ABSTRACT

Title of Dissertation: RELATION BETWEEN ADOLESCENT CALLOUS-UNEMOTIONAL TRAITS AND SUBJECTIVE AND PHYSIOLOGICAL REACTIONS TO SOCIAL EXCLUSION

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Callous-unemotional (CU) traits (e.g., lack of empathy and guilt toward others) occur dimensionally, across the age range, and in both clinical and nonclinical populations. Among adolescents with co-occurring conduct problems, elevated CU traits are linked to multiple negative outcomes. Yet, little is known about the potential negative or positive impact of CU traits among adolescents at low-risk for displaying conduct problems. Prior research suggests the unique constellation of cognitive, emotional, and

biological characteristics associated with CU traits may buffer adolescents' negative emotional reactions to distressing social situations. In the current study, I tested this idea by examining whether the severity of CU traits impacted adolescents' experience as victims of a negative social interaction, namely social exclusion. Specifically, I examined the impact of CU traits on adolescents' self-reported distress following social exclusion, and physiological arousal during exclusion. Participants included a mixed community-based and clinical sample of 86 adolescent-parent dyads. Dyads completed measures of adolescent social anxiety and CU traits. Next, adolescents completed a computerized social exclusion task during which I collected measures of adolescent physiological arousal (e.g., heart rate). Adolescents then completed a subjective distress scale to assess mood and distress following the social exclusion task. Adolescent males and those with clinically elevated levels of social anxiety displayed significantly higher CU traits relative to females or those without clinically elevated levels of social anxiety. Surprisingly, adolescent CU traits were not significantly related to differences in self-reported distress following exclusion. Adolescents' physiological arousal varied throughout the social exclusion task, with adolescents experiencing increased arousal transitioning from social inclusion to social exclusion, and heightened arousal persisting through the remainder of the task. Adolescent gender and CU trait severity significantly predicted overall physiological arousal during the social exclusion task. Specifically, as CU trait severity increased, adolescent males displayed decreased physiological arousal, whereas no differences in arousal were observed for adolescent females, regardless of CU trait severity. These findings suggest that among male adolescents at low risk for

conduct problems, elevated CU traits may serve to buffer negative emotional reactions to aversive social situations.

RELATION BETWEEN ADOLESCENT CALLOUS-UNEMOTIONAL TRAITS AND SUBJECTIVE AND PHYSIOLOGICAL REACTIONS TO SOCIAL EXCLUSION

by

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List of Abbreviations

Attention-Deficit/Hyperactivity Disorder	ADHD
Beats per minute	BPM
Callous-unemotional	CU
Conduct Disorder	CD
Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition	DSM-5
Inventory of Callous-unemotional Traits	ICU
Need Threat Scale	NTS
Social Phobia and Anxiety Scale for Children	SPAI-C

Chapter 1: Introduction

Callous-unemotional (CU) Traits

Callous-unemotional (CU) traits are characterized by a lack of concern for the feelings of others, a lack of remorse or guilt, shallow or superficial affect, and callous use of others for personal gain (Frick & White, 2008). These CU traits emerge as early as the preschool years (Ezpeleta, de la Osa, Granero, Penelo, & Domènech, 2013) and manifest in both community-based and clinical samples (Frick, Ray, Thornton, & Kahn, 2013). Further, CU traits predict numerous negative outcomes, including antisocial behavior, poor interpersonal relationships, and hyperactivity (Viding & McCrory, 2012). Although both males and females may display CU traits, males tend to display increased CU traits relative to females (Essau, Sasagawa, & Frick, 2006).

Despite the considerable clinical implications of elevated CU traits for some children and adolescents (i.e., collectively referred to as "youth"), the identification of personality traits during youth, including CU traits, remains controversial among mental health professionals. This controversy stems from the idea that CU traits may remain malleable prior to adulthood (Seagrave & Grisso, 2002). If true, the implication of this idea is that even though adolescents may display features of callous-unemotionality, they do so in inconsistent or state-like ways. For example, some researchers and clinicians have raised concerns that, particularly during adolescence, measures of CU traits may simply reflect transient behaviors typical of normal development (e.g., egocentricity) that closely resemble CU traits (e.g., lack of sensitivity towards others' thoughts; Seagrave & Grisso, 2002). However, these ideas are inconsistent with multiple lines of research on adolescent CU traits. First, measures of CU traits in youth appear to capture callous and

unemotional attitudes and behaviors, over and above those reflecting typical development (Frick, Kimonis, Dandreaux, & Farell, 2003). Second, CU traits remain relatively stable during childhood, adolescence and adulthood, as well as from childhood to adolescence and from adolescence to adulthood (Fontaine, Rijsdijk, McCrory, & Viding, 2010; Frick, Kimonis et al., 2003; Frick, Ray, Thornton, & Kahn, 2014). Third, researchers have identified a variety of genetic and environmental risk factors that may contribute to the development and stability of CU traits during youth. For instance, youth with co-occurring elevated CU traits and conduct problems display a variety of abnormal functional and structural brain responses across a range of social, emotional, and cognitive tasks; abnormalities which may be indicative of or predispose youth to the development of deviant empathy skills, emotional processing, or reinforcement learning (Viding & McCrory, 2012). Similarly, CU traits appear highly heritable, with genetic effects accounting for between 42% to 68% of variability in CU traits (Frick et al., 2013).

Given the robust support for the presence of trait-like levels of CU traits during various developmental periods, prior literature suggests adolescence may serve as a particularly important developmental period within which to examine CU traits (Seagrave & Grisso, 2002). Specifically, researchers have observed significant differences in the severity of CU traits during the course of adolescence. For instance, prior literature suggests that mid-adolescents (e.g., 15- and 16-year-olds) may display increased CU traits relative to both younger adolescents (e.g., 13- and 14-year-olds) and older adolescents (e.g., 17- and 18-year-olds; Essau et al., 2006). Specifically, researchers have observed cohort effects regarding the stability of CU traits during adolescence, such that some youth display stable CU traits across adolescence whereas others present with

decreasing traits towards the end of adolescence. In fact, researchers have observed higher heritability estimates observed for youth, particularly males, who display stable and high CU traits from childhood to adolescence and into adulthood, relative to those displaying less stable CU trajectories (Fontaine et al., 2010). Collectively, prior work indicates that adolescents are capable of displaying CU traits, and variations in CU traits may reflect individual differences among adolescents in behavioral, emotional, cognitive, and physiological functioning.

CU Traits and Negative Outcomes

Elevated CU traits are widely implicated in a variety of negative outcomes, particularly among antisocial youth (Frick et al., 2013). Researchers have repeatedly observed worse outcomes for youth with co-occurring Conduct Disorder (CD) and elevated CU traits, relative to youth with CD and low CU traits (Frick, Cornell, Barry, Bodin, & Dane, 2003). For instance, relative to youth presenting with severe conduct problems and low CU traits, youth presenting with severe conduct problems and high CU traits are at a heightened risk for engaging in more severe forms of aggressive and antisocial behavior (e.g., bullying, interpersonal aggression, proactive aggression; Thornton, Frick, Crapanzano & Terranova, 2013), befriending deviant peers (Kimonis, Frick, & Barry, 2004), and endorsing deviant values and goals during social interactions (e.g., viewing aggression as appropriate method for self-gain; Pardini & Byrd, 2012). Longitudinally, increased CU traits in youth predict increased risk for antisocial outcomes in adulthood such as criminal behavior and incarceration, even after controlling

for the severity of conduct problems during childhood and adolescence (Frick et al., 2013).

Additionally, youth with CD and elevated CU traits comprise a subgroup of youth who are particularly difficult-to-treat. For example, behavioral parent training interventions are regularly used as effective treatments for youth with conduct problems (Brestan & Eyberg, 1998). However, youth with elevated CU traits consistently display reduced treatment response to behavioral parenting interventions, relative to youth without co-occurring CU traits (Hawes & Dadds, 2005). For instance, males with elevated and stable CU traits display decreased responsiveness to parental discipline (i.e., time out): a hallmark component of parenting interventions (Hawes & Dadds, 2005). Moreover, treated youth who display a stable trajectory of CU traits from pretreatment to posttreatment tend to experience worse outcomes, relative to youth who display decreases in CU traits over the course of treatment (Hawes & Dadds, 2007). Thus, clinical evidence indicates that relative to youth who display conduct problems without CU traits, youth who display co-occurring CU traits and conduct problems tend to respond poorly to treatments designed to target conduct problems.

Given the demonstrated risk associated with elevated CU traits and the substantial support for the clinical utility of identifying co-occurring CU traits among conduct disordered youth, the diagnostic criteria for CD were revised to include a CU specifier (i.e., "with limited prosocial emotions") in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013). Specifically, the diagnostic criteria for CD with limited prosocial emotions, includes meeting full criteria for a diagnosis of CD, as well as displaying at least two of

the following symptoms for at least 12 months and across multiple settings: (a) lack of remorse or guilt; (b) callousness or lack of empathy; (c) unconcerned about own performance, and (d) shallow or deficient affect (American Psychiatric Association, 2013).

Why might some youth who display CU traits experience poor clinical outcomes? Among conduct disordered youth, those displaying elevated CU traits present with numerous unique cognitive, emotional, and biological characteristics. First, youth with elevated CU traits are more likely to act based on self-interest—despite causing harm to others—and emphasize the use of dominance or revenge in social situations (Frick et al., 2013). Similarly, individuals with elevated CU traits display an insensitivity to punishment cues and underestimate the likelihood they will be punished in a given situation (Roose, Bijttebier, Decoene, Claes, & Frick, 2010).

Second, elevated CU traits are linked to numerous deficits associated with processing emotional information, including difficulty experiencing affective empathy (Dadds et al., 2009), and decreased self-reported arousal to emotionally evocative stimuli (Herpers, Rommelse, Bons, Buitelaar, & Scheepers, 2012). Third, elevated CU traits are related to a variety of important and unique biological characteristics, such as decreased physiological (e.g., heart rate) responses to emotionally evocative stimuli, distress, or provocation (Frick et al., 2013; Herpers et al., 2012).

In short, multiple lines of both basic and clinical research highlight the negative implications of elevated CU traits among conduct disordered youth, with numerous cognitive, emotional, and biological factors contributing to the unique negative consequences associated with increased CU traits, above conduct problems alone.

Moreover, increases in our understanding of the negative outcomes associated with co-occurring elevated CU traits and conduct problems continue to inform our ability to understand, diagnose, and treat high-risk youth.

The Impact of CU Traits among Adolescents at Low Risk for Conduct Problems

Although researchers largely examine CU traits among the most severe clinical populations presenting with co-occurring conduct problems (e.g., those with CD), researchers have suggested that the presence of elevated CU traits are not unique to clinical populations (Herpers et al., 2012). That is, youth can display elevated CU traits in the absence of clinical concerns (Kumsta, Sonuga-Barke, & Rutter, 2012), with prevalence rates for CU traits in youth ranging from 10% to 32% in community-based samples (Frick, Ray, Thornton, & Kahn, 2014). Furthermore, CU traits present dimensionally among clinical and non-clinical, community based samples (Hare & Neumann, 2008). Yet, an understudied area of research involves examinations of the impact of CU traits across a spectrum of severity among adolescents at low risk for conduct problems. Consequently, the current study sought to expand prior literature on CU traits by examining these traits in a community-based sample at low-risk for concurrent conduct problems.

As outlined previously, elevated CU traits predict numerous maladaptive outcomes across various domains of functioning (e.g., social, emotional; Frick et al., 2013). Yet, many questions remain about the extent to which CU traits universally portend negative outcomes. Upon first glance, the idea that CU traits could result in positive consequences may seem counterintuitive. However, prior research supports that

various types of psychopathology often considered maladaptive may also demonstrate adaptive benefits. For instance, social anxiety predicts elevated risk for a variety of negative outcomes, such as negative affect, decreased satisfaction with social relationships, and less career attainment (Kashdan, 2002). However, some elements of social anxiety (e.g., heightened concern of being negatively evaluated by others) have also been linked to positive outcomes, including increased interpersonal competence with peers (Rudolph & Conley, 2005).

Researchers have examined similar questions among adults who display the interpersonal and affective features of psychopathy (e.g., superficial charm, callousness, low empathy) but either lack severe antisocial and violent behaviors or have avoided conviction, a subsample known as "successful psychopaths" (Lillienfeld, Watts, & Smith, 2015; Mullins-Sweatt, Glover, Derefinko, Miller, & Widiger, 2010). Researchers propose that certain psychopathic features, similar to those characterized by CU traits in youth, may serve adaptive functions in the absence of severe conduct problems. For instance, characteristics such as decreased arousal to stressful situations and decreased empathy may assist individuals in maintaining a self-serving attitude that can result in success, especially within highly competitive environments (e.g., corporate finance; Gao & Raine, 2010).

