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Exploring The Development of Social Responses in Children with Callous and Unemotional Traits: An Examination of The Impact of Hypothesized Reinforcing and Aversive Stimuli

Andre Maharaj

Florida International University, andremaharaj@gmail.com

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FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

EXPLORING THE DEVELOPMENT OF SOCIAL RESPONSES IN CHILDREN
WITH CALLOUS AND UNEMOTIONAL TRAITS: AN EXAMINATION OF THE
IMPACT OF HYPOTHESIZED REINFORCING AND AVERSIVE STIMULI

A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

in

PSYCHOLOGY

by

André V.M. Maharaj

2014

To: Dean Kenneth Furton
College of Arts and Sciences

This dissertation, written by André V.M. Maharaj, and entitled Exploring the Development of Social Responses in Children with Callous and Unemotional Traits: An Examination of the Impact of Hypothesized Reinforcing and Aversive Stimuli, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

Jacob Gewirtz

Daniel Waschbusch

Golam Kibria

Anibal Gutierrez, Major Professor

Date of Defense: March 28, 2014

The dissertation of André V.M. Maharaj is approved.

Dean Kenneth G. Furton
College of Arts and Sciences

Dean Lakshmi N. Reddi
University Graduate School

Florida International University, 2014

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DEDICATION

This dissertation is dedicated to my mother, without whom I would not have been able to accomplish all that I have. We are just getting started. Rock n' Roll.

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I would like to thank the members of my committee for all of their support and assistance in completing this dissertation. To Dr. Jacob Gewirtz, thank you very much for providing me the space to learn and grow, and for immeasurable wisdom and advice. I would especially like to thank Dr. Anibal Gutierrez for believing in me, helping me to defeat my arch-nemesis and taking me in, and Dr. Maricel Cigales for being what can only be described as the most appropriate academic mother possible; thank you both for your support. To Dr. Golam Kibria, who I took my first class with at the university, I am truly honored that I was able to complete my graduate training with you, and that my love of statistics was furthered by your instruction. I also would specifically like to thank Dr. Dan Waschbusch, who gave me the opportunity and inspiration to actually do the project I always wanted to do, but without whose mentorship I would certainly have been lost. Finally, I would to thank Logan McDowell for all her love and support going through this process. Without being in the trenches with me, I surely would not have come through the other side.

ABSTRACT OF THE DISSERTATION

EXPLORING THE DEVELOPMENT OF SOCIAL RESPONSES IN CHILDREN
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by

André V.M. Maharaj

Florida International University, 2014

Miami, Florida

Professor Anibal Gutierrez, Major Professor

Callous and unemotional (CU) traits in children with conduct problems have been indicated as precursors to adult psychopathy. The analysis of the sensitivity to rewards and punishment in this population may be useful in the identification of effective behavior modification programs and particularly the delineation of ineffective punishment procedures. Scores on the Child Psychopathy Scale, Inventory of Callous and Unemotional Traits, Contingency Response Rating Scale and the Sensitivity to Reward Sensitivity to Punishment – Children Revised scale were used to evaluate 20 children, aged 7-13, recruited from FIU's Center for Children and Families. The sample comprised 14 males and 6 females displaying a range of psychopathic traits measured by the CPS, with scores from 9 to 46 ($\bar{x} = 28.45$, $SD = 10.73$).

Sensitivity to punishment was examined using a behavioral task in which children endured various amounts of either white noise (type I punishment) or time-out from positive reinforcement (type II punishment) in order to gain access to a demonstrated reinforcer. The sample was stratified on the basis of the magnitude of psychopathy

scores, and sensitivity to rewards and punishment were evaluated using a Behavioral Activation / Behavioral Inhibition framework by examining task performance: the frequency and duration of punishment conditions selected, electrodermal activity (skin conductance response), and parent-reported measures of child sensitivity to reward and punishment.

Results indicated that the magnitude of CU traits was directly proportional to hyposensitivity to punishment and hypersensitivity to reward. Children with elevated levels of CU traits elected to endure a greater frequency and duration type I punishment in order to maintain continued access to the reinforcer. Significant differences were not found between high- and low-psychopathy children in the selection of type II punishment. The findings indicate that although there may be a hyporeactivity to type I punishment in children with CU traits, the use of a type II punishment by the removal of a positive stimulus has demonstrated treatment efficacy. The difference in sensitivity to rewards and the types of effective punishment in children with CU traits may affect reinforcement based learning, leading to the ineffectiveness of traditional methods informing the development of social responses.

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ABBREVIATIONS AND ACRONYMS

APA	American Psychiatric Association
APD	Antisocial Personality Disorder
BAS	Behavioral Activation System
BIS	Behavioral Inhibition System
CCF	Center for Children and Families
CFA	Confirmatory Factor Analysis
CP	Conduct Problems
CPS	Child Psychopathy Scale
CRRS	Contingency Response Rating Scale
CU	Callous and Unemotional
D-PICS	Dyadic Parent-Child Interaction Coding System
DSM	Diagnostic and Statistical Manual of Mental Disorders
EDA	Electrodermal Activity
EDR	Enhanced Data Rate
ER-SCR	Event Related Skin Conductance Response
FIU	Florida International University
FFFS	Fight, Flight and Freeze System
GSR	Galvanic Skin Response
ICU	Inventory of Callous and Unemotional Traits
NS-SCR	Non-specific Skin Conductance Response
RST	Reinforcement Sensitivity Theory
SCR	Skin Conductance Response

SPSRQ-C	Sensitivity to Punishment and Sensitivity to Reward Questionnaire – Children
TO	Time Out
UR	Unconditioned Response
WN	White Noise

I. INTRODUCTION

A question of marked significance in the field of developmental psychopathology is whether stimuli traditionally demonstrated to be aversive or punishing function in the same way for typically developing children as they do for children with conduct problems (CP) that demonstrate callous and unemotional (CU) traits. CU traits include: a lack of remorse or guilt, shallow affect or superficial emotions, a callous-lack of empathy or concern for other's feelings, and a lack of concern about performance in important activities (Frick & Moffitt, 2010). The presence of CU traits in children with CP has been indicated as a precursor to adult psychopathy, and it has been suggested that there may be differences within the group of children diagnosed with CP between those with and without CU traits (Waschbusch & Willoughby, 2008).

The American Psychiatric Association has recently included a CU specifier for conduct disorder (CD; the clinical diagnosis for CP) in the latest revision of the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association [APA], 2013), operationalized as low prosocial emotions. The inclusion of the new specifier is the result of a substantiation of the differences within the CP group (Moffitt et al., 2008), including a divergent neural profile, heritability of antisocial traits and behavioral differences such as more severe aggression (Frick & Marsee, 2006; Viding, Blair, Moffitt & Plomin, 2005). Moffitt (2008) suggests that the treatment for CP/CU children may be different than that for CP-only, and that the distinction is relevant to informing appropriate intervention techniques. Frick and White (2008) propose that by identifying a discrete subgroup classification on the basis of CU traits, options for treatment as well as ease of diagnosis and developmental outcomes may

be improved for children with CP. Recent evidence indicates that CU traits do indeed explain unique variance in predicting aggression in CP/CU groups, above that predicted by CP measures alone (Thornton, Frick, Crapanzano & Terranova, 2013). This indicates that research into this area is not only important for the advancement of scientific knowledge, but also that there is a societal need for the investigation and dissemination of information surrounding this phenomenon. Considerations surrounding the inappropriate labeling of those diagnosed with these traits as well as the desire to improve current treatment methodologies justify pointed investigation into the best methods with which to approach treatment.

Some evidence suggests that CP/CU children show decreased sensitivity to conventional behavior therapy in comparison to children with CP alone. Indeed, studies examining the efficacy of typical behavior therapy have shown comparatively reduced positive outcomes for the CP/CU children as compared to CP children without CU traits (CP-only) (Hawes & Dadds, 2005; Waschbusch, Carrey, Willoughby, King & Andrade, 2007). It is hypothesized that that this may be because of a relative under-sensitivity to punishment, and oversensitivity to reward (Lynam, 1998; O'Brien & Frick, 1996). Specifically, it has been hypothesized that punishment by the removal of an appetitive stimulus or the presentation of an aversive one does not affect children with CU traits in the same way as children without CU traits, and that the x shaped by interaction with these stimuli develop differently. While Daugherty and Quay (1991) showed that children diagnosed with CD did display perseveration in responding to attain reward despite a decreasing probability of the reward occurring, O'Brien and Frick (1996) found that this response dominated reward style was related to psychopathic features regardless of

comorbidity with CD. Evidence for the insensitivity to punishment in adult psychopaths has also been substantiated, especially when the opportunity to respond is not inhibited (Newman, Patterson & Kosson, 1987). Similar insensitivity to aversive stimuli was also found in adolescents with antisocial behavior problems, where CU traits were correlated with reduced reaction times to negative words (Loney, Frick, Clements, Ellis & Kerlin, 2003). Additionally, children with CU traits may be less intimidated by the chance of punishment, especially if the behavior results in a favorable outcome for the child, and despite the possible suffering of others (Pardini & Byrd, 2012).

Dadds and Salmon (2003) assert that reward and punishment sensitivity exist along a continuum, and that children with psychopathic traits may be considered to be at the far end of the spectrum, where the insensitivity to punishment may be relevant to the development of aggressive or antisocial behavior disorders (Dadds & Salmon, 2003). Byrd, Loeber and Pardini (2013) have also reviewed findings of studies examining differences in the sensitivity to reward and punishment processing in youths with psychopathic traits. They found that abnormalities in processing reinforcing and punishing stimuli are associated with psychopathic traits within subgroups of children displaying antisocial behaviors, and that an insensitivity to punishment was consistently implicated in both childhood and adolescence, while an oversensitivity to rewards was commonly observed in childhood but appeared reduced in adolescents (Byrd et al., 2013). Notably, they also one shortcoming of research in this area: the assessment of reward and punishment usually involve tasks that encompass both conditions, and thus elucidate the possible difficulties in parsing the individual influence of each condition. Gray (1982; Gray & McNaughton, 2000) has proposed the reinforcement sensitivity theory (RST), a

model that may be helpful in understanding the performance and development of behaviors impacted by reinforcement or punishment. This model has been found useful in the evaluation of psychopathy (Newman, MacCoon, Vaughn & Sadeh, 2005; Tull, Gratz, Latzman, Kimrel & Lejuez, 2010), and it is has multitude of empirical validation (Gray & McNaughton, 2000). Further, the RST approach has also been demonstrated to allow analysis of reinforcement and punishment as individual processes, and the theory is amendable to inquiry at multiple levels of evaluation (Byrd et al., 2013).

This study attempts to address the following research objectives: 1.) To establish the presence or absence of CU traits in a sample consisting of previously identified CP children, 2.) To ascertain whether parent reported scores of sensitivity to punishment are correlated with actual child behavior and a demonstrated sensitivity to punishment, 3.) To determine if the presence of clinically measured psychopathic traits predict the child's willingness to endure hypothesized punishment, 4.) To discern whether a physiological difference exists between the CP and CP/CU group when exposed to varying punishment procedures. By examining multiple levels of contributory systems: parent-report, task performance on a behavioral assessment, and physiological measurement, I attempt to garner a holistic perspective on the phenomena under investigation and to provide an in-depth analysis of causal, maintenance and predictive factors associated with the relationship between psychopathic traits in children and the effectiveness, or ineffectiveness of punishment.

II. THEORETICAL PERSPECTIVE

"Every act in every moment is the emergent product of context and history, and no component has causal priority" (Thelen, 2005, p. 271).

Dynamic Systems Approach to Psychopathy and Behavior

The current work is grounded in a dynamic systems methodology (Thelen, 2005) by including multiple measurements at the parent child-behavior and psychophysiological levels. Dynamic systems refer to a matrix of elements that change over time, which may interact with each other at varying levels within the system. By utilizing such an approach, individual measures may be woven together to facilitate understanding of the phenomenon from multiple, equally important levels (Thelen, 2005). I explore the progression of psychopathy, sensitivity to punishment, and sensitivity to rewards at different timescales: at pretest, two years later, for the duration of a behavioral task and at the millisecond level during the task, and examine the interactions at each level in the behavioral and physiological output of the individual. The findings are considered with regard to the possible impact they may have for the developmental trajectory of the child.

The investigation and evaluation of psychopathic traits in children and adolescents has received much attention in the fields of developmental and clinical psychology, with a focus on the assessment of proposed traits and their behavioral stability (Frick, Bodin & Barry, 2000; Lynam, Caspi, Moffitt, Loeber & Stouthamer-Loeber, 2007). Analogues of adult psychopathic traits such as superficial charm, untruthfulness, lack of remorse or shame, flat affect, impulsivity, neuroticism and violence (Cleckly, 1976; Cooke & Michie, 2001; Hare, 2003) have all been identified in

childhood manifestations, such as oppositional defiant disorder (ODD), conduct disorder (CD) and attention deficit hyperactivity disorder (ADHD, Frick & White, 2008). However, CU traits have been associated with the affective component of psychopathy, and have been demonstrated to account for aspects not otherwise explained by the aforementioned disorders (Frick & White, 2008). Also, CU traits show stability over time from early childhood to late adolescence, particularly when assessed by parental reports Frick, (Frick, Kimonis, Dandreaux & Farell, 2003; Obradović, Pardini, Long & Loeber, 2007). Several instruments have been developed to assess the presence and magnitude of these traits, including clinical scales (Frick, 2004; Lynam, 1997; Waschbusch & Willoughby, 2008), physiological measures such as electrodermal activity (EDA) and functional magnetic resonance imaging (fMRI, Fowles, 2004; Hare, 1968; Isen et al., 2010; Marsh et al., 2008), and behavioral measures (Hawes & Dadds, 2005; Muñoz, Frick, Kimonis & Aucoin, 2008). However, a theoretical framework wherein the multifaceted components can be explored has not been operationalized. Each component may have been considered in its own domain, but to gain a more thorough evaluation, I suggest that a combination of methodologies (psychometric measurement, behavioral observations and EDA) would provide a more suitable basis of understanding. Finally, applying a single case design methodology with a concurrent group design may allow fruition of this approach and aid in understand the interaction at the level of the individual, as well as providing a basis for generalizing differences.

