruction before starting the training phase. Secondly, the participants were asked if they understood the instruction, and to give a summary in 1 or 2 sentences before starting. Participants were instructed to respond to each stimulus as quickly as possible, but without compromising on accuracy. Finally, if there were no more instructions needed, the actual experiment was started. At the end of the study, participants were debriefed, were given the option of requesting group-based results and received compensation.

2.5. Statistical analysis

Based on the original study by Krebs et al. (2010), two types of analyses were performed (with SPSS v. 23) to assess the effect of relevant reward information as well as the effect of irrelevant reward information in incongruent trials. The primary analysis consisted of a 2 x 3 x 3 Repeated Measures Analyses of Covariance (rmANCOVA) on reaction time (RT in ms) and accuracy (% correct) with *reward prospect* (reward vs. no-reward), and *Stroop congruency* (congruent vs. incongruent vs. neutral) as within-subject factors, and *group* (AG vs. NG vs. HC) as between-subjects factor. Because participants differed statistically on the trait anxiety scale, this factor was added as a covariate of no interest. The secondary analysis consisted of a 2 x 2 x 3 rmANCOVA for RT and accuracy with *reward prospect* (reward vs. non reward) and *reward-induced interference* (incongruent reward-related vs. incongruent reward-unrelated) as within-subject factors, and *group* as between-subjects factor. Importantly, as response variability may differ between groups and because of possible heterogeneity of the different groups, RT data (correct trials only and >100 ms to avoid anticipatory responses) were log-transformed as log-transformed RT are less susceptible to extreme scores and may be more robust (Kliegl, Masson, & Richter, 2010). For the accuracy analysis, conditions with less than 60% (averaged) accuracy were removed. In total, for 8 participants 1 block was removed, for 2 participants 2 blocks, and for 1 participant 3 blocks were removed. Differences in demographic information were assessed with multivariate ANOVAS. Finally, Cohen's *d* and partial eta squared are reported as measures of effect size, where appropriate. P was set at alpha = 0.05, two-tailed.

3. Results

3.1. Reaction time

The 2 x 3 x 3 rmANCOVA testing for the effect of relevant reward information revealed a main effect of Stroop congruency ($F_{(1,94)} = 5.54$, $p = .005$, part. $eta^2 = 0.10$). Consistent with typical findings in the Stroop task, responses in congruent trials were faster relative to incongruent trials ($t_{(97)} = 15.30$, $p < .001$) and neutral trials ($t_{(97)} = 9.66$, $p < .001$), and responses in neutral trials were also faster than in incongruent trials ($t_{(97)} = 6.89$, $p < .001$). Importantly, the 2-way interaction between *group* and *reward prospect* was significant ($F_{(2,94)} = 3.40$, $p = .038$, part. $eta^2 = 0.07$) (Fig. 2, Table 2). Given that this pattern was not further modulated by Stroop congruency (3-way interaction p = .592), post-hoc univariate analyses were conducted on the difference scores (reward minus no-reward, averaged across congruent, incongruent, and neutral trials) to compare the magnitude of the reward-prospect effect between the three groups (while still including trait anxiety as covariate of no interest). This revealed that the AG group displayed a significantly larger reward-prospect effect than the NG group ($F_{(1,56)} = 4.25$, p = .044, $d = 0.52$) and the HC group ($F_{(1,65)} = 5.93$, p = .018, $d = 0.62$). NG and HC groups did not differ from each other ($F_{(1,67)} = 0.20$, p = .660, $d = 0.07$) (Fig. 2). No further main effects or interactions were statistically significant.

The 2 x 2 x 3 rmANCOVA testing for the influence of irrelevant reward information yielded an interaction between *reward prospect* and *group* $F_{(2,94)} = 3.46$, $p = .036$, part. $eta^2 = 0.07$ (Table 2). Follow-up tests of this interaction revealed a significantly larger reward effect for AG relative to HC ($F_{(1,65)} = 4.19$, p = .045, $d = 0.51$), but the differences between AG and NG and NG and HC were no longer significant (p > .290). This shows that the increased performance benefit in reward trials in the AG group is preserved relative to HC (but not relative to NG) when considering incongruent trials alone. In addition, we observed a trending 2-way interaction between *reward prospect* and *reward-induced interference* ($F_{(1,94)} = 3.39$, p = .069, part. $eta^2 = 0.04$) (Fig. 3), with numerically slower responses in trials featuring incongruent reward-related word meanings, especially in no-reward trials. Albeit only observed at trend level, this pattern is consistent with the original study (Krebs et al., 2010). In contrast to the effect of relevant reward information, this was not further modulated by *group* (3-way interaction p = .290). No further main effects or interactions were observed.

