

THE EFFECTS OF CHILD MALTREATMENT ON FIXATION PATTERNS AND
EMOTION RECOGNITION

A Thesis
by
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Abstract

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Child maltreatment is a pervasive problem that affects thousands of children each year. Several studies have found links between child maltreatment and impaired cognitive functioning, such as working memory, in children and young adults. Other studies have found links between child maltreatment and impaired emotion recognition and processing in both children and adults. To this date, there has been no research on how child maltreatment affects fixation patterns in regards to negative and positive stimuli. The purpose of this study was to investigate emotion recognition and fixation patterns in young adults with a history of child maltreatment. Participants included 49 undergraduate students recruited through SONA. Participants completed the SLESQ and the CTQ to assess for trauma and maltreatment. Participants who indicated no physical abuse or neglect were in the comparison group, while those who indicated physical abuse, emotional abuse, sexual abuse, or emotional neglect were recruited as part of the general abuse group. Those who reported physical neglect were included in the physical neglect group. Participants partook in an eye-tracking task where they were presented with varying facial stimuli and instructed to label the

expression. Results indicated that child maltreatment did not affect emotion labeling accuracy, nor did it affect how and where participants fixated on particular facial features. These results suggest that child abuse does not affect attentional biases toward particular facial features, and thus does not affect emotion recognition in young adults.

Keywords: child maltreatment, facial recognition, eye-tracking, fixation patterns, attentional bias

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Dedication

I dedicate this thesis to my parents, Linda and David Mohr, who have always provided me with the support and encouragement to pursue my educational goals. I would also like to dedicate this thesis to my friend, Cassy Standish, for providing an endless amount of support and understanding throughout this process. I would also like to dedicate this thesis to anyone who has ever been the victim of child abuse.

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Forward

This thesis is written in accordance with the style of *Publication Manual of the American Psychological Association (6th Edition)* as required by the Department of Psychology at Appalachian State University.

The Effects of Child Maltreatment on Fixation Patterns and Emotion Recognition

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Abstract

Child maltreatment is a pervasive problem that affects thousands of children each year. Several studies have found links between child maltreatment and impaired cognitive functioning, such as working memory, in children and young adults. Other studies have found links between child maltreatment and impaired emotion recognition and processing in both children and adults. To this date, there has been no research on how child maltreatment affects fixation patterns in regards to negative and positive stimuli. The purpose of this study was to investigate emotion recognition and fixation patterns in young adults with a history of child maltreatment. Participants included 49 undergraduate students recruited through SONA. Participants completed the SLESQ and the CTQ to assess for trauma and maltreatment. Participants who indicated no physical abuse or neglect were in the comparison group, while those who indicated physical abuse, emotional abuse, sexual abuse, or emotional neglect were recruited as part of the general abuse group. Those who reported physical neglect were included in the physical neglect group. Participants partook in an eye-tracking task where they were presented with varying facial stimuli and instructed to label the expression. Results indicated that child maltreatment did not affect emotion labeling accuracy, nor did it affect how and where participants fixated on particular facial features. These results suggest that child abuse does not affect attentional biases toward particular facial features, and thus does not affect emotion recognition in young adults.

Keywords: child maltreatment, facial recognition, eye-tracking, fixation patterns

The Effects of Child Maltreatment on Fixation Patterns and Emotion Recognition

Child maltreatment is a pervasive problem that affects thousands of children each year. According to the National Child Abuse and Neglect Data System (NCANDS), approximately 686,000 children were abused or neglected in the United States in 2012. Out of those 686,000 children, 78.3% experienced neglect, 18.3% experienced physical abuse, and 9.3% experienced sexual abuse (U.S. Department of Health and Human Services, 2013).

Although there is no standardized definition of child maltreatment, the Child Abuse Prevention and Treatment Act (CAPTA) has broadly described child maltreatment as “any recent act or failure to act on the part of a parent or caretaker that results in death, serious physical or emotional harm, sexual abuse, or exploitation” and “an act or failure to act that presents an imminent risk of serious harm” (Goldman, Salus, Wolcott, & Kennedy, 2003, p. 13). These descriptions of child maltreatment encompass acts of commission, such as physical, sexual, and psychological abuse, and acts of omission, such as physical, emotional, medical, and educational neglect (Center for Disease Control, 2014; Goldman et al., 2003).

Goldman et al. (2003) have identified several different subtypes of child maltreatment. Physical abuse is usually characterized by physical injury and can result from a multitude of situations, including punching, beating, kicking, and biting. Goldman et al. (2003) explained that while the act of physical abuse is intentional, injuring the child may have been accidental. Sexual abuse is any sexual or sexually motivated act involving or exploiting children. The most prevalent form of sexual abuse involves incest between fathers and daughters; however, other caretakers such as grandparents, cousins, or a parent’s significant other can commit sexual abuse.

Neglect, the most prevalent form of maltreatment, is commonly described as a parent or caretaker not meeting a child's basic needs. Physical neglect includes such instances as abandonment, delay or refusal in health care, and inadequate supervision. Educational neglect is a failure to provide education for a child (e.g., permitting chronic truancy or failing to enroll a child into a school). Emotional neglect, a failure to meet a child's psychological and emotional needs, includes such things as inadequate nurturing, permitting alcohol or drug abuse, and refusal of psychological care (Goldman et al., 2003).

Child Maltreatment and Emotional Development

Research has shown that child maltreatment can have several detrimental effects on development. For instance, child maltreatment can influence neurobiological processes, particularly regarding the development of neurons and neural pathways in early childhood (Child Welfare Information Gateway, 2015). This can lead to both cognitive and psychosocial impairments. For example, research has demonstrated that children who experience maltreatment show developmental delays in theory of mind; that is, children who experience maltreatment have difficulties understanding the beliefs and states of mind of other individuals (O'Reilly & Peterson, 2015). Research also suggests that children who experience maltreatment show deficits in self-esteem, prosocial behavior, and appear more withdrawn in social settings than children without histories of maltreatment (Kaufman & Cicchetti, 1989; Sroufe, 1979). In general, children with histories of maltreatment seem to have difficulties with peer relations (Kaufman & Cicchetti, 1989).

Physical abuse has been shown to cause direct damage to a child's developing brain, leading to long-term development impairments, as well. Shaken Baby Syndrome (SBS) can lead to a destruction of brain tissue or broken blood vessels, causing pressure to build within

the skull. In the short-term, SBS can lead to decreased levels of consciousness, seizures, and in extreme instances, death. The long-term consequences of SBS include cognitive impairments, learning disabilities, and behavior disorders (Child Welfare Information Gateway, 2015).

Along with neurobiological and psychosocial deficits, individuals with a history of child maltreatment show impairments in emotional processing. In both adults and children, child maltreatment can negatively influence the emotional processing and identification of emotional expressions in others. Research has shown that children with a history of maltreatment exhibit more aggressive behaviors and negative affect than non-maltreated children exhibit. Physically abused children are often rated higher on aggression factors on peer nomination measures and adult observer behavioral measures (Kaufman & Cicchetti, 1989; Shackman & Pollak, 2014). Electromyography (EMG) data also support the relationship between physical abuse and negative affect. Shackman and Pollak (2014) measured facial skeletal muscles in children with histories of child maltreatment and found that during aggression tasks, physically abused children exhibited elevated negative affect as compared to non-maltreated children.

Adults with a history of maltreatment have shown biases in emotional processing in the amygdala, as well. Dannlowski et al. (2013) found that adults with a history of child maltreatment showed increased excitability in the amygdala when presented with negative facial emotion stimuli but decreased excitability when presented with positive facial emotion stimuli, suggesting that maltreatment influences how an individual engages with and processes negative and positive facial stimuli.

Research has also shown that child maltreatment can affect the ability to identify emotional expressions accurately; however, the research on how child maltreatment affects emotional labeling accuracy is mixed. Some research has shown that children who experience child maltreatment are just as likely to correctly label facial expressions as non-maltreated children are; however, other research has shown differences between maltreated children and non-maltreated children in emotion recognition ability. For example, Masten et al. (2008) and Nazarov et al. (2014) found that maltreatment did not significantly affect facial expression accuracy, whereas other research has shown that maltreated individuals are worse than non-maltreated individuals at correctly identifying facial expressions (Camras et al., 1990; During & McMahon, 1991; Pollak, Cicchetti, Hornung, & Reed, 2000; Pollak & Sinha, 2002).

However, the number of facial expressions and types of facial expressions with which participants are presented could explain these conflicting results. It seems that when participants are presented with a limited number of facial expressions, typically three facial expressions, there are fewer differences between maltreated and non-maltreated participants in emotional accuracy (Masten et al., 2008; Nazarov et al., 2014). Research that includes more than three facial expressions typically shows differences in emotional accuracy (Camras et al., 1990; During & McMahon, 1991; Pollak et al., 2000; Pollak & Sinha, 2002). When three facial expressions are used, those facial expressions are typically opposing valances. For example, Masten et al. (2008) used happy, fearful, and neutral faces and Nazarov et al. (2014) used positive, negative, and neutral valances of facial expressions. When more facial expressions are added, it is possible more variability between the facial expressions becomes available, thus allowing for more differences between maltreated and

non-maltreated children to emerge (Camras et al., 1990; During & McMahon, 1991; Pollak et al., 2000; Pollak & Sinha, 2002). It is possible that this limited variability in facial expressions, such as type and amount presented, accounts for some of these conflicting results seen in the literature.

It should also be noted that participant ages across studies varied, as well. Across these studies, ages ranged from 3 to 15 years (Camras et al., 1990; During & McMahon, 1991; Masten et al., 2008; Nazarov et al., 2014; Pollak et al., 2000; Pollak & Sinha, 2002). This vast difference in ages could also account for inconsistencies in the literature. These studies also failed to account for response bias—the likelihood that an individual will respond with a particular emotional label (Isaacowitz et al., 2007). Response biases could have distorted participants' true ability to identify facial expressions.

Differences in Emotional Recognition by Abuse Type

Another potential reason for the conflicting results is that some research fails to differentiate between the sub-types of child maltreatment. When looking at different types of maltreatment in conjunction with certain emotional expressions, differences in facial expression accuracy between maltreated children and non-maltreated children are clearer. For example, Pollak et al. (2000) separated and defined maltreatment as physical abuse and physical neglect and measured emotion recognition and facial expression discrimination in children. Participants completed an emotion recognition task and an emotion discrimination task in which participants had to identify the correct emotion in a story and then discriminate between different facial expressions.

Results showed that, compared to physically abused and non-maltreated children, physically neglected children were less able to recognize emotions through the contextual

cues provided in each story. In the facial expression task, physically abused children did not significantly differ from the other groups in their ability to label anger; however, physically abused children had more difficulty recognizing sadness and disgust. Pollak et al. (2000) also found that physically abused children had a response bias toward angry faces and physically neglected children had a response bias toward sad faces, meaning that physically abused children and neglected children were more likely to choose an angry or sad label when presented with the faces. Results also showed that physically abused children were more likely to label a neutral face as anger or sadness. Physically abused children also perceived more distinction between anger and sadness, fear, and disgust (Pollak et al., 2000).

Neglected children, on the other hand, perceived less distinction between angry, sad, and fearful faces as compared to physically abused children and comparisons. Neglected children also saw a greater similarity between happy and sad faces when compared to physically abused children and comparisons. Similar to physically abused children, neglected children were also more likely to label a neutral face as anger or sadness (Pollak et al., 2000).

Reasons for Impaired Emotional Processing and Recognition

Several theories attempt to explain why maltreatment seems to affect emotional processing and recognition. Some theories attribute emotional processing and recognition deficits to parental facial behaviors and impaired emotional processing in parents, whereas other theories attribute these deficits to problems with cognition, particularly attentional bias.

Parental emotional processing and recognition. One such theory states that abusive parents are more likely to exhibit certain types of facial expressions and thus, maltreated children are able to process certain expressions to a better degree than non-maltreated children are. Camras, Grow, and Ribordy (1983) found that during an emotional expression

judgement task, maltreated children ranging from three to six years were less accurate at identifying surprise, fear, and disgust and were able to better identify happiness, sadness, and anger; however, maltreated children were overall less able to identify all facial expressions than non-maltreated children. Camras et al. (1983) theorized that abusive parents are less likely to exhibit positive expressions and more likely to exhibit negative expressions, meaning that abused children are more likely to be able to identify negative expressions. However, this theory fails to account for some of the results found in the study. Maltreated children were just as likely to label happiness accurately as they were sadness and anger. If this were a sound theory, maltreated children would have been more correct in labeling sadness and anger than happiness. This theory also implies that maltreated children would be better at identifying other negative facial stimuli such as fear. However, results clearly show that maltreated children were less accurate at identifying fear as compared to sadness and anger while also being less accurate than non-maltreated children were in the identification of all facial expressions, which noticeably contradicts this proposed theory.

Camras et al. (1990) tested maternal facial expressions and did not find evidence to support the theory that abusive mothers exhibit fewer positive facial expressions than non-abusive mothers do. One explanation for these results is that abusive mothers display different emotions in unobserved situations; however, there is no evidence to support this theory (Camras et al., 1990).

Other research has shown that abusive mothers and non-abusive mothers do not significantly differ in their ability to label facial expressions accurately, opposing the theory that abusive parents have impaired emotional recognition and processing (During & McMahan, 1991). A meta-analysis found similar results when looking at parents with a high

risk for physical abuse. Parents who were at high-risk for parental abuse did not significantly differ from low-risk parents in their ability to recognize emotions and correctly identify emotions (Wagner et al., 2014). While there are few studies examining the role of parental emotional processing and recognition, the results from these studies suggest that parental emotion recognition does not lead to deficiencies in childhood emotion recognition. Based on this evidence, the theory that parental emotion recognition causes impairments in childhood emotion recognition is less than sound.