Together, these lines of prior research provide "proof of concept" for the idea that psychological symptoms commonly conceptualized as inherently maladaptive may be adaptive within certain circumstances. Unfortunately, there exists a dearth of literature applying this concept as to understanding CU traits among youth. Moreover, callous-unemotional traits manifest within interpersonal interactions (e.g., lack of concern for

other's interests, appearing cold to others); yet, one important area that has received relatively little attention involves understanding links between CU traits and reactions to social experiences.

Unfortunately, literature on the links between CU traits and social function has largely focused on social outcomes linked to externalizing problems, such as conduct problems. For instance, researchers tend to focus on whether adolescents who display elevated CU traits react aggressively to emotionally evocative stimuli (e.g., recognizing others' emotional responses to aversive stimuli; Frick et al., 2013). Additionally, prior work has largely focused on examining the impact of CU traits on one's processing of emotionally evocative stimuli depicting the victimization of others (e.g., Anastassiou-Hadjicharalambous & Warden, 2008). Yet, less is known about the impact of CU traits on an adolescent's own internal reactions to experiencing negative social interactions. In other words, do variations in CU traits differentially impact the extent to which adolescents experience increased subjective distress or physiological arousal when being treated poorly by peers? Although elevated CU traits are associated with increased negative outcomes linked to externalizing behaviors (e.g., conduct problems) and deficits in processing the emotional responses of others (e.g., poor affective empathy; Dadds et al., 2009), might these same traits buffer against negative internal emotional reactions to adverse social situations among adolescents at low risk for conduct problems?

Exposure to social exclusion, or the process of being ignored or ostracized by others, represents one such aversive social situation. Increased social exclusion tends to elicit aversive emotional responses among adolescents generally, in that increased exclusion predicts decreased self-perceived meaningfulness, self-esteem, mood, and

sense of belonging; and importantly, increased subjective distress (Williams & Sommer, 1997). Social exclusion also elicits aversive physiological reactivity. For example, during periods of social exclusion, individuals typically experience symptoms indicative of increased activation of the autonomic nervous system (i.e., "fight or flight" responses), including increased heart rate (Iffland, Sansen, Catani, & Neuner, 2014; Sijtsema et al., 2011).

The negative effects of social exclusion on mood and distress appear robust across a variety of clinical and non-clinical samples (Iffland et al., 2014). However, prior work also suggests that certain personality characteristics may moderate reactions to social exclusion, such that some individuals experience relatively little aversive reactions to such exclusion (Wirth, Lynam, & Williams, 2010). Given the unique interpersonal, emotional and cognitive characteristics associated with CU traits, to what extent might CU traits moderate an individual's subjective and physiological reactions to social exclusion?

Adolescents presenting with symptoms of social anxiety represent a unique population for addressing these questions, given that socially anxious adolescents experience increased risk for social difficulties (e.g., decreased social functioning, fewer close friendships (Greca & Lopez, 1998). Additionally, prior work demonstrates a strong, negative relation between CU traits and anxiety (Fanti, 2013; Frick et al., 2013; Verona, Patrick, Joiner, 2001), such that individuals high in CU traits typically display decreased anxiety. Further, adolescents presenting with increased social anxiety often display hyper-reactivity or hyperarousal during negative social encounters (Goldin, Manber, Hakimi, Canli, & Gross, 2009). Yet, given that CU traits predict decreased arousal during

distressing situations (Frick et al., 2013; Herpers et al., 2012), these traits may buffer negative reactions to distressing situations among youth with or without co-occurring social anxiety symptoms. Thus, I specifically recruited adolescents at low-risk for conduct problems who presented with various degrees of CU traits and co-occurring social anxiety symptoms to explore whether varying severity of CU traits predicted individual differences in response to social exclusion. I know of no prior study examining the unique impact of CU traits on one's experience of social exclusion. However, several lines of prior work support the hypothesis that adolescents who display elevated CU traits also display atypical reactions to social exclusion.

Potential Impact of CU Traits During Social Exclusion

First, prior research using both clinical and typically developing adolescents suggests that the unique constellation of cognitive, emotional, and biological characteristics associated with CU traits described previously may buffer youths' negative reactions to distressing social situations broadly. For instance, although limited research has specifically examined adaptive effects of CU traits, researchers have investigated the potential protective role of CU traits in predicting decreased suicidal thoughts and behaviors among depressed adolescents. Females who display emotion regulation difficulties (e.g., ineffective strategies for regulating emotions) are at increased risk for engaging in suicidal behaviors (Miller, Rathus, & Linehan, 2006; Pasani et al., 2013). Yet, among adolescent females, CU traits may serve a protective role against suicide attempts, such that increased CU traits predict decreased risk for suicide attempts (Javdani, Sadeh, & Verona, 2008).

A second line of research supports the hypothesis that individuals with CU traits likely experience social exclusion in atypical ways. As mentioned previously, adolescents displaying high CU traits tend to display diminished response to threatening situations (Frick et al., 2013). Consequently, they may not experience the enhanced distress and arousal to social exclusion expected from typically developing adolescents. Similarly, given the unique emotion processing deficits linked to CU traits and the general social disinterest among those who display such traits, adolescents with elevated CU traits may fail to experience exclusion events as threatening or punishing. Additionally, it may be that among adolescents displaying varying degrees of CU traits (i.e., not just elevated CU traits), these traits may impact a youth's social functioning to differing extents. In line with these ideas, might youth at low risk for displaying conduct problems who present with various levels of CU traits experience relatively low aversive reactions to distressing social situations? I designed this study to directly address this question.

Current Study

The current study sought to augment prior research by examining the extent to which adolescents presenting with varying levels of CU traits differentially experience social exclusion. By addressing the three specific aims described below I sought to understand the extent to which an adolescent's subjective and physiological reactions to social exclusion vary based on his or her level of CU traits?

Specific Aims and Hypotheses.

Specific Aim 1: First, I examined the relation between CU traits and subjective reports of distress following periods of social exclusion.

Hypothesis 1: Adolescents displaying high CU traits tend to display diminished response to threatening situations (Frick et al., 2013), and consequently, they may not experience the enhanced distress and arousal to social exclusion expected of typically developing adolescents. Furthermore, given the unique emotion processing deficits associated with CU traits and the general social disinterest that often accompanies these traits, adolescents with elevated CU traits may fail to experience exclusion events as threatening or punishing. Consequently, I expected CU traits to negatively relate with adolescents' reports of subjective distress following social exclusion, such that increased CU traits would predict decreased self-reported distress.

Specific Aim 2: Next, I examined the moderating role of CU traits on physiological arousal during periods of social inclusion and periods of social exclusion.

Hypothesis 2: Prior work suggests that increased CU traits predict decreased physiological arousal following distress (Herpers et al., 2012). Therefore, I hypothesized CU traits would moderate adolescents' physiological arousal during periods of social exclusion. Specifically, I predicted a gradated physiological response to social exclusion, such that adolescents with low CU traits would experience increased physiological

arousal during periods of social exclusion relative to those displaying moderate or elevated CU traits.

Exploratory Aim: Finally, I conducted exploratory analyses to investigate the correspondence between subjective and physiological response to exclusion and the potential moderating role of CU traits. I predicted that adolescents with decreased CU traits would exhibit strong, positive relations between their arousal during and perceived distress following social exclusion (i.e., high arousal during, high distress following exclusion). Due to the dearth of research examining the impact of CU traits on social exclusion, I considered two possible outcomes regarding the relation between subjective distress and physiological arousal among those with high CU traits. First, adolescents with increased CU traits may display lower subjective distress and physiological arousal, relative to those with lower CU traits, resulting in a similar, strong positive relation between arousal during and perceived distress following social exclusion. In contrast, one might observe a negative relation, such that adolescents with increased CU traits report decreased subjective distress following exclusion relative to those with low CU traits, yet still exhibit increased physiological arousal. If found, these results could potentially demonstrate that increased CU traits may predict decreased insight into one's experience of social distress, versus a lack of experiencing negative reactions to aversive social experiences (e.g., increased arousal).

A second set of exploratory aims were informed by work reviewed previously on age and gender differences in levels of CU traits. Specifically, I examined potential age and

gender differences in CU traits to identify covariates to include in tests of specific aims, as well as the exploratory aim of correspondence between subjective and physiological reactions to social exclusion.

Chapter 2: Methods

Participants

Participants included a mixed community-based and clinic-referred[1] sample of 86 caregiver and adolescent dyads, recruited as part of a larger research project. Participants were recruited through several means, including: a) flyers placed in the community targeting dyads interested in participating in a study on "how parents and teens interact," b) flyers soliciting dyads interested in having an adolescent complete a "shyness evaluation," and c) postings through online recruitment resources (e.g., Craigslist). Consistent with prior research using similar recruitment methods (e.g., De Los Reyes et al., 2012), I anticipated that this recruitment approach would result in a sample of participants with demographic characteristics closely matching those of the broader region of recruitment (i.e., the MD/DC/VA area).

Adolescent participants were specifically recruited to address two primary gaps from previous literature. First, I employed recruitment methods to attract adolescents displaying a broad range CU traits. As mentioned previously, prior literature has demonstrated that CU traits occur across a spectrum of severity within community-based adolescents (Frick et al., 2014). Consequently, the current study included adolescents recruited from the general population, and I hypothesized that a community-based sample of adolescents would display a spectrum of CU traits, in much the same way as recruiting a community-based sample may result in a spread of scores reflecting dimensionally

[1] Of note, unlike the clinic-referred populations typically recruited for studies of elevated CU traits in youth, the clinic-referred youth participating in the current study were recruited based on parent-reports of elevated anxiety or shyness and not elevated levels of conduct problems.

varying levels of other domains such as internalizing symptoms or engagement in delinquent behavior. Participants also included a subsample of adolescents presenting with increased levels of social anxiety. As previously discussed, researchers tend to observe negative correlations between CU traits and anxiety (Essau, Sasagawa, & Frick, 2008; Frick, O'Brien, Wootton, & McBurnett, 1994), suggesting that clinic-referred adolescents presenting with elevated anxiety may endorse lower CU traits relative to those adolescents reporting low anxiety. Therefore, additional recruitment methods targeted individuals with and without co-occurring symptoms of social anxiety to maximize the likelihood of capturing a range of reported CU traits.

Second, despite the negative relation often observed between anxiety and CU traits, adolescents can present with increased anxiety and CU traits (Lahey, 2014). Moreover, social anxiety is commonly associated with hyper-reactivity and arousal during distressing situations (e.g., stressful social interactions; Goldin et al., 2009), whereas increased CU traits are commonly associated with hypo-reactivity during such situations (Frick et al., 2013; Herpers et al., 2012). Consequently, variation in social anxiety within the current sample afforded increased opportunity to assess adolescents who exhibited a relatively high likelihood of displaying aversive emotional reactions to social exclusion.

Participating adolescents were primarily female (68.6%), and all adolescents were between 14 and 15 years old. For the purposes of the current study, I refer to participating caregivers as "parents." Primary inclusion criteria consisted of: (a) ability to speak English, (b) the adolescent residing with the participating parent at the time of the study, and (c) current high school matriculation. Adolescents were excluded if they or their

participating parents reported a serious developmental disability or medical condition, resulting in an inability to complete study procedures, or if they reported an inability to read at an 8th grade level or above.

The adolescent participants consisted of 27 males (27.9%) and 59 females (68.6%) with a mean age of 14.50 years (*SD* = 0.50). Parents described the participating adolescents as African American or Black (59.3%), European American (26.7%), Latino/a American (7.0%), Asian American (4.7%), American Indian (1.2%) or Other (9.3%). Parent's self-identified as African American or Black (60.5%), European American (32.6%), Latino/a American (4.7%), Asian American (3.5%), American Indian (3.5%), or Other (4.7%). (As an aside, some demographic values surpass 100% because parents identified the adolescents or themselves as more than one racial/ethnic category.)

Each participating parent self-identified as the participating adolescent's primary caregiver. Participating parents consisted of 15 males and 71 females who self-identified as the adolescent's biological mother/father (94.2%) or another caregiver (5.8%; e.g., step-parent, adoptive parent, parent's significant other). Parents' reported marital status varied with 44.2% married, 27.9% never married, 14.0% divorced, 9.3% separated, 3.5% living together, and 1.2% widowed. Parents' self-reported highest level of education varied with 4.7% who did not earn a high school diploma, 13.9% who completed at least a high school education or GED, and 81.4% who completed some higher education beyond high school (e.g. some college, associate's, vocational, or bachelor's degree). Parents reported weekly household income across 10 categories that varied by $100 increments (i.e., *Less than $100 per week* through *901+ per week*). Based on this scale,

30.2% of the families had a weekly household income of $500 or less, 23.3% had a weekly income between $501 and $900, and 46.5% earned $901 or more per week.

