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Group Differences in Hot and Cool Executive Functioning Performance in College Students with and without a History of Child Maltreatment

Kady Barthelemy
University of Northern Colorado, bart1207@bears.unco.edu

Dr. Eric Peterson
University of Northern Colorado

Marilyn Welsh
University of Northern Colorado

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Kady Barthelemy

Mentors: Eric Peterson, Ph.D., & Marilyn Welsh, Ph.D. Psychological Sciences

Abstract: We explored the degree to which a history of child maltreatment impacts performance in college settings. In recent studies, researchers have explored "hot" versus "cool" executive functioning (EF). Cool EF is comprised of cognitive processes in non-emotional settings and are known to play an important role in educational achievement. Hot EF is comprised of cognitive processes supported by emotional awareness. Given that child maltreatment is associated with emotional arousal difficulty, we explored the degree to which hot and cold EF tasks are differentially impacted by a history of child maltreatment. Our research approach involved modifying two traditional cool EF tasks (Tower of London and Go/No Go) in order to compare an individual's performance in both the cool and heated version of the task. An important aspect of our study involved comparing the relative impact of a "social heating" (i.e., emotion faces) versus a "nonsocial heating" (monetary reward). We believed individuals with a maltreatment history would show relatively more difficulty with social heating. The data suggested that there were some sensible correlations between the subscales of a trauma questionnaire and other EF measures. Overall, we were unable to find clear group effects suggesting that a larger sample size would be beneficial.

Keywords: *executive functioning, hot and cool, maltreatment*

In this investigation, we are exploring individual differences in executive functioning, toward the goal of understanding why some individuals in a college setting may have relatively more difficulty in academics and attrition. Executive functions are a set of cognitive processes (e.g. working memory, planning, flexibility, shifting) that support goal-directed behavior. Individuals who have impaired executive functions but relatively spared overall IQ tend to exhibit more difficulty in real-world settings as far as decision making and self-efficacy. Our examination of executive functioning will consider a very contemporary approach that emphasizes both *hot* and *cool* executive processes. The traditional cool executive function approach that has been studied for decades (Peterson & Welsh, 2014) has emphasized testing in laboratory settings designed to minimize emotional or motivational factors (i.e. heat). Such an approach reduces ecological validity and may fail to explain individual differences that emerge in real-world settings. In contrast, hot executive functioning involves cognitive processes which are exhibited in high arousal, emotional, or motivational settings

(Peterson & Welsh, 2014). The study of both hot and cool processes emphasizes the important principle that traditional cool processes such as working memory, planning, and inhibition always occur in a context. Contexts differ with respect to their emotional salience (e.g., a student in a quiet, relaxed laboratory versus an adolescent in an automobile with three peers). The integration of both hot and cool processes into the executive functioning framework may help explain some individual differences. In particular, the examination of hot processes may provide an explanation as to why some individuals have so much more difficulty in everyday life despite relatively normal cool executive functioning. To date, this approach has been adapted for study to help understand many groups with known difficulties, such as adolescents (Zelazo & Carlson, 2012) and those struggling with addiction (Hagen et al., 2016)).

To date, two different approaches have been very successful for the exploration of hot and cool executive functioning. First, researchers have developed tasks that are specifically designed to measure hot executive processes in order to include these into a battery of executive tasks (i.e.,

including both hot and cool tasks). Second, researchers have taken traditional cool tasks and adapted them in order to create a heated version of the task. For example, the task may be made more stressful (e.g., based on difficulty or potential negative feedback) or potentially rewarding (e.g., based on the chance to win a reward for strong performance). Our investigation included both of these approaches through three established tasks.

One of the first tasks for exploring hot executive functions, the Iowa Gambling Task, was developed by Bechara, Damasio, Damasio, and Anderson (1994). In this task, participants play a card game that assesses response to reward and punishment. Across the task, participants have the opportunity to choose a card from one of four different decks. Two of the decks of cards present participants with more immediate large awards, but worse performance as choosing from those decks of cards ultimately leads to loss. In contrast, the other two decks of cards present much smaller immediate rewards, but lead to an overall gain at the end of the task. Bechara et al. (1994) found that healthy participants demonstrated a pattern of gradual learning over the 100 trials of the task resulting in high scores with preference for the less risky decks of cards. The researchers found that the performance of those who did not exhibit a pattern of learning throughout the duration of the task and exhibited poor performance overall could be attributed to one or more of three decision-making deficits: hypersensitivity to reward, hyposensitivity to punishment, or myopia for the future. Since the development of this task (originally for the study of patients with focused brain damage in the ventromedial prefrontal cortex), many research studies have used it to assess individual differences in one aspect of hot executive processing (e.g., adaptive decision making in the context of a reward).

A second task for exploring traditional executive functions, the Go/No-Go Task, assesses sustained attention and response control. Across the task, participants have the opportunity to make a motor response or inhibit an action when presented with stimuli upon a computer screen.

Participants are given instructions on which stimuli they need to make a response (go) or inhibit an action (no-go). In an effort to manipulate the traditional task to assess hot executive functions, the task can include a cool block of trials (make a response to color), a warm block of trials (make a response to a neutral face), and a hot block (make a response to an emotion face). Casey et al. (2011) used a longitudinal study where the participants completed a delay of gratification task when they were four years old, and then given a Go/No-Go task when they were in their forties. The Go/No-Go task consisted of using face stimuli to heat the task by using happy, fearful, and neutral faces as the targets in the task. Casey et al. (2011) found that there was a difference between the delay groups only when exposed to the presence of emotional cues, which were the happy and fearful faces. This research suggested that there were larger performance differences only when participants were in the presence of hot emotional cues suggesting the distinction between hot and cool executive functioning.