Attentional processes. Another explanation for impaired emotional recognition is that individuals who have histories of maltreatment may experience problems with attentional processes, such as attentional bias. An attentional bias is an allocation of attention toward particular stimuli relative to neutral stimuli. Attentional bias typically manifests through observable characteristics, such as engagement and disengagement with stimuli (i.e., a particular stimulus attracting attention), facilitated attention (i.e., how quickly attention is drawn to a particular stimulus), and attentional avoidance (i.e., the allocation of attention toward an opposing stimulus; Cisler & Koster, 2010). Certain disorders, such as depression and anxiety, can affect these three observable characteristics of attentional bias. For example, individuals who have depression tend to have a harder time disengaging from sad faces and individuals who have anxiety tend to have a harder time disengaging from threatening stimuli (Koster, Crombez, Verschuere, & De Houwer, 2004; Sanchez, Vazquez, Marker, LeMoult, & Joormann, 2013). In regards to facilitated attention, individuals with anxiety tend to detect threatening stimuli faster than non-threatening stimuli. Anxious individuals may also avoid certain threatening stimuli, as well (Mogg, Bradley, Miles, & Dixon, 2004).

These observable characteristics of attentional bias have also been seen in individuals with histories of child maltreatment. For example, Pine et al. (2005) examined children with a history of maltreatment and post-traumatic stress disorder (PTSD) and found that the children demonstrated avoidance of threatening facial expressions. Attentional bias was also associated with severity of maltreatment, in that children who experienced more severe abuse were more likely to avoid the threatening expressions. Electroencephalogram (EEG) data has also shown that physically abused children have a harder time disengaging from angry faces as compared to non-physically abused children. This suggests that physically abused children may show a bias toward threatening faces (Pollak & Tolley-Schell, 2003).

Further cognitive research has lent support for attentional deficits, as well. Cromheeke, Herpoel, and Mueller (2014) examined college-aged women with a history of life stress unrelated to childhood maltreatment, women with a history of child maltreatment, and women with no history of life stressors or child maltreatment and found that women with a history of sexual abuse exhibited working memory impairments during a spatial emotional match to sample task. During the task, participants were presented with positive, neutral, and negative faces and then presented with a distractor. After the distractor, participants were presented with a memory cue in the form of a facial stimulus and had to report whether the facial stimuli and the memory cue were in the same location. Results showed that, compared to the neutral stimuli, the women with a history of child maltreatment were less likely to report the correct location of the positive facial stimuli, but not the negative facial stimuli, indicating that participants experienced poorer memory for positive information than for neutral information. It is possible that working memory was interrupted by the positive facial

stimuli because participants were engaging with and attending to the negative stimuli to a much greater degree than the positive facial stimuli.

One important aspect of attentional bias is the underlying mechanisms responsible for the presentation of these observable characteristics. One possible mechanism is attentional control. Attentional control can be described as the ability to actively regulate the allocation of attention (Eysenck, Derakshan, Santos, & Calvo, 2007).

This regulation of attention occurs through two interacting systems: a top-down system and a bottom-up system. The top-down system of attention is goal-directed, driven by everyday knowledge and experience, whereas the bottom-up system is stimulus and sensory driven (Corbetta & Shulman, 2002). Theories of attentional control suggest that certain disorders, such as anxiety, can disrupt the balance between these two systems. For example, the bottom-up system may have a greater influence in some cases, leading to a decreased influence of the top-down system. In these cases, there is a greater influence of the stimulus-driven mechanisms of attention (Eysenck et al., 2007). Some have argued that these two systems mirror attentional bias and attentional control, in that attentional bias is a stimulus-driven mechanism, designed to orient toward and attend to relevant stimuli, whereas attentional control is a goal-directed mechanism designed for the preparation and application of responses (Schäfer et al., 2015).

In the cases of maltreatment, it is possible that children and adults are experiencing a disruption between the top-down and bottom-up systems. This disruption would mean that these individuals might be experiencing an increase in stimulus-driven mechanisms, which could be observed through attentional bias. It would also mean that this increase in stimulus-driven mechanisms would lead to an impairment in the goal-directed process of attention.

While previous research has shown attentional bias in cases of child maltreatment, it has not explained any reasons as to why child maltreatment might impair emotional expression recognition. Some research has shown evidence suggesting that facial emotion recognition is a top-down process, indicating that expression recognition is a goal-directed process (Wallbott & Ricci-Bitti, 1993). Given this evidence, it may be possible that attentional bias is impeding the goal-directed process of emotion identification, leading to an impairment in emotion recognition found in previous research.

Eye-tracking and Child Maltreatment

While several studies have measured attentional control and attentional bias in individuals with a history of child maltreatment, these studies have not looked at the eye movements of these individuals when presented with facial stimuli. Previous eye-tracking research has investigated emotion recognition and attentional control with facial stimuli in individuals with certain disorders, such as anxiety and PTSD; however, individuals with a history of child maltreatment have been left out of this literature.

The previous research examining attentional control and attentional bias in individuals with a history of maltreatment found evidence in support of neural components responsible for attentional deficits in regards to facial stimuli; however, particular eye movements may provide more insight into the processing of facial stimuli (Pollak & Tolley-Schell, 2003). Analyzing the eye movements of these individuals provides a direct measure of the observable characteristics found in attentional bias.

Eye-tracking and emotion recognition. Some of the research in eye-tracking has examined how individuals view and decode facial stimuli. The research has shown that depending on the type of task, individuals are more biased toward particular facial features,

particularly the eye region. Regardless of facial expression, individuals tend to make more fixations directed toward the eyes. Birmingham, Bischof, and Kingstone (2008), for example, examined gaze patterns of young adults when looking at visually complex scenes containing people. When presented with the complex images, participants were more likely to focus on the eyes of the people in the images than on any other body part or object. Other research has also found support for this bias toward the eye region. Hall, Hutton, and Morgan (2010) found that during facial emotion recognition tasks (FER), men and women made more fixations to the eyes when identifying facial expressions. Previous research has also shown individuals tend to spend more time fixating on the eyes when presented with emotional expressions, as well (Eisenbarth & Alpers, 2011).

While this research provides evidence for bias toward the eyes in certain tasks, it does not explicitly test diagnostic information needed to identify facial expressions accurately. Previous research has shown that when decoding certain emotional expressions, individuals fixate on particular facial features differently than other facial features. For example, Eisenbarth and Alpers (2011) found that individuals were more likely to fixate initially on the mouth than any other facial feature when decoding happiness, but were more likely to fixate initially on the eyes when decoding sadness and anger. When presented with neutral and fearful facial expressions, individuals were just as likely to fixate initially on the eyes and the mouth. These findings suggest that the mouth is an important facial feature when decoding happiness, whereas the eyes are important for decoding sadness and anger. These findings also suggest that both the eyes and the mouth are equally important when decoding neutral and fearful expressions, though some evidence suggests that fear is more accurately

identified using just the eye and brow regions (Calder, Young, Keane, & Dean, 2000; Eisenbarth & Alpers, 2011).

This diagnostic approach to the identification of emotional expressions is further supported by results reported by Tanaka, Kaiser, Butler, and Le Grand (2012). Across multiple studies, Tanaka et al. (2012) tested holistic processing versus diagnostic processing of facial expressions by presenting participants with varying versions of happy and angry faces. For example, participants were given a whole face and had to identify facial expressions in which the top half of the face appeared angry and the bottom half appeared happy. Participants were also presented with just the top half of the face, just the bottom half of the face, a complete happy face, and a complete angry face. The results showed that participants were slower and less accurate in identifying the facial expressions when there was conflicting information (e.g., an angry half with a happy half), suggesting that participants were using holistic processing to identify the expressions. Results also showed that participants were just as fast and accurate in identifying the expressions when the faces were consistent (e.g., a whole happy or angry face) as they were when they were presented with just the top or bottom halves of the facial expressions, suggesting that participants were able to use diagnostic processing to identify the expressions. These results suggest that individuals use both holistic and diagnostic processing to identify expressions, depending on the situation. The results suggest that when a facial expression appears to have conflicting information, individuals use holistic processing; however, when a facial expression appears congruent, individuals use diagnostic information to identify expressions.

It is possible that this diagnostic approach to identifying facial expressions occurs due to the inherent geometric shapes of particular facial features. Previous research has shown

that certain geometric shapes are associated with threatening information, such as sharp angles and downward pointing Vs. On the other hand, other geometric shapes are associated with joy and happiness, such as round and curvilinear shapes (Larson, Aronoff, & Stearns, 2007; Larson, Aronoff, & Steuer, 2012). These geometric shapes have been previously found in emotional expressions, particularly anger and sadness. For example, in angry faces, the eyes and brows typically point downward in a V, which signals a threat. In happy faces, the mouth and cheek areas are typically round and curvilinear, which signals pleasantness (Aronoff, 2006). This could explain why the eyes have been found to be important in decoding such expressions as anger and why the mouth has been found to be important when decoding happiness (Calder et al., 2000; Eisenbarth & Alpers, 2011).

Eye-tracking and attentional bias. Previous eye-tracking research has looked into attention to threatening stimuli in individuals with both anxiety and PTSD. For example, when compared to faces depicting sadness and disgust, anxious individuals are more likely to attend to fearful and angry facial expressions, and just as likely to attend to happy facial expressions as they are angry facial expressions (Holas, Krejtz, Cyprianska, & Nezelek, 2014).

Similar results have been seen in individuals with PTSD. For example, 11 adults with PTSD and 10 traumatized comparisons were presented with four words on a computer screen. Three words were neutral while one word was considered a trauma relative word. Participants were told they could look at the words in any way they would like. Eye movements were recorded using eye-tracking software. Data from the study showed that individuals with PTSD had significantly more fixations on the trauma relative words than the comparison group (Felmingham, Rennie, Manor, & Bryant, 2011).

This phenomenon is similar to Cromheeke et al. (2014) in that severe, possibly long-term stress and trauma, such as child maltreatment and PTSD, affected information processing differently than other forms of trauma or stress. Similar to threatening, trauma relative words, negative stimuli, such as angry faces, could be seen as a threat to individuals with a history of child maltreatment.

The previous research examining attentional bias has typically utilized the simultaneous presentation of facial stimuli — multiple faces displayed at the same time — in order to measure gaze orientation or disengagement from whole faces. These studies have been able to show evidence suggesting that certain disorders contribute to biases toward particular facial expressions. Given some of the evidence suggesting that individuals can process faces diagnostically instead of holistically, it is possible that certain disorders or trauma may contribute to biases toward particular facial features (e.g., eyes or mouth) that differs from individuals without histories of trauma or particular disorders (Tanaka et al., 2012). This attentional bias may lead to impairments in emotion recognition. In the case of child maltreatment, it is possible that certain facial features are more threatening than other facial features and under the assumptions of theories of attention, it is possible that the attentional bias toward these facial features leads to a disruption when attempting to identify the facial expression.

Present Study

The current literature lacks sufficient research examining the effects of child maltreatment on young adults; in particular, the literature lacks research examining the effects of child maltreatment on young adults' ability to attend to different facial expressions. For that reason, the present study sought to investigate how child maltreatment affects

fixation patterns when young adults with a history of maltreatment are presented with varying facial stimuli.

Research questions and hypotheses.

1. Are there differences in accuracy of identifying emotional expressions between adults with and without a history of childhood maltreatment?

H1: Adults with a history of physical abuse, emotional abuse, sexual abuse, or emotional neglect (general abuse group) will be more proficient than the neglect and comparison groups at labeling angry faces, but worse than the comparison group at labeling sadness and neutral faces (Pollak et al., 2000). Adults with a history of physical neglect will be less proficient than the comparison and general abuse groups at labeling all emotions correctly (Pollak et al., 2000).

2. Do fixation patterns of adults with a history of maltreatment differ from non-maltreated adults when looking at facial expressions?

H2: All groups will initially orient toward the eye region, but the general abuse and neglect groups will make more fixations on the eye region and spend more time fixating on the eye region as compared to the comparison group (Eisenbarth & Alpers, 2011; Hall et al., 2010; Pollak & Tolley-Schell, 2003).

Method

Design

This study was a 3 (type of abuse) X 4 (emotional expression) mixed factorial design. The level of abuse (physical abuse, neglect, and comparison group) was a between subjects factor, while the level of emotional expression (happy, angry, sad, and neutral) was a within

subjects factor. Labeling of facial expressions and fixation patterns were measured. It should be noted that while physical abuse was the original target group, pre-screening data analysis showed that only seven participants met the criteria just for physical abuse. Because of this, the new target group included anyone who met the criteria for physical abuse, sexual abuse, emotional abuse, and emotional neglect.

The labeling of the facial expression was defined as the accuracy in emotional label of the expression represented on the image. Fixation patterns were separated into initial gaze orientation, number of facial feature fixations, and duration of facial feature fixations. Initial gaze orientation was defined as the first facial feature (e.g., eyes, eyebrows, mouth, and entire face) to which the participant oriented. Number of facial feature fixations was defined as the total number of times a participant looked at a particular facial feature. Duration of facial feature fixations was defined as the participant looking at any particular facial feature for at least 100 ms (Eisenbarth & Alpers, 2011).

Participants

Appalachian State University students were recruited via the psychology departmental participant pool, SONA. Participants ($N = 839$) were at least 18 years of age and completed online versions of the Stressful Life Events Screening Questionnaire (SLESQ) and the Childhood Trauma Questionnaire (CTQ) as pre-screening measures to assess for histories of general life traumas and child maltreatment (Bernstein et al., 2003; Green, Chung, Daroowalla, Kaltman, & DeBenedictis, 2006). Students were compensated with course credit for completing the questionnaires. General participant demographic information and CTQ results are presented in Table 1.

Based on the results from the CTQ, participants who met any of the following inclusion criteria were recruited via email (see Appendix A) to partake in the eye-tracking portion of the study: (a) participants who met the threshold for emotional abuse, physical abuse, sexual abuse, or emotional neglect ($N = 53$); (b) participants who met the threshold just for physical neglect ($N = 86$); and (c) participants who did not meet the threshold for any type of child maltreatment ($N = 160$). For a cleaner comparison, only participants who received a score of 5 on all CTQ subscales were considered for the comparison group. The final sample consisted of 15 participants in the general abuse group, 17 participants in the physical neglect group, and 17 participants in the comparison group ($N = 49$; see Table 2). Participants received course credit and/or \$5 for participation. The Institutional Review Board at Appalachian State University approved all procedures for this study on September 28, 2015 and February 10, 2016 (see Appendices B and C).