Procedures and Task

Prior to participating in the study, parents completed a phone screen with a member of the laboratory staff to assess for eligibility. Once determined eligible, families completed all research procedures within a single laboratory visit. As mentioned previously, the current study represents a subset of tasks completed by participants from the larger study. However, the description below will focus exclusively on procedures relevant to the current study. Upon providing informed consent (parents) and assent (adolescents), participating dyads completed a counterbalanced battery including assessments of the adolescents' callous-unemotional traits, and internalizing symptoms (i.e., social anxiety). Parents also completed a family demographics form. Adolescents then completed a computer-based social exclusion task during which trained research assistants administered a comprehensive psychophysiological assessment, described below. Lastly, adolescents completed an assessment of subjective distress following the social exclusion task. At the conclusion of their participation, families received $100 as compensation for their time and transportation costs, and were debriefed regarding the purpose of the study and the use of deception within the procedures.

Cyberball Social Exclusion Task.

The Cyberball social exclusion task (Williams, Cheung, & Choi, 2000) is a widely-used, computer-based social exclusion task comprised of a virtual ball-tossing

paradigm which alternates between blocks of inclusion and exclusion for the participant. The current version of Cyberball was adapted from previous iterations of the task (e.g., Bolling et al., 2011; Crowley et al., 2009; McPartland et al., 2011; Williams, Cheung, & Choi, 2000) to reflect a within-subjects, ABAB inclusion/exclusion design. Specifically, in the current study, the Cyberball task consisted of four alternating blocks, during which adolescents experienced two blocks each of inclusion and exclusion within a simulated game of toss between themselves and two age- and gender-matched mock participants.

Prior to beginning the task, the researcher took a digital picture of the adolescent. The adolescent was told the picture would be used during the task; however, the picture was actually immediately deleted without the adolescent's knowledge. Once the adolescent's picture was taken, the adolescent was accompanied by the researcher to a novel laboratory space to complete the Cyberball task. During this transition, adolescents were told they would be playing a ball-tossing game with two other adolescents their age located in nearby testing rooms. The "adolescents" presented during the game were actually computerized confederates programmed into the task, and thus no real-world confederates or additional adolescent participants were used during this task. Of note, adolescents were fully debriefed of all deception following the completion of the study. In total, the computerized Cyberball portion of the study took approximately 45 minutes to complete, including: (a) a five-minute baseline period, (b) the ABAB Cyberball task, and (c) the computerized scale of subjective distress described below (see Figure 1 for an outline of task procedures).

Throughout the task, I assessed changes in adolescents' mean heart rate (beats per minute [BPM]) (i.e., physiological arousal) in response to the social exclusion task.

Specifically, adolescents were administered a psychophysiological assessment via the Biopac MP150 system (http://www.biopac.com/data-acquisition-system-mp150-system-glp-win). The Biopac MP150 allows for data acquisition across multiple units of psychophysiological analysis. Specifically, adolescents' responses to the social exclusion task were assessed using resting heart rate and changes in heart rate over the course of the task. Data were collected using Acq*Knowledge*™ 4 data acquisition software (http://www.biopac.com/acqknowledge-data-acquisition-analysis-software-win), which allows simultaneous recording of multiple psychophysiological units of analysis. A gender-matched researcher assisted participating adolescents in applying a two-electrode ECG monitor, with an electrode placed on the participant's right collarbone and lower, left ribs, to monitor continuous heart rate, sampled at a rate of 1000Hz. Participating adolescents also had two electrodes placed on the index and little finger of their non-dominant hand to monitor galvanic skin response (GSR), collected as part of a larger project and not used within the current study. Importantly, the GSR electrodes acted as the grounding electrodes for the other physiological metrics. As mentioned previously, all physiological equipment was placed on the adolescent by a gender-matched researcher, with a second researcher present during the placement for support and technical trouble-shooting.

Once the equipment was placed on the participant, adolescents completed the five-minute baseline, followed by the Cyberball task, subjective distress scale, and manipulation check questions (Figure 1). During the five-minute baseline period, adolescents were seated in front of a desktop computer and were presented first with a visual display of instructions to remain as still as possible for the duration of the task,

followed by a black screen with a single white fixation cross in the center display. After the five-minute baseline period, adolescents were presented with instructions to choose a baseball glove of their preference, out of six possible options, to use during the Cyberball task. Immediately following glove selection, adolescents were presented with an instruction screen explaining the button selections available to "throw" the ball as well as the general rules of the game. Specifically, adolescents were instructed to "throw" the ball to either the left or right adolescent on the screen each time the ball was in their control. After successfully reading the instructions, adolescents completed the task.

During Cyberball, adolescents were presented with a screen display including an image of a single age and gender-matched adolescent in each of the upper right and left corners (two adolescent confederates total), as well as an image of each adolescent's chosen glove in the lower center portion of the screen (see Figure 2). Participating adolescents completed a standardized version of the ABAB task design, specifically preprogrammed to run automatically using the E-Prime 2.0 presentation software (Psychology Software Tools, Pittsburgh, PA). Each inclusion, or A, block consisted of 54 ball-tossing trials, and each exclusion, or B, block consisted of 47 trials. A single ball toss between any two characters (i.e., computerized confederates and/or the participant) represented a single trial. During the inclusion blocks, the participant received the ball 31% of the trials, or 17 trials; whereas, during the exclusion block, the participant only received the ball 6%, or 3 trials. The exclusion block represents 94% exclusion, meaning the participant only received the ball 3 times (i.e., trials 14, 25, and 39) to maintain attention. The Cyberball task was programmed to transition seamlessly between the inclusion and exclusion blocks to minimize any explicit cues that a transition was taking

place. In total, the ABAB Cyberball portion of the study consisted of 202 trials and took approximately 20 minutes to complete. Upon completion of the Cyberball task, adolescents completed a 30-item computerized distress scale and manipulation check. Upon completion of the final manipulation check item, a gender-matched researcher assisted the adolescent in removing the physiological equipment and accompanied the adolescent to the initial laboratory setting to rejoin his or her parent, complete debriefing, and receive participant compensation.

Measures

Parents completed measures assessing domains of adolescent and family demographics. Next, parents and adolescents completed parallel reports of the adolescents' callous-unemotional symptoms and social anxiety. Then, after completing the social exclusion task described previously, adolescents completed a self-report measure of distress during the task.

Adolescent and Family Demographics.

Demographic data was obtained through parent reports of adolescent age and gender, family/ethnicity/race, and family income via a computerized demographics questionnaire (Appendix A).

Adolescent Callous-unemotional Traits.

Parents and adolescents completed parallel versions of the *Inventory of Callous-unemotional Traits* (ICU; Frick, 2004) to assess the presence of CU traits among

participating adolescents. The ICU consists of 24 items rated on a four-point scale ranging from 1 (*Not at all true*) to 4 (*Definitely True*), with higher scores reflecting greater callous-unemotional symptoms. Individual items on the ICU load onto one of three subscales: uncaring (e.g., "*I work hard on everything I do*"), callousness (e.g., "*The feelings of others are unimportant to me*"), and unemotional (e.g., "*I do not show my emotions to others*"), as well as a general total score (Kimonis et al., 2008). The uncaring subscale consists of eight items (maximum score = 24). Nine items comprise the callousness subscale (maximum score = 27), and five items comprise the unemotional scale (maximum score = 15). Scores on the overall ICU range from 0 to 66[2], with higher scores indicative of more CU symptoms. Twelve ICU items are positively worded and are consequently reverse scored. Parallel versions of the ICU are available, including parent and adolescent self-report versions. Each parallel version contains identical item content, with the items only differing on the perspective of the informant (e.g., "*I*..." versus "*My child*..."). The ICU has extensive evidence attesting to its internal consistency and validity when assessing clinical, community, and incarcerated adolescents (e.g., Essau et al., 2006; Kimonis et al., 2008, 2014; Roose et al., 2010).

Of note, adolescent CU traits acted as a dependent variable for some analyses and a covariate for other analyses. When treated as a dependent variable, parent and

[2] As described previously, prior versions of the Inventory of Callous-Unemotional traits consisted of scores ranging from 0 to 72 (e.g., Kimonis et al., 2013). However, scoring procedures for the current study were modified to reflect updated scoring recommendations from the author of the measure. Specifically, prior research has suggested two items from the ICU (i.e., item 2, item 10) fail to load onto a three-factor model, supporting the exclusion of these two items from further analysis (e.g., Essau et al., 2006; Kimonis et al., 2008). Consequently, only 22 of the 24 items were included in analysis, resulting in a maximum total score of 66 (versus 72).

adolescent reported CU traits were treated as a continuous, repeated measures variable, described in additional detail below. However, parent and adolescent reports of adolescent CU traits significantly correlated in the moderate range (r = .40), suggesting the informants provided related but not redundant reports of CU traits. Therefore, I aggregated the multi-informant CU data to create a single within-subjects independent variable to reduce the number of distinct analyses required to address the corresponding aims and to reduce the risk of committing a Type 1 error. Researchers examining CU traits in adolescents typically rely solely on self-reports of CU traits (e.g., Essau et al., 2006; Fanti, Frick, & Georgiou, 2009; Lorber, Hughes, Miller, Crotheres, & Martin, 2011). However, researchers have also recommended collecting reports from multiple informants to capitalize on the unique perspectives each informant may bring to the assessment of trait-like variables, such as CU traits (Piacentini et al., 1992; Frick, Cornell et al., 2003; Roose et al., 2010).

Consistent with these recommendations, I applied an item-by-item "or" rule to integrate parent and adolescent reports of adolescent CU traits. Specifically, the ICU total score used in this study consisted of summing up item responses based on the highest observed value from each informant dyad for each item (Table 1). To assist in interpreting the moderating and main effects of CU traits and to maximize my statistical power to detect effects, I grouped each adolescent into one of three ICU groups based on these ICU combined total scores. Adolescents were evenly split into thirds, with groups representing those adolescents presenting with relatively low (n = 25; M = 20.34, SD = 3.70), moderate (n = 28; M = 29.29, SD = 2.13) and high (n = 21; M = 38.30, SD = 4.70) CU traits.

Adolescent Social Anxiety Symptoms.

Parents and adolescents also completed parallel assessments of adolescent social anxiety symptoms. Specifically, parents and adolescents completed parallel versions of the *Social Phobia and Anxiety Scale for Children* (SPAI-C; Beidel, Turner, & Morris, 1995) The SPAI-C is a 26-item self-report instrument designed to assess symptoms of social anxiety in children and young adolescents. Items on the SPAI-C assess symptoms across a range of potentially anxiety-producing situations (i.e., reading aloud, eating in the school cafeteria) including physical and cognitive symptoms and avoidance behaviors. Each item is rated on a three-point scale (*never or hardly ever*, *sometimes*, *most of the time or always*). Additionally, nine of the 26 items include follow-up questions assessing the degree of distress across various audience types (e.g., "boys and girls I know", "boys and girls I do not know", "adults"). Scores on the SPAI-C range from 0 to 52, with higher scores indicating increased symptoms of social anxiety. The SPAI-C has demonstrated strong internal consistency in similar adolescent samples (e.g., Lipton, Augenstein, Weeks, & De Los Reyes, 2013). Likewise, I observed strong internal consistency within the current sample for both parent reported (M = 18.13, SD =11.09, α = .95) and adolescent reported (M = 15.72, SD = 10.56, α = .95) adolescent social anxiety symptoms.

Parent and adolescent reports of adolescent social anxiety symptoms typically correlate in the low-to-moderate, suggesting that the reports are related but not redundant (Achenbach, McConaughy, & Howell, 1987; De Los Reyes, Augenstein, Wang et al., 2015). In other words, reports from parent and adolescent reports of adolescent social

anxiety may provide incremental information due to the unique perspectives of each informant. I observed similar levels of correspondence in the current study, with parent and adolescent reports of adolescent social anxiety symptoms correlating in the low range (r = .37).

Consequently, parent and adolescent reports of adolescent social anxiety symptoms were combined to capitalize on the information gathered from SPAI-C ratings from both parents and adolescents in lieu of relying on a single informant alone. First, total scores on the parent- and adolescent-completed SPAI-C were converted into binary values denoting whether each informant rated the adolescent above or below clinical cut-off (i.e., a score of 18; Beidel et al., 1995). Consistent with previous studies, I then applied an "or" combination rule such that if either parent or adolescent reports denoted an adolescent was above the clinical cut-off, that adolescent would be classified as having "high" social anxiety (see Piacentini, Cohen, & Cohen, 1992). In contrast, if neither report denoted clinical levels of social anxiety symptoms, the adolescent would be classified as below cut-off, or presenting with "low" social anxiety. Using this combination technique, approximately 56% (n=48) of participating adolescents displayed relatively high levels of social anxiety.