3.2. Accuracy

The 2 x 3 x 3 rmANCOVA of the accuracy data (relevant reward information, Table 1) revealed no significant main effects or interactions. Similarly, the 2 x 2 x 3 rmANCOVA (irrelevant reward information, Table 2) revealed no significant main effects or interactions.

3.3. Additional post-hoc analyses: sex of experimenter effects

To assess whether the sex of the experimenter may have influenced the findings, we re-ran, *post-hoc*, the main analysis with sex of experimenter included as a covariate as 76% of the sample were collected by

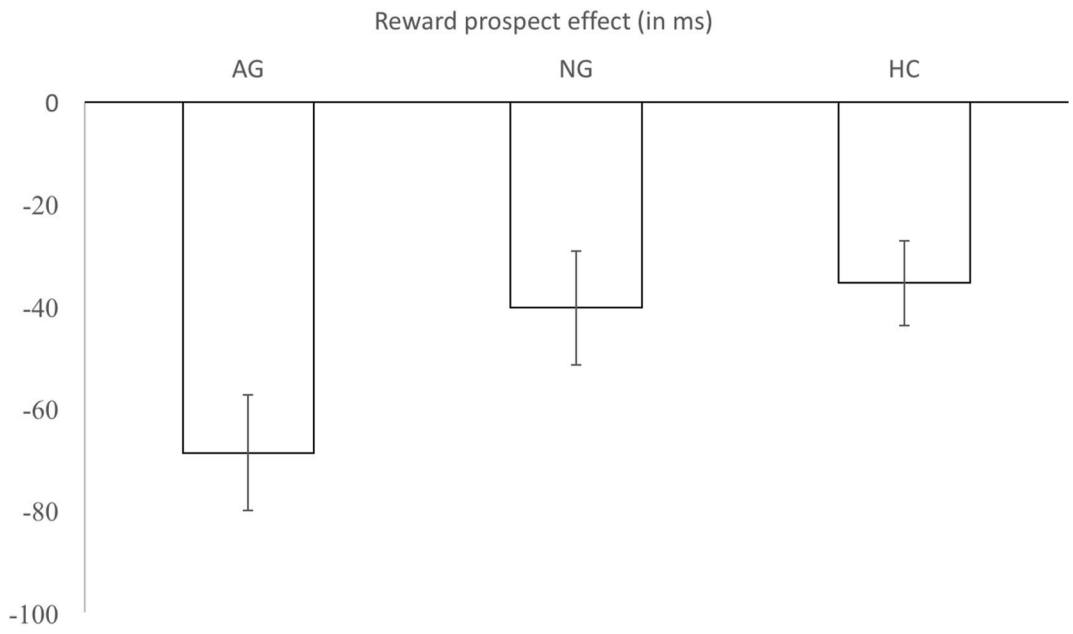

Fig. 2. Reward prospect effects in the three groups (relevant reward information). The effect is represented by difference scores (reward minus no-reward ink colors), averaged across congruent, incongruent, and neutral (in ms) trials. Negative scores indicate performance benefits in terms of faster responses for trials featuring relevant reward information. Error bars denote S.E.M.

Table 2
Mean and standard deviations of reaction times (milliseconds) and accuracy (in % correct) for the abuse, neglect and comparison group.

Condition	Abuse group (n = 28)		Neglect group (n = 30)		Comparison group (n = 40)	
	Mean RT (SD)	Mean Acc (SD)	Mean RT (SD)	Mean Acc (SD)	Mean RT (SD)	Mean Acc (SD)
Rew Congruent	528 (62)	92 (5)	570 (72)	91 (6)	571 (84)	94 (4)
Rew Incongr-RR	569 (71)	92 (5)	605 (81)	91 (6)	606 (87)	94 (4)
Rew Incongr-NR	573 (84)	93 (6)	612 (83)	92 (6)	612 (85)	93 (4)
Rew Neutral	553 (71)	94 (5)	592 (65)	95 (4)	598 (78)	95 (4)
Norew Congruent	595 (69)	92 (7)	613 (73)	91 (7)	611 (74)	94 (5)
Norew Incongr-RR	647 (74)	90 (7)	656 (68)	90 (8)	658 (82)	93 (4)
Norew Incongr-NR	639 (76)	89 (8)	633 (74)	89 (8)	636 (74)	92 (6)
Norew Neutral	621 (70)	91 (8)	634 (68)	92 (7)	626 (73)	94 (4)
Rew Incongruent	571 (77)	93 (5)	609 (80)	92 (5)	609 (84)	94 (4)
Norew Incongruent	643 (73)	89 (7)	645 (68)	90 (8)	647 (76)	93 (4)
Reward	556 (70)	93 (4)	595 (71)	93 (5)	597 (80)	94 (4)
Noreward	625 (69)	90 (7)	634 (67)	90 (7)	633 (73)	93 (4)