Measures

Pre-screening Questionnaires. Participants completed online versions of two pre-screening questionnaires, along with demographic information. The questionnaires were hosted by Qualtrics.

Stressful Life Events Screening Questionnaire – Revised. In order to rule out the possibility that general traumatic events were influencing any differences between groups, participants completed the Stressful Life Events Screening Questionnaire – Revised (SLESQ) to assess for histories of general trauma. The SLESQ is a 13-item self-report questionnaire designed to assess for traumatic events (Green et al., 2006). The questionnaire includes questions regarding life-threatening illnesses, life-threatening accidents, death, and childhood and adult abuse. The test utilizes 13 “yes” and “no” questions along with open ended sub-

items. The SLESQ has good test-retest reliability, with a median Cohen's kappa of .73. The SLESQ also has good convergent validity, with a median kappa of .64 (Goodman, Corcoran, Turner, Yuan, & Green, 1998). Because of the inherent differences in childhood abuse experiences among the three groups, one item regarding childhood abuse was removed before creating a total stressor score. Items referring to adult (≥ 18 years) instances of abuse were included in the total score. The final items were summed together to create a total stressor score and analyzed for differences between the three groups. In my sample, the SLESQ had poor internal consistency, with a Cronbach's α of .42.

Childhood Trauma Questionnaire – Short Form. Participants completed the Childhood Trauma Questionnaire – Short Form (CTQ – SF) to assess for histories of child maltreatment (Bernstein et al., 2003). The CTQ - SF is a 25-item retrospective self-report questionnaire designed to assess childhood trauma. The questionnaire includes 25 items arranged according to physical abuse, emotional abuse, emotional neglect, sexual abuse, and physical neglect. Items are measured using a 5-point likert-type scale, with 1 = *never true* and 5 = *very often true*. Scores for each subscale range from 5 to 25, with 5 indicating no abuse and 25 indicating severe abuse. Responses from each subscale were summed together to create a total subscale score. Recommended cutoff scores for each subscale were provided by Bernstein and Fink (1998). For the purposes of this study, participants who met the following cutoff scores were considered for recruitment: a score ≥ 9 for emotional abuse, a score ≥ 8 for physical abuse and physical neglect, a score ≥ 6 for sexual abuse, and a score ≥ 10 for emotional neglect. Participants who scored 5 on all subscales were recruited as part of the comparison group. Scores for each subscale were coded as either meeting the cutoff or

not meeting the cutoff for abuse. Responses from this questionnaire were not analyzed further.

The CTQ – SF also includes three validity items designed to measure minimization and denial of childhood maltreatment. For the purposes of this study, the three validity items were removed due to the unavailability of those items. Omitting these validity items is not an uncommon practice; in fact, researchers have begun to question the utility of these items, finding evidence indicating that they do not function as a measure of response bias in the CTQ – SF (MacDonald, Thomas, MacDonald, & Sciolla, 2015). For these reasons, it is not unreasonable to remove the validity items and expect reliable and valid results from participants.

The CTQ-SF has good internal consistency for all five subscales, with Cronbach's α ranging from .79 to .94 (Bernstein et al., 1994). The CTQ-SF scale structure has also been reported to have adequate fit using confirmatory factor analysis (Bernstein et al., 2003). For the present study, the CTQ-SF had good internal consistency for the emotional abuse subscale (Cronbach's $\alpha = .89$), the physical abuse subscale (Cronbach's $\alpha = .82$), the sexual abuse subscale (Cronbach's $\alpha = .90$), and the emotional neglect subscale (Cronbach's $\alpha = .94$). Unlike previous research, the internal consistency for the physical neglect subscale in my sample was poor, with a Cronbach's α of .58.

Demographic Measures. Following the SLESQ and the CTQ, participants were asked to provide demographic information on gender, age, race and ethnicity, year in school, and the county and state in which they grew up. Analyses on age, race and ethnicity, and gender were conducted between groups and are presented in Table 2.

Digit Symbol Substitution Task. In order to measure possible differences in cognitive abilities between the groups, participants completed the Digit Symbol Substitution Task (DS). The DS is a neuropsychological test used to measure cognitive impairments and is sensitive to age, dementia, depression, and brain injuries (Bettcher, Libon, Kaplan, Swenson, & Penney, 2011). This task was chosen because it is a short and reliable measure (Hinton-Bayre & Geffen, 2005).

During this task, participants were given a coding system of digits ranging from 1 to 9, along with geometric symbols corresponding to each digit. Below the coding system, participants were presented with numbered boxes with blank boxes beneath. Participants were given 2 min to copy the corresponding geometric symbols under the numbered boxes. The number of correct responses was measured.

Stimuli and Apparatus

Stimuli. Colored images of 20 male models and 20 female models ($M_{\text{age}} = 25$ years) displaying happy, angry, sad, or neutral expressions were chosen from the Karolinska Directed Emotional Faces (KDEF) database (Lundqvist, Flykt, & Öhman, 1998). The KDEF database contains 4,900 images with 35 males and 35 females wearing happy, angry, sad, fearful, disgusted, surprised, and neutral facial expressions. This dataset was found to have good test–retest reliability, with 87.9% of the emotion ratings staying consistent across Time 1 and Time 2 (Goeleven, De Raedt, Leyman, & Verschuere, 2008). The KDEF dataset was also found to be a valid instrument, with a mean hit rate of 71.87% across all emotions (Goeleven et al., 2008).

The images in the KDEF database were chosen to include five male and five female models displaying happy expressions, five male and five female models wearing angry

expressions, five male and five female models wearing neutral expressions, and five male and five female models wearing sad expressions. Each model was shown wearing only one expression. The images had a visual angle of $17.4^{\circ} \times 23.6^{\circ}$. Each image depicted the face in a standard, upright position (see Figure 1). Fixation cross locations for each face were created based on the halfway point between the eyes and the mouth. Areas of interest (AOIs) for each facial expression were defined as the eye region, the brow region (the section between the eyebrows), the mouth region, and an “other” region, which encompassed all other areas of the face (see Figure 2). For clarity, the “other” region will be referred to as the “face region” in any analyses.

For practice sessions, four emotion words (happy, angry, sad, and neutral) were displayed on the computer monitor in white text on a black background. Each word was displayed in the center of the computer screen.

Apparatus. Stimuli was presented on an LCD monitor at a resolution of 1920 x 1080 in 32-bit color at a refresh rate of 144 Hz. The monitor was driven by a standard Dell PC; stimuli were displayed, and eye-position data and manual response data was recorded by a Windows-based program created with SR Research Ltd. Experiment Builder software. The eye-tracking system was an SR Research Ltd. EyeLink 1000 video-based eye-tracking system that records eye position at a rate of 500 Hz with an estimated accuracy of 0.3° .

Procedure

Participants provided informed consent (see Appendix D) and completed the pre-screening questionnaires and demographic information. Participants who met the threshold for emotional abuse, physical abuse, sexual abuse, or emotional neglect were invited to take part in the eye-tracking portion of the study as part of the general abuse group. Those who

met the threshold for only physical neglect were invited to partake in the eye-tracking portion of the study as part of the physical neglect group. Those who did not meet the threshold for any childhood maltreatment were invited to partake in the eye-tracking portion of the study as part of the comparison group.

Following informed consent (see Appendix E) for the eye-tracking portion of the study, participants completed the Digit Symbol Substitution Task. Following this task, each participant was placed in front of the computer monitor, where he or she placed his or her chin in the eye tracker chinrest. In order for the program to calculate each participant's gaze accurately, each participant completed a 9-point calibration. During this process, both eyes were calibrated, but only the eye that calibrated more accurately was tracked. If the calibration error was not within acceptable limits, the calibration process was repeated.

Following calibration, participants were told that they would be seeing a series of images with people wearing different facial expressions and they would need to identify those facial expressions. They were also told that they would complete a series of practice trials, during which they would see a word and need to identify the word they just saw.

Participants completed 12 practice trials in order to familiarize themselves with the procedure. Each practice trial began with a fixation point in the center of a white background. Participants were required to focus on the center of the fixation point and press the spacebar on the keyboard in order to begin each practice trial. During each practice trial, one of four emotion words was displayed for 10 s, or until the participant hit the spacebar. Once the participant hit the spacebar, the word was removed from the screen and four choices (happy, sad, angry, and neutral) were displayed on the right side of the screen. Participants were

required to use the computer mouse to click on the word that was presented previously. Once the participant made a choice, the computer screen indicated “correct” or “incorrect” for 1 s.

The eye-tracking task began immediately after the practice session and followed the same procedure. Each trial began with a fixation point in the center of a white screen (on the model’s nose, halfway between the eyes and the mouth) and participants were required to press the spacebar in order to begin the trial. During each trial, participants were presented with one of 40 randomized images of a model wearing a particular emotion. The image was displayed for 10 s, or until the participant hit the spacebar. Once the participant hit the spacebar, the face was removed from the screen and four choices (happy, sad, angry, and neutral) were presented on the right side of the screen. Participants used the computer mouse to identify the emotion. The session concluded once all 40 images were presented.

Results

Preliminary Analyses

Stressful Life Events Screening Questionnaire. To explore possible differences in general life stressors between those who experienced general abuse, physical neglect, and no maltreatment, I conducted a one-way ANOVA using the SLESQ total stressor score as the dependent measure. Results showed no significant differences in general life trauma between the general abuse group ($M = 1.20$, $SD = 1.52$, 95% CI [0.36, 2.04]), the physical neglect group ($M = 0.88$, $SD = 0.86$, 95% CI [0.44, 1.32]), and the no abuse group ($M = 0.41$, $SD = 0.87$, 95% CI [-0.04, 0.86]), $F(2, 46) = 2.07$, $p = .138$, $\omega^2 = .04$. Because these results showed no differences in general life trauma between groups, trauma was not controlled in subsequent analyses.

Digit Symbol Substitution Task. To explore possible differences in cognitive ability between those who experienced general abuse, physical neglect, and no maltreatment, I conducted a one-way ANOVA using the responses from the digit symbol substitution task as the dependent measure. Results showed no differences in digital substitution scores between those who experienced general abuse ($M = 80.73$, $SD = 19.60$, 95% CI [69.88, 91.59]), physical neglect ($M = 80.88$, $SD = 16.56$, 95% CI [72.37, 89.40]), and no maltreatment ($M = 83.76$, $SD = 12.29$, 95% CI [77.45, 90.08]), $F(2, 46) = 0.18$, $p = .833$, $\omega^2 = -.03$. These results suggest that there were no differences in cognitive ability between any of the groups; thus, cognitive abilities were not controlled in subsequent analyses.

Analysis of Research Hypotheses

Emotional labeling accuracy. To test the effects of childhood maltreatment on the ability to identify emotional expressions, I conducted a 3 (type of abuse) x 4 (emotional expression) mixed-subjects ANOVA, with the type of abuse as the between subjects factor and the emotional expression as the within subjects factor. For the dependent variable, I created a proportion of accurate responses for each emotional expression. This was done by calculating the total number of correct responses per emotion and then dividing by 10 (the number of images per expression). If a participant failed to make an identification during a trial, that response was classified as incorrect.

Mauchly's test indicated that the assumption of sphericity had been violated for emotional expression, $\chi^2(5) = 28.35$, $p < .001$; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .73$). I also used Bonferroni corrections for the post hoc tests. Results showed a significant main effect of emotion, $F(2.20, 101.14) = 18.78$, $p < .001$, $\eta_p^2 = .29$. Bonferroni post hoc tests indicated that

participants accurately identified a higher proportion of happy faces ($M = .998$, $SD = .01$, 95% CI [.99, 1.00]) as compared to sad ($M = .97$, $SD = .06$, 95% CI [.95, .99]), $d = 0.49$, angry ($M = .94$, $SD = .07$, 95% CI [.92, .96]), $d = 0.83$, and neutral faces ($M = .90$, $SD = .11$, 95% CI [.87, .93]), $d = 0.89$. Results also showed that participants were able to identify a higher proportion of sad faces as compared to neutral faces, $d = 0.57$. There were no differences in accuracy between sad faces and angry faces, nor were there any differences between angry faces and neutral faces (see Figure 3).

I originally predicted that abuse type would affect how well participants identified particular emotions. Specifically, I predicted that those who experienced physical neglect would be worse at identifying all emotions as compared to those who experienced other types of abuse and those who experienced no abuse. I also predicted that those who experienced physical abuse would be worse at identifying sad and neutral faces but better at identifying angry faces as compared to those who experienced no abuse. Contrary to my hypotheses that type of abuse would affect participants' ability to identify particular emotions, there was not a significant main effect of abuse type, $F(2, 46) = 1.72$, $p = .191$, $\eta_p^2 = .07$, nor was there a significant interaction between abuse type and emotion, $F(4.40, 101.14) = 1.79$, $p = .131$, $\eta_p^2 = .07$. Taken together, these results suggest that while some emotions were more identifiable than others were, abuse type did not affect participants' ability to identify particular emotions.

Response bias. Because of the nature of the procedure in the present study, it is possible that response biases toward specific emotion labels were distorting the effects of abuse type on emotional labeling accuracy. Participants were provided with four emotional labels from which to choose, and it is possible that this method misrepresented participants'

true ability to accurately identify emotions. Theoretically, it is possible for participants to have accurately labeled an emotion by chance (Isaacowitz et al., 2007). Because of this, I investigated whether participants showed a disproportionate preference for a particular response option. Using the methods provided by Isaacowitz et al. (2007), I conducted a 3 (abuse type) x 4 (emotional expressions) mixed subjects ANOVA, with the abuse type as the between subjects factor and the emotional expressions as the within subjects factor. For the dependent variable, I calculated the number of times each emotion was provided as an incorrect response.