Reinforcement Sensitivity Theory

In order to effectively investigate the suggested differing impact that appetitive or aversive stimuli may have on children with CU traits, a model is needed that facilitates

measurement at the behavioral, physiological and social level. Such a theoretical orientation should provide a means through which the stimulus-response relationship may be examined and compared to children who do not demonstrate CU traits. Gray's original model of reinforcement sensitivity (Gray, 1981; Gray, 1987) postulated that there are two primary neurocognitive systems that control motivation: the behavioral inhibition system (BIS) and the behavioral activation system (BAS). The former was thought to be responsible for responses to aversive stimuli while the latter was implicated in responding to appetitive or positive stimuli (Carver & White, 1994). In addition to being responsive to punishment, the BIS has been shown to be attuned to novel stimuli (Carver & White, 1994) as well implicated in the subjective experience of anxiety, however it may not be the only contributing system (Gray, 1978; Gray, 1981; McNaughton & Gray, 2000). The BIS has also been implicated in the trait of neuroticism, which is commonly comorbid with a diagnosis of psychopathy (Corr, 2004; Gray & McNaughton, 2000; Tull et al., 2010). The BAS is thought to be associated with the reward circuits of the brain, comprising primarily catecholaminergic pathways, and particularly pathways for dopamine (Carver & White, 1994). The system is responsive to reward and the escape from punishment (Gray, 1987), resulting in the movement of a person toward attaining a reinforcer or escaping from an aversive stimulus

Grey and McNaughton (2000) revised their original conceptualization to include a third system; the fight-flight-freeze system (FFFS) that they assert is a defensive avoidance system that, in the presence of aversive stimuli, underlies escape behavior (Tull et al., 2010). Corr (2010) has substantiated the utility of the additional system, and proposes that psychoticism may be associated with a defective FFFS and BIS, along with

a hyperactive BAS. The BIS, while still inhibiting behavior and assessing risk, has been extended to include a subsystem that acts to resolve disagreements among opposing objectives. The foremost difference between the FFFS and the BIS is that the FFFS is activated when the only recourse from an aversive is avoidance behavior, while the BIS responds to mediate responses to threats that the person is motivated to approach (DeYoung, 2010). When the FFFS is activated, the individual must choose to either fight or flee in order to remove the aversive stimulus from the environment. In contrast, the BIS is activated in order to resolve conflicts from approach-avoidance situations, wherein the objective is to attain a reinforcer under conditions where an aversive is also present (DeYoung, 2010). In combination, these systems are thought to balance the interaction of the organism in the environment to provide the most favorable outcome while seeking to avoid punishment. Both systems have been implicated in the manifestation of psychopathy as a result of a deficit in BIS activation (Newman et al., 2005).

Gray & McNaughton (2000) propose that the BIS encompasses the septohippocampus, neocortical projections in the frontal lobe and monoaminergic afferents from the brainstem (Carver & White, 1994). These connections have been supported in the animal literature (MacDougall & Capobianco, 1976) and the BIS has been implicated as an underpinning source in theories of risk-taking behaviors (Vermeersch, T'Sjoen, Kaufman & Van Houtte, 2013). Two such theories, where the BIS may affect adolescent risk are: social control, whereby the individual develops a bond with society (Hirschi, 1969), and strain, wherein negative life events may lead to risk-taking behaviors because of resultant negative emotional states (Agnew, 1992). Additionally, some question whether the system is associated with active avoidant

behavior, or the discontinuation of ongoing behavior to prevent harm or punishment (Amodio, Master, Yee & Taylor, 2007). Current research has also suggested that inhibitory control may be related to the right parietal and prefrontal cortical regions, as well as the cingulate cortex (Garavan, Roos, Murphy, Roche & Stein, 2002), and that amygdala volume is positively associated with BIS sensitivity (Cherbuin et al., 2008). The FFFS promotes escape and avoidance by mediating behavior directed to unconditioned and / or conditioned aversive stimuli and is primarily associated with fear (Corr, 2004; Gray, & McNaughton, 2000; Dufey, Fernández & Mourgues, 2011). Higher BAS activity has been shown to predict a decrease in impulsivity (Corvi, Juergensen, Weaver & Demaree, 2012), and dysregulation of the BAS has been implicated in depression (Kasch, Rottenberg, Arnow & Gotlib, 2002).

The model proposed by Gray and McNaughton (2000) may be useful in understanding the possible oversensitivity to punishment and undersensitivity to reward, as well as factors such as neuroticism and flat affect, that contribute to the manifestation of psychopathy in children. Such characteristics are associated with CU traits in children, suggesting that they may exhibit atypical responses relative to typically developing children: behaviors that would normally be suppressed by punishment may not be affected in the same way for children with CU traits as they might disregard aversive or punishing stimuli in favor of continued responding in order to gain access to reinforcement. Specifically, it is suggested that relative to typically developing kids, children with CU traits may display a hypoactive BIS resulting in an insensitivity to punishment, and a hyperactive BAS resulting in an oversensitivity to rewards (Herpers, Rommelse, Bons, Butelaar & Scheepers, 2012).

Reinforcement sensitivity theory provides a framework appropriate to a dynamic systems approach to understanding the effects of reinforcement and punishment in children with CU traits. The BIS / BAS / FFFS readily lends itself to self- and parent-report measures (Carver & White, 2004; Dufey et al., 2011;), as well as physiological measurement (Amodio et al., 2007; Fowles, 2000). Furthermore, it delineates responses to stimuli that easily facilitate the formulation of a behavioral setting wherein the environment can be manipulated to elicit activation or suppression of the systems (Tull et al., 2010). Finally, it provides a common theoretical construct that allows movement between levels of analysis of the phenomena of interest, while enabling relationships among the variables to be explored in the most suitable domain, whether physiological, behavioral or environmental.

III. LITERATURE REVIEW

Psychopathy in Children

The construct of psychopath does not translate directly from the adult domain, and must be tempered appropriately for use in understanding antisocial and aggressive behavior in child and adolescent populations (Dadds, Fraser, Frost & Hawes, 2005). Two distinct forms of adult psychopathy have been delineated: 1) Primary psychopathy, which is purported to be an outcome of phenotypic determination and typically characterized by a deficit in affect, and 2) Secondary psychopathy, which is viewed as a consequence of a disruption in psychosocial learning and usually reflects a disturbance in affect (Blackburn, 1975; Cleckley, 1976; Skeem, Johansson, Andershed, Keer & Loudon, 2007). Similar distinctions have been attempted with moderate success in child populations, with primary and secondary groups differing on negative and positive personality traits, respectively (Lee, Salekin & Iselin, 2010). However, difficulties in separating primary and secondary types into homogenous groups have resulted in less than adequate attempts to clarify their underlying etiology (Newman et al., 2005). Khan et al., (2013) have offered support for the dichotomy within children with psychopathic traits on the basis of primary and secondary variation, and proffer that a distinction be made on the basis of behavioral inhibition and anxiety. With regard to managing maladaptive developmental trajectories, Salekin (2002) has found that treatment may be effective especially if intensive intervention is performed prior to adulthood. Multisystematic therapeutic approaches have also been employed in antisocial adolescent populations, with cognitive-behavioral and psychoanalytic approaches regarded as the most suitable for interventions (Harris & Rice, 2006; Salekin, 2002).

Conduct problems are typically considered to comprise antisocial behaviors, which may include aggression to people and animals, oppositional behaviors, rule violation, deceitfulness or theft and property destruction (Frick & Moffit, 2010); they are archetypally comorbid with impulsivity and hyperactivity (Shaw, 2013). According to Moffit (1993; 2003), antisocial behavior has two developmental trajectories: life-course-persistent and adolescent-limited. She states that while adolescent-limited antisocial behavior has its genesis in social processes, those classified as life-course-persistent begin displaying antisocial tendencies in childhood, progressing and worsening into adulthood, and aligning with a diagnosis of antisocial personality disorder (APD; Moffit, 2003). According to the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; APA, 2013), the hallmark of APD is a pervasive pattern beginning in early adolescence or childhood marked by the encroachment or disrespect for the rights of others, and in which manipulation and deception are predominant features. These tendencies may be resultant of the interaction of neuropsychological differences in development, abnormalities in autonomic nervous system (ANS) functioning and social environments that are conducive to fostering their development, such as dysfunctional family settings (Frick & White, 2008; Moffit, 2003). Patterson (1982) proposes that the genesis of antisocial behavior stems from operant learning within the confines of the family, and is later generalized to the wider social environment. He states that the antisocial behaviors are acquired through imitation of a model, the failure of punishment to suppress maladaptive behavior, and the reinforcement of antisocial-aggressive behavior (Dadds & Salmon, 2003; Patterson, 1982). The interaction between genes and the environment may be especially of interest, as the environment created by the parent

as well as the heritable traits may both be relevant to the developmental trajectory of maladaptive behaviors in the child. Raudino, Fergusson, Woodward and Horwood (2013) illustrated that an intergenerational transmission of CP is likely because of parenting behaviors as well as genetic contributions. Executive function has also been implicated as a means by which to assess CP, as it has been shown that differences exist between criminal and non-criminal groups (Tausch, 2013). Tausch (2013) has also indicated correlations with executive function and ADHD, rule breaking, and intrusive, antisocial or aggressive behavior

One factor implicated in CP is a dearth of emotional recognition (Schwenck et al., 2013). This deficiency has also been identified in persons with psychopathic traits, and Dawel, O’Kearney, McHone and Palermo (2012) provided substantiating claims from a meta-analysis on research involving a multitude of emotional categories, including anger, fear, happiness sadness disgust and fear. They found that for postural, facial and vocal emotional expression, adults as well as children with psychopathic traits demonstrated shortfalls in the identification and processing of emotions (Dawel et al., 2012). For children with CP/CU traits, it has been specifically shown that they may have more trouble processing affect related to the emotions of happiness, sadness and fear (Schwenck et al., 2014). Antisocial children who demonstrate CU traits also demonstrate this alienation from the emotions of others. Pasalich, Dadds, Hawes and Brennan (2012) have indicated that insecure attachments in childhood may be a contributing factor to this scarcity in reciprocated emotional exchange. Psychopathic traits independent of conduct problems have been shown to predict psychosocial disorders in adolescents, and their

relevance to modification in early intervention is implicated (López-Romero, Romero & Luengo, 2012).

Diagnostic Implementation - Conduct Disorder

As defined in the *DSM-5* (APA, 2013) CD is characterized by an assiduous recurring behavior pattern where, similarly to APD, the rights of others are violated. The center for disease control (CDC) has estimated a 12-month prevalence of 2.7% in CD for children between the ages of 8-15 (CDC, 2013). Unlike APD, the definition includes the violation of societally determined age-appropriate norms (APA, 2013). Diagnosis of CD subscribes to the two aforementioned developmental trajectories, resulting in two subtypes: childhood-onset and adolescent-onset with severity specifiers for mild, moderate and severe, and is typically preceded by a diagnosis of ODD (APA, 2013). The associated behaviors of CD include severe rule violation, nonaggressive behavior resulting in property damage or loss, deceitfulness or theft and physical harm to animals or persons (APA, 2013). Children with CD traits may display attribution biases, interpreting others' intent as hostile and responding with aggression (APA, 2013), as well as displaying other psychosocial impairment (Davis & Anastassiou-Hadjicharalambous 2013). Though differences vary with the individual, the behavioral trajectory of conduct problems tend to follow a pattern of increasing severity with age, and for some, eventually lead to psychopathy in later adult life (APA, 2013; Tsopelas & Armenaka, 2012), and these developmental pathways may have far-reaching effects and long-term costs with respect to human capital and criminal behavior in adulthood (Webbink, Vujić, Koning & Martin, 2012).

Callous and Unemotional Traits

Children with CP may also demonstrate an additional subset of callous and unemotional (CU) attributes (APA, 2013), and have been identified as having a poorer prognosis than their CP-only counterparts (Moffit et al., 2008). The *DSM-5* recently included CU traits (operationalized as low prosocial emotions) as a specifier for CD, indicating the clinical usefulness of the distinction for diagnostic purposes in a diagnosis of CD (Viding & McCrory, 2012). Similar to the features of CD, several characteristics of CU traits have been identified, including but not limited to: a lack of guilt and remorse, unsympathetic use of others, a deficit of empathy, thievery or dishonesty and relational aggression (Pardini, Stepp, Hiopwell, Stouthamer-Loeber & Loeber, 2012; Frick & Moffit, 2010; Frick & White, 2008). The traits have been demonstrated to be stable over time (Muñoz, & Frick, 2007), and although a resistance to typical treatment has been identified (Newcorn, 2013), CU traits may be amenable to modification if the intervention is specifically tailored to afford the consideration which are required (Frick et al., 2003).

CP/CU and CP-Only Differences

Frick, Ray, Thornton and Kahn (2014) reviewed extant research on children with CU traits and found that the measurement of CU traits is useful in identifying a distinct subgroup of youth within the larger set of children with CP. They state that dissimilar etiological influences may be indicated by marked disparities in discrete biological, cognitive, environmental, personality and genetic physiognomies, when compared to the genesis of behavior problems in CP-only children (Frick et al., 2014). Neuronal differences implicating suppressor effects between CP and CU in the amygdala have been

found, with an inference of increased response to affective stimuli (CP-only) and reduced response to distress in others (CP/CU) (Sebastian, et al., 2012). The predictive validity of CU traits for antisocial and disruptive behavior as an antecedent to CD have also been established in child and adolescent samples (Dadds et al., 2005). Likewise, Waschbusch et al. (2007) demonstrated that in an intensive summer treatment program (STP) for children with disruptive behavior disorder, children displaying ADHD with CP/CU displayed increased severity of conduct problems relative to a comparison ADHD/CP-only group. Furthermore, Hawes and Dadds (2007) assert that paucity of positive treatment outcomes are related to stability in levels of CU traits, and find that this is consistent even after controlling for initial CP levels. These findings are also maintained when examining multi-informant data; in an investigation of ODD severity over 6-month follow-up, Hawes, Dadds, Brennan, Rhodes and Cauchie (2013) found that higher levels of CU traits positively predicted severity of ODD traits. The model was preserved even after controlling for socio-economic status, pre-treatment sensitivity, age and gender (Hawes et al., 2013).

However, it should be noted that the delineation of CP/CU is not a solution for all possible discrepancies, but instead may be useful by ruling out the possibility of simply exacerbated traits of CP. Collins and Vermeiren (2013) question the utility of the CU subtype for predicting reoffending in delinquent youth, claiming that no meaningful distinction can be made between the two groups, and Wymbs et al. (2013) have found no significant contribution to CU traits over CP for risk factors in adolescent sexual activity. Further, an elevated risk for problems with substance use, bullying, narcissism, inattention, impulsivity and low familial support have been mapped to CP/CU children

compared to CP-only groups (Fanti, 2013), and the specifier distinction may indeed be seen to have utility in distinguishing between these groups (Fanti, Demetriou & Kimonis, 2013).