Note. RT = reaction time; Acc = accuracy; (No)Rew = (no)reward color; Congr = congruent word; Incongr-RR = incongruent reward-related word; Incongr-NR = incongruent reward-unrelated word.

female experimenters and 24% of the sample by a male experimenter. A significant interaction between sex of experimenter and reward ($F_{(1,93)} = 6.88$, $p = .010$, part. $eta^2 = 0.07$) showed that the reward effect under a male experimenter was smaller (20 ms) relative to a female experimenter (55 ms). Yet, this effect did not interact with group ($F_{(6,176)} = 0.88$, $p = .51$) and moreover, the interaction of reward by group was also still statistically significant ($F_{(2,93)} = 3.19$, $p = .046$, part. $eta^2 = 0.064$) suggesting no influence on the critical group by reward interaction. Other factors that may have also contributed, as 76% of the sample were collected in autumn and the 24% in spring thus making interpretation of this finding difficult.

4. Discussion

This study examined the effects of reward expectation on cognitive control after different types of childhood maltreatment using a rewarded Stroop task. Based on previous findings, the main hypothesis was that unlike women with NG or HC, women with AG would not benefit from reward expectation in this task, which would be indicative of a deficit in employing goal-directed cognitive control mechanisms. Contrary to this prediction, women in the AG group responded faster in reward prospect (as compared to no-reward) trials relative to women in the NG and HC group (who also showed reward effects, as predicted). Importantly, this effect does not reflect overall cognitive performance differences as no-reward trials were performed equally well by all groups with no statistically significant difference.

The present findings contradict earlier work in related cohorts, but data are too scarce to fully reconcile the differences. Whereas the findings do not fit with reduced reward effects in early-life stress youth (adoption before 24 months of age) (Mueller et al., 2012), they do fit with inhibitory control improvement with positive reinforcement in foster youths (Jankowski et al., 2017). In line with this, previously abused women (AG) in this study improved their performance during monetary reward by an average of 72 ms and showed medium to strong effect differences relative to the neglected and unaffected comparison groups, who showed average increased reaction times of 40 ms and 33 ms, respectively. Of note, the findings cannot be explained by a speed-accuracy trade-off, given the absence of any effects on accuracy variables. In addition, because the present accuracy rates were a) very high and b) very uniform (92–94% (with SDs 4–6%) in the healthy group