Shallice (1982) developed the Tower of London task which is a relatively cooler executive functioning task in order to assess impairments in planning processes. Within the task, participants are presented with colored discs placed upon three different sized pegs and a disc number restriction for each peg. Participants are given an initial setup of discs in a certain pattern and are asked to move discs within a certain number of moves in order to attain a goal finishing state. Shallice (1982) found that participants who visualized the solution in advance and exhibited mental preplanning overall had a better performance on the task. Poor performance during the Tower of London task can be attributed to participants not being able to plan efficiently. In an effort to heat the task and assess differences in hot versus cool executive functioning, the Tower of London task can include manipulations such as monetary rewards in exchange for a certain level of performance in order to determine if incentives impact performance levels across the task.

One group that is particularly interesting for an examination of hot and cool executive functioning is individuals with a history of child maltreatment. Child maltreatment can be defined as any type of abuse and neglect (e.g., physical, sexual, and emotional) to a child under the age of 18 years old by a parent or other individual in a custodial role (Centers for Disease Control and Prevention, 2015). Many maltreatment studies that have examined college students have used the Childhood Trauma Questionnaire (Bernstein & Fink, 1998), a self-report instrument that measures emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect. Exposure to violence could influence child-development pathways and trauma-related psychopathology. For example, children who experienced higher amounts of relatively severe child-directed violence from parents demonstrated attention bias to threat, as well as higher amounts of anxiety and fear in response to threats (Briggs-Gowan et al., 2015). Children who demonstrate attention bias to threat may respond differently when exposed to facial stimuli of fear and anger as compared to those without a history of child-directed violence. Bar-Haim et al. (2007) suggested that attention bias stems from the tendency to dedicate more attention in an unbalanced manner towards less extreme threats such as images of anger. In a study completed by Ferguson (2013), the researcher found a significant relationship between the use of spanking and corporal punishment with long-term negative outcomes on externalizing behaviors, internalizing behaviors, and cognitive performance. He also found little evidence to support the advantages of the use of spanking and other forms of punishment that involve physical violence. This suggests that children who are exposed to these types of punishments could face more difficulty when completing tasks, and maintaining good social interactions, as they develop into adulthood.

The purpose of this study is to fill the gap in executive functioning research in terms of hot versus cool executive functioning. Further, a history of child maltreatment in childhood has been associated with emotional arousal difficulties and other executive functioning deficits; this project will help to determine if and how a history of child maltreatment affects individuals and their ability to complete cognitive functioning tasks. We want to observe the degree to which heated executive functioning tasks differentially impact an individual's performance during these tasks. In order to complete this research, we modified three traditional executive functioning tasks (i.e., Tower of London, Iowa Gambling, and Go/ No-Go) in order to compare performance in a heated and cool version of each task. In doing so, we will be manipulating each task in order to explore the degree to which social versus nonsocial heating will impact performance on a given task. We predict that students with a history of child maltreatment may show more difficulty with performance during executive functioning tasks. We also believe that students will be more impaired during their performance on executive functioning tasks that have been manipulated to have a social heating component.

METHOD

Design and Variables of Interest

In order to address our research question and to support or reject the findings in my hypothesis, we conducted a quasi-experimental design in which participants were exposed to two different executive functioning tasks. The tasks were purposefully manipulated with a heating construct to assess how an emotionally charged task can affect an individual's performance in exhibiting cognitive control. The two executive functioning tasks contained a heated component of social and nonsocial manipulations to assess different types of hot executive functioning. Both sets of executive functioning tasks had a control without heating in order to give participants an introduction to the task they were completing. The social heated manipulation exposed participants to different facial stimuli containing fearful, angry, and neutral faces in a Go/No-Go task. The nonsocial heated manipulation had participants be required to complete a Tower of London task by performing different blocks of trials with an

accuracy stipulation in order to obtain a monetary incentive of a lottery scratch ticket. This project is part of a larger ongoing study. My piece of the larger study separate from the other researchers was to assess performance differences on hot and cool executive functioning, and to determine how a history of child maltreatment affected performance on different types of manipulations surrounding hot and cool executive functioning

Participants

Male and female participants ($N = 66$, mean age = 19 years) were recruited from an Introductory Psychology Course Participant pool using the SONA system. All introductory psychology students must participate in eight credits of research toward their course grade; this experiment and description were posted to the system as one of several options, and students signed up for available testing sessions according to their schedules. There were no exclusionary criteria. Students received up to six credits of research participation towards their requirement for their psychology course.

Executive Functioning Tasks

Go/No-Go

The Go/No-Go task is an executive functioning task that tests participants on attention and response control. This task involves a computer program that contains a central fixation cue followed by a series of images. The objective of the task is to perform an action such as pushing a button in response to a certain set of stimuli known as the go portion of the task. Another objective of this task is to inhibit an action based on a different set of stimuli known as the no-go portion of the task. This task will measure reaction times in addition to correctness in response to go/no-go actions. Our task included practice trials with simple different colored shapes with assigned go/no-go actions, followed by trials consisting of images of faces with different facial expressions with assigned go/no-go actions.

Iowa Gambling Task

The Iowa Gambling Task (Bechara et al., 1994) is an executive functioning task that tests

participants on their performance during a monetary reward and punishment task. The task involves a computer simulation where four decks of cards are presented on the screen. By selecting one of the cards from any given deck, the computer will alert the participant to some amount of money won with the potential to lose money simultaneously. The objective of the task is to exceed the initial amount borrowed of money by selecting cards until the computer instructs the participant stop. Advantageous performance during gambling is for participants to forego larger immediate sums of money for smaller longer term rewards to prevent from more major losses.