Mauchly's test indicated that the assumption of sphericity had been violated for emotional expression, $\chi^2(5) = 35.06, p < .001$; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .70$). I also used Bonferroni corrections for the post hoc tests. Results showed a main effect of emotion, $F(2.09, 96.15) = 18.19, p < .001, \eta_p^2 = .28$. Bonferroni post hoc tests showed that participants incorrectly classified fewer facial expressions as happiness ($M = 0.04, SD = 0.20, 95\% CI [-0.02, 0.10]$) as compared to anger ($M = 0.35, SD = 0.56, 95\% CI [0.18, .51]$), $d = 0.57$, sadness ($M = 0.98, SD = 1.03, 95\% CI [0.69, 1.27]$), $d = 0.90$, and neutral faces ($M = 0.43, SD = 0.61, 95\% CI [0.26, 0.61]$), $d = 0.61$. Participants also incorrectly classified more facial expressions as sadness as compared to anger, $d = 0.62$, and neutral faces, $d = 0.48$. There was no main effect of abuse type, $F(2, 46) = 2.48, p = .097, \eta_p^2 = .10$, nor was there a significant interaction between abuse type and emotional expressions, $F(4.58, 105.22) = 0.94, p = .448, \eta_p^2 = .04$ (see Figure 4). These results suggest that participants had response biases toward certain emotional labels, particularly sadness; however, the type of abuse did not seem to affect response bias.

Controlling for response biases. Because of the unequal distribution of responses, I chose to control for these response biases using the methods outlined by Isaacowitz et al. (2007). Based on these methods, I produced four kappa scores for each participant (e.g., a happy kappa score, an angry kappa score, etc.). To do this, I first calculated the total number of correct identifications. These correct identifications were defined as the participant correctly identifying a particular emotion, as well as not choosing to attribute that particular emotional label to an incorrect emotional expression (i.e., valid rejection). For example, if a participant was presented with a happy face and identified that facial expression as happy, that would be a correct classification. If a participant was presented with a neutral face and chose to identify that facial expression as angry, that was considered a valid rejection of the happy emotional label. I then calculated the total number of chance expected correct responses for each participant. I then applied these calculations to the following formula, provided by Isaacowitz et al. (2007), to calculate accuracy scores for each participant: $\kappa = (\text{number of correct responses} - \text{number of chance expected correct responses}) / (40 - \text{number of chance expected correct responses})$. For each participant, the number of chance expected correct responses equated to 25, and the number 40 was the total number of emotional stimuli with which each participant was presented. The kappa scores ranged from 0 (participants performed at chance level) to 1 (all responses were correct classification).

In order to measure differences in kappa scores, I conducted a 3 (abuse type) x 4 (emotional expression) mixed subjects ANOVAs, with the abuse type as the between subjects factor and the emotional expression as the within subjects factor. The dependent variable was participants' kappa scores for each emotion.

Mauchly's test indicated that the assumption of sphericity had been violated for emotional expression, $\chi^2(5) = 25.64, p < .001$; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .77$). I also used Bonferroni corrections for the post hoc tests. Results showed a main effect of emotion, $F(2.32, 106.58) = 17.46, p < .001, \eta_p^2 = .28$. Bonferroni post hoc tests showed that participants scored higher on happy emotional stimuli ($M = .997, SD = .01, 95\% \text{ CI } [.99, 1.00]$) as compared to angry ($M = .98, SD = .04, 95\% \text{ CI } [.97, .99]$), $d = 0.42$, neutral ($M = .96, SD = .05, 95\% \text{ CI } [.95, .98]$), $d = 0.72$, and sad ($M = .93, SD = .07, 95\% \text{ CI } [.91, .95]$) emotional stimuli, $d = 0.95$. There was also a significant difference in kappa scores between angry and sad emotional stimuli, $d = 0.67$. There was no main effect of abuse type, $F(2, 46) = 1.72, p = .191, \eta_p^2 = .07$, nor was there a significant interaction between abuse type and emotional expression, $F(4.63, 106.58) = 0.98, p = .430, \eta_p^2 = .04$ (see Figure 5).

These results suggest that when response biases are controlled for, the pattern of emotion identification accuracy is altered. Before controlling for response biases, results showed that neutral faces were identified least accurately; however, kappa scores suggest that participants scored significantly worse on sad classifications as compared to the other emotional labels. While correcting for response biases did alter the pattern of emotion recognition, these results still do not suggest that abuse type affected emotion identification.

Initial gaze orientation. In order to test my prediction that all participants would initially orient toward the eye region more than any other facial feature, I conducted a 3 (abuse type) x 4 (emotional expression) x 4 (facial feature) mixed subjects ANOVA, with the abuse type as the between subjects factor and the emotional expression and the facial feature as the within subjects factors. For the dependent variable, I created a proportion of initial

facial feature fixations per emotional expression. To do this, I calculated the total number of times participants initially oriented toward each particular facial feature per expression and divided by 10 (the number of images per expression). Initial gaze orientation was only calculated if the latency of the initial fixation away from the fixation point was greater than 100 ms. Fixation latencies less than 100 ms were removed from analysis. This yielded four proportions per emotion (e.g., happy eyes, happy brow, happy mouth, and happy face). In the comparison group, 109 (18%) fixations on the eye region were removed; in the physical neglect group, 136 (20%) fixations were removed; and in the general abuse group, 75 (11%) fixations were removed. In total, 320 (16%) fixations on the eye region were removed.

Results showed a main effect of emotion, $F(3, 138) = 5.56, p = .001, \eta_p^2 = .11$, such that participants had a lower proportion of initial gaze orientations when presented with happy faces than angry, sad, and neutral faces. There were no differences between angry, sad, and neutral faces or sad and neutral faces

Mauchly's test indicated that the assumption of sphericity had been violated for facial feature, $\chi^2(5) = 58.55, p < .001$; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .59$). I also used Bonferroni corrections for the post hoc tests. Results showed a main effect of facial feature, $F(1.75, 80.69) = 62.77, p < .001, \eta_p^2 = .58$. Bonferroni post hoc tests revealed that participants initially gazed toward the eye region more often than the mouth, face, and brow regions. Participants also initially oriented to the mouth more frequently than the brow. There were no differences in initial gaze orientation between the brow and face, or the mouth and face. There was no main effect of abuse, $F(2, 46) = 1.74, p = .188, \eta_p^2 = .07$.

Mauchly's test indicated that the assumption of sphericity had been violated for the emotion x facial feature interaction, $\chi^2(44) = 203.42, p < .001$; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .54$). These main effects were qualified by a two-way interaction of emotion x facial feature, $F(4.84, 222.79) = 10.96, p < .001, \eta_p^2 = .19$ (see Figure 6). Follow up tests of simple main effects showed that when presented with happy faces, participants initially oriented toward the eye region ($M = .43, SD = .29, 95\% CI [.34, .51]$) more often than the face ($M = .05, SD = .12, 95\% CI [.01, .08]$), $d = 1.15$, and the brow ($M = .02, SD = .08, 95\% CI [.00, .05]$) regions, $d = 1.33$. Participants also initially oriented toward the mouth region ($M = .57, SD = .28, 95\% CI [.16, .32]$) more often than the brow region, $d = 0.73$, and face region, $d = 0.59$. Although participants initially oriented toward the mouth region more often than the eye region, the difference was not statistically significant. There was also no difference between the face and the brow regions.

Bonferroni post hoc tests showed that when presented with angry faces, participants initially oriented toward the eye region ($M = .57, SD = .28, 95\% CI [.49, .65]$) more often than the mouth ($M = .12, SD = .20, 95\% CI [.06, .18]$), $d = 1.09$, brow ($M = .05, SD = .10, 95\% CI [.02, .08]$), $d = 1.71$, and face ($M = .06, SD = .15, 95\% CI [.02, .11]$) regions, $d = 1.14$. There were no differences in initial gaze orientation between the mouth, brow, and face regions, or the face and brow region.

Results also showed that when presented with sad faces, participants initially oriented toward the eye region ($M = .54, SD = .29, 95\% CI [.46, .63]$) more often than the mouth ($M = .17, SD = .26, 95\% CI [.09, .24]$), $d = 0.77$, face ($M = .09, SD = .16, 95\% CI [.04, .13]$), $d = 1.24$, and brow ($M = .02, SD = .07, 95\% CI [.00, .04]$) regions, $d = 1.74$. Participants also

initially oriented toward the mouth region more often than the brow region, $d = 0.54$. There were no differences between the mouth, face, and brow regions.

Finally, Bonferroni post hoc tests showed that when presented with neutral faces, participants initially oriented toward the eye region ($M = .59$, $SD = .29$, 95% CI [.51, .68]) more often than the mouth ($M = .12$, $SD = .21$, 95% CI [.06, .18]), $d = 1.11$, brow ($M = .03$, $SD = .08$, 95% CI [.00, .05]), $d = 1.83$, and face ($M = .05$, $SD = .14$, 95% CI [.01, .09]) regions, $d = 1.48$. Participants also oriented to the mouth region more often than the brow region, $d = 0.38$. There was no difference between the face, brow, and mouth regions.

There was no significant interaction of facial feature x abuse type, $F(3.51, 80.69) = 0.35$, $p = .819$, $\eta_p^2 = .02$, nor was there an interaction of emotional expression by abuse type, $F(6, 138) = 1.29$, $p = .265$, $\eta_p^2 = .05$. There was also no significant interaction of abuse type x emotional expression x facial feature, $F(9.69, 222.79) = 0.78$, $p = .640$, $\eta_p^2 = .03$.

In support of my predictions, participants initially oriented toward the eye regions more often than any other facial feature for all facial expressions, except for happy facial expressions. Participants initially oriented toward the mouth region just as often as the eyes when presented with happy facial expressions. Contrary to my predictions, abuse type did not affect where participants initially oriented when presented with particular emotional expressions.

Number of facial feature fixations. To test the effects of child maltreatment on the number of times participants fixated on the eye region, I conducted a 3 (abuse type) x 4 (emotional expression) mixed subjects ANOVA, with the abuse type as the between subjects factor and the emotional expression as the within subjects factor. For the dependent variable,

I calculated the total number of times each participant fixated on the eye region per expression.

Results showed a main effect of emotion, $F(3, 138) = 11.11, p < .001, \eta_p^2 = .19$. Bonferroni post hoc tests indicated that participants made more fixations on the eye region when presented with neutral faces ($M = 24.23, SD = 1.70, 95\% \text{ CI } [23.74, 24.72]$) as compared to happy ($M = 23.12, SD = 1.64, 95\% \text{ CI } [22.64, 23.61]$), $d = 0.47$, and sad faces ($M = 23.14, SD = 1.95, 95\% \text{ CI } [22.56, 23.71]$), $d = 0.44$. Participants also made more fixations on the eye region when presented with angry faces ($M = 24.19, SD = 1.71, 95\% \text{ CI } [23.72, 24.67]$) as compared to sad faces, $d = 0.44$, and happy faces, $d = 0.43$. There were no differences in the number of fixations between happy and sad faces, or angry and neutral faces. There was no main effect for abuse type, $F(2, 46) = 0.18, p = .840, \eta_p^2 = .01$, nor was there an interaction of abuse type x emotional expression, $F(6, 138) = 0.74, p = .616, \eta_p^2 = .03$, suggesting that abuse type did not affect how often participants fixated on the eye region for any particular emotion (see Figure 7).

Duration of facial feature fixations. To test the effects of child maltreatment on the duration of the eye region, I conducted a 3 (abuse type) x 4 (emotional expression) mixed subjects ANOVA, with the abuse type as the between subjects factor and the emotional expression as the within subjects factor. For the dependent variable, I calculated the total duration of the eye region per expression.

Mauchly's test indicated that the assumption of sphericity had been violated for emotion, $\chi^2(5) = 28.27, p < .001$; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .70$). Results showed a main effect of emotion, $F(2.11, 97.04) = 8.78, p < .001, \eta_p^2 = .16$. Bonferroni post hoc tests indicated that

participants spent more time fixating on the eye region when presented with neutral facial expressions ($M = 7087.02$, $SD = 1842.55$, 95% CI [6544.67, 7628.31]) as compared to happy ($M = 5926.41$, $SD = 1580.47$, 95% CI [5461.98, 6392.02]), $d = 0.55$, and sad facial expressions ($M = 5995.80$, $SD = 1547.23$, 95% CI [5540.64, 6450.91]), $d = 0.60$. Participants also spent more time fixating on the eye region when presented with angry faces ($M = 6588.45$, $SD = 1661.65$, 95% CI [6097.36, 7072.33]) as compared to happy, $d = 0.45$, and sad facial expressions, $d = 0.41$. There were no differences between sad and happy expressions, or angry and neutral expressions. There was no main effect of abuse type, $F(2, 46) = 0.03$, $p = .974$, $\eta_p^2 = .00$, nor was there an interaction of abuse type x emotional expressions, $F(2.11, 97.04) = 0.08$, $p < .991$, $\eta_p^2 = .00$, suggesting that child maltreatment did not affect how long participants spend fixating on the eye region (See Figure 8).

In conclusion, emotional expression affected how long participants spent fixating on the eye region. Contrary to my predictions, however, abuse type did not affect how long participants spent fixating on the eye region. These results suggest that abuse type does not affect how long young adults fixate on the eye region when identifying facial expressions.

Discussion

Summary of Findings

In the present study, I sought to investigate how different types of child maltreatment affect emotion recognition and attentional biases toward particular facial features in young adults. Contrary to my major hypotheses, I did not find any indication that different types of child maltreatment affect the ability to identify emotions accurately, nor did I find any indication that child maltreatment affected where an individual looks on a face when

attempting to identify certain facial expressions. Based on this evidence, it is possible that child maltreatment does not affect the ability to attend to different facial features in young adults and thus, does not impair an individual's ability to identify facial expressions accurately.