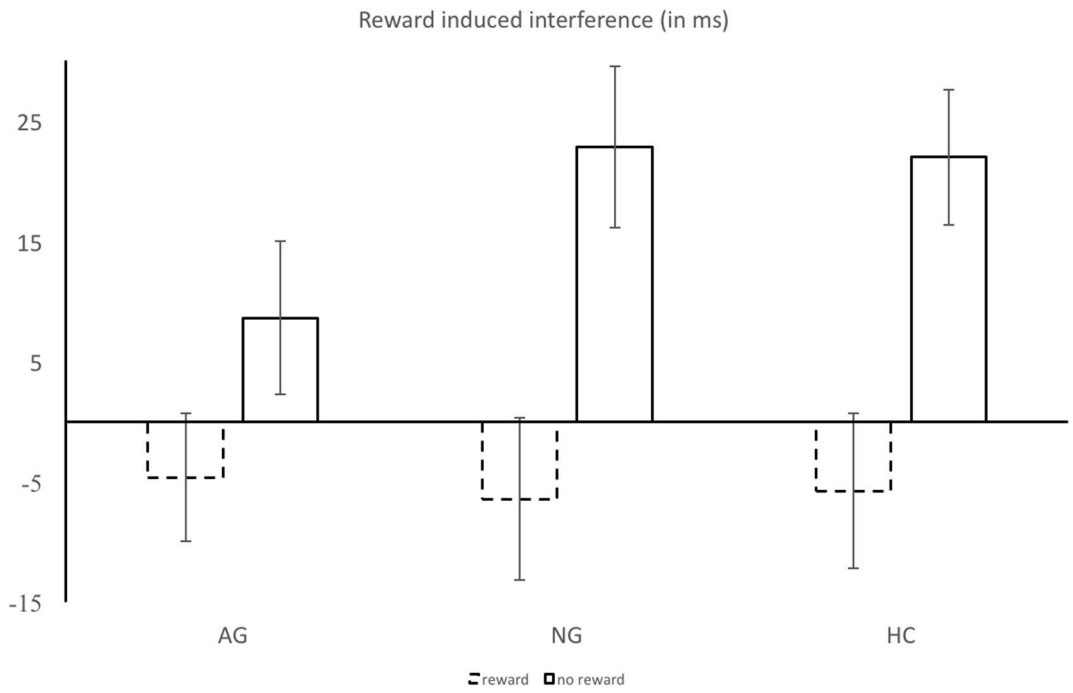

Fig. 3. Reward-induced interference in incongruent trials (irrelevant reward information). The effect is represented by difference scores (incongruent reward-related minus incongruent reward-unrelated word meanings). Solid and dashed bars depict this effect for reward and no-reward trials, respectively (i.e., trials featuring relevant reward or no-reward ink colors). Positive scores indicate increased interference when irrelevant word meanings were reward-related as compared to reward-unrelated. Error bars denote S.E.M.

across all conditions vs. 80–94% (with SDs 2.6–10%) in a healthy group in Krebs et al.), they did not replicate the interaction of accuracy by trial type reported by Krebs et al. (2010). Although performance of the present healthy comparison group seemed better than the participants in Krebs et al., 2010 in terms of accuracy, responses were on average slower. This is likely related to the task design as the present task has a less strict response time out and did not provide direct feedback on response speed. As a result, more careful responding will likely increase global accuracy, and will also decrease the impact of interfering information. In any case, even though improved responding during reward in a maltreated group seems contradictory, several possible explanations exist for these striking results. Some of these may be relevant for therapeutic settings.

One possible interpretation is that of an ingratiating effect and social likeability. As abused women (AG) have been reported to have lower self-esteem and/or higher anxiety, they may have wanted to please (i.e., ingratiate themselves with) the experimenters, and thus they may have worked harder than the HC and NG groups. Supporting this theory, maltreated youths performed generally faster than the non-maltreated comparison group in another study despite being insensitive to monetary incentive (Guyer et al., 2006), also suggesting increased ingratiating effects. Moreover, as rates of maltreatment history in depressed patients are high (Negele, Kaufhold, Kallenbach, & Leuzinger-Bohleber, 2015), Mueller, De Rubeis, Lange, Pawelzik, and Sutterlin (2016) demonstrated that clinically depressed participants who were more sensitive to social exclusion also benefitted more from psychotherapy and had larger improvements on their depression scores after ~2 months of inpatient treatment. This suggests that ingratiating behaviors may influence performance, also within a therapeutic context. However, these previous data are only partially consistent with the present findings as one might have expected generally increased performance for the AG group across all conditions and not only the reward condition.

Other possible factors that may have contributed to the paradoxical increased sensitivity to reward in the AG group is the level of resilience and/or comorbid psychopathology. The present sample of women were all young women who, despite their traumatic experiences, were able to proceed with their education and attend university thus making it a relatively resilient sample. This was evident in the fact that their level of resilience and depression scores did not differ from the other groups. Although the sample of female university students by Cromheeke et al. (2014) also had high resilience, they suffered from more comorbid depression, psychopathology, and state anxiety, which was not the case for the present sample. As noted by others (Kalisch, Müller, & Tüscher, 2015) thoroughly and truly measuring resilience may require more than a simple summary questionnaire score and may also include other factors such as positive appraisal styles. Inclusion of such additional measures in future work may help to explain additional variance in performance.

Importantly, the observation regarding the influence of irrelevant reward information (a trending interaction between *reward prospect* and *reward-induced interference*) seems to provide additional insights regarding the underlying mechanisms. Supporting the original study (Krebs et al., 2010), we found that irrelevant incongruent word meanings that are implicitly referring to a rewarded ink color induce additional interference, especially in no-reward trials. It has been argued previously that this effect is the result of increased saliency of reward-related stimulus features that can bypass cognitive control and impair performance. In other words, incongruent reward-related stimulus features increase erroneous response tendencies fairly automatically, thereby impairing task performance especially in no-reward trials in which cognitive control is assumed to be relatively low (Krebs et al., 2010, 2016). As such, this effect provides an index of potential low-level influences of reward-related features – above and beyond goal-directed voluntary control. Importantly, this (trending) effect was observed across all three groups (cf. Fig. 3), providing no indication of differences in (low-level) saliency processing. In turn, this suggests that the performance advantage in the AG group under reward prospect is indeed the result of increased motivation and goal-directed cognitive control.