Tower of London

The Tower of London task is an executive functioning task that tests participants on their ability to plan. The task involves a peg puzzle board and a set of different colored beads. The objective of the task is to rearrange the beads to match a designated model in a certain number of moves. The Tower of London will measure how effective a participant is at planning or visualizing the solution in advance of moving the beads. Our task will include practice trials, followed by trials consisting of monetary incentives based on correct responses. Our trials will differentiate with number of moves required to obtain a correct response. Some of the trials will have more than one way to correctly solve the puzzle.

Measures

Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) Vocabulary Subtest

The WAIS-IV (Wechsler, 2008) is an assessment that measures cognitive ability using a core battery of 10 subtests that focus on four domains of intelligence: verbal comprehension, perceptual reasoning, working memory, and processing speed. The vocabulary subtest of the WAIS-IV consists of 30 items increasing in vocabulary difficulty. Participants were asked to provide definitions to words provided. The vocabulary subtest measures word knowledge and verbal concept formation. The WAIS-IV features a normative sample of 2,200 adults and was

stratified by age, gender, education level, ethnicity, and region to provide the highest reliability of results.

Symptom Checklist-90 Revised (SCL-90-R)

The SCL-90-R (Derogatis, 1994) is an instrument that helps evaluate a range of symptoms of psychopathology and psychological problems. It consists of 90 items that yields nine symptom subscales: Somatization, Obsessive-Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism. The assessment also provides two global indices: the Global Severity Index (measures overall psychological distress) and the Positive Symptom Distress Index (measures the intensity of symptoms). For each item, participants were asked to rate how much they were distressed by it on a 5-point scale (0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit, 4 = extremely). The SCL-90-R is an established instrument and has over 1,000 independent studies supporting its reliability and validity.

Childhood Trauma Questionnaire (CTQ)

The CTQ (Bernstein & Fink, 1998) is a retrospective self-report measure of childhood and adolescent abuse and neglect experiences. It consists of 28 items and yields five subscales: three scales assess different forms of abuse (Emotional, Physical, and Sexual) and two assess neglect (Emotional and Physical). For each item, participants were asked to report the frequency of a behavioral occurrence on a 5-point scale (1 = never true, 2 = rarely true, 3 = sometimes true, 4 = often true, 5 = very often true). CTQ scores can be compared to data from more than 2,200 males and females from seven different clinical and community samples, representing a broad range of ages, socioeconomic statuses and different racial/ethnic groups. The CTQ has been used extensively in trauma literature and helped us obtain a sample that specifically included our population of interest, which were young adults with a history of stressful or traumatic interpersonal experiences.

Trauma Symptom Checklist (TSC-40)

The TSC-40 (Elliot & Briere, 1992) is a 40-item self-report instrument that evaluates symptoms associated with childhood or adult traumatic experiences. It consists of six subscales: Anxiety, Depression, Dissociation, Sexual Abuse Trauma Index, Sexual Problems, and Sleep Disturbance. Participants are asked to rate the frequency of each symptom over the prior 2 months. Response options range from 0 (never) to 3 (often). For participants who endorse a trauma history, the TSC-40 is a measure used to briefly screen for the presence of symptoms associated with posttraumatic stress disorder (PTSD) and gauge the individual's current levels of distress.

Reactions to Research Questionnaire-Revised (RRQR)

This brief questionnaire helps provide the research assistant a sense of whether the participant has experienced any stress. It greatly facilitates the process of checking in with our participants. The procedure involves a decision tree that guides our experimenters in the event that an individual has experienced stress.

Demographics Form

The demographics form is a brief questionnaire that has the participant report age, gender, ethnicity, semesters completed of school, and mother's highest level of education.

Aggression Questionnaire (AQ)

The AQ (Buss & Warren, 2000) is a 34-item questionnaire that measures an individual's aggressive responses and their ability to channel those responses in a safe manner. Response options range on a 5-point scale from (1 = not at all like me to 5 = completely like me). Norms are based on an age-stratified sample of 2,138 individuals; separated by sex for Verbal and Physical Aggression Scales. The AQ consists of 5 subscales: Physical Aggression, Verbal Aggression, Anger, Hostility, and Indirect Aggression.

Student Adaptation to College Questionnaire (SACQ)

The SACQ (Baker & Siryk, 1989) is a 67-item self-report questionnaire that helps determine how well a student is adjusting to college. The SACQ focuses on 4 subareas: Academic Adjustment, Personal-Emotional Adjustment, Social Adjustment, and Attachment to the institution. Norms are based on a sample of more than 1,300 male and female college freshmen and stratified by semester of attendance (first and second semesters in college).

Psychopathic Personality Inventory-revised (PPI-R)

The PPI-R (Lilienfeld & Widows, 2005) is a 154-item self-report measure of both global psychopathy and the component traits of psychopathy. It has been designed to detect traits that are related to psychopathy that can be found along a continuum in any typical population, and therefore it is appropriate for use with a college sample. The survey includes subscales measuring: egocentricity, non-planfulness, non-conformity, blame externalization, social influence, fearlessness, and cold-heartedness. Standardized and validated for use with men and women in a community/college sample that reflects 2002 U.S. Census data for race/ethnicity, educational background, and geographic area.