While I did not find any evidence suggesting child maltreatment affected the ability to identify facial expressions, I did find that certain facial expressions were identified more accurately than other facial expressions. For example, happiness was identified to a higher degree than anger, sadness, and neutral facial expressions, even when controlling for response biases. I also found that once response biases were controlled for, participants had a harder time identifying sad faces as compared to the other emotional expressions.

Furthermore, had significantly higher kappa scores for happy faces as compared to angry faces, effect size indicates that this difference was relatively small by benchmark standards ($d = 0.42$; Cohen, 1988). Effect sizes also indicated moderate to large differences in kappa scores between happy and neutral faces ($d = 0.72$) and happy and sad faces ($d = 0.95$). In regards to angry versus sad faces, the effect size was moderate ($d = 0.67$). Although effect sizes indicate moderate to large differences in how well participants accurately identified certain emotions, mean kappa scores for emotion recognition were fairly high (κ ranged between .93 – .997), indicating the presence of a ceiling effect. Given that the *SD* of happy kappa scores was relatively small and limited in comparison to the other kappa scores (.01), it seems likely that the ceiling effect reduced the size of the happy kappa score *SD*, leading to an inflated effect size (Coe, 2002). Given the presence of the ceiling effect and possible reduction of the happy kappa score *SD*, it seems likely that the magnitude of the

differences in participants' ability to identify particular emotions are not be as meaningful as these effect sizes suggest.

I also found that participants might have had attentional biases toward particular facial features when identifying facial expressions. For example, participants initially gazed at the eye region more often than any other facial feature when presented with angry, sad, and neutral faces. Although not significant, participants did orient toward the mouth region more often than the eye region when presented with happy faces. It is possible that participants had an attentional bias toward the mouth when presented with happy faces. I also found that participants fixated on the eye region differently depending on the emotion presented. For example, participants made more fixations to the eye region and spent longer fixating on the eye region when presented with neutral faces. Contrary to my predictions that child abuse would affect where and how long participants would fixate on particular facial features, those who experienced different types of child abuse did not fixate on the facial features differently than those who did not experience child abuse.

Child Maltreatment and the Identification of Facial Expressions

The results from this study suggest that child maltreatment does not affect how well young adults identify facial expressions. These results contradict previous research that found that child abuse affects how well children identify certain facial expressions (Camras et al., 1990; During & McMahon, 1991; Pollak et al., 2000; Pollak & Sinha, 2002). However, previous research has primarily focused on how child maltreatment affects emotion identification in children and adolescents. Very few studies have investigated the effects in older adults, and no studies have investigated the effects of emotion recognition in young adults. While the results of the present study do contradict previous research, it is possible

that child maltreatment affects emotion recognition in young adults differently than in children. It is also possible that child maltreatment affects college-educated young adults differently than other young adults and children. For example, Cromheeke et al. (2014) postulated that it is possible that college-educated individuals are more resilient to trauma and thus, any effects of child maltreatment may not be seen in college-educated young adults. Resiliency has also been found to moderate depression in adults who have histories of childhood maltreatment (Wingo et al., 2010). Given this information, it is possible that the individuals in my sample were particularly resilient to past trauma and thus, those who experienced child maltreatment were better able to identify emotions than the typical young adult with a history of trauma would be able to.

Another issue with previous research regarding child maltreatment and emotion recognition is the inconsistent findings regarding exactly how child abuse affects the ability to identify certain facial expressions accurately. Some research has shown that children who experience maltreatment are worse than children who do not experience maltreatment at identifying facial expressions, while other research has not found any differences in emotion recognition these groups; however, this research failed to account for response biases (Camras et al., 1990; Doring & McMahon, 1991; Masten et al., 2008; Nazarov et al., 2014; Pollak et al., 2000; Pollak & Sinha, 2002). Previous research has shown that when controlling for emotion specific response biases, the pattern of emotion identification accuracy is slightly altered (Isaacowitz et al., 2007). It is possible that some of the conflicts seen in previous research regarding child maltreatment and emotion identification are in part due to the lack of researchers controlling for response biases. While controlling for response biases in the present study did not yield any effects of child maltreatment, I did find that the

overall effect of emotion had changed. Taken together, further research should investigate the effects of child maltreatment on emotion recognition while taking into account response biases.

Some findings also suggest that type of maltreatment matters, as well (Pollak et al., 2000). A large portion of research regarding emotion recognition and different subtypes of child maltreatment focuses on the effects of physical abuse and/or physical neglect. Results of these studies have revealed that there are differences in emotion recognition between those who experience physical abuse, physical neglect, and no abuse (Pollak et al., 2000); however, there is little to no research regarding the effects of other types of maltreatment on emotion recognition. In the present study, I was unable to differentiate certain types of maltreatment cleanly. While the physical neglect group included individuals who only experienced physical neglect, the general abuse group included individuals who may have experienced up to four different types of maltreatment and it is possible that these different types of maltreatment affect emotion recognition differently. Because of the small cell size and the occurrence of different types of abuse in this group, it is possible that any effects of child maltreatment on emotion recognition were not detected.

As stated previously, my study had the presence of a ceiling effect on emotion recognition. Results showed that while some emotions were more difficult to identify than others were, participants were highly successful in correctly labeling all emotions. Mean kappa scores for emotion recognition were between .93 and .997, indicating that participants did not struggle with identifying these emotions. These results could have occurred due to the amount of time participants were given when identifying facial expressions. Participants had 10 s to look at each image, and unlimited time to make their choice once the image was

removed. Participants had a substantial amount of time to identify each face, making it easier to process each emotion and choose the correct response. Along with timing was the issue of the amount of images used in this study. There were 10 images per each facial expression and only 4 emotions, which may not have been enough variability to increase the range of scores. Given the virtual lack of time constraints and limited stimuli, it is possible that this task was too easy for the participants, which is evident by the limited range of kappa scores. In order to avoid this ceiling effect, participants should have been instructed to identify each expression as quickly as possible, which would have made the task more difficult. It is also possible that adding more stimuli, such as more expressions or more images per expression, would have eliminated the ceiling effect by providing participants a larger variety of images and expressions. It is also possible that the ceiling effect could have been eliminated by having participants respond using the computer keyboard with designated keys corresponding to the emotions. This methodology would have also made the task slightly more difficult.

Attentional Bias and Emotion Recognition

One possible explanation for impairments in emotion recognition among individuals who have histories of child maltreatment is a difference in attentional bias. Previous research has shown that children who experienced child maltreatment avoided threatening facial stimuli, such as angry faces (Pine et al., 2005). This attentional bias differed from individuals who did not experience child maltreatment. While there are several studies examining attentional bias in those who have histories of child maltreatment, these researchers did not investigate emotion recognition along with attentional bias (Pine et al., 2005; Pollak & Tolley-Schell, 2003).

In general, individuals attend to certain facial features when identifying particular emotional expressions. For example, the mouth is important for decoding happiness while the eyes are important for decoding anger (Calder et al., 2000; Eisenbarth & Alpers, 2011). Previous research has shown that individuals use these facial features when decoding emotions due to the geometric shapes of these facial features (Larson et al., 2007; Larson et al., 2012). For example, the eye region of an angry face resembles a downwards V, which has been shown to represent a threat. The mouth of a happy face, on the other hand, typically resembles a rounder geometric shape, which is seen as non-threatening (Larson et al., 2007). Given that certain facial features are important for decoding emotional expressions, and individuals who have histories of child maltreatment show particular attentional biases when presented with certain emotional stimuli, I expected that abuse type would affect where and how long individuals fixated on certain facial features, specifically the eye region, when presented with different emotional expressions. I also expected that this difference in facial feature fixations would lead to a difference in emotion recognition.

In partial support of my hypothesis, I found that participants initially oriented toward the eye region more often than other facial features for angry, sad, and neutral faces. I also found that although participants did orient more toward the mouth than the eyes when presented with happy faces, the difference was not significant, which contradicts previous research (Eisenbarth & Alpers, 2011). Furthermore, effect sizes indicate that the differences in proportions between the eye region and other facial features were very large by benchmark standards (d ranged between 1.09 – 1.83; Cohen, 1988). These large effect sizes indicate that participants made substantially more initial fixations to the eye region than any other facial feature. For example, when presented with neutral faces, participants made 4.83 times more

initial fixations toward the eye region than the mouth region. Mean differences in initial fixation proportions, along with the large effect sizes, provides partial evidence that young adults are biased toward the eye region when attempting to identify emotional expressions.

Interestingly, the present study showed that emotion affected how often and how long participants fixated on the eye region. For example, participants made more fixations to the eye region and spent longer fixating on the eye region when presented with neutral faces. Although these findings contradict previous research (Eisenbarth & Alpers, 2011), effect sizes indicate that the mean differences in the number of fixations toward the eye region between emotional expressions were relatively small (d ranged between 0.43 – 0.47). Effect sizes also indicate small to moderate differences in how long participants spent fixating on the eye region between all emotions (d ranged between 0.41 – 0.60). Contextually, effect sizes and mean differences suggest that the type of emotion may be somewhat inconsequential in regards to how long and how often participants spent fixating on the eyes.

Contrary to my predictions, child maltreatment did not affect how participants fixated on the different facial features. I predicted that those who experienced child maltreatment would spend more time fixating on the eye regions than those who did not experience child maltreatment, thus showing an attentional bias toward the threatening stimuli as seen in previous research (Pine et al., 2005). These results suggest that maltreatment did not affect participants' attentional bias of threatening stimuli.

Since abuse type did not affect facial feature fixation or number of facial feature fixations, I expected that participants would have initially oriented to the mouth region more than the eye region for happy faces; however, I did not observe this effect in the present study. One possibility for these findings is that participants were using holistic processing to

identify facial expressions. Previous research has shown that individuals use holistic and diagnostic information to identify facial expressions, depending on the situation (Tanaka et al., 2012). It is possible that in this situation, participants did not necessarily need to process diagnostic information in order to identify facial expressions and thus, participants did not need to fixate on stereotypical facial features to identify facial expressions accurately. The fact that participants were able to identify happiness to such a great degree while initially fixating on the eyes just as often as the mouth suggests that participants were not using only stereotypical facial features when identifying emotions. Similarly, I would have expected that participants would have initially oriented toward the mouth region as often as the eye region for neutral expressions, as shown by Eisenbarth and Alpers (2011). However, participants initially oriented more toward the eyes than the mouth when presented with neutral expressions, which provides further evidence that participants may not have been processing emotional expressions diagnostically.

It is possible that I did not observe any effects of maltreatment due to the unclear differentiation of the subtypes of maltreatment. As stated earlier, the general abuse group included individuals who may have experienced up to four different types of maltreatment, while the physical neglect group included individuals who experienced only physical neglect. Previous research has shown that severity of maltreatment affects attentional bias, such that individuals who experienced more severe maltreatment were more likely to avoid threatening stimuli (Pollak & Tolley-Schell, 2003). Based on these findings, it is possible that severity and type of maltreatment affect where young adults look when attempting to identify facial expressions but because of the small cell size and unequal distribution of the subtypes of

maltreatment in the present study, any effects of the different types of maltreatment were not seen.

As stated earlier, I did not observe any differences in emotion recognition between those who experienced child maltreatment and those who did not experience child maltreatment. While my results suggest that child abuse does not affect attentional bias and emotion recognition in young adults, the results do not indicate whether attentional bias is a potential reason behind deficits in emotion recognition in those who have histories of child abuse. It is possible that the lack of differences in emotion recognition in my sample is due to the lack of differences in attentional biases in my sample. Theoretically, there would need to be differences in emotion recognition between individuals who have experienced child maltreatment and those who have not experienced child maltreatment in order to determine if fixation patterns are associated with the ability to identify emotions accurately. Further research would need to be conducted in order to truly determine the role of attentional bias in emotion recognition in individuals who have histories of child maltreatment.

Psychopathology and Attentional Bias

Previous research has shown that child maltreatment affects several neurobiological processes and increases the risk of certain mental illnesses, including depression, in adulthood (Anda et al., 2006; Chapman et al., 2004). Child maltreatment has also been found to be a large risk factor for post-traumatic stress disorder (PTSD; Brewin, Andrews, & Valentine, 2000).

Mental illnesses, such as depression and anxiety, have been found to affect attentional bias toward emotional stimuli. For example, those who experience depression are more likely to attend to sad facial expressions and those who experience anxiety are more likely to attend

to fearful and angry facial expressions (Koster et al., 2004; Sanchez et al., 2013). PTSD has also been found to affect attentional bias, such that those who experience PTSD are more likely to attend to threatening stimuli quicker and more often than non-threatening stimuli (Felmingham et al., 2011). Child maltreatment has been found to affect attentional bias similarly to anxiety, such that children are more likely to attend to angry facial expressions (Pollak & Tolley-Schell, 2003).

Although both mental illness and child maltreatment have been found to affect attentional bias, researchers have typically investigated child maltreatment without regard for mental illness and vice versa. It is possible that combinations of child maltreatment and mental illness affect attentional bias in a way that differs from how mental illness and child maltreatment affect attentional bias separately.

I did not measure psychopathology in the current study. It is possible that some participants met the criteria for certain mental illnesses and it is possible that mental illness combined with childhood maltreatment altered attentional bias. It is also possible that individuals who did not experience child maltreatment met criteria for certain mental illnesses, which would have affected how they attended to particular facial features. Those in the comparison group and those in the maltreatment groups may have exhibited similar patterns in attentional bias because of the presence of mental illnesses. Future research would need to consider psychopathology as a covariate in order to see if child maltreatment affects how an individual looks at a face when identifying a facial expression.