Measurement of CU Traits

Clear delineation of the CU group is considered paramount, as children within this group seem to be at increased jeopardy for elevated antisocial outcomes (Frick et al., 2014). These CU traits have been implicated in leading to more severe, persistent and violent antisocial behavior compared to their CP-only counterparts (Frick & White, 2008). Parent ratings have been found to be a reliable and valid medium for measuring CU traits in children (Frick et al., 2003; Willoughby, Mills-Koonce, Gottfredson & Wanger, 2013). Additionally, stable scores are observed despite measurement over extended time (Obradović, et al., 2007), and item similarity over the developmental period can be observed (Frick & White, 2008).

A multitude of scales have been developed to measure CU traits, two of which include: the Child Psychopathy Scale (CPS) by Lynam (1997), and the Inventory of Callous-Unemotional Traits (ICU) by Frick (2004). Lynam (1997) attempted to create a child and adolescent counterpart to Hare's landmark Psychopathy Checklist-Revised (PCL-R; Hare, 1991), with the resulting measure including subscale ratings for callousness, manipulateness, lack of guilt, lack of planning, glibness, untruthfulness, poverty of affect, behavioral dyscontrol, impulsivity, parasitic lifestyle and a failure to accept responsibility. Lynam, Derefinko, Caspi, Loeber and Stouthamer-Loeber (2007) have shown that the items on the CPS converge appropriately with additional measures of psychopathy in youth populations (Lynam et al., 2009), and high scores in delinquent

youths have been reliably shown to relate to low empathy, and elevated levels of externalizing problem, anger, aggression and impulsivity (Verschuere, Candel, Van Reenen & Korebrits, 2012). Ward (2005) suggests that there are significant impacts on CPS score that are the result of environmental and genetic influences; however, these influences may not necessarily be manifested physiologically (Ward, 2005). The scale has been utilized in numerous studies examining the development of psychopathy and antisocial behavior in childhood, and has been found to generate reliable and relevant clinical ratings (Bijttebier & Decoene, 2009; Lynam, Caspi, Moffit, Loeber, Stouthamer-Loeber, 2005; Wiklunk, Ruchkin, Kaposov & af Klinteberg, 2014). A cutoff score of 30 has been found to be indicative of elevated levels of psychopathy, and of particular interest when identifying CP/CU children (Maharaj et al., 2013).

The ICU (Frick, 2004) is also purported to measure the underlying construct of CU, however unlike the CPS, it focuses strictly on affective components rather than the larger constructs of psychopathy. There are three versions of the scale: self-, parent-, and teacher-report versions (Frick, 2004). The scale has been used in a multitude of studies, and has demonstrated a stable factor structure comprised of callousness, uncaring and unemotional (Essau et al., 2006; Fanti, Frick & Georgiou, 2008; Kimonis et al., 2008). Particularly related to the conceptualization of callous traits, research on the construct validity of the scale has demonstrated a significant inverse relationship between CU scores and compassion towards others (Berg et al., 2013). However, incongruences in the form of positive correlations of psychological distress have been made apparent and it is suggested that while some aspects may be relevant to CU traits, the scale may be steeped with global disturbance and negative emotionality (Berg et al., 2013). Analysis by Hawes

et al. (2013) on the parent-reported factor structure revealed that the proposed models resulted in a very poor fit and they have suggested a revised short form utilizing a two-factor model comprising half of the original items that demonstrates higher internal consistency and suitable CU construct percipience. A similar two-factor model of 1) uncaring and 2) callous unemotional for the self-report version of the scale has also been suggested by Houghton, Hunter and Crow (2013), and it has been demonstrated to be hardy across demographic variation.

Comorbidity and Relationship to CD, ADHD and ODD

Callous and unemotional traits have been demonstrated as a discrete factor independent of comorbid diagnoses of CD, ADHD and ODD (Dadds et al., 2005; Lynam, 1997; Waschbusch et al., 2004). Also, Smith and Hung (2012) assert that conduct problem mediation (i.e., conduct problems alone) and not comorbidity with diagnoses such as ADHD (Abramowitz, Kosson & Seidenberg, 2004) are the most important elements in the development of psychopathy. However, symptoms of ADHD have been found to slightly intensify the relationship between CU and ODD traits, as well as strengthen the relationship between ODD symptoms and reactive and proactive aggression (Becker, Luebbe, Fite, Greening & Stoppelbein, 2013). Aggressive behaviors seem to be more methodical and instrumental (Poilin & Boivin, 2000), but this has not been found to decrease the effectiveness for ADHD psychopharmacological intervention (Blader et al., 2013). In their study examining the efficacy of stimulant treatment for impulse control in aggressive children with ADHD, Blader et al. (2013) found that pretreatment CU traits did not predict worsened outcomes, and a decline in CU traits was actually observed post-treatment. Their finding may add further support to the observed

comorbidity of CU traits and ADHD, but validate the utility of an independent CU construct. Evidence for the prevalence of CU traits in clinical and non-referred samples also suggests that rates are on par with those of ADHD, ODD and CD (Frick et al., 2000).

Punishment

Punishment is defined by Azrin and Holz (1966) as the reverse of reinforcement, whereby a stimulus follows a response and results in the decreased frequency of that response. Cooper, Heron and Howard (2007) point out that punishment is only demonstrated when there is an observed decline in the future frequency of the behavior. However, Skinner (1938; 1953) asserted that punishment was not the reflexive of reinforcement, but instead the presentation of an aversive stimulus or the removal of a positive reinforcer contingent on a response, without the proposition of this affecting future occurrences of the response (Holth, 2005; Sidman, 1989). For a stimulus to be considered aversive, it has been suggested that the organism must demonstrate both escape, as well as avoidance behavior (Walters & Grusec, 1977). It is also possible that the stimuli may elicit an unconditioned response (UR) that provides a reinforcing escape from the aversive, or that the UR is incompatible with the punished response (Guthrie, 1935). As such, it may be possible that the evocative effect of the aversive stimulus masks the intended suppression, as cessation of the behavior occurs in either circumstance (Michael, 2004). Spradlin (2002) also points out that the likelihood for a stimulus to function as a punisher is increased if it also signals a decrease or discontinuation of reinforcement, and also if an alternative response is accessible and subject to a schedule of reinforcement exceeding that of the delivery of the punisher. On the latter note, however, Baker, Woods, Tait and Gardiner (1986) argue that alternative

behaviors may not always be applicable in the explanation of the suppressing effects of punishment, and contend that the effect of the punisher may in fact be the most pertinent variable

Type I or positive punishment is the presentation of a stimulus traditionally demonstrated to be unpleasant being made contingent on a response (Foxx, 1982; Mayer, Sulzer-Azaroff & Wallace, 2012). It has been found that using a variety of aversive stimuli rather than the repeated presentation of the same one may increase the punishing effect for an individual (Charlop, Burgio, Iwata & Ivancic, 1988). Type II or negative punishment refers to the removal of an appetitive stimulus made contingent on a response (Foxx, 1982; Mayer et al., 2012). Regardless of the type utilized, punishment procedures are typically employed to reduce or eliminate undesirable responses from the behavioral repertoire (Walters & Grusec, 1977). Cooper et al. (2007) also illustrate that the threat of punishment is not actual punishment, and should be considered an EO for alternative behaviors if indeed it produces suppression of the target behavior.

The effectiveness of punishment is subject to the parameters within which it occurs. As is the case with reinforcement, discriminated stimuli for punishment (S^{D-} ; Mayer et al., 2012) may result from the organism's history of conditioning (Cooper et al., 2007; Spradlin, 2002). Upon discontinuation of non-severe punishment, rates of responding have been shown to return to those previously observed, or may even exceed them (Azrin, 1960; Lerman & Vorndran, 2002). Also, the duration and intensity of the punisher has been implicated in gauging severity (Hull & Klugh, 1973). Recovery may also be a function of pre-punishment reinforcements (Lawson & Born, 1964). Severe punishment has been demonstrated to suppress responding of the target behavior (Azrin

& Holz, 1961; Cooper et al., 2007; Mayer et al., 2012; Scobie & Kaufman, 1969).

However, side effects such as aggression and elevation of problem behavior outside of punishment conditions may result from the use of severe type I punishment (Cooper et al., 2007). Interestingly, better support for the discontinuation of target behaviors seems to be evidenced by utilizing the extinction of reinforcement rather than punishment techniques (Vogel-Sprott & Racinkas, 1969).

Operationalization of Punishment

For the current study, I operationalize punishment in accordance with Skinner's definition of punishment (Skinner, 1938; 1953) and make use of both the presentation of an aversive stimulus and the removal of an appetitive one in order to investigate the effects of each. The goal of punishment procedures is typically to remove or suppress undesirable responses from the behavioral repertoire (Walters & Grusec, 1977).

Unconditioned or primary punishers are those stimuli that, without any prior conditioning, result in the reduction of the future frequency of a behavior by instantiating either an escape or avoidance response (Cooper et al., 2007). Bijou and Baer (1965) point out that given sufficient intensity, any stimulus capable of acting on the receptors of an organism may function as an unconditioned / type I punisher. Additionally, an appropriate establishing operation may not be necessary for escape or avoidance of such stimuli, and their ability to quell contingent behavior is viewed as an inherent property (Cooper et al., 2007).

Loud bursts of white noise (WN) have been utilized in a range of studies as an operationalization of type I punishment (e.g. Masini, Day & Campeau, 2008; Nunn & Thomas, 1999; Peri, Ben-Shakhar, Orr & Shalev, 2000). When utilized as an

unconditioned stimulus, studies typically employ 100ms to 6s bursts at 95 to 116db with an almost immediate rise and fall time (Lissek et al., 2005). Additionally, anxious anticipatory states have also been reported prior to WN stimulus delivery under conditions where the burst is signaled by an S^D (Grillon & Ameli, 1998). Wang, Baker, Gao, Raine and Lozano (2012) have recently utilized unsignaled WN bursts at 105db in the investigation of the physiological responses to aversive stimuli in children demonstrating psychopathic traits. Their findings show that the WN burst is indeed effective as an aversive stimulus, resulting in observable differences in SCRs (Wang et al., 2012). While habituation to extended periods of WN is possible, it has been demonstrated in the animal literature that long-term acclimatization may be prevented by intervals between stimulus presentation (Masini, Day & Campeau, 2008) thus preserving the stimulus' aversive properties.

The removal of a demonstrated appetitive stimulus relies on the establishing of the stimulus first functioning as a reinforcer (Foxx, 1982). Once established, the removal of the stimulus may be used as type II punishment. By definition, time-out (TO) is the embodiment of negative punishment under the Skinnerian concept, (Skinner, 1938; 1953) as it involves the removal of the appetitive stimulus without any replacement stimulus, and can take the form of either being exclusionary, in which the child is estranged from the area of reinforcement while remaining in the room, or nonexclusionary, in which the child may observe the reinforcer but not partake (Harris, 1985). The use of TO procedures as a type II punisher is well documented (Warzak, Flores, Kellen, Kazmerski & Chopko, 2012), and these procedures have established clinical relevance, being utilized in both home and school based treatment settings (Brantner & Doherty, 1983; Clark,

Rowbury, Baer & Baer, 1973). Time-out has been shown to be effective in myriad situations, including the suppression of self-injurious behavior (Lerman, Iwata, Shore & DeLeon, 1997), reducing noncompliance (Benshoof, 2013) and other problem behaviors (Donaldson & Vollmer, 2012). However, Hawes and Dadds (2005) illustrated that children with CU traits are less responsive to TO and show less affect when placed under the condition even though the same children did not differ in their response to reward-based components of treatment. Further, Haas et al. (2011) investigated treatment responsiveness and outcomes from a summer treatment program in CP/CU children with ADHD, and found that CP/CU children displayed more negative behaviors in TO than their CP-only colleagues. Finally, Donaldson, Vollmer, Yakich and Van Camp (2013) explored the effect of reducing the duration of TO on the basis of compliance when given the instruction, and have found support for an increase of compliant behavior on the basis of the contingent reduction of the TO interval, although other research has demonstrated that when TO is implemented as part of a comprehensive behavioral intervention it is equally effective across minor procedural variations (Fabiano et al., 2004).

Delay / Temporal Discounting

Critchfield and Kollins (2001) outline the effects of human temporal discounting, whereby reinforcers that are further away in time are interpreted as having lower value than those that are available sooner to the individual. However, human beings do not always prefer the immediate delivery of smaller reinforcers to the delayed delivery of larger ones (Flora & Pavlik, 1992; Logue, King, Chavarro & Volpe, 1990). Critchfield and Kollins (2001) argue that the temporal discounting of individuals with ADHD will encourage the overlooking of delayed reward values in favor of instant access to

reinforcers, and the propensity for this is important to social behaviors. Additionally, they suggest that the value of punishers will also be discounted, and that both the rewarded and punished discounted values should be proportional to ADHD and impulsivity symptom severity (Critchfield & Kollins, 2001). Odum (2001) suggests that delay discounting may also be a personality trait. She outlines the social importance of the proposed trait with reference to the role of impulsivity and its role in reduced sensitivity to delayed outcomes (Odum, 2001). She concludes that therapeutic intervention targeting discounting may have far reaching repercussions for impulsivity especially in children with ADHD (Odum, 2001), a factor that may require consideration on the basis of the likelihood of comorbidity in children with CU traits.

Callous and Unemotional Children's Sensitivity to Reward and Punishment

Pardini & Byrd (2012) have found that, compared to CP-only kids, children with CP/CU traits exhibit less empathy for others, are more likely to use aggression to establish social dominance, and are significantly less daunted by the threat of punishment. They also suggest that CU children may be less amenable to classic methods of treatment aimed at reforming the child's hypothesized deviant social schema (Pardini & Byrd, 2012). Indeed, studies examining the effectiveness of typical behavior therapy have shown comparatively reduced positive outcomes for the CP/CU children (Waschbusch, Carrey, Willoughby, King, & Andrade, 2007). Hawes & Dadds (2005) assessed a sample of clinic-referred children with CP between the ages of 4 to 9, and found that interventions on the basis of positive reinforcement functioned equally well for both groups, however discipline strategies employing punishment techniques were only effective for the non-CU children. O'Brien and Frick (1996), compared another clinic-

referred sample with typically developing children on the associations between their behavior and task performance with increasing ratio of punished to rewarded responses. Children with elevated level of CU traits were divided into those with and without an anxiety disorder and compared to a control group (O'Brien & Frick, 1996). The most significant confirmation of a reward dominant response style was in children with low anxiety and psychopathic features, regardless of CP (O'Brien & Frick, 1996). Conversely, O'Brien and Frick (1996) found that anxious children who exhibited psychopathic features did not differ from the control group, and their results are consistent with Gray's (1982) psychobiological theory of personality (O'Brien & Frick, 1996).