Interpersonal Reactivity Index (IRI)

The IRI (Davis, 1983) is a 28-item self-report questionnaire that assess four separate aspects of empathy and its relationships with measures of social functioning, self-esteem, emotionality, and sensitivity. The IRI uses a 5-point response scale (1 = does not describe me well to 5 = describes me very well). The IRI has four subscales for empathy: Perspective Taking, Fantasy, Empathic Concern, and Personal Distress.

Procedures

Participants were asked to sign a consent form before beginning the executive functioning tasks or questionnaires. We collected data on their performance in a socially heated Go/No-Go task, a cool version of the Go/No-Go task, a nonsocial heated Tower of London task, and a cool version of the Tower of London task. Following the completion of the executive functioning tasks, the participants were asked to complete a series of questionnaires assessing history of child maltreatment and other behavioral variables.

Go/No-Go

The Go/No-Go task contained two blocks of trials. Block 1 contained a central fixation cue on the computer screen for 500ms. A neutral stimulus of either a yellow or blue colored rectangle was presented on the computer screen for 500ms followed by a button press for go trials of the blue rectangle, and incorrect data recorded for go responses on the no-go trials of the yellow rectangle. Following each button press, there was a 1s inter-trial interval. This was repeated 120 times, and then participants were given a break before completing block 2. Block 2 contained a central fixation cue on the computer screen for 500ms. A heated stimulus of an emotional face consisting of a neutral, fearful, or angry expression was presented on the computer screen for 500ms followed by a button press for go trials of a specific gender, and incorrect data recorded for go responses on the no-go trials of the opposite gender depending on the gender chosen for the go trials. Following each button press, there was a 1s inter-trial interval. This was repeated 180 times with 60 trials of each facial expression.

Iowa Gambling Task

For the 100 trials of the Iowa Gambling Task, participants were told that if they could successfully exceed the initial amount of money borrowed at the start of the task, participants would win a scratch ticket. Participants were presented with four decks of cards on the screen and began the task with $2000. Participants were asked to continue selecting cards from the deck of their choice until the computer instructed them to stop. At the end of the task, if winnings exceeded the initial amount of money borrowed, participants were given the scratch ticket as their winnings.

Tower of London

For the thirty trials of the Tower of London task, participants were told that on some blocks of trials, they would have the opportunity to win a scratch ticket, and on other blocks of trials, no monetary incentive would be rewarded. On the incentivized blocks of trials, participants were told that they had to get 4 out of 5 problems correct in order to win the scratch ticket. All participants were given the hot conditions on the following blocks of 5 trials: block 1, block 3, and block 5. They were told whether they won the scratch ticket after each block of trials, and were given the ticket. However, they were not allowed to scratch them off until after the test session was over. On the non-incentivized "cool" blocks of trials, they were told to do their best, but there was no opportunity to win the scratch ticket. Each block of trials varied on the number moves in order to obtain the correct answer. Two blocks contained four total moves, two blocks contained five total moves, and the remaining two blocks contained six total moves.

Debriefing

At the end of the entire test session, the researcher debriefed the participants and checked in to see how the participants were feeling. Participants were given the opportunity to ask questions and were given a debriefing sheet to take home. A debriefing decision tree was created for the purpose of assessing distress in the participants.

RESULTS

Demographics

A total of 66 participants completed the study, including 19 males and 47 females. Thirty-three participants were assigned to the control group and 33 participants to the child maltreatment group. The average age of participants was 19.35 ($SD = 2.18$). Additional participant demographics are presented in Table 1. Participants were assigned to the maltreatment group if they reported a certain level of maltreatment within one or more of the subscales of the Childhood Trauma Questionnaire. Additional data and scores for the Childhood Trauma Questionnaire are presented in Table 2.

Assessment of Planning Skills in the Tower of London Task

To examine how effective participants were at planning or visualizing the solution in advance of moving the beads, mean scores on accuracy were compared between the two groups. A repeated-measures ANOVA was conducted with a 2 (group assignment) x 3 (block) x 2 (heat interaction) design, with group as the between-subjects variable. The dependent variable was accuracy. Scores were comparable between the control group and maltreatment group (see Table 3). There were no group main effects or group x block or group x heat interactions. We found a block main effect, $F(2, 118) = 37.17$, $p < .0001$; 4-move block trials were more accurate than the 5-move and 6-move blocks, which did not differ from one another (see Table 4). There was a heating main effect, $F(1, 59) = 51.85$, $p < .0001$; the heated trials were more accurate than cool trials. In addition, there was a block x heat interaction, $F(2, 118) = 8.67$, $p < .0001$; the heating (incentive) manipulation had its greatest impact on the 4-move and 6-move blocks.

Assessment of Real-Life Decision Making Skills in the Iowa Gambling Task

To examine how effective participants were at real-life decision-making skills, where performance required participants to forgo immediate rewards for smaller rewards to achieve a better outcome, mean scores for adaptive decision making were compared between the two groups (see Table 5). A repeated-measures ANOVA was conducted with a 2 (group assignment) x 5 (block) repeated design on adaptive responses (positive scores reflect more adaptive deck choices), with groups as the between-subjects variable. There were no group main effects or group by condition interactions. There was a block main effect, $F(4, 240) = 19.66$, $p < .0001$. Block 1 was less adaptive than all the following blocks. There was a block x group interaction, $F(4, 240) = 3.05$, $p = .02$; the control group was riskier than maltreatment group in block 1, but more adaptive in block 2. However,

in blocks 4 and 5, maltreatment group was more adaptive than control group.