Subjective Distress Following Social Exclusion.

Upon completion of the Cyberball social exclusion task described previously, adolescents completed a computerized version of the *Need Threat Scale* (NTS; van Beest & Williams, 2006; Appendix B). The NTS consists of 20 questions assessing adolescents' distress across several domains, including need for belonging (e.g., "*I felt*

rejected"), self-esteem (e.g., "*I felt liked*"), meaningful existence (e.g., "*I felt invisible*"), and control (e.g., "*I felt powerful*"). The NTS includes nine negatively worded items that are reverse scored prior to further analysis. Consistent with prior research (e.g., Jamieson, Harkins, & Williams, 2010), the NTS used in the current study was adapted to include eight additional items assessing adolescents' mood following social exclusion (e.g., "*During the game, I felt sad*"). Each item consists of five response options ranging from 1 (*Not at all*) to 5 (*Extremely*). Four of the mood items are negatively worded, and thus were reverse scored prior to analysis. The eight mood items were then combined to create a total mood score, with lower scores reflecting worse mood. As a manipulation check for perceived ostracism, adolescents were asked to rate their feelings of exclusion during the task (e.g., "*During the game, I was ignored*") on two items using a five-point scale ranging from 1 (*Not at all*) to 5 (*Extremely*). Ratings of perceived exclusion on both exclusion items were reverse-scored and then combined to create an overall perceived exclusion score. Consistent with prior NTS scoring, lower scores reflect increased reports of perceived exclusion. Including the original NTS items, the mood items, and the exclusion items, participating adolescents completed a total of 30 computerized questions following Cyberball social exclusion task. The NTS has demonstrated adequate internal consistency and validity (e.g., Jamieson, Harkins, & Williams, 2010; van Beest & Williams, 2006).

Prior literature indicates that Cyberball-induced social exclusion increases distress across all four domains assessed via the NTS (e.g., Jamieson, Harkins, & Williams, 2010), resulting in reports of reduced belonging, self-esteem, control, and meaningfulness. Consequently, I computed bivariate correlations to examine the

correspondence between scores taken from the four domains of distress as well domains of mood, and exclusion. Consistent with prior literature (e.g., Jamieson, Harkins, & Williams, 2010), I observed significant, positive correlations between the distress, mood, and exclusion subscales (Table 2). Therefore, participants' reports across all 30 items on the NTS were averaged to create composite distress total scores for each participant.

Data Analytic Plan

Preliminary Analysis.

I conducted preliminary analyses to test for deviations from normality for parent- and adolescent self-reports of adolescent CU traits and social anxiety as well as adolescent reports of subjective distress following social exclusion. Additionally, I examined the internal consistency estimates across each measure. Adolescent self-reports and parent-reports of adolescents' symptoms typically correlate in the low-to-moderate range (e.g., Achenbach, McConaughy, & Howell, 1987; De Los Reyes, Augenstein, Wang et al., 2015); therefore, I computed between-subject correlations to examine the correspondence between parent and adolescent reports of adolescent CU traits and determine the extent to which these traits display similar cross-informant reporting patterns. Further, I conducted paired samples *t*-tests to assess mean differences between parent and adolescent reports of adolescent CU traits. Using the combined social anxiety grouping variable noted previously as a between-subjects factor, I conducted a One-way ANOVA to examine the extent to which adolescent ICU scores differed based on adolescent social anxiety status. Prior work suggests differences in CU traits by adolescent age and gender (e.g., Essau et al., 2008). Consequently, I conducted

preliminary analyses to examine the extent to which CU traits varied as a function of adolescent age or gender status within the sample (n = 86). Results indicated a significant difference between male and female adolescent CU traits (F (1,84) = 5.42, $p < .05$), with males (M = 24.18, SD = 9.17) typically presenting with higher CU traits relative to females (M = 19.35, SD = 8.81), based on parent reported ICU scores. Based on these results, I included adolescent gender as an independent variable for subsequent analyses. In contrast, results did not support an effect of adolescent age on adolescent CU traits, presumably due to the restricted age range in the current study (i.e., 14 – 15 year olds).

Specific Aims.

For my specific aims, I examined the relation between adolescent CU traits and subjective and physiological responses to social exclusion. Given that parent and adolescent reports of youth psychopathology often disagree yet still significantly correlate in the low-to-moderate range (e.g., Achenbach et al., 1987; De Los Reyes, Augenstein, Wang et al., 2015), it would be difficult to assume these measures to be independent observations. Thus, this correlated data structure violated key assumptions underlying general linear modeling (GLM) of data. Consequently, I tested my specific research aims regarding links between adolescent CU traits and subjective and physiological reactions to social exclusion using generalized estimating equations (GEE): an extension of the GLM that assumes correlated observations of dependent and/or independent variables (Hanley, Negassa, Edwardes, & Forrester, 2003). Consistent with prior work using GEE to examine repeated-measures dependent variables (e.g., Augenstein et al., 2016; De Los Reyes, Alfano, Lau, Augenstein, & Borelli, 2016; De

Los Reyes, Lerner, Thomas, Daruwala, & Goepel, 2013) for GEE modeling, I used an identity link function with an unstructured correlation matrix. I employed an unstructured correlation matrix in light of the small number of dependent variables used in each analysis and the fact that participants in my GEE models provided complete data on all constructs assessed.

Aim 1: Relation between CU traits and adolescent self-reports of distress following social exclusion. To examine relations between adolescent self-reported distress and parent- and adolescent self-reported CU traits, I ran a GEE model, with the overall distress total score (i.e., the composite distress total score described previously), adolescent gender, and adolescent social anxiety symptoms (i.e., the combined social anxiety "or" variable described previously) entered as independent variables and adolescent CU traits entered as a nested, repeated-measures (within dyadic subjects) dependent variable. GEE requires a repeated-measures variable to function as the dependent variable; therefore, I created a repeated-measures dependent variable consisting of parent- and adolescent self-reported CU traits. Specifically, to test my first aim, I statistically modeled the CU dependent variable as a function of the following independent variables: (a) adolescent gender, (b) informant (i.e., coded in ascending order of parent, then adolescent), (c) adolescent social anxiety (i.e., low, high), and (d) adolescent subjective distress following social exclusion.

Aim 2: Relation between CU traits and adolescent physiological arousal during periods of social exclusion.[3] Adolescent physiological data was segmented into five blocks: (a) one baseline block, (b) two social inclusion blocks, and (c) two social exclusion blocks. Following collection, adolescents' heart rate data was hand segmented using the Acq*Knowledge*™ 4 data acquisition software described previously. Next, the heart rate data was cleaned of movement artifacts using Mindware analysis software (MindWare Technologies LTD, 2009) and analyzed to calculate participants' average heart rate within each task condition. Trained research staff visually inspected the data for quality, excluding any cases with excessive movement artifacts and correcting all incorrectly placed R-spikes. Adolescent mean heart rate (BPM) values were then computed using an automated algorithm within the Mindware analysis software.

For each participant, I calculated a single heart rate average value within each block of the task, totaling five heart rate values per adolescent. For example, I averaged the heart rate data from the entire five-minute baseline period to calculate a single baseline heart rate value per participant. Next, I conducted a One-way ANOVA to examine mean group differences in baseline heart rate between adolescents presenting with low, moderate or high levels of CU traits to examine whether baseline heart rate would act as a covariate in subsequent analyses. Results indicated that CU groups did not significantly differ in baseline heart rate values (F (2, 71) = 0.23, p = .79). Consequently,

[3] Of note, of the 86 participating adolescents included in the current study, I collected interpretable heart rate data from a subset of 74 adolescent participants (71.6% female). The additional heart rate data was excluded for a variety of reasons including the data was too noisy to interpret, equipment malfunction, or the task being discontinued prior to completion.

I did not control for baseline heart rate when testing my primary and exploratory hypotheses.

To examine the moderating role of CU traits on physiological arousal during periods of social inclusion and periods of social exclusion, I conducted a GEE analysis to statistically model a repeated-measures dependent variable consisting of the five average heart rate values per participant, described above. Specifically, I modeled the dependent variable as a function of the following independent variables: (a) adolescent gender, (b) social anxiety (i.e., low, high), (c) heart rate block (i.e., coded in ascending order of baseline, first inclusion block, first exclusion block, etc.), (d) CU group (i.e., low, moderate, high), and (e) all possible 2-way interactions.

Exploratory Research Aim.

I conducted exploratory analyses to examine the correspondence between adolescents' subjective and physiological responses to exclusion and the extent to which CU traits moderate this relation. To examine the moderating role of CU traits on the relation between subjective distress and physiological arousal, I ran a GEE analysis to statistically model the repeated-measures physiological arousal variable described above as a function of the following independent variables: (a) adolescent gender (between-subjects), (b) CU group (between-subjects, coded low, moderate, high), (c) heart rate block (within-subjects), (d) composite distress score, (e) all possible two-way interactions, and (f) the three-way interaction between CU group X composite distress score X heart rate block. Of note, prior to running the exploratory analysis, I converted

adolescents' composite distress total scores into mean centered scores to aid in the interpretability of interaction effects.

Chapter 3: Results

Preliminary Analyses

Before testing the main hypotheses, I conducted preliminary analyses and tested for deviations from normality. All measures conformed to normality assumptions (i.e., skewness and kurtosis; see Tabachnick & Fidell, 2001). Additionally, all measures exhibited acceptable levels of internal consistency (i.e., > .70; Nunnally & Bernstein, 1994). See Table 1 for a complete list of internal consistency estimates by informant and measure completed.

Next, I conducted bivariate correlations to examine the relations between the parent and adolescent-reported variables of interest, namely adolescent CU traits and self-reported subjective distress following exclusion (Table 3). As reported previously, I observed low-to-moderate correlations between parent and adolescent reports of adolescent CU traits (r = .40). Consequently, adolescent and parent reports of CU traits were combined into a single combined score of adolescent CU traits, as described previously. As depicted in Table 3, adolescent and parent reports of CU traits significantly correlated with the corresponding combined CU score (r = .76, .84, respectively). Parent reported adolescent CU traits significantly correlated with distress, indicating that increased parent reported adolescent CU traits were significantly related to decreased adolescent reported distress following social exclusion. Yet, I observed no significant relation between the combined CU score and adolescent reported distress following exclusion.

Prior literature suggests complex relations between anxiety and CU traits (e.g., Frick et al., 2013; Lahey, 2014); therefore, I conducted a One-way ANOVA to examine

the extent to which adolescent CU traits varied as a function of adolescent social anxiety symptoms (e.g., low vs. high social anxiety status based on combined report). I observed no statistically significant differences in adolescent CU traits by adolescent social anxiety status. (F (1,84) = 3.68, p = .06).

Specific Research Aims.

Relation between CU traits and adolescent self-reports of distress following social exclusion. I conducted the GEE modeling procedures described previously to examine the extent to which adolescents' CU traits were statistically predicted by adolescent gender, social anxiety symptoms, and self-reported distress following social exclusion. First, consistent with results from the preliminary analyses discussed previously, I observed a significant main effect of adolescent gender (b = -3.77, SE = 1.46, p < .05; Table 4). Specifically, male participants reported significantly higher mean CU traits (M = 22.66, SE = 1.23), relative to female participants (M = 18.90, SE = 0.82; Figure 3). Second, I observed a significant main effect of adolescent social anxiety symptoms, based on the combined social anxiety grouping variable (e.g., high vs. low) described previously (b = 2.88, SE = 1.44, p < .05; Table 4). As depicted in Figure 4, social anxiety symptoms above the clinical cut-off (e.g., High) predicted significantly higher CU traits (M = 22.22, SE = 1.01), relative to social anxiety symptoms falling below the clinical cut-off (e.g., Low) (M = 19.34, SE = 1.05). Contrary to my original hypotheses, adolescent self-report distress following social exclusion did not significantly predict adolescent CU traits (b = 1.53, SE = 0.89, p = .08; Table 4).

Relation between CU traits and adolescent physiological arousal during periods of social exclusion. Next, I conducted the GEE model presented previously to examine my second aim, specifically whether level of CU traits moderates an adolescent's physiological response to social exclusion. Results supported a significant main effect of condition block or timing on adolescent physiological arousal (Table 5). Adolescent's mean heart rate significantly varied by condition within the Cyberball social exclusion task (Figure 5). Specifically, adolescents experienced a significant decrease in mean heart rate (BPM) from baseline (M = 73.41, SE = 1.24) to the first inclusion block (M = 71.61, SE = 1.19, $p < .001$). Then, adolescent heart rate significantly increased from the first inclusion block to the first block of social exclusion (M = 73.49, SE = 1.26, $p < .001$), and again between the first exclusion block to the second inclusion block (M = 74.96, SE = 1.25, $p < .001$). Finally, adolescent heart rate did not significantly differ from the second inclusion block to the final exclusion block (M = 75.18, SE = 1.26, $p = .66$), suggesting increases in adolescents' mean heart rate during the first social exclusion phase influenced mean heart rate levels throughout the rest of the task (Figure 5).