Lykken (1957) proposed that individuals with psychopathic traits were unresponsive to punishment cues and demonstrated deficits in passive avoidance learning, where behavior elicited by a stimulus is halted on the basis of the resultant punishment of the response. As such, he suggests that the techniques relying on the fear of punishment would be ineffective in the modification of behavior with psychopathic individuals (Lykken, 1957). In comparisons among three groups: institutionalized persons meeting criteria for primary psychopathy, those defined as secondary psychopaths, and a matched control group, he found a marked reduction in the ability to inhibit responses between psychopathic individuals and controls (Lykken, 1957). Additionally, the primary psychopathy group also demonstrated a significantly lowered ability to inhibit responses compared to the secondary group (Lykken, 1957). This unresponsiveness appears to stem from early developmental deficits in suppressing antisocial behavior, and eventually culminate in adult aggressive and delinquent behavior (Eron, 1987).

Electrodermal Activity in Psychopathy and CU Traits

Electrodermal activity (EDA), a subset of the galvanic skin response (GSR)¹, has been demonstrated to be a reliable and representative measure of stimulus strength, and has been used extensively in the appraisal of psychophysiological responses (Boucsein, 2012). The dermis is the singular organ that is exclusively innervated by the sympathetic nervous system, and exosomatic recording of skin conductance responses (SCRs) is possible because of the high conductivity of the dermis and subcutaneous tissue, as well as the activity of the sweat glands (Boucsein, 2012; Bach, Friston & Dolan, 2010).

Measurement systems of electrodermal activity (EDA) are commonly divided into phasic and tonic responses: the former is a measure of short term SCR, while the latter reflects longer-term fluctuations in electrodermal level (Boucsein, 2012). Within measures of phasic responses, event-related skin conductance responses (ER-SCRs) are used to demarcate activity elicited by external stimuli. Nonspecific SCRs (NS-SCRs) may also occur that do not readily appear to be related to the presentation of a stimulus or environmental variation (Boucsein, 2012; Fowles, 1998).

Initially, investigation into skin conductance and psychopathy posited that lowered EDA was owing to a deficit in fear conditioning (Lykken, 1957). In accord with the revised RST, Gray and McNaughton (2000) assert that EDA hyporeactivity is related to a weak BIS, wherein the individual shows a strong motivation to attain reinforcement, but is insensitive to the threat or presence of punishment. Quay (1993) agreed with this posture, and suggested that children with CD display the same hyposensitivity to aversive

¹ The term “EDA” is used in favor of “GSR” as it is considered more accurate. “GSR” is considered depreciated (Boucsein, 2012).

stimuli as a result of an underactive BIS and overactive BAS. Wang et al. (2012) also support this pattern of BIS/BAS activity: in their investigation utilizing signaled or unsignaled WN, elevated psychopathic traits in children were shown to be related to lowered rates of nonspecific SCR when anticipating the aversive stimulus, as compared to children low in psychopathic traits who demonstrated elevated SCR responses when anticipating the stimulus (Wang et al., 2012). In contrast to expectations, however, Fowles (1987) did not find support for nonspecific SCR when individuals were presented with a monetary reward, however this may have been a result of ceiling effects rather than stimulus insensitivity.

Atypical neurodevelopment has been demonstrated in children with CU traits via the examination of electrophysiological correlates (Sumich et al., 2012). The retardation of neuro-typical responses in favor of immature activation along the midline frontal and temporal regions concurs with observed cortical tapering that may underscore psychopathic propensities (Sumich et al., 2012). Hyporeactivity of skin conductance may index characteristics such as impulsivity and emotional deficits that underlie or heighten the propensity toward negative interpersonal relationships and antisocial behavior in individuals with psychopathy (Wang, et al., 2012). Also, atypical patterns in cardiovascular and electrodermal responses in psychopathic individuals are believed to be biological indicators of disinhibition and fearless (Wang et al., 2012). Additionally, it has been shown that a hypersensitivity to reward and a hyposensitivity to punishment may also be predicted by indicators of psychopathy, such as fearlessness and aversive motivation (punishment avoidance), and skin conductance measures may provide a reliable measure of these predictors (Fowles, 1998). Finally, Fung et al. (2005) have also supported the

finding that children demonstrating psychopathic traits show physiological hyporeactivity to anticipation of both signaled and unsignaled onset of an aversive stimulus. Utilizing scores from the CPS (Lynam, 1997), Fung et al. (2005) created a dichotomous group on the basis of psychopathy scores and tested the children's responses to WN bursts at 105db, both in the presence and absence of an S^D. Their results indicated that the hyposensitivity to aversive stimuli found in psychopathic adults was mirrored in the adolescent sample.

Theories of Maladaptive Responses to Behavioral Contingencies

Investigations into the relationship between punishment insensitivity and parenting indicate that hyposensitivity to punishment may be influenced by both environmental factors, as well as child temperament, and that parental discipline may not be effective for children who exhibit a fearless temperament (Dadds & Salmon, 2003). As a result of lowered parental effectiveness, children with elevated levels of fearlessness may be at risk for developing callousness and a reduced concern for punishment (Pardini, 2006). In a study by Miller et al. (2013) during a summer treatment program, behavioral intervention emphasizing reward and reduced punishment was conducted utilizing a modified A-B-C reversal design with 11 children having a comorbid diagnosis of ADHD and either ODD or CD. The results indicated that the most positive treatment outcomes occurred during reduced-punishment phases (Miller et al., 2013). However, rates of aggression, stealing and other negative behavior increased during the treatment even while demonstrating improvement.

With regard to neuronal activation, children demonstrating low CU traits display emotional hyporeactivity, contrasted with those displaying high CU traits (Sebastian, et

al., 2014). In a task measuring neural responses via fMRI to calm and fearful faces, Sebastian et al. (2014) found significant correlations between reaction time and activation in the amygdala for fearful faces in the CP-only group, indicating a deficit of emotional response for the CP/CU children. Stronger activity of the BAS compared to the BIS has been found to lead to reward-dominant response style in children with psychopathic features that are non-anxious (Gray & McNaughton, 2000; O'Brien & Frick, 1996), and it is suggested that the activation of the BIS in children with psychopathic features and anxiety counteracts reward dominance.

The response modulation model proposed by Newman may partially explain the ineffectiveness of behavioral treatment (Newman, Patterson, Howland & Nichols, 1990): it is suggested that psychopathic traits are correlated with an inability for punishment feedback to alter the direction of responding appropriately, and though the process is principally automatic, it originates the cognitive processes used for adaptive behavior regulation (Wallace, Vitale & Newman, 1999). Thus, the individual displays perseveration of a previously rewarded response (Barry et. al., 2000; Newman et al., 1990) and may continue to do so regardless of increases in punishment (Fisher & Blair, 1998; O'Brien & Frick, 1996). Corr (2010) proposes that the principal deficits observed in psychopathy might stem from a dysfunction in the BIS, leading to a deficiency in the ability to correctly modulate responses as well as inhibit attention and promote cognitive inflexibility. Newman et al. (1990) and Wallace et al. (1999) also claim that a hypersensitivity to reward may not affect disinhibited responses, but rather the inaccurate processing of punishment cues. Evidence from Blair, Colledge and Mitchell (2001) support this assertion. In their study examining orbitofrontal cortex and amygdala

functioning related to a task requiring shifting on the basis of punishment, they found that once children were able to detect the altered contingencies, the ability to alter the response set became apparent (Blair et al., 2001).

However, Marini and Stickle (2010) examined sensitivity to reward in children with CU traits and concluded that these traits also significantly predated a lowered sensitivity to reinforcement. They propose that instead of a one-sided deficit, discrepancies exist in both sensitivity to reward and punishment. Blair (2005) suggests the use of an integrated emotion systems model, which accounts for deficits in both reward and punishment systems because of differences in orbital and medial frontal cortex, as well as the amygdala. Work by Budhani and Blair (2005) and Blair, Peschardt, Budhani, Mitchell and Pine (2006) imply that disruptions in these (and possibly other) neurological systems leads to an inability to form or modify stimulus-response associations, leading to the abnormality in reward and punishment sensitivity. They further suggest that the stimulus-response deficit may lead to the characteristically observed reactive aggression, as well as the failings of standard socializing procedures (Blair et al., 2006).

Recent evidence suggests that disruption in learning can be assessed in children as young as preschoolers; Briggs-Gowan et al. (2014) conducted an assessment requiring children, previously rated on a scale assessing punishment insensitivity, to avoid punished stimuli in favor of rewarded stimuli. They found evidence for passive avoidance via errors on punishment trials were associated with ratings of punishment insensitivity, and suggest intervention might be appropriate beginning in early childhood (Briggs-Gowan et al., 2014). It has been validated that CP/CU children display a diminished

response to treatment when compared to CP-only groups (Hawes, et al., 2013). Herpers et al. (2012) assert that emotional processing deficits are prevalent in children with CU traits, outlining inhibition and responses to distress as particular areas of dearth. They propose that an atypical sensitivity to rewards may be associated with the existence of CU traits irrespective of the comorbidity with CP, and state that CP/CU children exhibit a characteristic response of hypersensitivity to reward, whereby a perseveration of behavior in order to gain access to a reinforcer regardless of consequences may be observed (Herpers et al., 2012). Further, a hyposensitivity to punishment may also be observed, where maladaptive behaviors are not suppressed when previously demonstrated punishment occurs contingently on a target behavior (Herpers et al., 2012). In a clinical-referred sample of 6- to 13-year-olds, Barry et al. (2000) also found evidence of a reward dominated response class, characterized by the perseveration of maladaptive behaviors to attain reinforcers, in children demonstrating prominent CU traits. Barry et al. (2000) also assert that CU children displayed less distress than their non-CU colleagues with regard to their behavior problems, and typically revealed a predilection for thrill-seeking activities while simultaneously showing lowered levels of anxiety.

Measuring Reinforcement Sensitivity Theory

While a central assumption of the aforementioned theories is that children with CU traits show insufficient response to punishment, this assumption has not yet been sufficiently tested. The current model of reinforcement sensitivity suggests that there are three main neurobiological systems that control behavior: the BIS, the BAS and the FFFS (Gray & McNaughton, 2000). The BIS underlies an individual's sensitivity to threat and fear, while the BAS has been implicated in the persistent search for reinforcement

(MacDonald, 2012). Pertinent to analysis under Gray's model (Gray & McNaughton, 2000), children identified as being CP/CU exhibit a preference for novel, as well as dangerous or exhilarating events (Barry et. al., 2000; Frick, et al., 2003), and this finding could have relevance to an atypical activation of the BIS system. Further, when attempting to gain access to a reinforcer, children demonstrating these CP/CU traits have shown a reduced sensitivity to S^D's indicating punishment (Barry et al., 2000; Essau, Sasagaway & Frick, 2006; Fisher & Blair, 1998; Frick et al., 2003). The implications for CP/CU differences in sensitivity are likely to influence the underdevelopment of appropriate social responses in these children, showing a cascading effect for their immediate environment and possibly society as whole. Indeed, MacDonald (2012) asserts that the greatest socially damaging amalgamation of conduct disorder behaviors are embodied in individuals demonstrating high behavioral approach and callous traits.

Roose, Bijttebier, Claes and Lilienfeld (2011) explored the association of psychopathic traits with amended RST theory (Gray & McNaughton, 2000), and concluded that the BIS, BAS and FFFS could independently be linked to varying traits. BAS drive has been implicated in showing a positive relationship to disinhibited approach behaviors, while narcissistic and manipulative traits seem to moderate reward-responsiveness (Roose et al., 2011). Further, CU traits appear to have an antithetical relationship with the FFFS, reward sensitivity appears to be indexed by the BAS, and anxiety indexed by the BIS (Roose et al., 2011). Keiser and Ross (2011) investigated the BIS, BAS and FFFS in relation to the Five Factor Model of personality and found that agreeableness was the only factor that discriminated between the FFFS and the BIS, with constraint and social inhibition also included in the BIS. However, the interactions of the

systems determine stimulus response, and therefore cannot be considered in isolation: hyposensitivity to punishment could be the result of an overactive BAS or an underactive BIS (Dadds & Salmon, 2003).

Approaches to Examining CU Traits and Punishment

Most previous research exploring the response to punishment by children with CU traits has utilized computer tasks or similarly synthetic approximations of punishment. It is suggested that a task utilizing an ecologically valid assessment with hypothesized punishment contingent on behavioral responses may be beneficial in providing a more realistic measure of punishment sensitivity in the CU population. Additionally, a dearth of research exists on the exploration of the possible differing effects between the two types of punishment, and this suggests a need for understanding how each may affect CP/CU children. The implications of such a difference may be useful in informing approaches used in behavioral techniques to manage maladaptive behaviors in this population. Established methodologies for assessing reinforcement and punishment may be useful in the exploration of the possible differences in both punishment and reward sensitivity.

Reinforcer Preference Assessments

Prior to the use of a stimulus as a reinforcer, it must first be established as having reinforcing value (Mayer et al., 2012). A stimulus may function as a reinforcer in one setting, but not in another; additionally, the same stimulus may function as a reinforcer for some persons and not others. It is therefore imperative to establish the reinforcing value of the stimulus in a particular setting and to a particular individual prior to its use. By providing the option for a person to select a reinforcer, it is hypothesized that the

likelihood of it functioning as one is increased, and it has been demonstrated that high-preference items, as compared to lower preference items, produce higher rates of responding when access to them is contingent on response rate (Graff, Gibson & Galiatsatos, 2006).