These findings bear important clinical implications. As noted earlier, one prior study had documented that positive reinforcement may

positively influence cognitive control in foster youths (Jankowski et al., 2017). Together with the present finding, the data suggest that despite reductions in reward processing (Dillon et al., 2009), some sensitivity to rewards is present in previously maltreated persons, which can be used in therapeutic settings. For example, Linke and Wessa (2017) showed that mental imagery training may increase reward sensitivity and reduce depressive symptoms. Second, little is known regarding differential effects of subgroups with specific childhood trauma histories. However, the literature is presently unclear as many studies appear to divide subgroups along different categories or dimensions (Cecil, Viding, Fearon, Glaser, & McCrory, 2017; Debowska, Willmott, Boduszek, & Jones, 2017; Vachon, Krueger, Rogosch, & Cicchetti, 2015), which may also highly depend on the specific sample or population tested. Nonetheless, the present findings potentially show a trend that reward-based training may indeed help in treatment that could decrease the adverse outcomes of childhood trauma on neural systems (Linke & Wessa, 2017). Further scrutiny of this effect is warranted.

Some limitations require discussion. First, because participants were recruited via online screening of first-year students, participant selection might have been biased. The potential recruitees were possibly more motivated to participate relatively to the non-participants (e.g., willingness to support science, earn money and/or course credits). In turn, because of the link between motivation and reward sensitivity (Linke & Wessa, 2017), the effect of motivation might have impacted the results. Yet, this point would not explain the statistically significant interaction between groups. Likewise, secondly, although the gender of the experimenter may have influenced the findings showing a reduced reward effect when the experiment was administered by a male vs. female experimenter, it did not influence the critical group by reward interaction. Third, the sample size was relatively small. However, while the sample size was small, it is in-line with what is reasonable/feasible in terms of recruiting participants from these cohorts (Harned, 2004; Orchowski, Untied, & Gidycz, 2013). Fourth, as the main goal of this study was to disentangle the differences in AG and NG, we did not report on the co-occurrence of sexual and physical maltreatment nor whether participants experienced a single type of maltreatment. Despite high interrelations, it might be of interest to separate AG groups according to their individual types of abuse in the future (Cecil et al., 2017). However, separating AG from NG already goes beyond previous work (Aas et al., 2011; Kaczmarczyk et al., 2018; Majer et al., 2010; Miller et al., 2015) and constituted a strengh of the present work.

5. Conclusion

Contrary to the hypothesis, women with prior abuse history strikingly improved performance relative to the NG and HC group suggesting that reward schedules may, despite general impairments in cognitive control and reward processing, be useful for this cohort in clinical settings. However, closer examination of the underlying bio-psycho-social factors as well as generalizability across other cognitive control domains is necessary.

Author statement

SCM, MJJL, JD, & MK conceived of the study, MK curated the data, SCM, MK, & RK conducted the analyses, SCM acquired the funding, RK provided the software, MJJL, JD & SCM supervised and administered the project, MK visualized the data, MK & SCM wrote the original draft and MK, MJJL, RK, JD, and SCM wrote and edited the revision.

Declaration of competing interest

None. This work was supported by a 2–4 year grant (01J05415) from the Special Research Fund (BOF) at Ghent University to SCM, by a starting grant of the European Research Council (ERC) under the Horizon 2020 framework awarded to RMK (grant No. 636116), and the EU Cofund Rosalind Franklin Fellowship to JKD. The funders had no role in conception, design, analysis or interpretation of the data or the decision to publish. MK would like to extend her gratitude to Ümit Kavak and Lisa Van Holsbeke for their constant scientific support and for eliminating grammatical errors.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbtep.2020.101629.

References

Aas, M., Dazzan, P., Fisher, H. L., Morgan, C., Morgan, K., Reichenberg, A., et al. (2011). Childhood trauma and cognitive function in first-episode affective and non-affective psychosis. *Schizophrenia Research, 129*(1), 12–19. https://doi.org/10.1016/j.schres.2011.03.017

Beck, Steer, R. A., & Brown, G. K. (1996). *BDI-II, Beck depression inventory : Manual*.

Bernstein, D. P., Fink, L., Handelsman, L., Foote, J., Lovejoy, M., Wenzel, K., et al. (1994). Initial reliability and validity of a new retrospective measure of child abuse and neglect. *American Journal of Psychiatry, 151*(8), 1132–1136. https://doi.org/10.1176/ajp.151.8.1132

Blair, K. S., Aloi, J., Crum, K., Meffert, H., White, S. F., Taylor, B. K., … Blair, R. J. (2019). Association of different types of childhood maltreatment with emotional responding and response control among YouthsAssociation of different types of maltreatment with emotional responding and response control among YouthsAssociation of different types of maltreatment with emotional responding and response control among youths. *JAMA Network Open, 2*(5), e194604. https://doi.org/10.1001/jamanetworkopen.2019.4604. e194604.