I also observed a significant main effect for adolescent CU traits, such that increased CU traits were related to overall decreased mean heart rate. As outlined previously, within the current model adolescent CU traits were represented using combined parent and adolescent reported CU traits. Combined reports of adolescents' total CU symptoms were then used to create three CU groups to categorize adolescent CU traits across the spectrum of severity, relative to the current sample. In other words, adolescent males and females were categorized as having low (n = 1 and 24, respectively), moderate (n = 11 and 17, respectively), or high (n = 9 and 12, respectively)

CU traits. However, the significant main effect of adolescent CU traits was qualified by a significant Gender x CU traits interaction (Table 5). Specifically, CU traits did not predict any significant differences in mean heart rate for adolescent females (Figure 6). In contrast, increased CU traits were related to significantly lower mean heart rate levels for adolescent males. Although males presenting with low CU traits displayed higher mean heart rate (M = 81.93, SE = 3.17) relative to those displaying moderate-level CU traits (M = 75.26, SE = 2.93), these differences were not statistically significant (p = .11). Yet, both low and moderate-level males displayed significantly higher mean heart rate relative to those males presenting with high CU traits (M = 63.85, SE = 1.95, p-values < .01).

The relations between male and female heart rates also varied as a function of CU severity. First, adolescent males presenting with "low" CU traits displayed significantly higher mean heart rate (M = 81.93, SE = 3.17) than females similarly grouped as having low CU traits (M = 72.97, SE = 1.53, p < .01). Next, male and female adolescents with moderate-range CU traits did not display significantly different mean heart rates (p = .37). Lastly, adolescent males presenting with high CU traits displayed significantly lower mean heart rates (M = 63.85, SE = 1.95) than females, regardless of the severity of female CU traits.

Exploratory Research Aim.

Relations between adolescent CU traits, subjective distress following exclusion, and physiological arousal during periods of social inclusion and exclusion.

I conducted the final exploratory analysis described previously, to examine the relations between subjective and physiological responses to social exclusion, and whether

adolescent CU traits moderate these relations. Similar to the results reported previously, I observed significant main effects of task block (e.g., timing) and adolescent CU traits in predicting mean heart rate (Table 6). Once again, the main effect of CU traits was qualified by a Gender x CU Group interaction, demonstrating similar effects outlined previously. I also observed a significant main effect of subjective distress *(b* = 7.97, *SE* = 4.36, $p < .05$; Table 5), such that increased subjective distress following exclusion related to increased overall mean heart rate. Of note, I did not observe a significant Block x CU Group x Distress interaction, suggesting that severity of adolescent CU traits did not moderate levels of correspondence between mean heart rate during social exclusion and subjective distress following social exclusion.

Chapter 4: Discussion

Main Findings

The purpose of this study was to extend the literature on the effects of CU traits on emotional reactivity to aversive social interactions. I observed six findings. First, consistent with prior work (e.g., Essau et al., 2006), adolescent males displayed greater levels of CU traits relative to adolescent females. Second, prior work indicated a complex relation between social anxiety and CU traits (e.g., Frick et al., 2013). In line with these previous findings, adolescent social anxiety status (e.g., above vs. below clinical cut-off) significantly related to adolescent CU traits, such that relative to lower levels of adolescent social anxiety, increased adolescent social anxiety (e.g., above clinical cut-off) predicted increased CU traits.

Third, contrary to my hypotheses, severity of adolescent CU traits did not predict adolescents' subjective distress following social exclusion. Fourth, adolescent physiological arousal during the social exclusion task significantly varied over time. Specifically, adolescent physiological arousal varied across blocks of the task including baseline, inclusion blocks, and periods of exclusion. Fifth, consistent with my hypotheses, adolescent CU trait severity predicted adolescents' overall physiological arousal during the social exclusion task; however, this relation varied as a function of adolescent gender. Specifically, among adolescent males, increased CU traits related to lower arousal throughout the social exclusion task. Yet, I observed no significant relations between CU traits and physiological arousal among adolescent females.

Lastly, exploratory analyses revealed a significant main effect of subjective distress on adolescents' overall physiological arousal during the social exclusion task,

such that increased distress predicted increased physiological arousal. However, I observed no significant moderating effect of adolescent CU severity on the relation between self-reported subjective distress following social exclusion and physiological arousal during the social exclusion task. In other words, the severity of adolescent CU traits did not significantly impact the relation between subjective and physiological reactions to social exclusion.

Collectively, the results from the current study augment prior literature in meaningful ways by further clarifying the complex relations between adolescent gender, social anxiety status and CU traits, and through supporting the idea that CU traits may buffer adolescents' negative reactions to aversive social experiences. However, several of the aforementioned results warrant additional discussion.

First, although the gender effects observed were consistent with prior literature, I observed a surprising relation between adolescent social anxiety status and severity of CU traits. Specifically, adolescent social anxiety status significantly and positively correlated with adolescent CU traits, such that increased adolescent social anxiety predicted higher CU traits (Figure 4). These findings are inconsistent with some prior work (e.g., Fanti, 2013). Yet, the results support prior claims that CU traits and social anxiety are not mutually exclusive constructs (Frick et al., 2013; Lahey, 2014). In other words, findings from the current study demonstrate that youth may present with varying levels of co-occurring social anxiety and CU traits. Moreover, post-hoc analyses revealed that participating adolescents presented with various combinations of social anxiety symptoms and CU trait severity (i.e., high social anxiety symptoms/ high CU traits, low/low, etc.). The heterogeneity of social anxiety and CU presentations within the

current sample further illustrates that adolescents may present with various degrees of co-occurring symptoms of social anxiety and severity of CU traits. These findings hold important implications, as social anxiety and CU traits may predict individual differences across a variety of outcomes, such as one's physiological response to distressing situations (e.g., hyper- vs. hypo-arousal; Frick et al., 2013; Goldin et al., 2009; Herpers et al., 2012), and severity of behavioral problems (Kahn et al., 2013).

The current study represents a first step in exploring the impact of CU traits on one's experience of a negative social interaction. As such, although I examined the role of social anxiety status in predicting CU trait severity and response to social exclusion, I was underpowered to further explore the interactions between adolescent CU traits and social anxiety symptoms. Consequently, future research is warranted to further dissect the complex relations between adolescent anxiety and CU traits, and the impact on adolescent social outcomes. Specifically, further elucidating the unique interactions between CU traits and anxiety may hold considerable implications for developing treatments specifically tailored to meet the seemingly unique needs of adolescents across the spectrums of social anxiety and CU traits.

Second, as mentioned previously, increased CU traits are commonly related to diminished response to threatening, punishing, or emotionally evocative situations (Herpers et al., 2012; Roose et al., 2010). Consequently, I hypothesized increased adolescent CU traits would predict decreased subjective distress following a negative social interaction, namely social exclusion. Contrary to my hypotheses, adolescent CU trait severity did not relate to significant differences in adolescents' subjective reactions to being socially excluded by peers. These contrasting results appear surprising, yet

several factors may account for the lack of effect of CU traits on one's subjective distress to this unique social situation. For instance, previous work examining the moderating role of CU traits on reactions to distressing situation often relied on social situations that consisted of viewing someone else (i.e., a stranger) in a distressing situation. Prior findings suggest youth with elevated CU traits display deficits in processing signs of fear or distress in others (Frick & White, 2008). However, do CU traits predict similar deficits in how one reacts to being the recipient of a negative social interaction? My findings suggest CU traits do not predict significant differences in the extent to which an adolescent experiences distress or processes negative emotional states for oneself following negative social interactions.

An alternative explanation may be found in how elevated CU traits impact one's reaction to punishment. Specifically, elevated CU traits predict increased insensitivity to punishment cues (Frick, Cornell et al., 2003). However, what if adolescents with increased CU traits do not view instances of social exclusion as punishing? Failure to perceive social exclusion as a punishing or threatening social situation may help account for the lack of significant impact of CU traits on adolescents' subjective reports of distress within the current study. Unfortunately, the current study was not designed to elucidate the mechanisms underlying the lack of moderating effect of CU trait severity on subjective distress following social exclusion. Thus, these interpretations remain speculative and warrant further research.

Third, I observed a significant effect of time or task block in predicting adolescent physiological arousal. Prior studies using the Cyberball social exclusion task have largely relied on iterations of the task that include counterbalancing the inclusion and exclusion

blocks between participants (e.g., Begen & Turner-Cobb, 2014) or having participant's complete single blocks of inclusion and exclusion (e.g., Crowley et al., 2009; McPartland et al., 2011). The modified version of the Cyberball social exclusion task used within the current study extends prior methods by asking participants to complete four alternating blocks of inclusion and exclusion in a within-subjects ABAB design. Consequently, I was able to investigate the extent to which periods of inclusion and exclusion differentially predicted rises and falls in physiological arousal. In fact, adolescents experienced significant differences in arousal across the course of the social exclusion task (Figure 5). Specifically, adolescents experienced significant decreases in arousal from baseline the first inclusion block. Multiple interpretations may explain this initial change in arousal. For instance, participants may have experienced an initial spike in heart rate prior to the beginning of the task (i.e., during baseline) due to exposure to novel research equipment or anticipation of the upcoming task, with decreased arousal signifying habituation as they settled into the task and became familiar with the testing setting and equipment.

Alternatively, as noted by others (e.g., Begen & Turner-Cobb, 2014), decreased arousal during the initial period of social inclusion may suggest that social inclusion confers beneficial physiological effects. Consistent with prior literature, adolescents experienced increased arousal from the first inclusion block to the first block of social exclusion (Iffland et al., 2014; Sijtsema et al., 2011). Yet, adolescents continued to experience increases in arousal from the initial exclusion block to the second block of social inclusion, refuting prior claims that social inclusion may provide beneficial effects. Furthermore, adolescents' elevated arousal appeared to persist through the remainder of the task (e.g., the final exclusion block), suggesting that adolescents failed to recover

following the initial exposure to social exclusion, despite participating in a subsequent period of social inclusion. As mentioned previously, social exclusion often predicts a variety of emotional and behavioral consequences (e.g., decreased mood, increased aggression; Iffland et al., 2014; Williams & Sommer, 1997). Consequently, the results from the current study hold important implications by illustrating that the negative effects of social exclusion may persist over time, even if an adolescent is presented with a seemingly positive social situation.

Lastly, adolescents' physiological reactions to the social exclusion task varied as a function of adolescent CU trait severity and adolescent gender (Figure 6). When exploring adolescent physiological arousal across the entire task, adolescent females did not demonstrate any significant differences in arousal, regardless of CU trait severity. In contrast, adolescent males displayed a significant decrease in physiological arousal as CU trait severity increased. In other words, increased severity of CU traits appeared to buffer adolescents' negative physiological response to the social exclusion task broadly, yet these buffering effects were only present for adolescent males.

As mentioned previously, and consistent with current findings, adolescent males tend to display increased CU traits relative to females (Essau et al., 2008). Moreover, elevated CU traits predict various associated characteristics for males relative to females. For instance, males tend to engage in risk-taking behaviors more quickly (Centifanti & Modecki, 2013), and display unique deficits in affective empathy (Dadds et al., 2009). Results from the current study illustrate that similar gender differences can be observed when examining the effect of CU traits on an adolescent's internal experience of experiencing a negative social interaction, or being socially excluded.

One potential explanation for the current gender effects lies in reported differences in how males and females tend to be affected by socialization factors. For instance, relative to males, adolescent females report perseverating on instances of being victims of social aggression more often, and they report being more distressed by social aggression (Paquette & Underwood, 1999). These effects may help explain the lack of buffering impact of CU trait severity among adolescent females in the current study. In other words, females across the CU spectrum may continue to experience social exclusion, or a socially aggressive act, as equally distressing or threatening, whereas males may experience less physiological distress as CU trait severity increases.

At first glance, the gender and CU trait effects on adolescents' physiological arousal support this theory. However, the adolescent male presenting with low CU traits displayed physiological arousal during the social exclusion task that was significantly higher than adolescent females, regardless of female CU status. Additionally, severity of CU traits did not predict significant differences in subjective distress following the social exclusion task, suggesting a discrepancy in the subjective versus physiological reactions to social exclusion. In other words, increased CU traits may predict individual differences in physiological arousal following social exclusion, but may not predict differences in subjective reactions to social exclusion.

Implications and Future Directions

The current study represents an important first step in demonstrating that dimensional CU traits may hold protective benefits for an adolescent's internal reactions to a negative social interaction, and current findings hold considerable implications for

informing future research. Yet, many questions remain regarding the extent to which these effects are impacted by methodological factors, generalize to various clinical samples of adolescents or across alternative types of aversive situations, and the extent to which the relation between CU traits and one's reactions to social exclusion predict differences in negative behaviors following exclusion.