Figure 1. Average reaction times (ms) during a Go/No-Go Task when participants were presented with emotion faces stimuli (i.e. anger and fear)
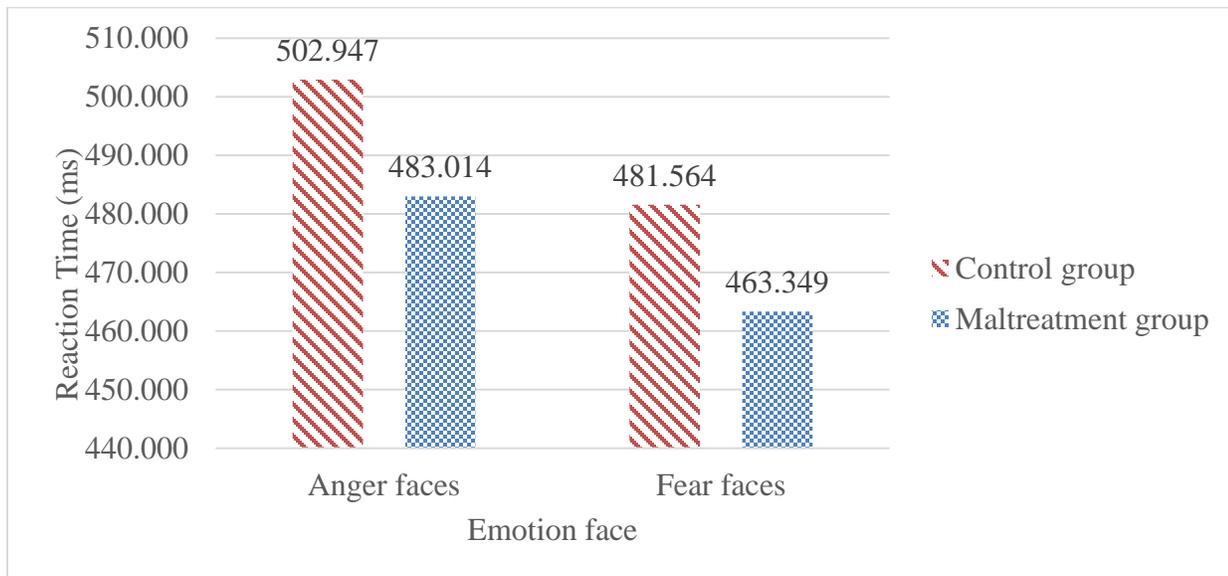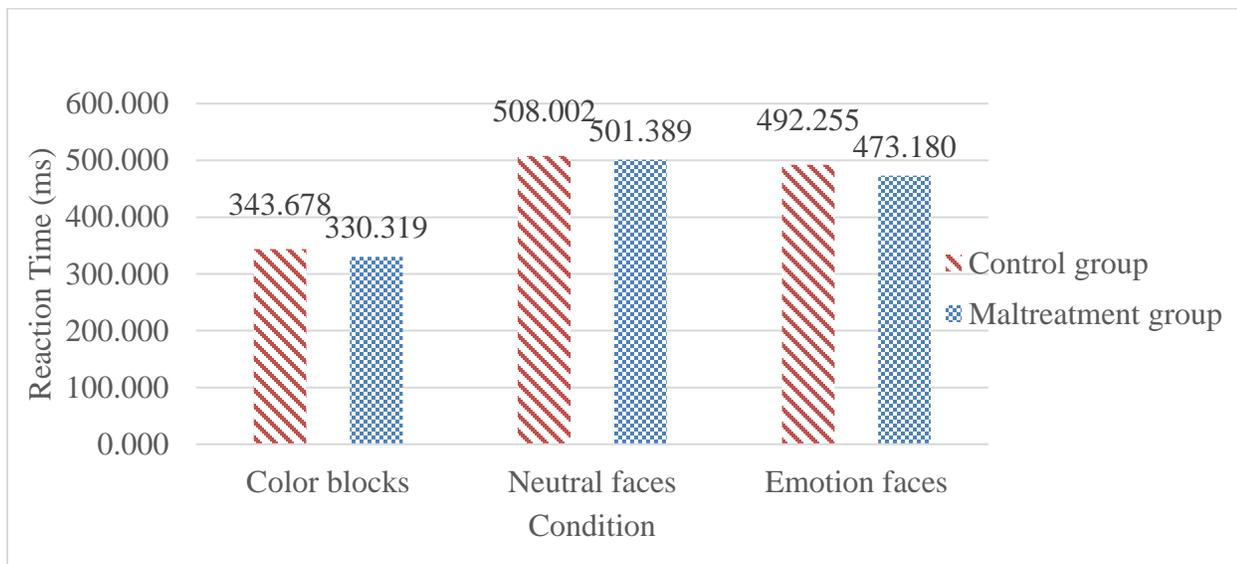

Figure 2. Average reaction times (ms) during a Go/No-Go Task when participants were presented with each of the conditions (i.e. color blocks and face stimuli).

Assessment of Impulse Control in the Go/No-Go Task.

To examine how effective participants were at performing or inhibiting a response to a certain set of stimuli, mean scores for reaction time and accuracy were compared between the two groups (see Tables 6, 7, 8, and 9).

Reaction Time

A repeated-measures ANOVA was conducted with a 2 (group assignment) x 3 (go conditions)

design on reaction time. We found a main effect for condition, $F(2, 120) = 310.44$, $p < .0001$; color condition was fastest, followed by emotion face stimuli, and neutral face stimuli. A second-repeated measures ANOVA was conducted with a 2 (group assignment) x 2 (emotion face) design on reaction time. We found a main effect for emotion face, $F(1, 60) = 18.28$, $p < .0001$; reaction time for fear face stimuli was faster than angry face stimuli.