Reinforcer preference assessments are a method for presenting stimuli and examining their impact on the future rate of response of a target behavior (Cooper et al., 2007). To identify reinforcers for use in clinical as well as experimental settings, the assessment of stimuli are typically conducted via the recurrent presentation of a multitude of items suspected to have reinforcing value, and a hierarchy of preference is determined on the basis of repeated selection, approach or engagement with the stimuli (DeLeon, Iwata, Conners & Wallace, 1999; Mayer et al., 2012; Pace, Ivancic, Edwards, Iwata & Page, 1985). The length of time that the stimuli are available may also affect the likelihood for selection: as the opportunity for acquisition diminishes, the relative strength of the reinforcer may increase (Mayer et al., 2012; Steinhilber & Johnson, 2007). By increasing the time between presentations of a repeated reinforcer, it may be possible to maintain the relative strength of its effect on the individual's behavior, as well as preventing satiation. The technique has been shown to be appropriate for both children with mental disabilities (DeLeon et al., 1999; Hagopian, Rush, Lewin & Long, 2001) and typically developing populations (Heal & Hanley, 2007). The reinforcing properties of a stimulus may not always be apparent, even with extremely favored stimuli that have been shown to function as a reinforcer under prior conditions (Higbee, Carr & Harrison, 2000), therefore it is important to empirically identify reinforcing stimuli using reinforcer assessments. Assessments of these types have also been shown to be amenable to list-

based rankings, and display equivalence between multiple stimulus preference assessments without replacement (MSWO; DeLeon & Iwata, 1996) and ranking surveys (Waldvogel & Dixon, 2008). Additionally, ordered rankings have been demonstrated as effective with array sizes between three and five with no degradation in reinforcer selection (Tullis, Canella-Malone & Flemming, 2012). Importantly, items that have a low or medium ranking on preference assessments may still exhibit value as reinforcers (Taravella, Lerma, Contrucci & Roane, 2000; Piazza, Fisher, Hagopian, Bowman & Toole, 1996). It is suggested that a reinforcer rated previously as moderate or low may increase in value as satiation of the highest preferred reinforcer occurs. Thus, it is possible that hierarchies of stimuli created during a preference assessment may be reorganized, with previously lower-rated stimuli achieving a higher ranking as satiation occurs with the earlier highest-rated stimulus. This becomes especially important in procedures that utilize a fixed number of stimuli repeatedly.

Some stimuli may function as unconditioned reinforcers or unconditioned punishers (Cooper et al., 2007). These are phylogenically determined stimuli that increase or decrease the frequency of behavior, respectively, without prior conditioning (Malott, Tillema & Glenn, 1978). However, the effects of these as well as other stimuli are subject to setting events (Michael, 2000), which determine whether or not they will function as a reinforcer or punisher in a given situation. These setting events may be considered establishing operations that increase the effectiveness of the reinforcer, or abolishing operations that decrease its effectiveness (Michael, 2000). Cooper et al. (2007) assert that circumstances such as deprivation or satiation may mediate the effects of a reinforcer, either encouraging or inhibiting its effect on the basis of the prior state of the organism.

Conversely, a discriminative stimulus (S^D) is one that signals the availability of reinforcement from the environment and although it may be a conditioned reinforcer, establishing a stimulus as an S^D is not sufficient for asserting its reinforcing status (Kelleher & Gollub, 1962). While it may be necessary for the behavior to occur, the evocation of a response necessitates an appropriate EO (Cooper et al., 2007; Michael, 2000). Thus, within the operant framework (Cooper et al., 2007; Skinner, 1938), the EO precedes the S^D , which evokes a response in the form of a performed behavior; this behavior is either reinforced or punished, resulting in the frequency of the behavior being repeated either increasing or decreasing. It is noted that in this conceptualization, behavior may be defined as anything an organism does, including unobservable or covert behaviors such as producing thoughts or feelings (Pierce & Cheney, 2008).

Whenever possible, it is suggested that a generalized-conditioned reinforcer be selected for use in behavioral applications as their utility across multiple motivating operations is advantageous (Wine, Gugliemella & Axelrod, 2013). Buckalew and Buckalew (1983) assert that free time to play video games may function as such a reinforcer, and may be even more effective than traditional stimuli such as toys or candy. Millar and Navarick (1984) concur, showing that immediate and prolonged access to a video game used as a reinforcer was very effective when examining choice behavior. An MSOW assessment has been demonstrated to provide the most effective reinforcer for participants, resulting in the evocation of the highest response rates (DeLeon & Iwata, 1996; Kodak, Fisher, Kelley & Kisamore, 2009).

Progressive Ratio Schedules

A ratio schedule may be defined as a procedure whereby the delivery of a reinforcer is made contingent on a previously determined fixed or variable number of emitted responses (Mayer et al., 2012). Reinforcement on the basis of iteratively increasing response rates may be useful in determining the strength of a stimulus as a reinforcer (Cooper et al., 2007). Progressive ratio schedules methodically elevate the magnitude or frequency of responses required in order to gain access to an established reinforcer, and it has been demonstrated that ratio schedules tend to produce high rates of responding, particularly if speedier responses lead to the expedited delivery of the reinforcer (Mayer et al., 2012). Conversely, there exists a direct relationship between the strength of a reinforcer and the effort required to produce a given response, and this is referred to as the response cost (Mayer et al., 2012). As the effort required in producing a response increases, so too must the strength or frequency of delivery of a reinforcer increase if the organism is to continue responding. Additionally, less preferred activities have also been shown to require larger magnitudes or frequencies of reinforcers. Under a progressive ratio schedule, the response requirement is increased per stimulus presentation (Cooper et al., 2007) until a breaking point is met, after which the rate of responding can be seen to decline (Roane, Lerman & Vorndran, 2001; Penrod, Wallace & Dyer, 2008). These breaking points are the highest frequency or magnitude of ratios that the person completes during the session: it indicates the threshold of responding that the individual is willing to make in order to access reinforcement (Stafford, LeSage & Glowa, 1998).

One strength of the progressive ratio approach over alternatives that have low schedule requirements is that the enduring effect of one reinforcer relative to others may be examined. Tustin (1994) found that the preference for a reinforcer might indeed be a function of the schedule requirements necessary in order to maintain access to the reinforcer. Glover, Roane, Kadey and Grow (2008) also examined stimulus preference under fixed ratio and progressive ratio schedule, and found that responding for differentially preferred stimuli may fluctuate on the basis of the requirements imposed by the reinforcement schedule. Thus, it may be the case that stimuli demonstrated to be a preferred reinforcer may lose efficacy in favor of previously lower-rated stimulus under more demanding schedules. DeLeon, Iwata, Goh and Worsdell (1997) have also shown that progressive ratio schedules may be especially useful in determining preferences between topographically similar stimuli. Under a fixed ratio schedule, stimuli were demonstrated to have approximately equal reinforcing value, but as the schedule requirement increased, differentiation between stimuli preference became apparent (DeLeon, 1997). Progressive ratio schedules have been utilized to assess myriad thresholds for reinforcers. Stafford et al. (1998) illustrate the usefulness of this method in the evaluation of the reinforcing value of drugs: the frequency of behavior required for the delivery of a drug is increased until the subject fails to produce the response, at which point the last frequency of behavior emitted is considered to be the breaking point. DeLeon, Frank, Gregory and Allman (2009) also demonstrate the utility of the progressive ratio method in ascertaining effective reinforcers; they suggest that this method be useful in the identification of reinforcer efficacy as measured by the varying level of work sustained. DeLeon et al. (2009) demonstrate that the break points

associated with reinforcers are directly proportional to the demonstrated preference for the stimuli. Finally, Roane et al. (2001) have also demonstrated that equality of the reinforcing effects of a stimulus be equivalent on tasks requiring little effort, but significantly different for tasks requiring greater effort. They examined the effect of a demonstrated preferred stimuli in the treatment of destructive behavior and concluded that stimuli which were linked to elevated rates of responding were more effective in treatment than stimuli that were related with lower response rates (Roane et al., 2001).

In addition to the assessment of reinforcement, a progressive ratio approach may also be suited to the assessment of tolerance for an aversive / punisher, defined by the breakpoint inherent in the schedule. Evidence from animal literature suggests that schedules of punishment have been effective in the suppression of behavior (Griffin, Locke & Landers, 1975), and it has also been shown that responses may be continuous despite progressively increasing demands even in the presence of an increasing punisher (Dardano & Sauerbrunn, 1964). Analogues in human subjects have also been found: Luman, Oosterlaan, Knol and Seargeant (2008) investigated the effect of increasing the frequency and magnitude of penalties in a task designed to assess the decision-making abilities in children with ADHD. For controls as well as children with ADHD, it was found that as the frequency of penalties increased, behavior directed toward attaining reinforcement decreased; however, children with ADHD appeared to be insensitive to changes in magnitude of the penalty (Luman et al., 2008).

The effect of satiation on an individual's response-cost assessment should also be considered when employing a progressive ratio schedule. If the reinforcer is additive, such as an edible, then the value of the reinforcer may have an inverse relationship to the

number of trials utilizing the reinforcer. Thus, as the response requirement is increasing, it may be conceivable that the establishing operations for the behavior are changing such that the reinforcing value of the stimulus is simultaneously decreasing. This suggests that if a progressive ratio schedule is to be effective, a highly preferred reinforcer, preferably with a demonstrated history of prolonged effectiveness, should be selected. By identifying a reinforcer that exhibits longitudinal value if unobstructed, the reduction of value because of the progressive ratio requirements should be greatly reduced (Hodos, 1961). While progressive ratio schedules may be useful in identifying the breaking point of stimulus preference, it is also noted that reinforcer or punisher potency may be indexed by other measures, such as the rate of responding or opposition to the interruption of a behavior sustained by a reinforcer (Poling, 2010). If a stimulus is demonstrated to be a highly preferred reinforcer, then it should be possible to gauge the level of tolerance for a noxious stimulus or the removal of an appetitive one on the basis of the individual's penchant for enduring the presentation (or withdrawal) in order to regain access to the reinforcer. Additionally, the simultaneous assessment of the continued potency of the reinforcer may be established under a fixed block designed trial, where the time allowed for interaction with the stimuli can be precisely measured. Finally, it may also be possible to observe any opposition to interruption via a subject's physiological response, particularly if presented with a prompt from the environment such as the end of a timer that signals the onset of disengagement.

Psychometric Measurement of Reward and Punishment Sensitivity

Torrubia, Ávila, Moltó & Caseras (2001) created the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) as an adapted version of the scales

created by Carver and White (1994) to operationalize the BAS / BIS, in order to assess the perceived effects of rewards and punishment. The SPSRQ has been evaluated and shows good internal consistency as well as test-retest reliability and appropriate external validity (Dufey et al., 2007). On measures of sensitivity to reward, the scale was found to be positively correlated with neuroticism, extraversion (Eysenck & Eysenck, 1964) and the reward sensitivity of the BAS scale (Carver & White, 1994). The scale was also moderately correlated with psychoticism, while punishment was negatively correlated with extraversion and positively with neuroticism (Dufey et al., 2007; Eysenck & Eysenck, 1964). However, O’Conner, Colder and Hawk (2004) performed a confirmatory factor analysis (CFA) on responses to the SPSRQ from several large samples and found unsatisfactory results for a model with up to five factors. They did find, however, that with the removal of several items, a two-factor-model did have satisfactory fit, and suggested that improvements be made on the basis of these findings (O’Conner et al., 2004). Colder and O’Conner (2004) adapted the questionnaire for use in a sample of 9-12 years olds (SPSRQ-C), and found that a CFA substantiated one dimension of the BIS: sensitivity to punishment, and three dimensions of the BAS: drive, impulsivity or fun seeking, and reward responsivity. Further revision was done on the scale (Colder et al., 2011) in order to achieve consistency with the revised RST (Gray & McNaughton, 2000), and findings indicated a shyness / fear factor corresponding to the FFFS and an anxiety factor corresponding to the BIS (Colder et al., 2011).

Waschbusch and Willoughby (2011) recently created the Contingency Response Rating Scale (CRRS), which also assesses the hypothesized effect of rewards and punishment. The scale consists of 34 questions on a Likert scale, rated from “strongly

disagree” to “strongly agree” represented numerically from zero to four. Evaluation of the scale was performed using 185 clinic-referred children between the ages 6-10. Good internal consistency was demonstrated ($\alpha = 0.82$), and exploratory factor analysis and parallel analysis revealed a four-factor model indicating an undersensitivity to punishment, an oversensitivity to rewards, and an oversensitivity to punishment, with a CU factor also being associated (Yaniz, Waschbusch, Maharaj, Haas, & Derefinko, n.d.). Test-retest analyses were also conducted, with results indicating that each factor successfully survived follow-up analyses (Yaniz et al., n.d.).

Measurement of Electrodermal Activity

The EDA of persons with psychopathic traits has indicated lowered overall autonomic activity compared to those without these traits (Hare, 1968; Anieskiewicz, 1979; Muñoz, Frick, Kimonis & Aucoin, 2008). Fowles (2000) asserts that psychopathy is highly correlated with lowered EDA activity when anticipating the presentation of an aversive stimulus and has been interpreted relating to a weak BIS (Gray, 1982); however, he also notes that this hyporeactivity is also related to the impulsivity dimension of psychopathy and that EDA differences may actually be representative of a larger deficit (Fowles, 2000). Higher scores on the CPS have been shown to correlate with electrodermal hyporeactivity in males, and it has been suggested that the reduced EDA may function as a physiological marker for dishonest and manipulative orientations (Isen et al., 2010). This difference was also supported by Fung et al. (2005), who demonstrated that stratification on the basis of CPS scores resulted in between-group differences in EDA, with children high in psychopathic traits demonstrating reduced responsivity.

In order to gather EDA data without the restrictive use of wired electrodes, a wireless wearable sensor (Q-sensor, version 2) was developed by Affectiva™. The device enables collection of EDA data over an extended time period, with data being stored locally. Poh, Swenson and Picard (2010) demonstrate the utility of the sensor prototype to record EDA data in the field, and under a range of circumstances: physical task, cognitive task and emotional task. Results from the sensor were comparable to a “gold standard” (Flexcomp Infiniti, Thought Technologies Ltd.) EDA device, and the results were found to be very accurate and strongly correlated with the Flexcomp device (Poh, Swenson et al., 2010). Zhao and Barreto (2006) confirmed the applicability of the sensor to non-invasively collect data during a computer task, while simultaneously collecting other physiological data; their results demonstrated that the EDA data collected was valid, and the method efficient. Poh, Loddenkemper et al. (2010) have also established the utility of the sensor in the detection of EDA during epileptic seizures. Problems during grand-mal seizures would typically inhibit the recording of physiological data, as a result of both the unpredictability of occurrence as well as the physical difficulties in attaching recording apparatus. The use of the wireless sensor enables recording during the seizure, but also provides a method for obtaining readings prior to the onset of the seizure (Poh et al., 2010).