First, although the majority of prior studies assessing CU traits during adolescence have consisted of collecting self-reports alone, I collected parent and adolescent reports of adolescent CU traits, consistent with prior recommendations on the incremental value of collecting multi-informant assessments of adolescent psychopathology, (De Los Reyes, Augenstein, Wang et al., 2015). Several strategies exist for statistically combining multi-informant reports of a single construct. For instance, in the current study, I applied an "or" combination rule to capture the most severe ratings of CU traits reported by either the participating parent or adolescent. This approach provided a liberal estimate of adolescent CU traits, further increasing my ability to observe variation in CU trait severity within the recruited sample. However, this approach may have over-captured CU traits appearing inconsistently across multiple settings versus more trait-like CU traits that would consistently appear across settings. In other words, when assessing trait-like CU symptoms, one would expect multiple informants to agree on the presence and severity of the symptoms. Consequently, future research should attempt to replicate the current findings using alternative combination strategies. Specifically, the "and" combination approach requires agreement between multiple informants for a specific symptom to be present (Piacentini et al., 1992). This

combination rule should be applied in future studies using larger samples in order to examine a more conservative estimate of trait-like CU symptoms.

Second, within the current study, increased CU traits buffered the negative physiological effects of social exclusion in a sample of adolescent males at low risk for conduct problems and displaying varying degrees of social anxiety concerns. Similarly, one previous study found protective effects of CU traits for other samples at low risk for conduct problems (e.g., depressed adolescents; Javdani et al., 2011), although in contrast to the current study the effects observed in this prior work were specific to adolescent females. These conflicting results suggest that the potential positive consequences of heightened CU traits are not uniform across internalizing domains and demographic groups.

Beyond adolescents with internalizing symptoms, youth presenting with some externalizing concerns might also experience a buffering effect of CU traits, namely those displaying ADHD concerns (Herpers et al., 2012). That is, similar to youth with internalizing symptoms (e.g., social anxiety), youth with ADHD often experience negative social interactions (e.g., increased social rejection or exclusion by peers) as well as emotion dysregulation (e.g., poor self-regulation of emotion, excessive emotional expression; Wehmeier, Schacht, & Barkley, 2010). However, youth who experience ADHD and elevated CU traits might display individual differences in the degree to which they experience these emotion dysregulation concerns (Musser, Galloway-Long, Frick, & Nigg, 2013). Consequently, future research might expand upon the current study by examining potential positive effects of CU traits on adolescents' internal reactions to negative social interactions, across a variety of clinical populations.

Third, a key goal of the current study was to examine the unique impact of CU traits on adolescents' reactions to a specific negative social interaction, namely social exclusion. However, might CU traits similarly buffer aversive reactions to other negative social situations? Moreover, given the conflicting gender results described previously related to potential protective effects of CU traits, who may benefit from the positive internal effects of CU traits within these alternative negative situations? Adolescence is marked by increased incidences of social aggression, with social aggression peaking around age 14, due to a range of factors such as increased importance placed on social status, and the desire to engage in aggressive acts that are less visible to outside observers or authority figures (e.g., teachers, parents) than other forms of aggression (e.g., physical aggression; Karriker-Jaffe, Foshee, Ennett, & Suchindran, 2008; Underwood, 2003). Consequently, in addition to social exclusion, adolescents experience a variety of acts of social aggression, including gossiping or threats of peers damaging one's social standing within a social group. Similar to social exclusion, other types of social aggression also predict negative emotional outcomes (e.g., poorer self-esteem, subjective distress; Prinstein, Boergers, & Vernberg, 2001). Given the similarities between social exclusion and other socially aggressive acts, it would be interesting to explore whether CU traits offer similar protective benefits for adolescents against other instances of social aggression.

Lastly, prior research suggests that being the victim of social exclusion can lead to a variety of negative behavioral responses, such as increased aggressive behaviors towards others, even innocent targets, and decreased displays of prosocial behavior (e.g., helping behaviors) (Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007; Twenge,

Baumeister, Tice, & Stucke, 2001). The current study expanded our understanding of how CU traits may impact an adolescent's internal experience of social exclusion; measuring adolescents' behavioral responses or reactions following exclusion fell outside the scope of the current study. Given concerns about increased engagement in conduct problems and antisocial behaviors among youth with elevated CU traits, future research should extend the current methods to include a subsequent task of social aggression (e.g., Taylor Aggression Paradigm; Taylor, 1967) to explore the extent to which varying levels of CU traits impact the relation between social exclusion and aggression.

Limitations

Despite the numerous strengths of the current study, results should be interpreted in light of a few limitations. First, I recruited a sample of community-based and clinical adolescents who would present with a spectrum of CU traits. Additionally, "shy" adolescents were recruited to augment the sample with adolescents presenting with a range of social anxiety symptoms to maximize the variation in adolescents' physiological and subjective reactions to the social exclusion paradigm. Due to this sampling design, participants displayed a wide range of CU traits and symptoms of social anxiety. However, this strategy also presented some consequences for the data analyses. For instance, targeting adolescents with social anxiety typically results in higher referral rates for females than males (Waite & Creswell, 2014). Consequently, the participant sample consisted of disproportionately more female adolescents than males. Additionally, when grouping adolescents based on CU severity relative to the current sample (i.e., low, moderate, high), I observed gender differences in both the number of adolescents in each

subgroup and the overall distribution of CU traits for males and females. In other words, although both males and females displayed variation in CU trait severity, when grouped based on sample CU characteristics, adolescent females were disproportionately skewed towards low CU trait severity (n = 24), whereas only one adolescent male was categorized as having low CU traits. Despite the small sample size within certain CU groups, the current study yielded sufficient power to detect significant CU and gender effects. However, the low cell sizes limited my ability to probe significant main and interaction effects further. Consequently, future research would benefit from including a larger sample of adolescent males and females presenting with a more consistent range of CU trait severity.

Second, as described previously, the ICU is comprised of three primary subscales, each capturing a dimension of behavior: callousness, uncaring, and unemotional. Prior research also supports the computation of a total score that statistically combines these distinct subscales into a single, overall assessment of a general dimension of CU traits (Essau et al., 2006). Due to the dearth of prior research examining the impact of CU traits on experiences of social exclusion, the current study was a first step in understanding this relation using a general measure of CU traits (i.e., the total score). Further, the modest sample size precluded my ability to observe large individual differences among the separate CU domains. However, future studies using larger samples should examine whether there is added value in examining CU domains separately. For instance, the three distinct subscales typically correlate in the low-to-moderate range (e.g., rs = .17 - .54 in the current study), suggesting that although the symptoms assessed as part of each domain are related, they are not highly redundant. Moreover, in a community sample of

adolescents, researchers have observed gender differences in the relations between each subscale and problematic behaviors. Specifically, the callousness subscale had substantial predictive power for males and females, whereas the uncaring factor only significantly predicted males' behaviors (Essau et al., 2006). Overall, I encourage future research to replicate and extend findings of this study to understand links between CU traits and social exclusion within and across its constituent domains.

Third, the modified social exclusion task and the composite subjective distress scale used within the current study afforded opportunities to expand prior literature by exploring the impact of adolescent CU traits on both subjective and physiological reactions to social exclusion. However, adolescent reports of subjective distress related to social exclusion were only collected at a single time point following the conclusion of the entire social exclusion task. Consequently, adolescents were asked to retrospectively report on distress experienced during the task. This decreased assessment burden on adolescents, and to do otherwise (e.g., include distress assessments after each block) might have resulted in adolescents detecting transitions between blocks of inclusion and exclusion. Yet, a single post-task administration also limited my ability to examine potential differences in adolescents' reports of distress across the various blocks of the task. In other words, did adolescent distress vary as a function of time or as between blocks of social inclusion versus exclusion?

The decision to administer the distress questionnaire at the conclusion of the task mirrored prior studies (e.g., Crowley et al., 2009; van Beest & Williams, 2006); however, future researchers should further evaluate the cost-benefit of administering the subjective questionnaire following each condition versus solely at the conclusion of the task.

Similarly, the current study did not include an assessment of participant mood and distress prior to the social exclusion task. Therefore, I was unable to evaluate task-related changes in mood and feelings of distress or the extent to which these changes were moderated by adolescent characteristics, such as CU trait severity or social anxiety symptoms. Consequently, future studies should include a pre-task assessment of adolescent mood and distress.

Concluding Remarks

The current study aimed to extend the literature on potential adaptive and maladaptive effects of CU traits on an adolescents' internal experience of being the recipient of a negative social interaction, namely social exclusion. Specifically, I sought to address previous gaps in the literature by exploring the impact of CU traits across a spectrum of severity, among community-based and socially anxious adolescents. Overall, results indicate that although CU trait severity did not predict differences in subjective distress following social exclusion, increased CU trait severity appears to buffer the negative physiological effects of the social exclusion task for adolescent males alone. To my knowledge, this is the first study examining the unique impact of CU traits across the spectrum of severity on adolescents' subjective and physiological reactions to being the recipient of a negative social act. As such, this study provides an important first step in improving our understanding of potential consequences of CU traits on one's internal experience of social events among adolescents at low risk for conduct problems.

Table 1.

Means, Standard Deviations, and Internal Consistency estimates for Parent and Self-reported Adolescent CU Traits and Subjective Distress Following Exclusion (n = 86)

Variable	***M***	***SD***	**α**
ICU-Total			
Parent report	20.87	9.15	.86
Adolescent report	19.62	7.08	.78
Combined report	29.00	8.04	.83
NTS-Total			
Adolescent report	83.35	21.61	.94

Note. Higher scores represent *more* callous-unemotional traits. Lower scores represent *more* subjective distress. ICU-Total= Inventory of Callous-Unemotional Traits total score; NTS-Total= Need Threat Scale Combined total score.

Table 2.

Correlations among Subscales of the Need Threat Scale (n = 86)

Variable	1	2	3	4	5	6	7
1 Belonging		.66**	.87**	.69**	.64**	.76**	.91**
2 Self-esteem			.70**	.59**	.65**	.51**	.81**
3 Meaningfulness				.71**	.67**	.75**	.92**
4 Control					.45**	.56**	.77**
5 Mood						.55**	.82**
6 Perceived Exclusion							.79**
7 NTS Total Score							

Note. ** $p < .01$.

Table 3.

Correlations among Variables of Interest (n = 86)

Variable	1	2	3	4
1 ICU- Adolescent Report		.40**	.76**	-.10
2 ICU- Parent report			.84**	.31**
3 ICU- Combined				.16
4 Distress				

Note. Higher scores represent *more* callous-unemotional traits. Lower scores represent *more* subjective distress. ICU- Adolescent report = ICU total score based on adolescent self-report. ICU- Parent report = ICU total score based on parent report. ICU Combined= Combined ICU total score based on combined parent and adolescent reports of adolescent CU traits on the ICU. Distress = Subjective distress based on the adolescent-reported Total score on the NTS following exclusion. $^{**}p < .01$.

Table 4.

Generalized Estimating Equations Predicting Adolescent CU Traits as a Function of Adolescent Gender, Social Anxiety Symptoms, and Subjective Distress Following Exclusion (n = 86)

Factor	**Wald X^2**	***p***
Main Effects		
Informant	1.65	p=.20
Gender	6.37	p<.05
Anxiety	3.97	p<.05
Distress	2.93	p=.08

Note. Overall Adolescent CU scores were calculated by creating a within-subject composite variable combining each participant's parent-reported and adolescent-reported ICU Total scores. Factor contrasts based on comparisons in descending order, with the Informant factor coded parent-reported ICU total scores = "Parent (0)" and adolescent-reported ICU total scores = "Adolescent (1)". Gender = Male coded "0", female coded "1". Anxiety = Adolescent social anxiety symptoms based on the combined parent and adolescent SPAI-C scores: Combined SPAI-C score above clinical cut-off = "High (1)"; Combined SPAI-C score below clinical cut-off = "Low (0)". Distress = adolescent-reported total score on the NTS following exclusion. For statistical tests of main effects, *p* values reported reflect significance tests for the reported unstandardized betas.

Table 5.