Figure 3. Average accuracy during a Go/No-Go Task when participants were presented with each of the conditions (i.e. color blocks and face stimuli) during the *go* trials
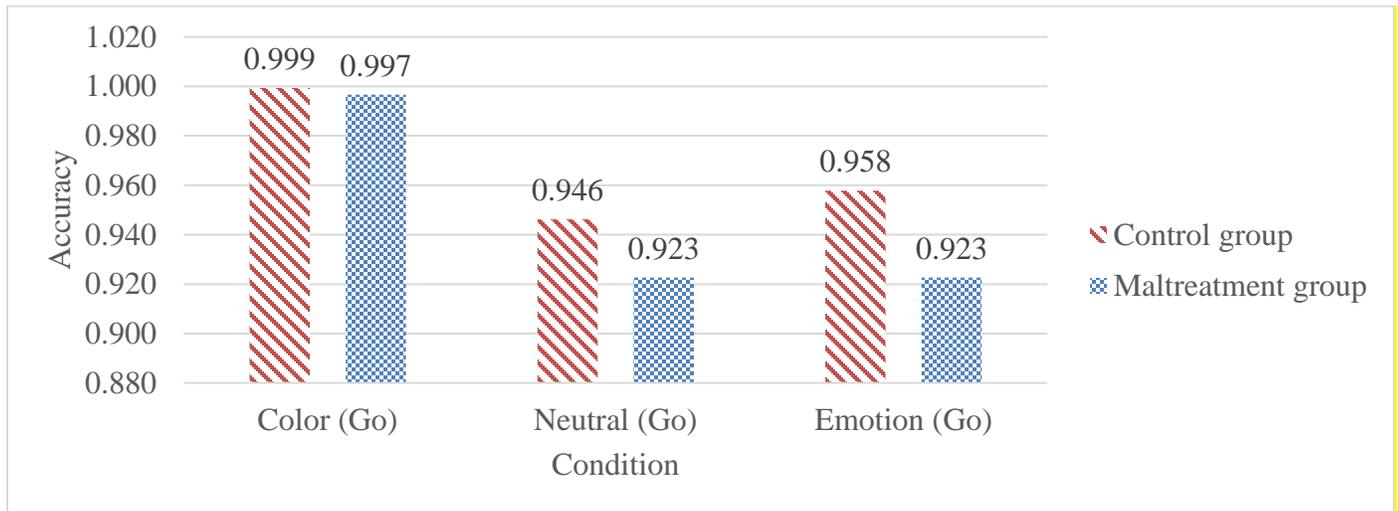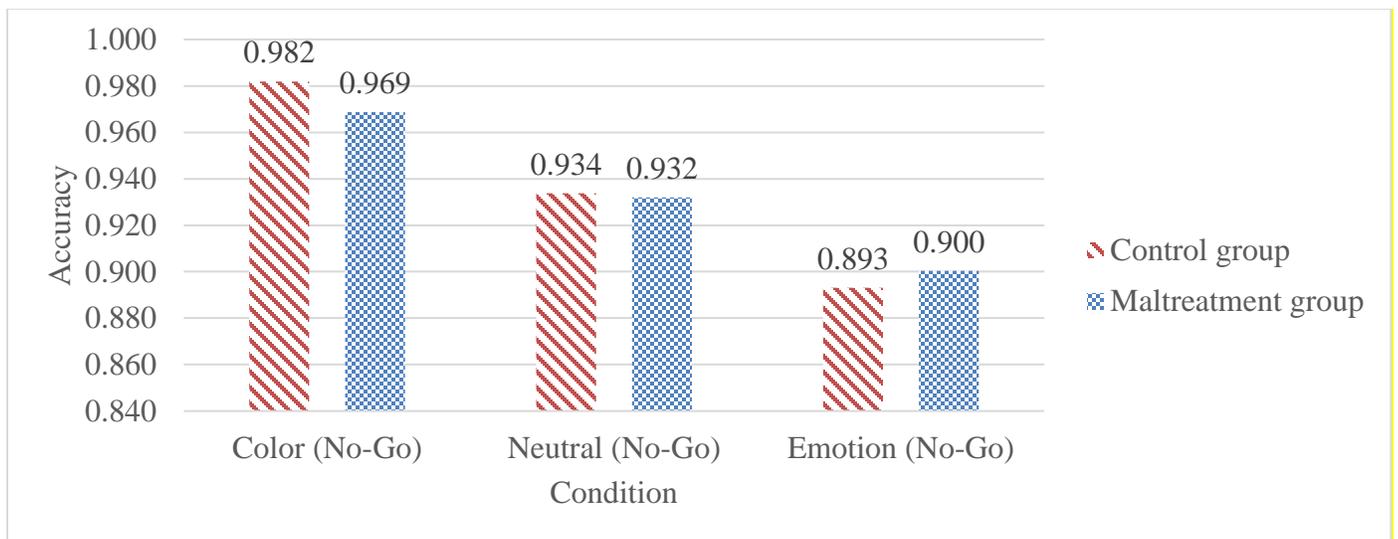

Figure 4. Average accuracy during a Go/No-Go Task when participants were presented with each of the conditions (i.e. color blocks and face stimuli) during the *no-go* trials.