The current study emphasizes results of phasic ER-SCRs, as they are produced via the onset of stimuli. The physiological activity contingent upon reinforcement or punishment can be used to index activation of the underlying BIS or BAS. However, it is noted that phasic SCR focuses only on a small portion of the overall signal, and it has been suggested that phasic and tonic responses may rely on separate neural mechanisms

(Dawson et al., 2001; Nagai et al., 2004). Dawson, Schell and Fillion (2001) suggest that the analysis of NS-SCR amplitudes and their corresponding standard deviations may provide a useful indicator of tonic arousal. They also suggest that phasic responses should be subtracted from the tonic signal in order to garner a more accurate representation of the ER-SCR response (Dawson et al., 2001). The latency of the SCR signal is the time between onset and the first deviation that is significant between 1-3s (Dawson et al., 2001). The ER-SCR threshold for the current experiment will be set at deviations above 0.05 microsiemens ($\mu\text{S } 10^{-6} \text{ s}$), as this is considered to be standard practice (Dawson et al., 2001), and has been utilized in previous research investigating the effect of WN bursts on children with psychopathic traits (Wang et al., 2012).

Statement of Hypotheses

The purpose of the present study was to examine the relationship between CU traits and punishment. It was postulated that children with high levels of CU traits will show a lower sensitivity to punishment than children with low levels of CU traits, and this will be reflected in parental reports, demonstrated performance on a behavioral task and physiological measurements operationalized as electrodermal activity. Thus, the following hypotheses were posited:

- H1: Children with CU traits will select higher frequencies of TO / WN than children without these traits in order to maintain access to a demonstrated reinforcer.
- H2: The frequency and duration of punishment selection will positively predict the level of psychopathic traits in children.
- H3: Sensitivity to punishment scores will predict the frequency and duration of TO / WN exposure.

H4: Children with CU traits will have a lowered EDA than those without these traits when exposed TO / WN.

IV. METHODOLOGY

Participants

A clinic-referred convenient sample was selected from a pre-existing database provided by the Center for Children and Families (CCF) at Florida International University (FIU), and stratified to obtain two groups on the basis of high and low scores on a measure of psychopathy. The sample consisted of 20 children, ranging in age from 7-13 years ($\bar{x} = 9.45$, $SD = 1.70$), comprising 14 males and 6 females. The majority of the sample comprised Hispanic-Americans ($n = 12$), along with four Caucasian children, one Asian-American and three participants identifying as an “other” ethnicity. Subjects were assessed for current medication use and other behavior problems including: ADHD, CD and ODD. The majority of the participants were right-handed, with only two children identified as being left-hand dominant. The CCF database comprised children who previously met criteria for CP, with a subset displaying CU traits. A subset of 16 children took part in the behavioral assessment portion of the study, with the remaining participants’ parents completing questionnaires only (See Table 1).

Apparatus and Materials

Rating Scales

Behavior ratings completed by parents were used to measure several constructs, as described next. Means, standard deviations and alpha (α) values are reported in table 1. All scales were coded into Qualtrics survey software and distributed online via an emailed hyperlink or in-person utilizing a computer table (iPad). The order of rating scales was counterbalanced across parents.

Child Psychopathy Scale (CPS)

The CPS (Lynam, 1997) consists of 55 items rated dichotomously as “yes” or “no,” with the former response receiving a score of 1 and the latter a score of 0. Total scores are used to indicate severity of psychopathy, with higher scores indicating elevated psychopathic traits. Half of the items on the scale are reverse scored, and items may be grouped into subscales for glibness, untruthfulness, boredom susceptibility, manipulation, lack of guilt, poverty of affect, callousness, parasitic lifestyle, behavioral dyscontrol, lack of planning, impulsiveness, unreliability and failure to accept responsibility. Scores ranged from 9 to 46 and the CU subscale measure ranged from 0 to 5, with a mean of 1.45 ($SD = 1.50$).

Inventory of Callous and Unemotional Traits (ICU)

The ICU (Frick, 2004) consists of 24 items rated on a Likert scale ranging from 0 (“not at all true”) to 3 (“definitely true”). Reverse scoring is employed for 12 items on the scale, and subscales for traits of callousness, uncaring and unemotional may be calculated as well as utilizing total scores. The factor structure for the scale has been validated elsewhere, and shown to be reliable (Essau et al., 2006; Fanti, Frick & Georgiou, 2008; Kimonis et al., 2008). Scores in the present sample ranged from 15 to 65.

Sensitivity to Punishment and Sensitivity to Reward Questionnaire – Child (SPSRQ-C)

The SPSRQ-C (Colder & O’Conner, 2004) contains 48 items measured on a five-point Likert scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). It was designed to measure Gray’s hypothesized BAS, BIS and FFFS (Gray & McNaughton, 2000). Odd-numbered questions comprise the punishment subscale, and even-numbered questions comprise the reinforcement subscale. Total scores are used for each subscale,

with higher scores indicating increased sensitivity to reward or punishment. The scale has been validated and is considered a reliable measure (Dufey et al., 2007). Punishment sensitivity ranged from 72 to 112, while reward sensitivity showed a range of 35 to 92.

Contingency Response Rating Scale (CRRS)

The CRRS (Waschbusch & Willoughby, 2011) consists of 34 questions rated on a five-point Likert scale, ranging from 0 (“strongly disagree”) to 4 (“strongly agree”). The scale has been demonstrated to display good internal consistency and reliability (Yaniz et al., nd). Subscales may be calculated for reward sensitivity, punishment sensitivity and measure for CU traits. Higher scores indicate higher sensitivity for each subscale. The CRRS was found to have a mean of 6.65 ($SD = 3.00$) and ranged from 3 to 12. Subscale scores were calculated for punishment and reward on the basis of a priori specifications from a confirmatory factor analysis model. The reward scale ranged from 18 to 34 and punishment ranged from 6 to 23.

Disruptive Behavior Disorder (DBD)

The DBD measures DSM-IV symptoms of CD, ODD and ADHD. It consists of 45 questions rated on a four-point Likert scale ranging from 0 (“not at all”) to 3 (“very much”). The scale has been established to have appropriate validity and reliability (Pelham, Gnagy, Greenslade & Milch, 1992; Wright, Waschbusch and Bradely, 2007). It contains subscales for 1) ADHD: Inattention symptoms and hyperactivity / impulsivity symptoms, 2) ODD, and, 3) CD: Aggression to people and animals, destruction of property, deceitfulness or theft, and serious violation of rules. Scores for each subscale are calculated by counting symptoms endorsed by the parent, with ratings of “pretty much” or “very much” receiving a score of 1 and all other responses scored as 0. In

order to meet criteria for a clinical diagnosis, a score of 6 or more must be obtained on the ADHD subscales, 4 or more on the ODD subscale and 3 or more for the conduct disorder subscale.

Table 1

Demographic and Rating Scale Measures of Children

Measure	Mean / %	SD	Alpha
Age	9.45	1.70	
Gender (% Male)	66.7		
Ethnicity (%)			
Caucasian	20		
Hispanic American	60		
Asian American	5		
Other	15		
CPS	28.45	10.73	0.92
ICU	38.90	12.73	0.72
SPSRQ-C			
Sensitivity to Punishment	86.75	11.89	0.80
Sensitivity to Reward	65.45	15.55	0.89
CRRS			
Sensitivity to Punishment	13.65	5.38	0.83
Sensitivity to Reward	25.40	3.99	0.67
# of Symptoms Endorsed by Parents on DBD			
Conduct Disorder	1.70	2.34	0.62
ADHD-Hyperactive/Impulsive	6.40	2.85	0.32
ADHD-Inattentive	7.60	2.34	0.94
Oppositional Defiant Disorder	4.25	2.67	0.83

Notes: Values in tables are means and standard deviations except where indicated

Reinforcers

Video games appropriate for the child's age were used as the primary reinforcer for the study. An iPad tablet was selected for use as the medium for the delivery of reinforcers. Five child-selected video games available from the distributor's online library (Apple Store) were used in the preference assessment and progressive ratio phases for each child.

Punishers

Type I punishment (WN) consisted of repeated sequential bursts of 2s Gaussian white noise at 96 dB (SPL) with a rise and fall time of < 0.2 msec played at 10s intervals. An audio recording was created corresponding to the duration of each punishment condition, and delivered via playback from an iPhone® through computer speakers placed on a table in front of the participant. A class-two sound level meter was used to set the intensity of the delivered stimuli to ensure that it was consistent across participants. Type II punishment (Time out; TO) comprised the participant sitting in the corner of session room on a chair facing the wall, away from the testing area, and without access to the reinforcer. In both conditions, a desktop countdown timer was placed in front of the participant and set to the consequent interval of the condition.

Electrodermal Activity – Skin Conductance Response

A wireless EDA sensor (Affectiva™ Q sensor 2.0) with proprietary Ag-coated acrylonitrile butadiene styrene core electrodes was used to measure SCR. The sensor also measured electrode temperature that was used to control for possible environmental influences. The operating range of the sensor is up to 33ft and it has an on-board 2GB flash memory capacity for storage. Output of the sensor was monitored in real-time via a

class one Bluetooth 2.1 +enhanced data rate (EDR) connection to an appropriately equipped MacBook Pro (Mid-2012) laptop on a table next to the participant approximately 6ft away. Data were simultaneously recorded on the computer and the on-board storage; both data streams were sampled at a rate of 32 Hz.

Software and Recording

The wireless EDA wrist monitor was attached to the underside of the wrist at the distal forearm of the participant prior to the beginning of the procedure. Electrodermal data were initially viewed and evaluated using Affectiva's Q (2.01.56) and Q Live (1.02.314) software, and later processed and analyzed using MATLAB (R2013a), and the Ledalab package (Version 3.4.5; Benedek & Kaernback, 2010a, 2010b) designed for SCL analyses. Microsoft Excel (2011), IBM SPSS Statistics (19) and RStudio (3.0.2) were used to analyze psychometric, duration and frequency data as well as post-processed EDA output. The R package, elrm (1.2.2), was used to conduct exact logistic regressions (Zamar, McNeney & Graham, 2009). All session were video recorded using a Canon Vixia HF R300 digital video camera for purposes of timeline corroboration with the EDA recordings.

Design

A mixed design was used to compare response to Type 1 vs. Type 2 punishment both within-subject using single case research methods and between-subjects by comparing response across participants with varying levels of psychopathic traits.

Behavioral Assessment

A single-case, changing-criterion design across subjects was utilized to evaluate the intra-subject response to punishment. The study was conducted in two phases: 1) a

preference assessment to identify a preferred reinforcer, and: 2) a progressive ratio schedule (Hodos, 1961; Poling, 2010) of punishment designed to assess the cut-off point for willingness to engage in TO or WN in order to gain access to a demonstrated preferred reinforcer. To regain access to the reinforcer, the participant had to engage in the behavior of either withdrawal from contact with the reinforcer (TO), or enduring an aversive stimulus (WN). Thus, in a three-term-contingency framework (Malott, 2008) the antecedent would be the option to engage or not engage in type I or type II punishment; the behavior would be selecting and engaging in the punishment, and the consequence would be regaining access to the reinforcer. A 2 x 2 between subjects design was also employed to assess group differences on the dependent variables of frequency of punishment and electrodermal activity when exposed to punishment.

Clinical Measurement

A cross-sectional survey design was utilized to collect psychometric and demographic data from additional parents whose children were not included in the behavioral assessment.

Procedure

All participants were recruited via phone calls made from an office at FIU, with contact information obtained from the university's clinic database. The study was conducted in two phases: 1) an assessment of preferences for reinforcers (multiple stimulus without replacement), and 2) a progressive ratio task designed to assess the cut-off point for willingness to engage in TO or WN in order to gain access to a demonstrated preferred reinforcer (progressive ratio punishment) (see figure 1). Parents / guardians of

participants were asked to complete the ICU, CPS, SPSRQ-C and CRRS either prior to the procedure, or during the task in a separate room.

Figure 1: Illustration of baseline and punishment assessment procedure.

R+ represents the reinforcer, R- represents the reinforcer removed (time-out, TO), P+ represents the punisher (white noise, WN) and X represents the initial reinforcer time of 2 min.

Assessments took place in a well-lit, temperature controlled session room at a university research lab. All children were assessed for the use of a pacemaker, as well as hearing problems, the use of a WN machine for sleep or other purposes and the use of TO in the home. The university's internal review board approved the study, and both parent consent and child assent for participation were obtained. Participants who completed the behavioral assessment were compensated with \$10 iTunes™ or Amazon gift cards for every one (of three) procedures in which they participated.

Preference Assessment – Multiple Stimulus Without Replacement (MSWO)

Participants were assigned to either the TO or WN groups prior to the reinforcer assessment. After meeting with the parents in a waiting room, the child was escorted into the testing area and asked to do some light physical activity: running back and forth

across the room, bouncing a ball or doing jumping jacks. This was to facilitate the activation of the EDA response when the child first put on the sensor (Affectiva, n.d.). The stimuli were chosen by asking the participant to identify five games that they really enjoyed playing on the iPad®, and all children were able to provide a satisfactory list of games that were then obtained by the experimenter. After completing the physical activity, the child was then asked to sit at a table opposite the experimenter. The preference assessment was then carried out utilizing the five hypothesized reinforcers as well as the option for the punishment procedure, which was included to assess its possible reinforcing value. Specifically, children were first asked to choose the game from the list that they would like to play the most, and that they would enjoy playing for the longest time. This was repeated until a list of ranked preference was created from the games. Next, children were asked if they would like to sit in TO or listen to a loud noise in order to assess the possible reinforcing value of these stimuli; no child selected either TO or WN, and all subjects proceeded into the next experimental phase. Once selected and rated in order of desirability, the games were used in the baseline phase to establish their purported values as reinforcers, and the highest rated game (demonstrated preferred reinforcer / R^+) was used in the second phase of assessment. Finally, the child was asked to watch a 3-minute cartoon video with neutral emotional and intellectual content to ensure a stable EDA before beginning the assessment (Benedek & Kaernbach, 2010).