Limitations

There were several limitations in my study, which could have affected the results and validity of my study. A large limitation of my study was the sample size and the uneven

distribution of participants who experienced certain types of maltreatment. Because my study required very specific criteria in order to participate, I was unable to reach the desired sample size and the desired cell size for each condition. I was also unable to find participants who met the original criteria of my study. Originally, I sought participants who met the criteria for just physical abuse, just physical neglect, and no history of abuse. However, I was unable to find enough participants who met the criteria for just physical abuse. Because of this, I had to recruit participants who met the criteria for physical abuse, sexual abuse, emotional abuse, or emotional neglect in place of the physical abuse group. There is a large possibility that I did not find any effects of child maltreatment because of the unclear comparison between the different types of maltreatment. I was also unable to achieve my desired sample size because not enough participants chose to participate in the eye-tracking portion of the study. It is possible that I did not find the desired results due to my small sample size.

Another problem occurred during the removal of initial gaze orientations. I had to remove a substantial amount of initial fixations due to the latency of initial fixations away from the fixation point. This means that some initial fixations are missing from the analysis, suggesting that I was unable to measure initial gaze orientation fully. It is possible that there are actually differences in initial gaze orientation between abuse types; however, it is possible that I was unable to detect these differences because of the removal of these data. It should also be noted that the removal of initial fixations was not equal across groups. It is possible that I could not detect any differences between groups due to the unequal removal of initial fixations.

Another possible limitation is the use of self-report measures to assess childhood maltreatment. As with any self-report measure, it is possible that participants may not have

been completely honest when answering questions from the Childhood Trauma Questionnaire (CTQ). Participants may have misinterpreted particular items, such as those dealing with particularly subjective events, or they may have chosen not to reveal instances in which they experienced abuse. Because of these issues surrounding self-report measures, it is possible that my final sample size was not a true reflection of those who experienced abuse versus those who did not experience abuse. It is also possible that the low reliability of the physical neglect subscale from the CTQ led to incorrect classifications of abuse. Due to the low reliability of this subscale, it is possible that some participants who did not experience physical neglect were included in the study. It is also possible that some participants who truly did experience physical neglect were erroneously excluded from the study.

Finally, my study lacked generalizability. My study utilized college-educated young adults, which could pose issues when trying to generalize to the young adult population. As mentioned previously, it is possible that young adults in a college environment are more resilient to trauma than the average young adult is. This resiliency in college-educated young adults could potentially defend these young adults against the effects of past trauma in a way that would not be typical in young adults who are not involved in higher education. This could be a potential reason as to why there were no differences found between participants who had histories of child abuse and participants who had no histories of child abuse.

Directions for Future Research and Conclusions

This particular study could be expanded in several ways. First, it would be prudent to have a more substantial sample size with young adults who are not part of the higher education environment. This could potentially provide better external validity, due to a larger and more representative sample. Next, it would be interesting to measure resiliency in

participants and investigate its association with emotion recognition. I would also like to investigate the effects of child maltreatment severity on emotion recognition and attentional bias. Previous research has shown that severity of maltreatment affected attentional bias, but measuring child maltreatment severity has not been done in regards to emotion recognition. Finally, I would be interested in replicating this study using children as participants. I would be interested in seeing if I could find similar results to previous research regarding emotion recognition, and I would like to see if I could find differences in fixation patterns between those who have histories of child abuse and those who do not have histories of child maltreatment.

In conclusion, while this study found some significant results, there was no evidence that abuse had an effect on emotion recognition or fixation patterns in young adults; however, these results do not necessarily mean that attentional bias does not affect emotion recognition. Future researchers should attempt to find more consistencies in how child maltreatment affects emotion recognition in children and young adults and then attempt to investigate how attentional bias affects emotion recognition in these populations.

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doi:10.1016/j.jad.2010.04.009

Table 1

Overall Participant Demographics and CTQ Results

Variables	Descriptives
Gender (%)	
Male	22.1 (<i>N</i> = 185)
Female	77.9 (<i>N</i> = 651)
Mean age (<i>SD</i>)	19.51 (1.82)
Race (%)	
Caucasian	88.9 (<i>N</i> = 743)
African-American	3.0 (<i>N</i> = 25)
Hispanic	3.5 (<i>N</i> = 29)
Other	4.6 (<i>N</i> = 39)
Abuse Threshold (%)	
Emotional Abuse	27.5 (<i>N</i> = 230)
Physical Abuse	11.0 (<i>N</i> = 92)
Sexual Abuse	10.3 (<i>N</i> = 86)
Emotional Neglect	25.6 (<i>N</i> = 214)
Physical Neglect	26.8 (<i>N</i> = 224)

Table 2

Final Participant Demographics and CTQ Results

Variables	General Abuse (<i>N</i> = 15)	Physical Neglect (<i>N</i> = 17)	Comparison (<i>N</i> = 17)	
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	Statistics
Gender (%)				$\chi^2 = 3.13, p = .209$
Male	46.7 (<i>N</i> = 7)	35.3 (<i>N</i> = 6)	17.6 (<i>N</i> = 3)	
Female	53.3 (<i>N</i> = 8)	64.7 (<i>N</i> = 11)	82.4 (<i>N</i> = 14)	
Age	20.0 (1.65)	19.75 (0.93)	19.82 (1.19)	$F = .16, p = .856,$
Race/Ethnicity (%)				$\chi^2 = 9.38, p = .153$
Caucasian	80.0 (<i>N</i> = 12)	100 (<i>N</i> = 17)	88.2 (<i>N</i> = 15)	
African-American	6.7 (<i>N</i> = 1)	0	0	
Hispanic	0	0	11.8 (<i>N</i> = 2)	
Other	13.3 (<i>N</i> = 2)	0	0	
Abuse Threshold (%)				
Emotional Abuse	53.3 (<i>N</i> = 8)	0	0	
Physical Abuse	80.0 (<i>N</i> = 12)	0	0	
Sexual Abuse	6.7 (<i>N</i> = 1)	0	0	
Emotional Neglect	66.7 (<i>N</i> = 10)	0	0	
Physical Neglect	0	100 (<i>N</i> = 17)	0	



Figure 1. An example of an emotional stimulus with which participants were presented. This is an example of a female neutral expression.



Figure 2. An example of an emotional stimulus with facial feature definitions.

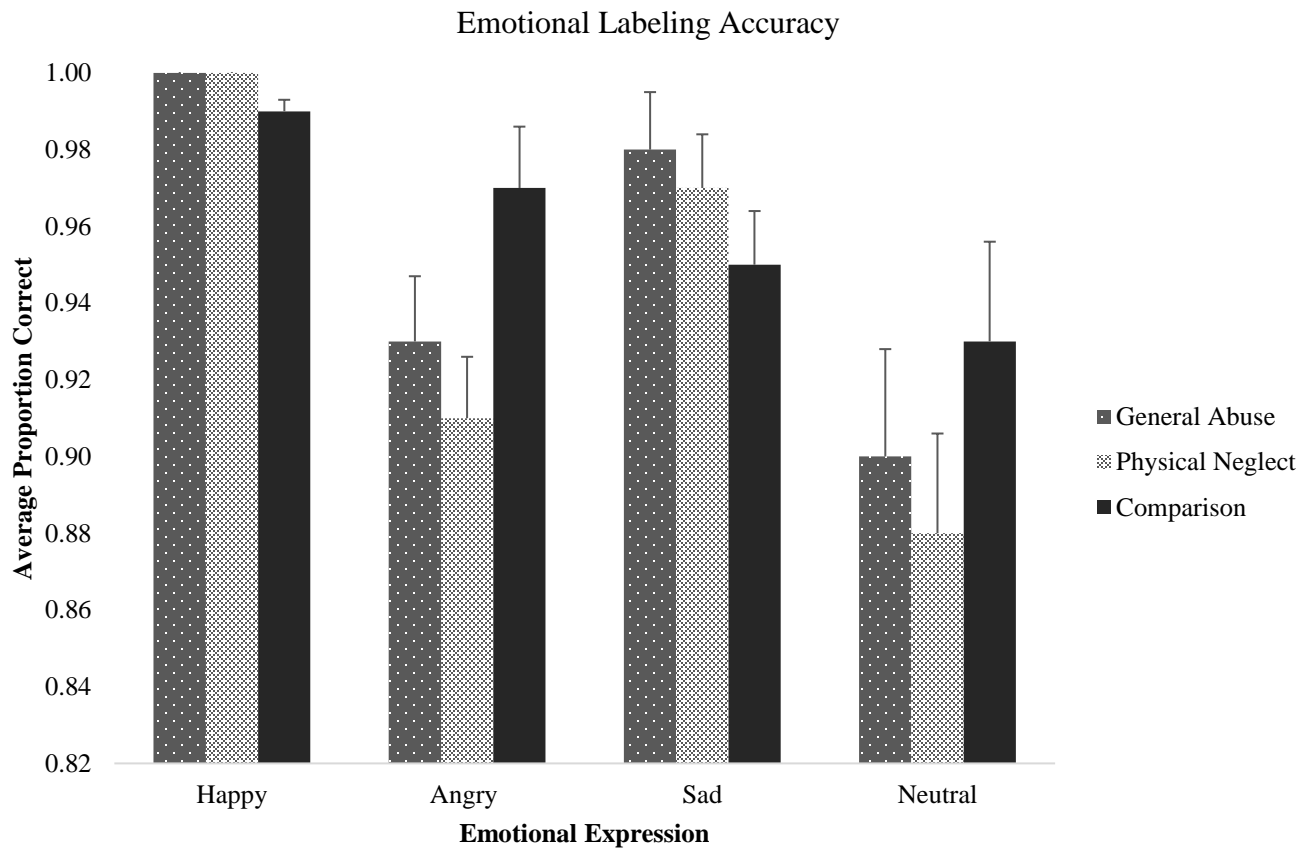


Figure 3. The proportion of correct classifications of each emotional expression. Error bars are standard error of the mean.

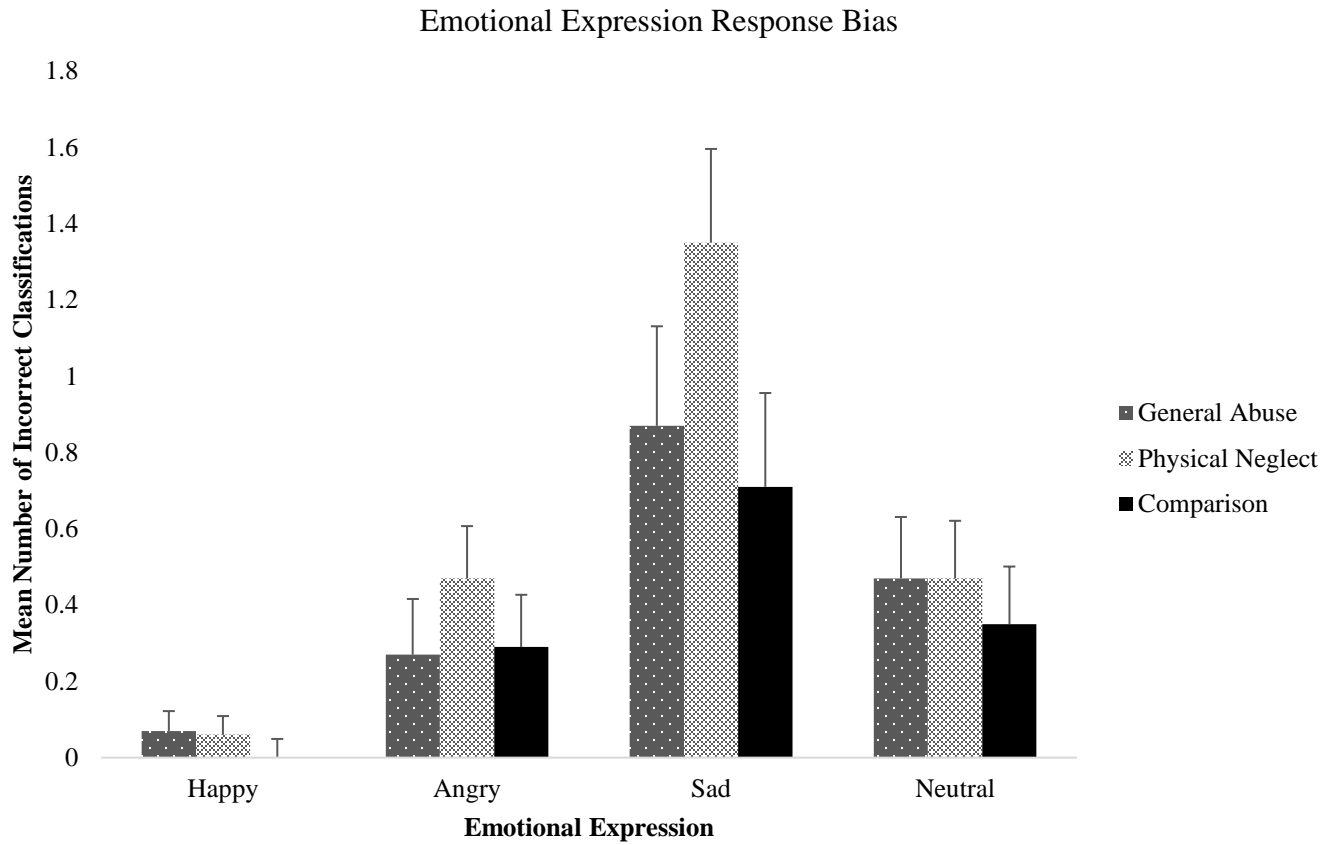


Figure 4. The proportion of incorrect classifications for each emotional expression. Error bars are standard error of the mean.