Braver, T. S., Krug, M. K., Chiew, K. S., Kool, W., Westbrook, J. A., Clement, N. J., & group, f. t. M. (2014). Mechanisms of motivation–cognition interaction: Challenges and opportunities. *Cognitive, Affective, & Behavioral Neuroscience, 14*(2), 443–472. https://doi.org/10.3758/s13415-014-0300-0 [journal article].

Cecil, C. A. M., Viding, E., Fearon, P., Glaser, D., & McCrory, E. J. (2017). Disentangling the mental health impact of childhood abuse and neglect. *Child Abuse & Neglect, 63*, 106–119.

Cecil, C. A. M., Viding, E., McCrory, E., & Gregory, A. M. (2015). Distinct mechanisms underlie associations between forms of childhood maltreatment and disruptive nocturnal behaviors. *Developmental Neuropsychology, 40*(3), 181–199.

Cicchetti, D., Manly, J. T., & undefined. (2001). Editorial: Operationalizing child maltreatment: Developmental processes and outcomes. *Development and Psychopathology, 13*(4), 755–757.

Colvert, E., Rutter, M., Kreppner, J., Beckett, C., Castle, J., Groothues, C., et al. (2008). Do theory of mind and executive function deficits underlie the adverse outcomes associated with profound early deprivation? Findings from the English and Romanian adoptees study. *Journal of Abnormal Child Psychology, 36*(7), 1057–1068. https://doi.org/10.1007/s10802-008-9232-x

Cowell, R. A., Cicchetti, D., Rogosch, F. A., & Toth, S. L. (2015). Childhood maltreatment and its effect on neurocognitive functioning: Timing and chronicity matter. *Development and Psychopathology, 27*(2), 521–533. https://doi.org/10.1017/S0954579415000139

Cracco, E., Hudson, A. R., Van Hamme, C., Maeyens, L., Brass, M., & Mueller, S. C. (2020). Early interpersonal trauma reduces temporoparietal junction activity during spontaneous mentalising. *Social Cognitive and Affective Neuroscience, 15*(1), 12–22. https://doi.org/10.1093/scan/nsaa015

Cromheeke, S., Herpoel, L. A., & Mueller, S. C. (2014). Childhood abuse is related to working memory impairment for positive emotion in female university students. *Child Maltreatment, 19*(1), 38–48. https://doi.org/10.1177/1077559513511522

De Bellis, M. D., Woolley, D. P., & Hooper, S. R. (2013). Neuropsychological findings in pediatric maltreatment: Relationship of PTSD, dissociative symptoms, and abuse/neglect indices to neurocognitive outcomes. *Child Maltreatment, 18*(3), 171–183. https://doi.org/10.1177/1077559513497420

Debowska, A., Willmott, D., Boduszek, D., & Jones, A. D. (2017). What do we know about child abuse and neglect patterns of cooccurrence? A systematic review of profiling studies and recommendations for future research. *Child Abuse & Neglect, 70*, 100–111.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135–168.

Dillon, Holmes, A. J., Birk, J. L., Brooks, N., Lyons-Ruth, K., & Pizzagalli, D. A. (2009). Childhood adversity is associated with left basal Ganglia dysfunction during reward anticipation in adulthood. *Biological Psychiatry, 66*(3), 206–213. https://doi.org/10.1016/j.biopsych.2009.02.019

Gilbert, R., Widom, C. S., Browne, K., Fergusson, D., Webb, E., & Janson, S. (2009). Burden and consequences of child maltreatment in high-income countries. *Lancet, 373*(9657), 68–81. https://doi.org/10.1016/S0140-6736(08)61706-7

Guyer, A. E., Kaufman, J., Hodgdon, H. B., Masten, C. L., Jazbec, S., Pine, D. S., et al. (2006). Behavioral alterations in reward system function: The role of childhood maltreatment and psychopathology. *Journal of the American Academy of Child & Adolescent Psychiatry, 45*(9), 1059–1067. https://doi.org/10.1097/01.chi.0000227882.50404.11

Harned, M. S. (2004). Does it matter what you call it? The relationship between labeling unwanted sexual experiences and distress. *Journal of Consulting and Clinical Psychology, 72*(6), 1090–1099. https://doi.org/10.1037/0022-006X.72.6.1090

Hart, H., & Rubia, K. (2012). Neuroimaging of child abuse: A critical review. *Frontiers in Human Neuroscience, 6*, 52. https://doi.org/10.3389/fnhum.2012.00052