Progressive Ratio Punishment

The second phase started by measuring baseline preference to engage in the highest selected activity by presenting the child with the selected reinforcer and giving them 2 minutes to play, after which the game was paused and they were asked, “Would

you like to continue playing?” (R). If they elected to continue, they were allowed to play for an additional 2 minutes. At the end of the additional 2 minutes they were again asked if they would like to continue and given 2 more minutes if they elected to do so. Thus there were three chances for the child to play the game, and if the child elected to engage with the stimulus three times, the game was considered to be functioning as a reinforcer (R+). If the child stopped, the process would have been repeated from phase one, and if this occurred three times, the trial would have been discontinued; however, no child ever exceeded this threshold.

At the conclusion of the last baseline interval, the child was presented with the option to either end the session or to engage in the punishment procedure (TO = R-; WN = P+), after which they were allowed access to the R+ for another 2 minutes. After the interval for R+ access had again elapsed, the child was then re-presented with the choice to discontinue or to engage in R- / P+ again, but with progressively increasing durations of TO / WN. This was done up to six times: 2 minutes for the first, 4 minutes for the second, 6 minutes for the third, 8 minutes for the fourth, 10 minutes for the fifth and 12 minutes for the sixth, or until the child elected to discontinue, at which point the last R- / P+ was considered their break point. If they child elected to engage in all possible punishment conditions, the total time spent in the TO / WN condition was 42 minutes, with 18 minutes of access to the reinforcer. Each session ended in a reinforcer condition and the entire procedure was repeated three times in order to ensure reliability (DeLeon, et al., 2009). Gottschalk, Libby and Graff (2000) have shown that stimuli which had previously been demonstrated as being least preferred may function as reinforcers in subsequent circumstances; thus the pool of games available as reinforcers remained

consistent among trials in order to minimize possible confounds impacting internal validity. A frequency count was taken for each time the child elected to engage in TO or WN and the mean break points for each subject were calculated across repeated conditions

Analysis

Data collected from the electronic questionnaires were input into SPSS for analysis. Normality testing was conducted for each scale and relevant subscale scores. Total scores on the CPS were then used to stratify the sample into high CU and low CU groups, on the basis of exceeding a total score of 30 for membership in the high CU group (Maharaj et al., 2013). Additional analyses were conducted with stratification on the CU subscale of the CPS with equivalent results.

Frequency counts and duration of punishments were used to graph the trends for each participant in order to compare inter-subject differences across category membership. A 2 x 2 factorial design was also employed to assess between-subjects differences on frequency of punishment and electrodermal activity. Correlational analyses between CU traits and duration spent in TO / WN were also conducted. Exact logistic regression was employed to examine predictive validity of the punishment and reward scale scores, with group membership as the dichotomous outcome variable. Logistic regression relies on asymptotic large sample results (Zamar et al., 2009). Additionally, it has been demonstrated (Peduzzi, Concato, Kemper, Holford & Feinstein, 1996) that in situations with less than 10 events per variable being measured, the regression coefficients may be both negatively and positively biased. As it is not advisable to use logistic regression in small samples because of the possibility of biases

in the maximum likelihood estimator (Mehta & Patel, 1995), exact logistic regression (Zamar, et al., 2009) was used to determine the predictive validity of CU traits for frequency, duration and physiological reactivity in the behavioral task. Exact logistic regression utilizes the sufficient statistics for the covariates in the model and is able to withstand small sample sizes (Mehta & Patel, 1995).

Finally, EDA data were analyzed by examining group differences on the basis of baseline and final raw scores at the end of the trial. Continuous decomposition analysis (CDA, Benedek & Kaernback, 2010a) was then used to assess the tonic component of the signal and separate it from the phasic data in order to examine the SCR response at the individual level. Prior to processing, manual smoothing (see figure 2) using a gauss window was used to remove artifacts related to movement and other signal noise.

Figure 2. Example of adaptive smoothing applied to a 1-minute EDA sample. Time (s) is on the x-axis, and skin conductance response (SCR, μ S) is on the y-axis.

The CDA method was selected as it takes into account all of the data instead of only peak analyses. A model of the general SCR shape was utilized to create a phasic driver (see Figure 3), serving as a continuous measure of phasic activity (Benedek & Kaernback, 2010a). CDA was also used to generate a continuous measure of tonic activity.

Figure 3. Example of continuous decomposition analysis: Phasic signal in blue & tonic signal in gray. Time (s) on the x-axis, and skin conductance response (SCR, μS) is on the y-axis

V. RESULTS

Psychometric Data

The Q-Q plots and the K-S test was performed to assess the normality of scores. Results indicated that, with the exception of the index of rule violation on the CD subscale of the DBD ($D > 0.05$), all scales demonstrated normality ($D < 0.05$).

Total scores on the CPS were correlated with CU measures of the CRRS ($r = 0.75, n = 20, p < 0.001$), ADHD-I ($r = 0.67, n = 20, p < 0.01$), ADHD-H ($r = 0.47, n = 20, p < 0.05$), ODD ($r = 0.78, n = 20, p < 0.001$) and CD ($r = 0.89, n = 20, p < 0.001$). Additionally, CPS-CU scores were also positively correlated with CRRS-CU ($r = 0.55, n = 20, p = 0.01$), total ICU score ($r = 0.44, n = 20, p = 0.05$), ADHD-I ($r = 0.51, n = 20, p < 0.05$), ADHD-H ($r = 0.60, n = 20, p < 0.01$), ODD ($r = 0.72, n = 20, p < 0.001$) and CD ($r = 0.83, n = 20, p < 0.001$).

Behavioral Assessment

A subset of 16 individuals participated in the behavioral assessment. Using a cut-off score of 30 on the CPS, seven children were placed in the CP/CU group, and 9 in the CP-only group. Within the CP/CU group, four children were placed in the type I punishment condition (WN) and three children were placed in the type II punishment condition (TO). Within the CP-only group, six children were placed in the type I punishment condition, and three children were placed in the type II punishment condition. Analysis of Q-Q plots and the K-S test revealed that the dependent variables of time and frequency of punishment selection were not normally distributed, therefore non-parametric analyses were conducted. Kruskal-Wallis tests were performed for age, gender and ethnicity to determine differences in the frequency and duration of punishments

selected, and results indicated that none of the demographic variables significantly impacted the choice to engage in punishment ($p > 0.05$). Participant 2 in the WN condition selected the maximum number of punishment conditions for any individual on the first trial: a frequency count of six, the total number available, resulting in 42 minutes of exposure to type I punishment. The same participant also had the highest number of punishment selection overall: he elected every single exposure, resulting in a total frequency count of 18, with 126 minutes of total type I exposure for the entire experiment. Conversely, participant 15 in the TO condition had the lowest total overall frequency score: he never elected to engage in TO, preferring to discontinue each trial at the end of the baseline phase. Figure 4 provides a summary for the trials on the basis of group membership and punishment condition.

Figure 4. Summary of punishment selections for all participants

Children in the CP/CU group exposed to WN demonstrated the highest overall frequency of punishment selection ($\bar{x} = 8.50$, $SD = 6.95$), while children in the CP-only group exposed to time-out demonstrated the lowest overall punishment selection ($\bar{x} = 0.67$, $SD = 0.58$). CP/CU children in the TO group had an average selection of 2 exposures ($\bar{x} = 2.00$, $SD = 1.00$), while CP-only children in the WN group selected on average 1.33 exposures ($\bar{x} = 1.33$, $SD = 0.82$). Participant 1 had the highest overall score on the CPS (46), and selected a total of 9 exposures to WN, while participant 10 had the lowest CPS score (9), and selected punishment only once. Table 2 illustrates the CPS scores of each participant, their WN or TO status, the number of punishment exposures selected and their mean break points.

Table 2:

Participant CPS Scores, Punishment Frequencies and Mean Break Points

ID	Total CPS	Punishment Type	T1	T2	T3	Total	$\bar{x}$ Break Point
1	46	WN	6	2	1	9	3.00
2	43	WN	6	6	6	18	6.00
3	40	WN	2	0	0	2	0.67
4	36	WN	5	dc	dc	5	5.00
5	28	WN	1	0	0	1	0.33
6	25	WN	1	0	0	1	0.33
7	22	WN	1	0	dc	1	0.50
8	19	WN	1	1	1	3	1.00
9	15	WN	1	0	0	1	0.33
10	9	WN	1	0	0	1	0.33
11	38	TO	1	0	0	1	0.33

12	37	TO	2	0	0	2	0.67
13	36	TO	3	0	dc	3	1.50
14	29	TO	1	0	0	1	0.33
15	24	TO	0	0	0	0	0.00
16	22	TO	1	0	0	1	0.33

dc = Discontinued

Mean break points between groups and across trials were also calculated. Results indicated that the highest break point occurred under the WN condition during the first trial ($\bar{x} = 2.50$, $SD = 2.22$) and the second highest during trial one of the TO condition ($\bar{x} = 1.33$, $SD = 1.03$). By comparison, the lowest between-groups break point occurred during the second trial under the WN condition ($\bar{x} = 0.89$, $SD = 1.96$). In order to assess the possible differences between groups on the basis of the type of punishment, a Kruskal-Wallis test was performed (see table 3). The results indicate that there was a significant difference, $\chi^2(1, N = 10) = 6.26$, $p = 0.01$, $\eta^2 = 0.70$, in choosing type I punishment between CP/CU ($H = 8.25$) and CP-only ($H = 3.67$) children. There was also a significant difference, $\chi^2(1, N = 10) = 5.64$, $p < 0.05$, $\eta^2 = 0.63$, between the amount of time (in minutes) spent in type I punishment for the CP/CU group ($H = 8.25$) and the CP-only group ($H = 3.67$). However, a between groups comparison showed no significant difference ($p > 0.05$) in the frequency or duration of type II punishment between CP/CU children ($H = 2.33$) and CP-only children ($H = 4.67$).

Table 3

Kruskal-Wallis Comparing Selection of Punishment Between CP/CU and CP-only

Punishment	χ^2	Mean Rank	p	% Variance
	$N = 10$	(CP/CU, CP-only)		Accounted
Frequency				
Type I (WN)	6.26	8.25, 3.67	0.01	69.55%
Type II (TO)	2.63	4.67, 2.33	0.12	-
Duration				
Type I (WN)	5.64	8.25, 3.67	0.02	62.67%
Type II (TO)	2.63	4.67, 2.33	0.12	-

Notes: Percentage of variance accounted only reported for significant differences.

A within-groups comparison was also conducted to determine possible differences on the selection of types of punishment. Within the high-CPS group, no significant difference ($p > 0.05$) was found between the frequency of selecting type I punishment ($H = 5.13$) and type II punishment ($H = 2.50$); within the low-CPS group, no significant difference ($p > 0.05$) was found between selecting type I punishment ($H = 5.67$) and type II punishment ($H = 3.67$). These results indicate that the willingness to engage in punishment procedures did not depend on the type of punishment (type I or type II). In order to consider any overall difference between a combined measure of punishment and children with high and low CPS scores, a Kruskal-Wallis was performed. Results indicated a significant difference, $\chi^2(1, N = 16) = 7.70, p < 0.01, \eta^2 = 0.51$,

confirming a difference between the overall frequency of punishment selection on the basis of CP/CU ($H = 12.00$) or CP-only scores ($H = 5.78$), with the CP/CU group selecting punishment more often, and CU traits accounting for approximately 51% of the variance. Finally, comparisons on the total time spent in punishment also revealed a significant difference overall ($\chi^2(1, N = 16) = 8.31, p < 0.01, \eta^2 = 0.55$), with CP/CU children willing to spend more time ($H = 12.21$) engaged in punishment than CP-only children ($H = 5.56$). Here, CU traits accounted for approximately 55% of the variance.

To explore the association of demonstrated performance on the behavioral task with parent-reported measures of psychopathy, exact logistic regression was utilized. Results indicated that the frequency of punishment selected was significantly associated with CPS-group membership, $\beta = 1.14, p = 0.01, CI [0.07, 4.09]$; a higher frequency of punishment selection indicated membership in the high-CPS group. The total time spent in punishment was also significantly associated with the dichotomous high- or low-CPS group membership, $\beta = 0.67, p = 0.01, CI [0.16, 1.96]$. Similarly, longer durations of punishment also indicated membership in the high-CPS group. However, elevated CU traits measured by the CPS subscale were not found to be significantly associated with either the frequency of selected punishment, or the total time spent in punishment. The measure of punishment sensitivity on SPSRQ-C was positively associated with membership in the elevated CPS score group, $\beta = 0.10, p = 0.001, CI [0.01, 0.23]$; however the beta weight indicated a relatively small influence, and this suggested that other contributing factors may influence psychopathic traits.

Non-parametric correlation analyses were conducted, revealing that SPSRQ-C sensitivity to reward and punishment scores were not correlated with punishment

selection measures ($p > 0.05$), though this may have been as a result of the small sample size (see figure 2). Despite the small sample, regression models using sensitivity to reward and punishment scores for the prediction of frequency and duration of punishment were fitted, but not found to be significant ($p > 0.05$). Sample size restrictions also prevented multivariate model analyses, thus more complex models could not be evaluated.

0.30) in the type I condition between low-CPS ($H = 7.17$) children and psychopathy-prone children ($H = 3.00$). However, results did not indicate a difference between former ($H = 4.00$) and latter group ($H = 3.00$) in the TO condition. No significant difference was found during baseline between the high- and low-CPS groups, ($p > 0.05$); however, when compared on scores of the CU subscale of the CPS, results indicated that CP/CU children ($H = 11.83$) demonstrated significantly higher EDA activity ($\chi^2 (1, N = 16) = 3.01, p < 0.05, \eta^2 = 0.20$) than their CP-only counterparts ($H = 6.50$), with CU traits accounting for approximately 20% of the variance. Figure 7 summarizes baseline SCR activity prior to access of the first reinforcer.

Figure 6: SCR Sensitivity to the presentation of type I and type II punishment. Error bars represent standard error.

Figure 7: SCR Sensitivity to the presentation of reinforcer
Error bars represent standard error

Spearman's rank-order correlational analyses revealed a significant inverse relationship between the frequency of punishment selected and the EDA after punishment exposure, $r_s(16) = -.51, p < 0.05$. Furthermore, significant inverse relationships were found between punishment exposure and CPS total scores ($r_s(16) = -.60, p = 0.01$) as well as between CP/CU and CP-only groups ($r_s(16) = -.53, p < 0.05$).

CDA analyses were conducted on EDA data for all participants in the behavioral trials. With the exception of participant 2 who entered all the punishment conditions, the highest frequency of punishment exposure occurred in the first trial for all other participants and thus, analysis of EDA data focused on those trials.