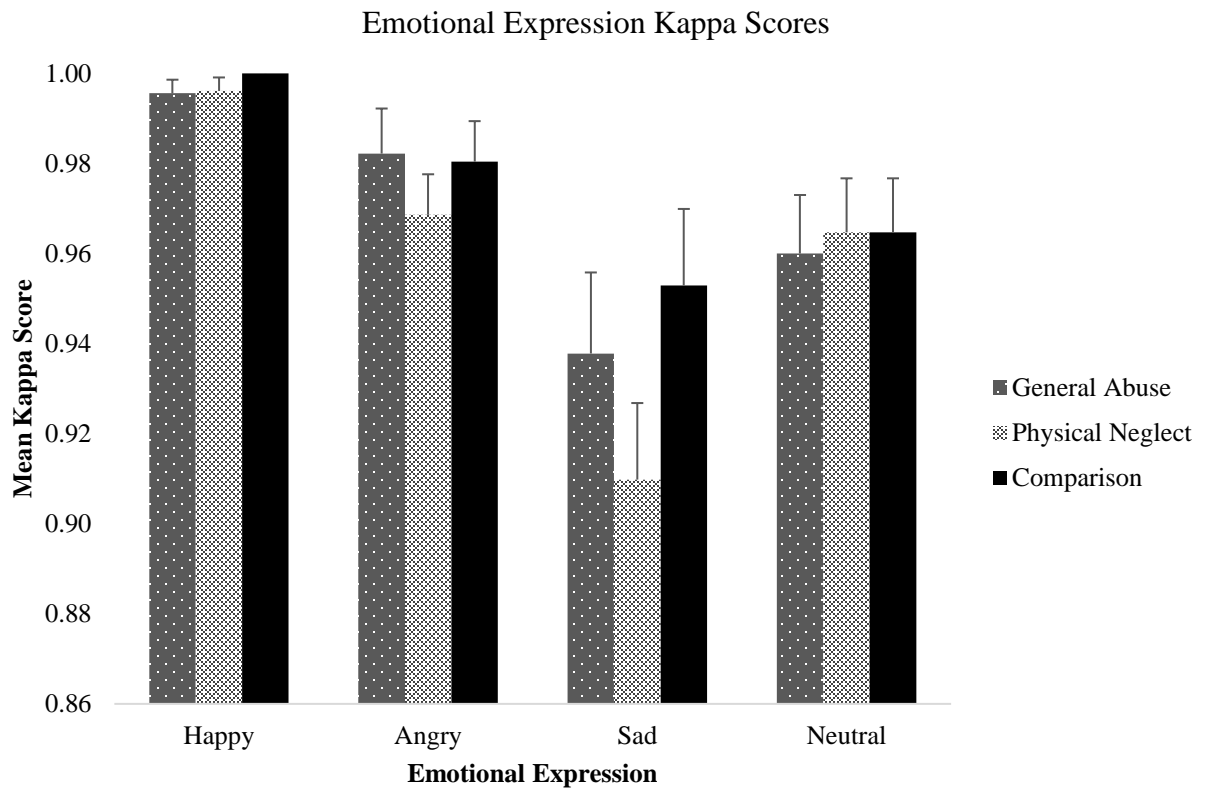


Figure 5. Participant kappa scores for the correct identification of emotional expressions. Error bars are standard error of the mean.

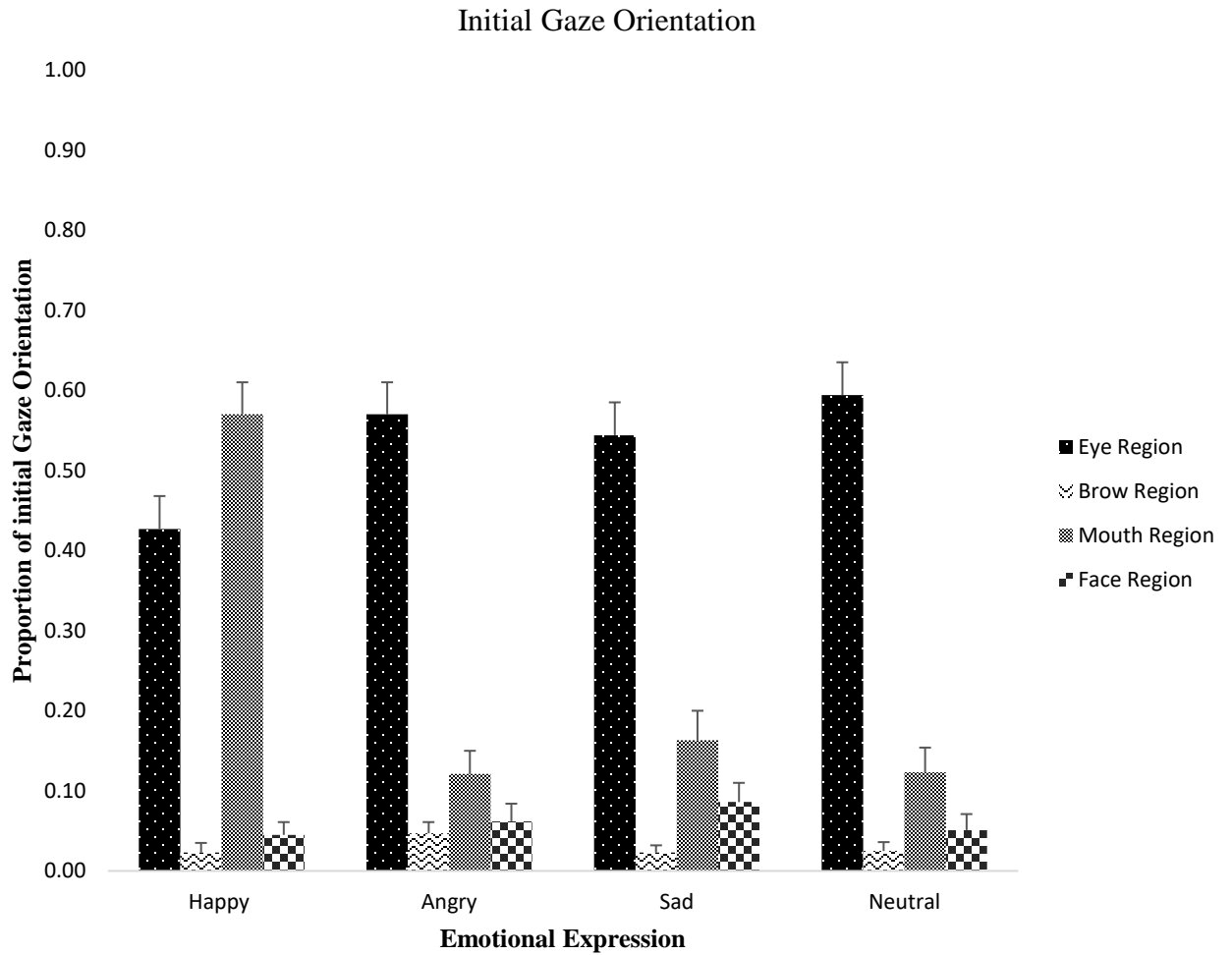


Figure 6. The proportion of initial gaze orientation for each facial feature as a function of emotional expression. Error bars are standard error of the mean.

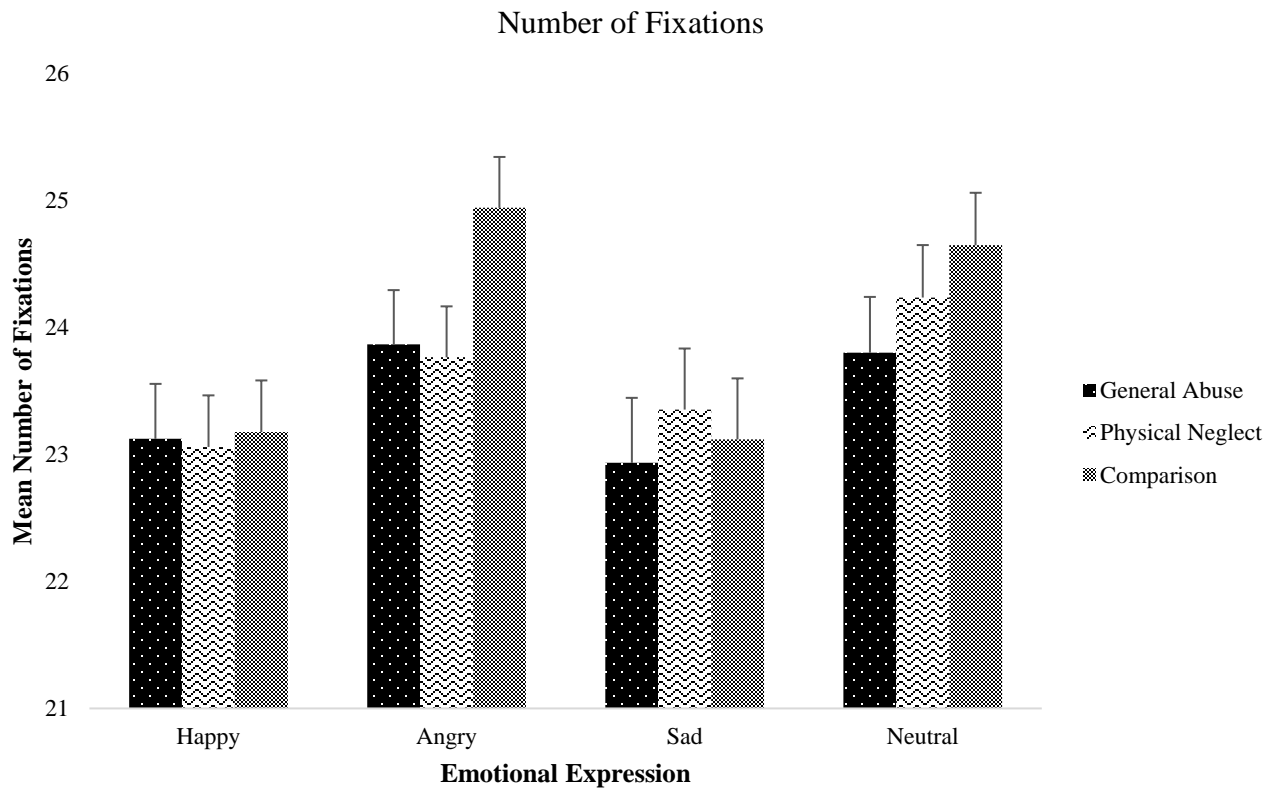


Figure 7. The mean number of times each group fixated on the eye region. Error bars are standard error of the mean.

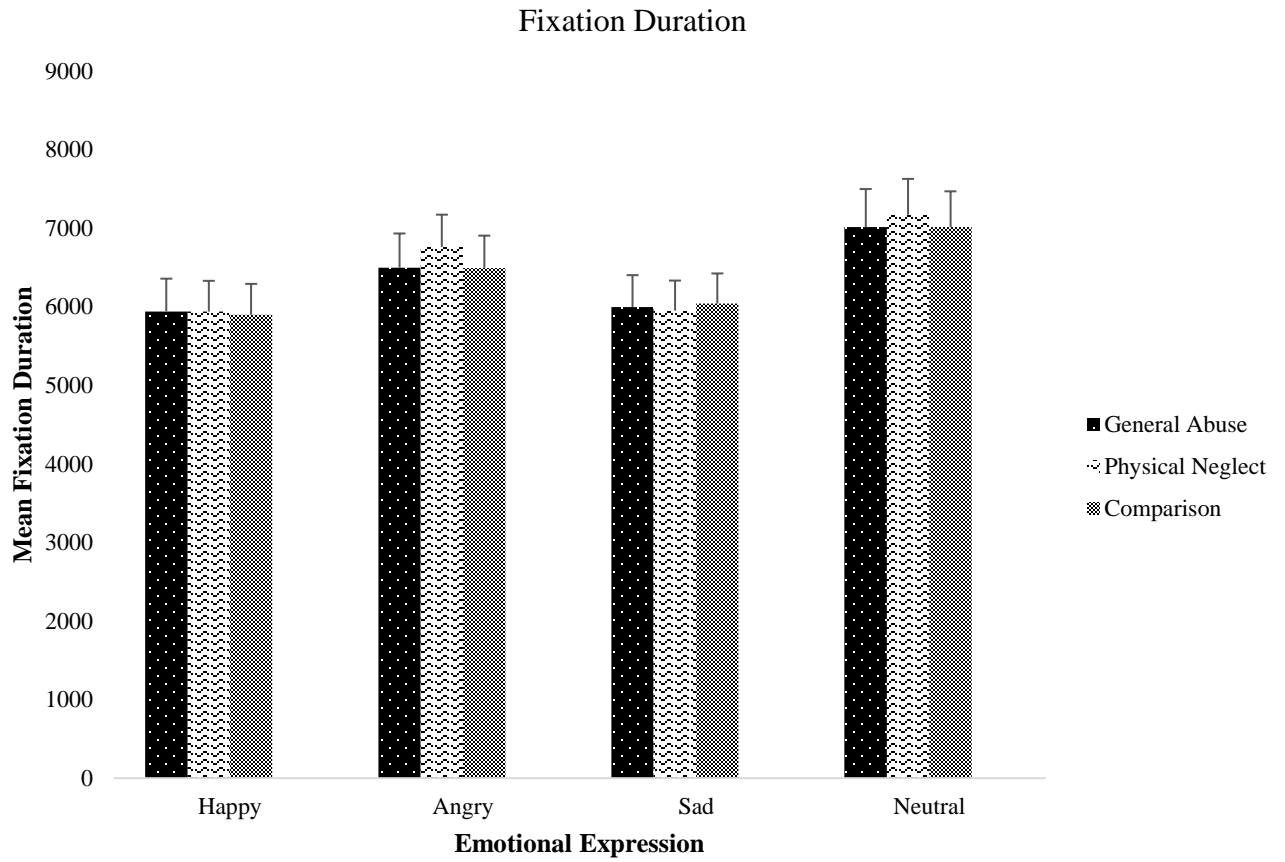


Figure 8. Mean fixation duration (ms) of the eye region per abuse type. Error bars are standard error of the mean.

Appendix A

Participant Recruitment Email

Subject: Emotion Recognition and Fixation Patterns Study Part 2

Dear [NAME],

Congratulations! You have been selected to participate in part 2 of the Emotion Recognition and Fixation Patterns study. During this study, participants are connected to eye tracking equipment and are shown a series of pictures depicting people wearing different facial expressions. If you decide to participate, you will earn 1 ELC.

If you are interested in this study and would like to participate, please visit the SONA system and locate Emotion Recognition and Fixation Patterns (II) to sign up.