Herrera, P. M., Van Meerbeke, A. V., Speranza, M., Cabra, C. L., Bonilla, M., Canu, M., et al. (2019). Expectation of reward differentially modulates executive inhibition. *BMC Psychology, 7*(1), 55. https://doi.org/10.1186/s40359-019-0332-x

Hudson, A. R., De Coster, L., Spoormans, H., Verbeke, S., Van der Jeught, K., Brass, M., et al. (2020). Childhood abuse and adult sociocognitive skills: Distinguishing between self and other following early trauma. *Journal of Interpersonal Violence, 886260520906190*. https://doi.org/10.1177/0886260520906190

Insel, M. D., Bruce, Cuthbert, Marjorie, Garvey, Robert, Heinssen, Daniel, S., Pine, M. D., Kevin, Quinn, Philip, Wang, DR.P.H. National Institute of Mental Health, Bethesda, Md (2010). Research domain Criteria (RDoC): Toward a new classification framework for research on mental disorders. *American Journal of Psychiatry, 167*(7), 748–751. https://doi.org/10.1176/appi.ajp.2010.09091379

Jankowski, K. F., Bruce, J., Beauchamp, K. G., Roos, L. E., Moore, W. E., III, & Fisher, P. A. (2017). Preliminary evidence of the impact of early childhood maltreatment and a preventive intervention on neural patterns of response inhibition in early adolescence. *Developmental Science, 20*(4), Article e12413. https://doi.org/10.1111/desc.12413

Jimura, K., Locke, H. S., & Braver, T. S. (2010). Prefrontal cortex mediation of cognitive enhancement in rewarding motivational contexts. *Proceedings of the National Academy of Sciences, 107*(19), 8871–8876. https://doi.org/10.1073/pnas.1002007107

Kaczmarczyk, M., Wingenfeld, K., Kuehl, L. K., Otte, C., & Hinkelmann, K. (2018). Childhood trauma and diagnosis of major depression: Association with memory and executive function. *Psychiatry Research, 270*, 880–886. https://doi.org/10.1016/j.psychres.2018.10.071

Kalisch, R., Müller, M. B., & Tüscher, O. (2015). A conceptual framework for the neurobiological study of resilience. *Behavioral and Brain Sciences, 38*, e92. https://doi.org/10.1017/S0140525X1400082X

Kavanaugh, B. C., Dupont-Frechette, J. A., Jerskey, B. A., & Holler, K. A. (2017). Neurocognitive deficits in children and adolescents following maltreatment: Neurodevelopmental consequences and neuropsychological implications of traumatic stress. *Applied Neuropsychology: Child, 6*(1), 64–78. https://doi.org/10.1080/21622965.2015.1079712

Kliegl, R., Masson, M. E. J., & Richter, E. M. (2010). A linear mixed model analysis of masked repetition priming. *Visual Cognition, 18*(5), 655–681. https://doi.org/10.1080/13506280902986058

Krebs, H., & Boehler. (2016). Within-trial effects of stimulus-reward associations. In T. Braver (Ed.), *Motivation and cognitive control* (pp. 65–82). Psychology Press.

Krebs, Boehler, C. N., & Woldorff, M. G. (2010). The influence of reward associations on conflict processing in the Stroop task. *Cognition, 117*(3), 341–347. https://doi.org/10.1016/j.cognition.2010.08.018

Linke, J., & Wessa, M. (2017). Mental imagery training increases wanting of rewards and reward sensitivity and reduces depressive symptoms. *Behavior Therapy, 48*(5), 695–706. https://doi.org/10.1016/j.beth.2017.04.002

Locke, H. S., & Braver, T. S. (2008). Motivational influences on cognitive control: Behavior, brain activation, and individual differences. *Cognitive, Affective, & Behavioral Neuroscience, 8*(1), 99–112.

Majer, M., Nater, U. M., Lin, J.-M. S., Capuron, L., & Reeves, W. C. (2010). Association of childhood trauma with cognitive function in healthy adults: A pilot study. *BMC Neurology, 10*(1), 61. https://doi.org/10.1186/1471-2377-10-61

McCrory, & Viding. (2015). The theory of latent vulnerability: Reconceptualizing the link between childhood maltreatment and psychiatric disorder. *Development and Psychopathology, 27*(2), 493–505. https://doi.org/10.1017/S0954579415000115

Miller, S., McTeague, L. M., Gyurak, A., Patenaude, B., Williams, L. M., Grieve, S. M., et al. (2015). COGNITION-CHILDHOOD maltreatment interactions in the prediction of antidepressant outcomes in major depressive disorder patients: Results from the iSPOT-D trial. *Depression and Anxiety, 32*(8), 594–604. https://doi.org/10.1002/da.22368

Mueller, S. C., De Rubeis, J., Lange, D., Pawelzik, M. R., & Sutterlin, S. (2016). Sensitivity to social exclusion in major depressive disorder predicts therapeutic outcome after inpatient treatment. *Psychotherapy and Psychosomatics, 85*, 50–52.