Generalized Estimating Equations Predicting Adolescent Heart Rate (BPM) as a Function of Adolescent Gender, Social Anxiety Symptoms, and Callous-unemotional Traits (n = 74)

Factor	**Wald X^2**	***p***
Main and Interaction Effects		
Gender	0.00	p=.96
Anxiety	0.02	p=.87
Block	76.20	p<.01
CU Group	10.72	p<.05
Gender x Anxiety	0.01	p=.92
Gender x Block	1.02	p=.90
Gender x CU Group	14.42	p<.05
Anxiety x Block	2.05	p=.72
Anxiety x CU Group	2.19	p=.33
Block x CU Group	2.02	p=.98

Note. Overall Adolescent CU scores were calculated by creating a within-subject composite variable combining each participant's parent-reported and adolescent-reported ICU Total scores. Factor contrasts based on comparisons in descending order, with the Block factor coded Baseline = "0", First inclusion block 1 = "1", First exclusion block = "2", Second inclusion block = "3", and Second exclusion block = "4". Gender = Male coded "0", female coded "1". Anxiety = Adolescent social anxiety symptoms based on the combined parent and adolescent SPAI-C scores, with

combined SPAI-C score above clinical cut-off = “High (1)”; Combined SPAI-C score below clinical cut-off = “Low (0)”. CU Group = Adolescent CU grouping based on combined total scores from parent and adolescent reports on the ICU, with adolescents presenting with CU traits falling in the lowest third of severity = “Low (1)”; Adolescents presenting with CU traits falling in the middle third of severity = “Mid (2)”; Adolescents presenting with CU traits falling in the highest third of severity = “High (3)”. For statistical tests of main and interaction effects, *p* values reported reflect significance tests for the reported unstandardized betas.

Table 6.

Generalized Estimating Equations Predicting Adolescent Heart Rate (BPM) as a Function of Adolescent Gender, Social Anxiety Symptoms, Callous-unemotional Traits, and Subjective Distress Following Exclusion (n = 74)

Factor	**Wald X^2**	***p***
Main and Interaction Effects		
Gender	0.18	p=.67
Anxiety	0.18	p=.66
Block	84.62	p<.001
CU Group	9.70	p<.01
Distress	4.68	p<.05
Gender x Anxiety	0.16	p=.68
Gender x Block	1.20	p=.87
Gender x CU Group	11.64	p<.01
Gender x Distress	0.51	p=.47
Anxiety x Block	2.39	p=.66
Anxiety x CU Group	1.08	p=.58
Anxiety x Distress	0.64	p=.42

Block x CU Group	2.38	p=.96
Block x Distress	4.14	p=.38
CU Group x Distress	2.28	p=.32
Block x CU Group x Distress	5.87	p=.66

Note. Overall Adolescent CU scores were calculated by creating a within-subject composite variable combining each participant's parent-reported and adolescent-reported ICU Total scores. Factor contrasts based on comparisons in descending order, with the Block factor coded Baseline = "0", First inclusion block 1 = "1", First exclusion block = "2", Second inclusion block = "3", and Second exclusion block = "4". Gender = Male coded "0", female coded "1". Anxiety = Adolescent social anxiety symptoms based on the combined parent and adolescent SPAI-C scores, with combined SPAI-C score above clinical cut-off = "High (1)"; Combined SPAI-C score below clinical cut-off = "Low (0)". CU Group = Adolescent CU grouping based on combined total scores from parent and adolescent reports on the ICU, with adolescents presenting with CU traits falling in the lowest third of severity = "Low (1)"; Adolescents presenting with CU traits falling in the middle third of severity = "Mid (2)"; Adolescents presenting with CU traits falling in the highest third of severity = "High (3)". Distress = adolescent-reported total score on the NTS following exclusion, with scores mean centered to assist in interpretability of interaction effects. For statistical tests of main and interaction effects, p values reported reflect significance tests for the reported unstandardized betas.

Figure 1.

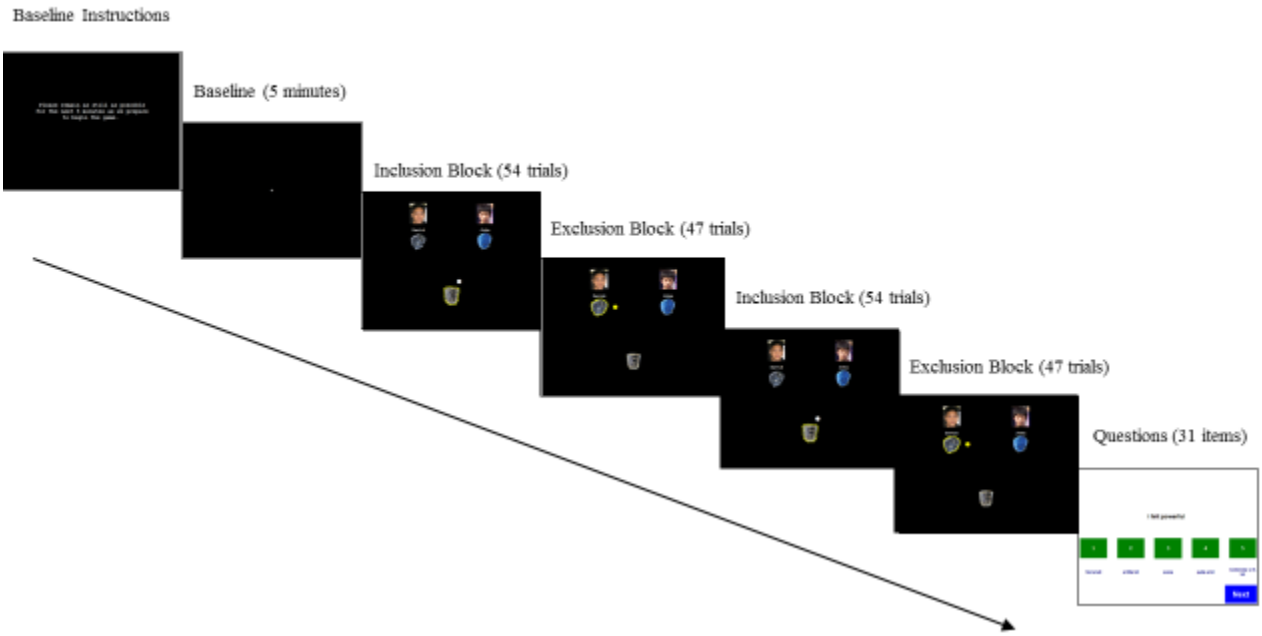

Baseline Instructions
Baseline (5 minutes)
Inclusion Block (54 trials)
Exclusion Block (47 trials)
Inclusion Block (54 trials)
Exclusion Block (47 trials)
Questions (31 items)

Figure 2.

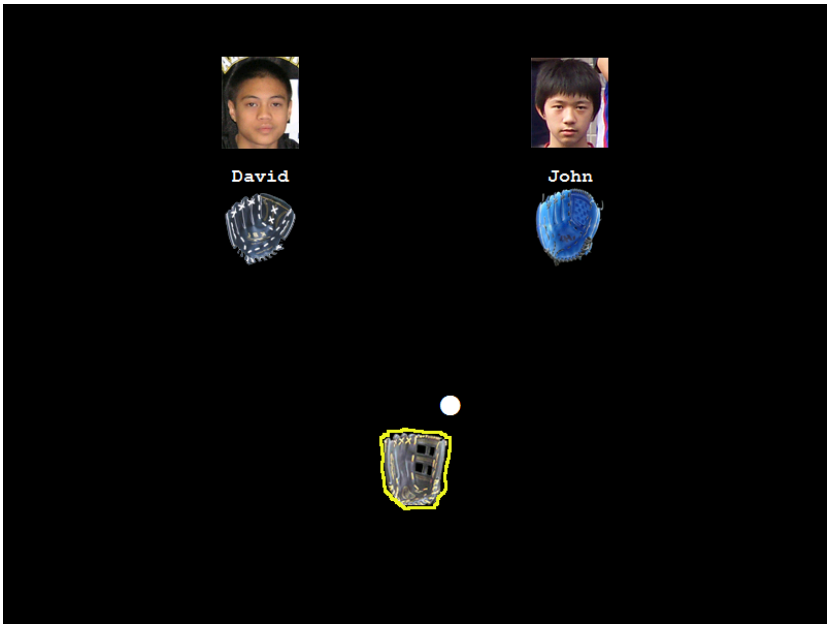


Figure 3.

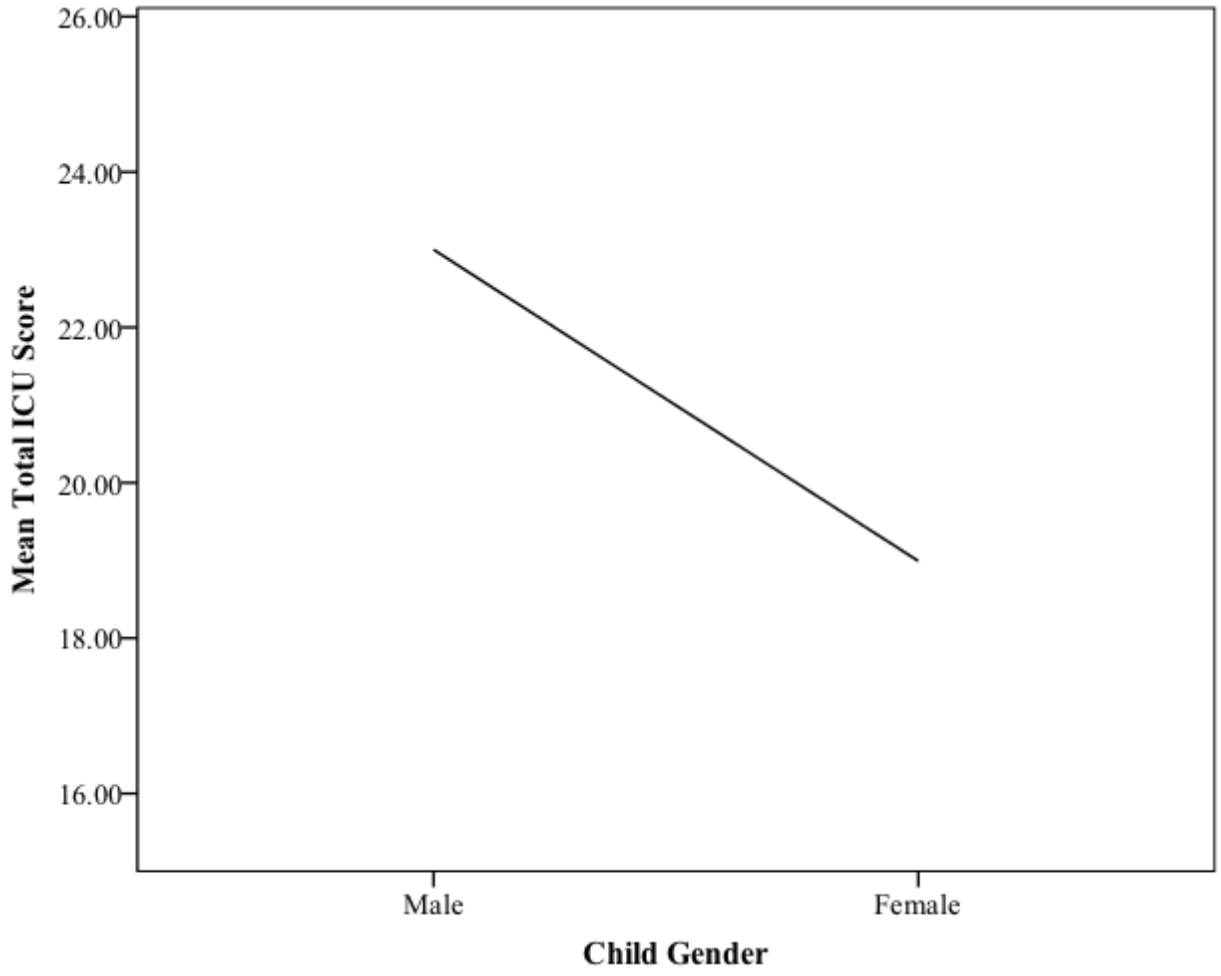

26.00
24.00
22.00
20.00
18.00
16.00
Mean Total ICU Score
Male
Female
Child Gender

Figure 4.