You will need the following invitation code to participate: **Emotion12!**

Thank you,

[NAME]

Research Assistant

Appendix B

To: Emily Mohr
Psychology
EMAIL

From: Dr. Lisa Curtin, Institutional Review Board Chairperson
Date: September 28, 2015
RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Study #: 16-0060

Study Title: Emotion Recognition and Fixation Patterns Study 1
Submission Type: initial
Expedited Category: 7. Research on Group Characteristics or Behavior, or Surveys, Interviews, etc.
Approval Date: September 28, 2015
Expiration Date of Approval: September 27, 2016

The Institutional Review Board (IRB) approved this study for the period indicated above. The IRB found that the research procedures meet the expedited category cited above. IRB approval is limited to the activities described in the IRB approved materials, and extends to the performance of the described activities in the sites identified in the IRB application. In accordance with this approval, IRB findings and approval conditions for the conduct of this research are listed below.

The IRB determined that this study involves minimal risk to participants.

Approval Conditions:

Appalachian State University Policies: All individuals engaged in research with human participants are responsible for compliance with the University policies and procedures, and IRB determinations.

Principal Investigator Responsibilities: The PI should review the IRB's list of PI responsibilities. The Principal Investigator (PI), or Faculty Advisor if the PI is a student, is ultimately responsible for ensuring the protection of research participants; conducting sound ethical research that complies with federal regulations, University policy and procedures; and maintaining study records.

Modifications and Addendums: IRB approval must be sought and obtained for any proposed modification or addendum (e.g., a change in procedure, personnel, study location, study instruments) to the IRB approved protocol, and informed consent form before changes may be implemented, unless changes are necessary to eliminate apparent immediate hazards to participants. Changes to eliminate apparent immediate hazards must be reported promptly to the IRB.

Approval Expiration and Continuing Review: The PI is responsible for requesting continuing review in a timely manner and receiving continuing approval for the duration of the research with human participants. Lapses in approval should be avoided to protect the welfare of enrolled participants. If approval expires, all research activities with human participants must cease.

Prompt Reporting of Events: Unanticipated Problems involving risks to participants or others; serious or continuing noncompliance with IRB requirements and determinations; and suspension or termination of IRB approval by an external entity, must be promptly reported to the IRB.

Closing a study: When research procedures with human subjects are completed, please complete the Request for Closure of IRB review form and send it to irb@appstate.edu.

Websites:

1. PI responsibilities:
<http://researchprotections.appstate.edu/sites/researchprotections.appstate.edu/files/PI%20Responsibilities.pdf>
2. IRB forms: <http://researchprotections.appstate.edu/human-subjects/irb-forms>

CC Dr. Twila Wingrove

Appendix C

To: Emily Mohr
Psychology
EMAIL

From: Dr. Lisa Curtin, Institutional Review Board Chairperson

Date: 2/10/2016

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)

Study #: 16-0147

Study Title: Emotion Recognition and Fixation Patterns Study 2

Submission Type: Initial

Expedited

Category: (4) Collection of Data through Noninvasive Procedures Routinely Employed in Clinical Practice,(6) Collection of Data from Recordings made for Research Purposes,(7) Research on Group

Characteristics or Behavior, or Surveys, Interviews, etc.

Approval Date: 2/10/2016

Expiration Date of Approval: 2/09/2017

The Institutional Review Board (IRB) approved this study for the period indicated above. The IRB found that the research procedures meet the expedited category cited above. IRB approval is limited to the activities described in the IRB approved materials, and extends to the performance of the described activities in the sites identified in the IRB application. In accordance with this approval, IRB findings and approval conditions for the conduct of this research are listed below.

Regulatory and other findings:

Please refer to comments below

Approval Conditions:

Appalachian State University Policies: All individuals engaged in research with human participants are responsible for compliance with the University policies and procedures, and IRB determinations.

Principal Investigator Responsibilities: The PI should review the IRB's list of PI responsibilities. The Principal Investigator (PI), or Faculty Advisor if the PI is a student, is ultimately responsible for ensuring the protection of research participants; conducting sound ethical research that complies with federal regulations, University policy and procedures; and maintaining study records.

Modifications and Addendums: IRB approval must be sought and obtained for any proposed modification or addendum (e.g., a change in procedure, personnel, study location, study

instruments) to the IRB approved protocol, and informed consent form before changes may be implemented, unless changes are necessary to eliminate apparent immediate hazards to participants. Changes to eliminate apparent immediate hazards must be reported promptly to the IRB.

Approval Expiration and Continuing Review: The PI is responsible for requesting continuing review in a timely manner and receiving continuing approval for the duration of the research with human participants. Lapses in approval should be avoided to protect the welfare of enrolled participants. If approval expires, all research activities with human participants must cease.

Prompt Reporting of Events: Unanticipated Problems involving risks to participants or others; serious or continuing noncompliance with IRB requirements and determinations; and suspension or termination of IRB approval by an external entity, must be promptly reported to the IRB.

Closing a study: When research procedures with human subjects are completed, please log in to our system at https://appstate.myresearchonline.org/irb/index_auth.cfm and complete the Request for Closure of IRB review form.

Websites:

1. PI responsibilities:

<http://researchprotections.appstate.edu/sites/researchprotections.appstate.edu/files/PI%20Responsibilities.pdf>

2. IRB forms: <http://researchprotections.appstate.edu/human-subjects/irb-forms>

CC:

Twila Wingrove, Psychology

Appendix D

Consent to Participate in Research *Information to Consider about this Research*

Emotion Recognition and Fixation Patterns Study 1

Principal Investigator: Emily Mohr

Department: Psychology

Contact Information:

PI: Emily Mohr

mohrem@appstate.edu

FA: Twila Wingrove

wingroveta@appstate.edu

What is the purpose of this research?

You are being invited to take part in a research study about the effects of childhood traumas on emotion recognition and fixation patterns. By conducting this study we hope to understand how childhood traumas influence the ability to identify facial expressions. We also hope gain insight into how childhood traumas influence eye-movements when looking at facial expressions. We plan to use the results of this study in a Master's thesis, which we then plan to publish.

Why am I being invited to take part in this research?

You have been invited to participate in this study because you are at least 18 years old and a student at Appalachian State University. If you volunteer to take part in this study, you will be one of about 60 people to do so.

What will I be asked to do?

If you agree to take part in this research study, you will be asked to complete a screening questionnaire. This questionnaire consists of 13 items regarding stressful life events. This will take about 15 minutes to complete. After the completion of this questionnaire, you will be asked to complete another questionnaire regarding childhood traumas. This questionnaire consists of 25 items and will take about 30 minutes to complete. Depending on your answers to this questionnaire, we may contact you by email to participate in a follow-up study.

What are possible harms or discomforts that I might experience during the research?

To the best of our knowledge, the risk of harm and discomfort from participating in this research study is no more than you would experience in everyday life. You may find that some of the questions we ask to be upsetting or stressful. If so, we can tell you about some

people who may be able to help with these feelings, or you can refer to the Counseling Center listed below.

Some of the answers you provide may be very personal or indicate behaviors that you do not want made public. We recommend that you complete this survey in a private setting. To minimize the potential for breach of confidentiality, we will make every effort to ensure the privacy of your information. All private information will be stored on this online survey provider, which is password protected, and only those directly involved in this study will have access. When data is downloaded, it will be stored only on password protected computers.

Appalachian State University Counseling Center:

Physical Address:

1st Floor, Miles Annas Building
614 Howard Street
Boone, NC 28608-2044

Phone: 828-262-3180

Hours of Operation:

Monday - Friday 8:00 a.m-5:00 p.m

Initial Consultation Hours:

Monday - Friday:
8:30-11:00 a.m. & 1:00-4:00 p.m.

What are possible benefits of this research?

There may be no personal benefit from your participation; however, the information gained by doing this research may help others in the future. This research may help us learn more about the effects of childhood traumas on the young adult population. By exploring the effects of child trauma, it is possible that society may be able to make necessary changes in order to provide more support for survivors of childhood trauma.

Will I be paid for taking part in the research?

You will not be paid for your participation in this study. However, you can earn 1 ELC credit for your participation. There are other research options and non-research options for obtaining extra credit or ELC's. One non-research option to receive 1 ELC is to read an article and write a 1-2 page paper summarizing the article and your reaction to the article. More information about this option can be found at: psych.appstate.edu/research. You may also wish to consult your professor to see if other non-research options are available.

How will you keep my private information confidential?

The information you provide will be kept confidential. All identifying information will be kept secure on a password protected computer. IP address will not be collected. We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information or what that information is. Confidentiality will be protected to the full extent of the law. We will keep all data collected from these surveys on this online survey provider, which is password protected. Downloaded data will be stored only on password protected computers. Only those directly involved in this study will have access to your information. Information collected during this study will be stored indefinitely, but any identifiable information will be deleted at the end of the semester in which you earned credit.

Whom can I contact if I have a question?

Please contact the PI or the Faculty Adviser listed at the top of this form for any questions you have about the research.

If you have questions about your rights as someone taking part in research, contact the Appalachian Institutional Review Board Administrator at 828-262-2692 (days), through email at irb@appstate.edu or at Appalachian State University, Office of Research Protections, IRB Administrator, Boone, NC 28608.

Do I have to participate?

Your participation in this research is completely voluntary. If you choose not to volunteer, there is no penalty or consequence. If you decide to take part in the study you can still decide at any time that you no longer want to participate. You will not lose any benefits or rights you would normally have if you do not participate in the study.

This research project has been approved on 9/28/2015 by the Institutional Review Board (IRB) at Appalachian State University. This approval will expire on 9/27/2016 unless the IRB renews the approval of this research.

I have decided I want to take part in this research. What should I do now?

If you have read this form, are at least 18 years old, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate, then **type your name** and print a copy for your records.

[Text Box]

Appendix E

Consent to Participate in Research *Information to Consider about this Research*

Emotion Recognition and Fixation Patterns Study 2

Principal Investigator: Emily Mohr

Department: Psychology

Contact Information:

PI: Emily Mohr

mohrem@appstate.edu

FA: Twila Wingrove

wingroveta@appstate.edu

What is the purpose of this research?

You are being invited to take part in a research study about the effects of childhood traumas on emotion recognition and fixation patterns. By conducting this study, we hope to understand how childhood traumas influence the ability to identify facial expressions. We also hope gain insight into how childhood traumas influence eye-movements when looking at facial expressions. We plan to use the results of this study in a Master's thesis, which we then plan to publish.

Why am I being invited to take part in this research?

You have been randomly selected to take part in this study because you are at least 18 years old, are a student at Appalachian State University, and participated in Study 1. If you volunteer to take part in this study, you will be one of about 60 people to do so.

What will I be asked to do?

If you agree to take part in this research study, you will be asked to complete a short cognitive task, during which you will have two minutes to match symbols with their corresponding digits. Following the cognitive task, you will complete an eye tracking task, during which you will be asked to identify several different facial expressions. During this task, you will first take part in a calibration processes. During this process, you will be asked to look at a series of fixation circles on the computer screen. Following the calibration, you will have a chance to practice using the keyboard to enter your responses. Once the practice session has ended, you will begin the session. Together, these tasks should take no more than 30 minutes.

What are possible harms or discomforts that I might experience during the research?

To the best of our knowledge, the risk of harm and discomfort from participating in this research study is no more than you would experience in everyday life. There is the risk of a breach of confidentiality; however, we will make every effort to ensure the privacy of your information. All private information will be stored on a secure, password protected computer, which is located in a secure, locked lab, and only those directly involved in this study will have access.

What are possible benefits of this research?

There may be no personal benefit from your participation; however, the information gained by doing this research may help others in the future. This research may help us learn more about the effects of childhood traumas on the young adult population. By exploring the effects of child trauma, it is possible that society may be able to make necessary changes in order to provide more support for survivors of childhood trauma.

Will I be paid for taking part in the research?

You will be paid \$5 for your participation in this study, and you may be eligible to earn 1 ELC credit for your participation. There are other research options and non-research options for obtaining extra credit or ELC's. One non-research option to receive 1 ELC is to read an article and write a 1-2 page paper summarizing the article and your reaction to the article. More information about this option can be found at: psych.appstate.edu/research. You may also wish to consult your professor to see if other non-research options are available.

How will you keep my private information confidential?

The information you provide will be kept confidential. All identifying information will be kept secure on a password protected computer. We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information or what that information is. Confidentiality will be protected to the full extent of the law. We will keep all data collected from this task on a secure, password protected computer. Only those directly involved in this study will have access to your information. Information collected during this study will be stored indefinitely and may be used for future research, but any identifiable information will be deleted at the end of the semester in which you earned credit.

Whom can I contact if I have a question?

If you have questions about your rights as someone taking part in research, contact the Appalachian Institutional Review Board Administrator at 828-262-2692 (days), through email at irb@appstate.edu or at Appalachian State University, Office of Research Protections, IRB Administrator, Boone, NC 28608.

Do I have to participate?

Your participation in this research is completely voluntary. If you choose not to volunteer, there is no penalty or consequence. If you decide to take part in the study you can still decide

at any time that you no longer want to participate. You will not lose any benefits or rights you would normally have if you do not participate in the study.

This research project has been approved on February 10, 2016 by the Institutional Review Board (IRB) at Appalachian State University. This approval will expire on February 9, 2017 unless the IRB renews the approval of this research.

I have decided I want to take part in this research. What should I do now?

If you have read this form, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate, then sign your name.

Participant's Name

Date

Vita

Emily Marie Mohr was born in Richmond, Virginia to Linda and David Mohr. In June 2010, she graduated from Eugene Ashley High School in Wilmington, North Carolina. The following fall, she attended University of North Carolina Wilmington. In December 2013, she acquired her Bachelors of Arts in Psychology. In August 2014, Emily began study toward a Masters of Arts in Experimental Psychology, where she earned her degree in December 2016. Emily has presented her research at two national conferences and will continue to research various topics regarding trauma, cognition, and neuropsychology.