Mueller, S. C., Hardin, M. G., Korelitz, K., Daniele, T., Bemis, J., Dozier, M., et al. (2012). Incentive effect on inhibitory control in adolescents with early-life stress: An antisaccade study. *Child Abuse & Neglect, 36*(3), 217–225. https://doi.org/10.1016/j.chiabu.2011.10.010

Negele, A., Kaufhold, J., Kallenbach, L., & Leuzinger-Bohleber, M. (2015). Childhood trauma and its relation to chronic depression in adulthood. *Depression Research and Treatment*. https://doi.org/10.1155/2015/650804

Nelson, E. C., Heath, A. C., Madden, P. A. F., Cooper, M. L., Dinwiddie, S. H., Bucholz, K. K., … Martin, N. G. (2002). Association between self-reported childhood sexual abuse and adverse psychosocial outcomes: Results from a twin study. *JAMA Psychiatry, 59*(2), 139–145. https://doi.org/10.1001/archpsyc.59.2.139

Orchowski, L. M., Untied, A. S., & Gidycz, C. A. (2013). Factors associated with college women's labeling of sexual victimization. *Violence & Victims, 28*(6), 940–958. https://doi.org/10.1891/0886-6708.VV-D-12-00049

Padmala, S., & Pessoa, L. (2011). Reward reduces conflict by enhancing attentional control and biasing visual cortical processing. *Journal of Cognitive Neuroscience, 23*(11), 3419–3432. https://doi.org/10.1162/jocna00011%M21452938

Portzky, M., Wagnild, G., De Bacquer, D., & Audenaert, K. (2010). Psychometric evaluation of the Dutch resilience scale RS-nl on 3265 healthy participants: A confirmation of the association between age and resilience found with the Swedish version. *Scandinavian Journal of Caring Sciences, 24*(s1), 86–92. https://doi.org/10.1111/j.1471-6712.2010.00841.x

Sheridan, M. A., Peverill, M., Finn, A. S., & McLaughlin, K. A. (2017). Dimensions of childhood adversity have distinct associations with neural systems underlying executive functioning. *Development and Psychopathology, 29*(5), 1777–1794. https://doi.org/10.1017/s0954579417001390

Shipman, K., Edwards, A., Brown, A., Swisher, L., & Jennings, E. (2005). Managing emotion in a maltreating context: A pilot study examining child neglect. *Child Abuse & Neglect, 29*(9), 1015–1029. https://doi.org/10.1016/j.chiabu.2005.01.006

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Palo Alto: Consulting Psychologists Press.

Stoltenborgh, M., Bakermans-Kranenburg, M. J., Alink, L. R. A., & van Ijzendoorn, M. H. (2015). The prevalence of child maltreatment across the globe: Review of a series of meta-analyses. *Child Abuse Review, 24*, 37–50. https://doi.org/10.1002/car.2353

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 121*(1), 15–23. https://doi.org/10.1037/0096-3445.121.1.15

Su, Y., D'Arcy, C., Yuan, S., & Meng, X. (2019). How does childhood maltreatment influence ensuing cognitive functioning among people with the exposure of childhood maltreatment? A systematic review of prospective cohort studies. *Journal of Affective Disorders, 252*, 278–293. https://doi.org/10.1016/j.jad.2019.04.026

Vachon, D. D., Krueger, R. F., Rogosch, F. A., & Cicchetti, D. (2015). Assessment of the harmful psychiatric and behavioral effects of different forms of child maltreatment. *JAMA Psychiatry, 72*(11), 1135–1142.

Wagnild, G. M., & Young, H. M. (1993). Development and psychometric evaluation of the resilience scale. *Journal of Nursing Measurement, 1*(2), 165–178.

Walker, E. A., Gelfand, A., Katon, W. J., Koss, M. P, Von Korff, M., Bernstein, D., & Russo, J (1999). Adult health status of women with histories of childhood abuse and neglect. *Am J Med., 107*, 332–339. https://doi.org/10.1016/S0002-9343(99)00235-1

Yoon, S., Howell, K., Dillard, R., McCarthy, K. S., Napier, T. R., & Pei, F. (2019). Resilience following child maltreatment: Definitional considerations and developmental variations. *Trauma, Violence, & Abuse*. https://doi.org/10.1177/1524838019869094, 0(0), 1524838019869094.