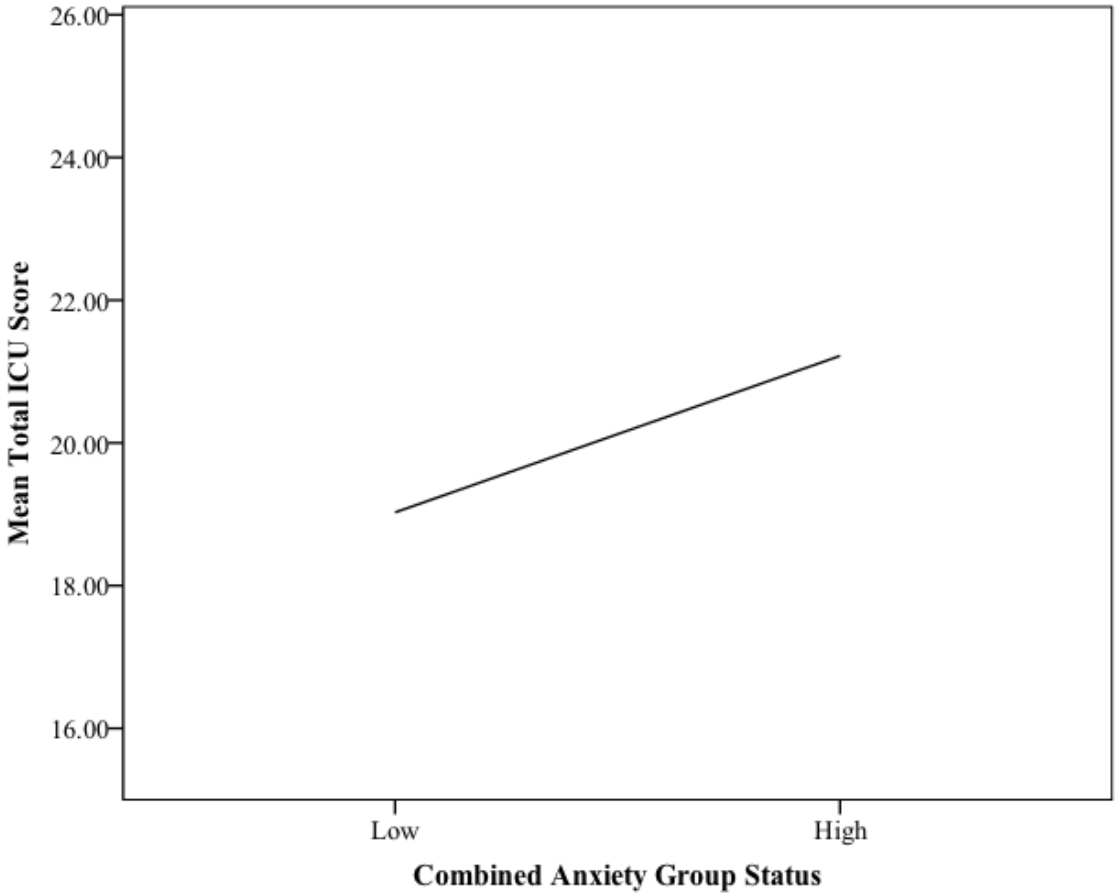

26.00
24.00
22.00
20.00
18.00
16.00
Mean Total ICU Score
Low
High
Combined Anxiety Group Status

Figure 5.

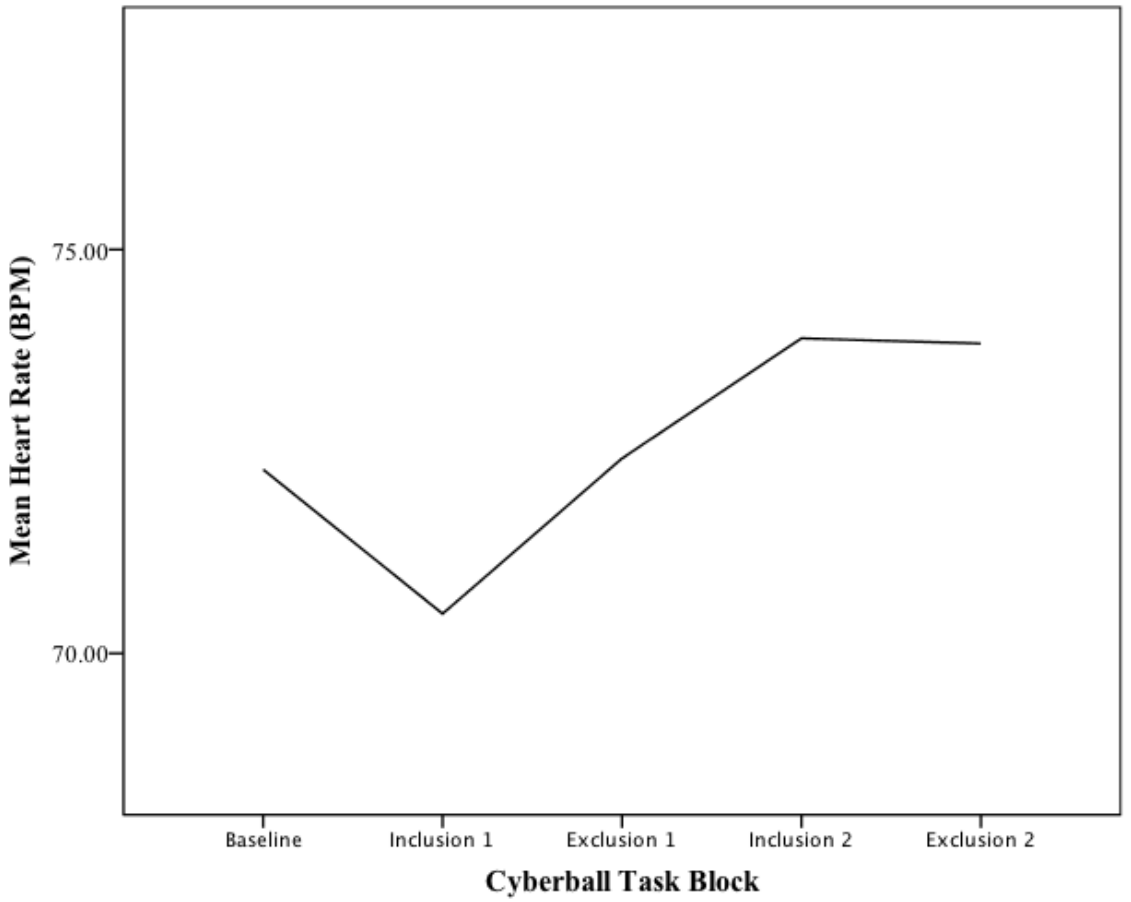
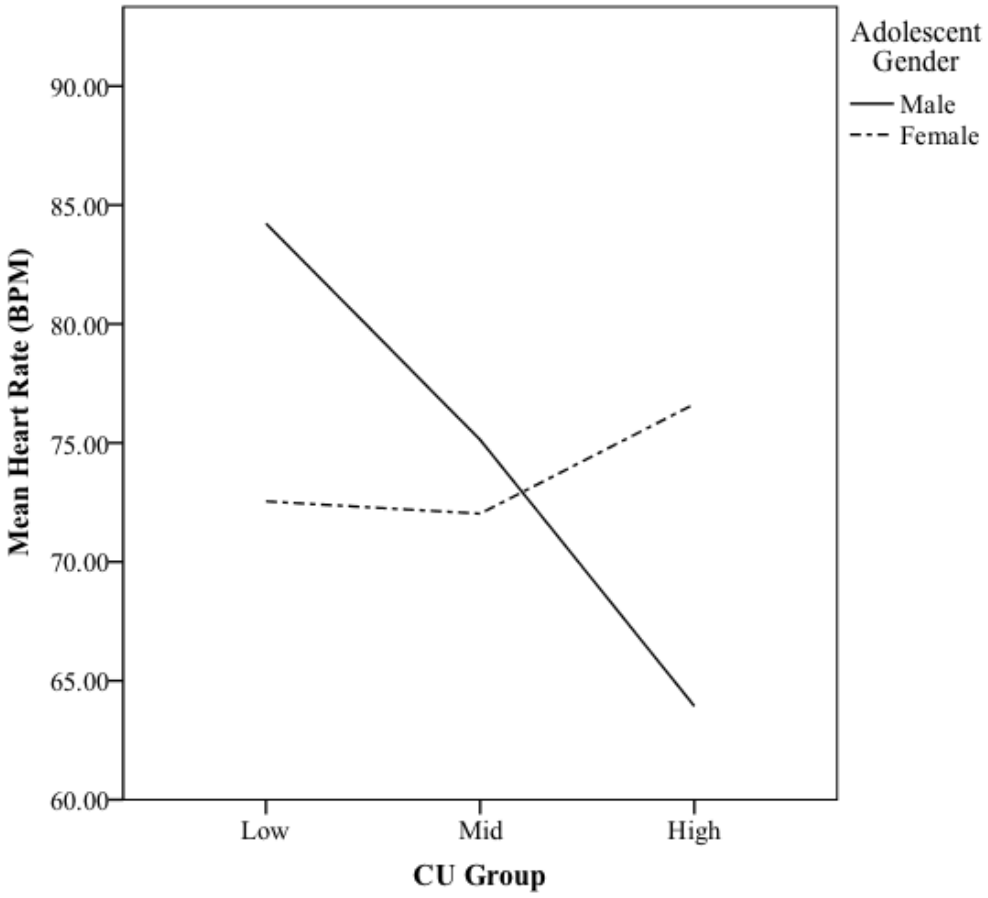

Mean Heart Rate (BPM)
75.00
70.00
Baseline
Inclusion 1
Exclusion 1
Inclusion 2
Exclusion 2
Cyberball Task Block

Figure 6.


Adolescent Gender
Male
Female
90.00
85.00
80.00
75.00
70.00
65.00
60.00
Mean Heart Rate (BPM)
Low
Mid
High
CU Group

Appendices

Appendix A: Family Demographic Form

The following is a short demographic survey.

1. What is the gender of your child?
    - Male
    - Female

2. How old is your child? [in years] _____

3. What hand does your child write with?
    - Right hand
    - Left hand

4. What race is your child? You can choose more than one.
    - Asian American or Asian
    - African American or Black
    - Hispanic or Latino/a (Spanish)
    - White, Caucasian American, or European
    - American Indian
    - Other (specify) _____

5. What is your relationship to your child? Are you his/her:
    - Natural (Biological) Mother/Father
    - Adopted Mother/Father
    - Stepmother/Father
    - Child's Father's/Mother's Girl/Boyfriend
    - Grandmother/Father
    - Other Relative (specify)

6. How many biological brothers and sisters does your child have?
   _____

Of those siblings, is your child first-born, second-born...?
    - 1st Born
    - 2nd Born
    - 3rd Born
    - 4th Born
    - 5th Born

- 6th Born
- 7th Born
- 8th Born
- 9th Born
- 10th Born
- Other

7. How many other children under the age of 18 live in your home, besides your child here today? For our purposes, "living in your home" means that they have lived there at least half the time over the past 3 months. (number of children living in home, NOT including target child)

_____

8. What is your date of birth? [MM/DD/YYYY]

_____

9. What is your gender?
- Male
- Female

10. What is your current marital status?
- Never Married
- Married
- Living Together
- Separated
- Divorced
- Widowed

11. [IF married or living together] How long have you and your partner lived together? [Insert number beside years and/or months]
*Select N/A if this question does not apply

Years _____
Months _____
- N/A

12. What race do you consider yourself to be? You can choose more than one.
- Asian American or Asian
- African American or Black
- Hispanic or Latino/a (Spanish)
- White, Caucasian American, or European
- American Indian
- Other (specify)

13. What is the highest grade in school or degree that you have completed?

- No Diploma (specify highest grade completed) _____
- High School Diploma
- GED
- Some College, No Degree
- Associate's Degree
- Vocational Degree (e.g., beauty school, electrician, mechanical)
- Bachelor's Degree (BA/BS)
- Master's Degree
- Advanced Degree (PhD, JD, MD, etc.)

14. Think of all the income from people who live in the same house with you. Which category is closest to the household earnings after taxes per week?

- Less than $100 per week
- $101-$200 per week
- $201-$300 per week
- $301-$400 per week
- $401-$500 per week
- $501-$600 per week
- $601-$700 per week
- $701-$800 per week
- $801-$900 per week
- $901+ per week

Appendix B: Modified Need Threat Scale

Following the Cyberball Task, each adolescent was asked to select the number the best represented their feelings during the game on a 5-point scale based on the following 30 questions. Item responses ranged from 1 (*Not at all*) to 5 (*Extremely).*

Original Items on the Needs Threat Scale

1. I felt powerful
2. I felt "disconnected"*
3. I felt important
4. I felt the other players decided everything*
5. I felt I had control over the course of the game
6. I felt I belonged to the group
7. I felt insecure*
8. I felt meaningless*
9. I felt satisfied
10. I felt invisible*
11. I felt good about myself
12. I felt like an outsider*
13. My self-esteem was high
14. I felt liked
15. I felt rejected*
16. I felt useful
17. I felt non-existent*
18. I felt I had the ability to significantly alter events
19. I felt the other players interacted with me a lot
20. I felt I was unable to influence the action of others*

Mood Items

1. During the game, I felt Good
2. During the game, I felt Bad*
3. During the game, I felt Friendly
4. During the game, I felt Unfriendly*
5. During the game, I felt Angry*
6. During the game, I felt Pleasant
7. During the game, I felt Happy
8. During the game, I felt Sad

Perceived Exclusion Items

1. During the game, I was ignored*
2. During the game, I was excluded*

*Items reverse-scored.

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