Accuracy on Go and No-Go Trials

A repeated-measures ANOVA was conducted with a 2 (group assignment) x 3 (condition) x 2 (go/ no-go) design on accuracy of response. There was a condition main effect, $F(2, 120) = 73.21$, $p < .0001$; color condition had best accuracy, followed by neutral face stimuli, and emotion face stimuli. There was a Go/No-Go main effect, $F(1, 60) = 5.23$, $p = .03$; the accuracy on go trials was better than during no-go trials. In addition, we

found a condition x Go/No-Go interaction, $F(2, 120) = 3.62$, $p = .03$; the largest difference in accuracy was during the emotion trials. A second repeated-measures ANOVA was conducted with a 2 (group assignment) x 2 (emotion face) x 2 (go/no-go) ANOVA on accuracy. We found an emotion face main effect, $F(1, 60) = 6.34$, $p = .02$; angry faces had more accuracy than fear faces. In addition, we found a Go versus No-Go main effect, $F(1, 60) = 8.03$, $p = .01$; go trials were more accurate than no-go trials.

Figure 5. Average accuracy during a Go/No-Go Task when participants were presented with emotion faces stimuli (i.e. anger and fear) during the *go* trials.
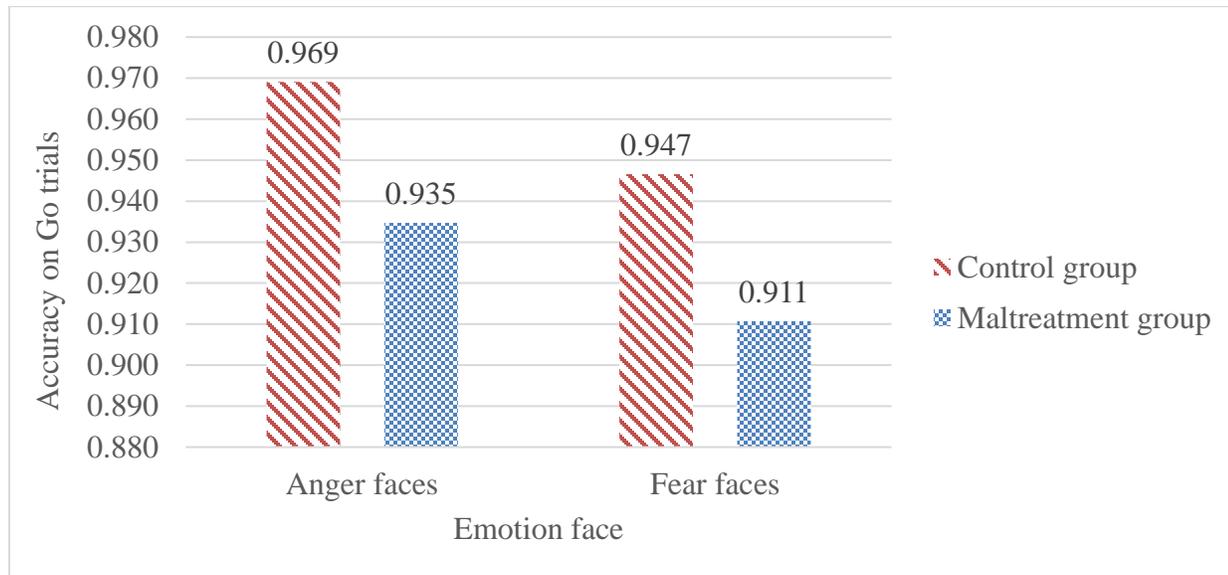

Figure 6. Average accuracy during a Go/No-Go Task when participants were presented with emotion faces stimuli (i.e. anger and fear) during the *no-go* trials.

Correlations between CTQ Subscales on Executive Functioning Measures

We conducted bivariate correlations between CTQ total and separate scale scores and the executive functioning scores for the full sample (collapsed over group; see Table 10).

Tower of London Task

No correlations were found with the Tower of London scores.

Go/No-Go Task

Both reaction time and accuracy were considered in relation to the subscales of the CTQ.

Reaction Time

Color go trials negatively correlated with emotional abuse, $r(61) = .24$, $p = .03$. Neutral go trials negatively correlated with emotional abuse, $r(61) = -.23$, $p = .04$, emotional neglect, $r(61) = -$ .23, $p = .04$, and CTQ total, $r(61) = -.22$, $p = .046$. Emotion face go trials negatively correlated with emotional abuse, $r(61) = -.31$, $p = .01$, and CTQ total, $r(61) = -.25$, $p = .03$. Emotion anger face go trials negatively correlated with emotional abuse, $r(61) = -.29$, $p = .01$, physical abuse, $r(61) = -.22$, $p = .04$, and CTQ total, $r(61) = -.25$, $p = .02$. Emotion fear face go trials negatively correlated with emotional abuse, $r(61) = -.29$, $p = .01$, and CTQ total, $r(61) = -.22$, $p = .05$.

Accuracy

Color block go accuracy negatively correlated emotional neglect, $r(61) = -.25$, $p = .02$. Color block no-go negatively correlated with emotional abuse, $r(61) = -.23$, $p = .03$. Emotion face no-go negatively correlated with sexual abuse, $r(61) = -$ .24, $p = .03$. Emotion anger face no-go negatively correlated with sexual abuse, $r(61) = -.25$, $p = .03$;

however, no correlations were found with emotion fear face.

Iowa Gambling Task

Block 2 adaptive responding negatively correlated with emotional abuse, $r(63) = -.28$, $p = .01$, emotional neglect, $r(63) = -.24$, $p = .03$, physical neglect, $r(63) = -.21$, $p = .046$, and CTQ total, $r(63) = -.27$, $p = .02$. Block 3 negatively correlates with emotional abuse, $r(63) = -.25$, $p = .03$, and emotional neglect, $r(63) = -.21$, $p = .047$. We found no correlations between CTQ scores and blocks 1, 4, or 5.

DISCUSSION

The purpose of this study was to fill the gap in executive functioning research in terms of hot versus cool executive functioning and see if a history of child maltreatment played a role in performance during executive functioning tasks in a college student sample. Child maltreatment in childhood has been associated with emotional arousal difficulties and other executive functioning deficits. Due to those challenges, we predicted that college students who had a history of child maltreatment would show a relatively more difficult time in performing executive functioning tasks and more specifically, tasks involving emotional arousal.

The data suggested that there were some sensible correlations between the subscales of the Childhood Trauma Questionnaire and the other measures (i.e. Tower of London, Iowa Gambling, and Go/No-Go). Overall, we were unable to find clear group effects between the control group and maltreatment group suggesting that a larger sample size would be beneficial. In addition, heterogeneity in our sample could have had an impact on our findings.

Some effects found during the study were that during certain parts of each task, there were times that performance was higher in a certain group, and would change throughout the duration of the task (i.e. Iowa Gambling Task and adaptive responses, Go/No-Go and accuracy, and Tower of London and accuracy). A large portion of the effects found were within-group effects, even though we were unable to find any group main effects or group by condition interactions.

Our limitation for this study was the sample size. Due to only having 33 participants in each group, this limited the ability to find large group effects within our sample. The goal of this study will be to continue to recruit participants over the course of several years in order to obtain a sample size that could reveal more potential group effects on executive functioning performance. In the future, if a larger sample size could reveal larger and more significant group effects, hot executive functioning performance could serve as an important link between child maltreatment experiences and college adaptation and achievement. Studies with hot executive functions is a large growing trend in order to predict life outcomes. Hot executive functioning skills could become an important focus on intervention efforts to improve academic outcomes for the college student population and lead to future research on how those skills could improve other real-world outcomes.

REFERENCES

Baker, R. W. & Siryk, B. (1989). *Student Adaptation to College Questionnaire manual*. Los Angeles, CA: Western Psychological Services.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van Ijzendoorn, M. H. (2007). Threat related attentional bias in anxious and non anxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*, 1–24. doi:10.1037/0033-2909.133.1.1

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, *50*, 7–15. doi:10.1016/0010-0277(94)90018-3

Bernstein, D. P. & Fink, L. (1998). *Childhood trauma questionnaire: A retrospective self-report manual*. San Antonio, TX: The Psychological Corporation.

Briggs-Gowan, M. J., Pollak, S. M., Grasso, D., Voss, J., Mian, N. D., Zobel, E., . . . Pine, D. S. (2015). Attention bias and anxiety in young children exposed to family violence. *Journal of Child Psychology and Psychiatry*, *56*, 1194-1201. doi:10.1111/jcpp.12397

Buss, A. H. & Warren, W. L. (2000). *Aggression questionnaire: Manual*. Los Angeles: Western Psychological Services.

Casey, B. J., Somerville, L., Gotlib, I., Ayduk, O., Franklin, N., Askren, M., . . . Shoda, Y. (2011). Behavioral and neural correlates of delay of gratification 40 years later. *Proceedings of the National Academy of Sciences, 108*, 14998-15003. doi:10.1073/pnas.1108561108

Centers for Disease Control and Prevention. (2015). *Child maltreatment prevention*. Retrieved from http://www.cdc.gov/violenceprevention/child maltreatment/

Davis, M. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, *44*(1), 113-126. http://dx.doi.org/10.1037/0022-3514.44.1.113

Derogatis, L. R. (1994). *SCL-90-R: Administration, scoring, and procedures manual*. Minneapolis, MN: National Computer Systems.

Elliot, D. M. & Briere, J. (1992). Sexual abuse trauma among professional women: Validating the Trauma Symptom Checklist-40 (TSC-40). *Child Abuse & Neglect*, *16*, 391-398. doi:10.1016/0145-2134(92)90048-V

Ferguson, C. J. (2013). Spanking, corporal punishment and negative long-term outcomes: A meta-analytic review of longitudinal studies. *Clinical Psychology Review*, *33*, 196–208. doi:10.1016/j.cpr.2012.11.002

Hagen, E., Erga, A. H., Hagen, K. P., Nesvåg, S. M., McKay, J. R., Lundervold, A. J., & Walderhaug, E. (2016). Assessment of executive function in patients with substance use disorder: A comparison of inventory- and performance-based assessment. *Journal of Substance Abuse Treatment, 66*, 1-8. http://dx.doi.org/10.1016/j.jsat.2016.02.010

Lilienfeld, S. O. & Widows, M. R. (2005). *Psychopathic Personality Inventory–Revised: Professional manual*. Lutz, FL: Psychological Assessment Resources.

Peterson, E. & Welsh, M. C. (2014). The development of hot and cool executive functions in childhood and adolescence: Are we getting warmer? In S. Goldstein, & J. A. Naglieri (Eds.), *Handbook of executive functioning* (pp. 45-65). New York, NY: Springer Science+Business Media. doi:10.1007/978-1-4614-8106-5_4

Shallice, T. (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, 298*, 199-209. doi:10.1098/rstb.1982.0082

Wechsler, D. (2008). *WAIS-IV administration and scoring manual*. San Antonio, TX: Psychological Corporation.

Zelazo, P. D., & Carlson, S. M. (2012). Hot and cool executive function in childhood and adolescence: Development and plasticity. *Child Development Perspectives*, *6*(4), 354-360. doi:10.1111/j.1750-8606.2012.00246.x