Participant 1 – CP/CU & WN

The signal for participant one contained a lot of noise and adaptive smoothing could not be performed. Manual smoothing was attempted with a gauss window (width = 8), but no significant change was found. However, the RMSE (0.00) indicated a good model fit for the data, with an error of 0.01. Skin conductance reached a peak of 5.86 μS ; because of the noise, a low threshold of 0 μS was reported.

Figure 8: Participant 1 – CDA

Participant 2: CP/CU & WN

Participant 2 initially demonstrated a relatively high SCR, which dropped off sharply at around 10 minutes into the trial. His overall measure ranged from 0 μS to a peak of 9 μS . Model fit was acceptable at RMSE = 0.00, error of 0.01.

Figure 9. Participant 2 – CDA

Participant 3: CP/CU & WN

All three sessions for this participant were recorded into the same file, so data were downsampled to 8Hz when importing into Ledalab for analysis. Model fit was appropriate, RMSE = 0.00, error of 0.02. The child exhibited an SCR range of 0.00 μ S to 3.76 μ S.

Figure 10. Participant 3 – CDA

Participant 4: CP/CU & WN

Participant 4 only completed the first trial of the study, and was not able to make it back. Manual smoothing was performed at a gauss window of width 8. CDA analysis was associated with a good model fit at RMSE = 0.00, with an error of 0.01. SCR ranged from 0.78 μ S to 9.58 μ S.

Figure 11. Participant 4 – CDA

Participant 5: CP/CU & TO

Again, all three sessions for this participant were recorded into the same file, and results are presented here. Manual smoothing was applied (gauss window of width 8), and the results demonstrated good model fit (RMSE = 0.00) error of 0.02. SCR ranged between 0.00 μS and 8.52 μS

Figure 12. Participant 5 – CDA

Participant 6: CP-Only & WN

Adaptive smoothing was applied to participant 6's data. Results from the model indicated a good fit, with RMSE = 0.00, error of 0.00. SCR ranged between 0.00 μS and 7.09 μS .

Figure 13. Participant 6 – CD

Participant 7: CP-Only & WN

Data for participant 7 were adaptively smoothed resulting a better signal representation, and processed at 32Hz. Results indicated good model fit (RMSE = 0.00, error = 0.00). SCR ranged from 0.50 μ S to 1.7 μ S.

Figure 14. Participant 7 – CDA

Participant 8: CP-only & WN

Data again did not conform to adaptive smoothing, so manual smoothing was again attempted with a gauss window of the same width. A minor improvement in the signal was visually detected. Model fit was appropriate (RMSE = 0.00), with an error of 0.01. The SCR range was 0.84 μ S to 7.78 μ S.

Figure 15. Participant 8 – CDA

Participant 9: CP-only & WN

Manual smoothing was performed with a gauss window of width 8. SCR ranged from 0.02 μS to 5.10 μS . Good model fit was indicated by an RMSE of 0.00 (error = 0.01).

Figure 16. Participant 9 – CDA

Participant 10: WN & CP-Only

EDA signal did not meet the criteria for adaptive smoothing, so manual smoothing with a gauss window width of 8 was performed. Results from the model indicated a good fit, with RMSE = 0.00, error of 0.02. SCR ranged between 0.00 μS and 7.22 μS .

Figure 17. Participant 10 - CDA

Participant 11: TO & CP/CU

Manual smoothing was performed with a gauss window of width 8, and CDA performed. Results indicated good model with (RMSE = 0.00, error = 0.00). Minimum SCR was 0.00 μS , and maximum SCR was 2.83 μS . Data were sampled at 32Hz.

Figure 18. Participant 11 – CDA

Participant 12: TO & CP/CU

Data confirmed to adaptive smoothing, and the model fit was found to be appropriate, with an RMSE of 0.00 and an error of 0.00. The maximum SCR was 3.75 μS and the minimum SCR was 0.21 μS .

Figure 19. Participant 12 – CDA

Participant 13: TO & CP/CU

Participant 13 had a maximum SCR of 6.41 μS and a minimum SCR of 0.00 μS . Adaptive smoothing could not be applied, so manual smoothing with a gauss window of width 8 was performed. Results indicated a good model fit, with an RMSE of 0.00 and an error of 0.02.

Figure 20. Participant 13 – CDA

Participant 14: TO & CP-only

Model fit for participant 14 was demonstrated to be appropriate, with an RMSE of 0.00 and an error of 0.00. Data conformed well to adaptive smoothing and were sampled at 32Hz. SCR values ranged from 0.29 μS to 1.04 μS .

Figure 21. Participant 14 – CDA

Participant 15: TO & CP-only

The Root Mean Square Error (RMSE) was 0.00 indicating good model fit, and the data conformed to adaptive smoothing. Skin conductance for the session was between 0.34 μS and 2.59 μS .

Figure 22. Participant 15 – CDA

Participant 16: TO & CP-only

Finally, participant 16's data demonstrated good model fit, with an RMSE of 0.00 and an error of 0.00. SCR ranged from 0.02 μS to 12.80 μS . Manual smoothing was performed with a gauss window of width 8, as the data did not meet criteria for adaptive smoothing procedures.

Figure 23. Participant 16 – CDA

Selected Qualitative Vignettes

Participant 1 was a 9-year-old girl who had the highest overall CPS score (46) and spent the second highest amount of time exposed to the punishment condition (WN). During the trials, she appeared quite happy: shouting and laughing, and did not seem bothered by the aversive stimulus. She continually spoke while the task was going on, even after redirection from the experimenter. On her last session, she stated that she had not been allowed to use her personal iPad recently because of misbehavior, which may have influenced her continued responding.

Participant 2 was a 9-year-old boy with the second highest CPS score in the experiment (43). He elected to be exposed to the maximum number of WN conditions in every trial, and remarked that he did not particularly mind the noise. His affect appeared pleasant; he smiled and was helpful. During punishment exposure, he would lean back and forth in his chair, but never tried to escape the stimulus by covering his ears. He would sing to himself while playing the game, and when the first session ended, he asked if he could immediately go on to the second trial. On his second trial during the 8-minute punishment phase, he stated that he had to make the best out of the two minutes he had to play the game, while on the last session, he spoke to himself about “keeping it together.”

Participant 3, another 9-year old female with a high CPS score, appeared very indecisive during baseline, opting to reselect her games on the first and second trials. She too was in the WN condition and after the first presentation she elected to discontinue. For each subsequent trial during baseline, she repeatedly asked if she would have to hear the noise again in order to continue playing, and stated that if she had to, she would stop

playing immediately. However, she did appear to realize that she could switch games and continue to play, thereby enabling her have access to more than one reinforcer per trial.

The sixth participant (CP-only) also appeared indecisive when choosing his reinforcer; he returned to baseline twice, and prior to the final selection requested a bathroom break. However, he did not seem to quite understand the task until the third baseline. This seemed to perseverate into the punishment trial (WN), although he elected to continually be presented with the aversive, until the second to last exposure, when he decided to stop at approximately 7 minutes into the stimulus presentation. During the presentation, he displayed mostly flat affect, and engaged in distracting or avoidant behavior, attempting to cover his ears after being instructed not to, and tapping out a rhythm on his leg during the presentation of the WN. He only completed the first trial, and subsequently withdrew from further participation.

The tenth participant was a 7-year-old male, who claimed that he was left handed, but proceeded to write his name with his right hand. As such, the EDA sensor was attached to his left hand, and he afterwards played his selected games with his right hand. During the first exposure to WN on trial one, he covered his eyes at the sound of the blast and appeared distraught. The experimenter asked twice if he wanted to stop, but he refused. He regained access to the reinforcer, but subsequently did not elect to be exposed to the aversive at the conclusion of the reinforcement period.

Participant 13 initially elected to enter TO three times on her first trial. However, toward the end of the trial, she appeared frustrated at the prospect of having to repeat the procedure. During the first phase of the second session, she returned to baseline, once to reselect the same game as the preferred reinforcer, and then a second time where she

proceeded to choose what had been her second choice for the previous two selections. She did not select TO on her second trial, and also elected not to continue onto the last session. With the exception of participant 13, most TO procedures were not particularly eventful, and the children did not show any distinct signs of discomfort beyond situational expectation.

VI. DISCUSSION

The purpose of the current work was to determine whether or not stimuli that traditionally function as aversive or punishing do so in the same way for children with CP-only as they do for children with CP/CU.

Main Findings

The findings support previous research in areas examining changes in reinforcement with CP/CU children (Fisher & Blair, 1998), the applicability of Gray's model of RST in examining psychopathic traits in children (Gray & McNaughton, 2000; Torrubio et al., 2001) and the physiological responses to aversive stimuli in children with psychopathic traits (Want et al., 2012). However, differences in the responses of CP/CU children to TO procedures were indicated and are in contrast to previously reported results (Haws & Dadds, 2005).

Selection of WN / TO

Children with elevated levels of psychopathic traits demonstrated a higher frequency in selecting WN than their low-trait counterparts, suggesting a willingness to engage in both more and longer sessions of type I punishment to regain access to the reinforcer. However, no significant difference was found in the selection of type II punishment between high-CPS and low-CPS children. Additionally, no significant difference was found between the selections of the type of punishment on the basis of group membership; this result implies that there appears to be homogeneity in the response to punishment based on the presence or absence of psychopathic traits. When considering the response to punishment as a whole (type I and II combined), psychopathy-prone children indicated a significantly higher rate of willingness to listen to

the WN or sit in TO if it meant that they would be able to once again play their chosen game. These results are consistent with the findings of O'Brien and Frick (1996) who illustrated a reward dominant response style characterizing children with psychopathic features in comparison to children with CP-only and CP-anxiety features. As such, reinforcement may be more effective in equalizing the effects of intervention for both groups. It is, however, possible that the punishment condition was actually functioning as an escape from the schedule of positive reinforcement (Azrin, 1961; Dardano, 1974), or that the schedule did not exert sufficient control (Zimmerman & Fester, 1964). For example, if the reinforcing value of the game decreased, it may have been possible though unlikely, that the punishment condition was selected in order to escape continued playing. It may also have been possible, but again unlikely, that the change in stimulus from the game to the type I or type II punishment could have functioned as a reinforcer (Appel, 1963). However, video games used in the procedure specifically because of their given their demonstrated high reinforcing value, and thus thought to outweigh any possible counter effects of reinforcement associated with the punishment conditions. Indeed, neurocognitive evidence supports the use of video games as reinforcers, and Koepp et al. (1998) have identified striatal dopaminergic discharge occurring when playing a video game, relating to activation of the reward circuits of the brain. Finally, Falk (1971) points out that engagement with the punisher might actually be linked with the reinforcer: provisioned by the contingency, but not manipulated by the schedule.

Differences between high- and low-scoring CPS children were not reflected in the selection of TO's. Contrary to predictions, the mean scores for selection of type I punishment were actually higher for both CP/CU ($\bar{x} = 8.50$, $SD = 6.95$) and CP-only ($\bar{x} =$

1.33, $SD = 0.82$) children, than in the type II punishment condition, where scores were lower for both CP/CU children ($\bar{x} = 2.00$, $SD = 1.00$) and CP-only children ($\bar{x} = 0.67$, $SD = 0.58$). This is particularly interesting given the nature of the punishment involved: where type I punishment involved the introduction of a demonstrated aversive stimulus, the behavior of psychopathy-prone children seemed not to be affected, and they continued to select the punishment so that they could continue to play their game. However, when the appetitive stimulus was removed under the type II condition, the effectiveness of the punishment became apparent; no significant difference was present between CP-only and CP/CU children. Hence, TO was demonstrated to function as an effective punisher for both CP/CU and CP-only children. This is in contrast to work done by Hawes and Dadds (2005), who demonstrated conflicting effectiveness when using TO as a disciplinary procedure between CP/CU children and CP-only children, where the former group were less responsive to the procedure, as well as displayed flatter affect. Indeed, the implications for these results are not only the delineation that positive punishment procedures may be ineffective in CP/CU groups, but that TO may be a very effective means for the modification of behavior. Furthermore, this may suggest that TO can be effectively deployed as a punishment strategy in settings such as the classroom in order to manage / suppress problem behavior effectively, without having to cater specifically to a subset of CP/CU children within the group. Findings from Vogel-Sprott and Racinkas (1969) seem to imply that the withdrawal of reinforcement, in the form of money on a consistent reward schedule, is more effective than the application of punishment, and this is congruent with the current findings. This implication may be substantial, as teachers may be trained on efficient TO procedures and be able to

effectively apply them to a large heterogeneous group. Reinforcers in the school setting may be readily available in the form of highly preferred activities, such as recess, and TO procedures may be applied via the removal from such activities.

Long-term studies on the effectiveness of utilizing rewards for appropriate behaviors as well as TO procedures for administering discipline have found that these methods have been successful in modifying behavior (Long, Forehand, Wiersen & Morgan, 1994). Children who were initially noncompliant showed comparatively similar outcome measures for behavior modification to typically developing cohorts on delinquency, parental relationships and other behavioral measures (Long et al., 1994). Indicated by the results of the current study, if CP/CU children are amenable to TO procedures for the modification of behavior, and follow a similar trajectory as noncompliant children, it would be reasonable to assume that the procedure should have long-term effectiveness. Lerman and Vorndran (2002) also point out that in lieu of severe punishment, effects are not retained after the punisher is removed. This is especially important in relation to the type of punishment being used, as severe type I punishment may be harmful to the individual, as well as result in negative behavioral outcomes such as aggression (Azrin, Hake & Hutchinson, 1965). Even though the use of corporal punishment such as spanking may have been found to have limited negative short- or long-term effects, the use of a TO procedure is considered more favorable for reducing objectionable behaviors (Saadeh, Rizzo & Roberts, 2002). The sample used in the present study comprised clinic-referred children who were previously seen at an intensive STP camp where TO was utilized as one form of punishment, as well as other children recruited from families seen at the university for behavior problems. Time-out techniques

were taught to the parents, and reported as being used in the home. This may have led to an established learning history where the removal of reinforcement was an effective form of type II punishment, thus leading to a conditioned predisposition to avoid such a situation. By comparison, screening revealed that only one child had any previous history with WN, and this was with a machine that produced a soothing tone for sleep purposes. The tone produced by such machines is functionally different from the tone generated in the punishment condition, and thus the stimulus used in the study was likely to be novel. As such, the WN may have been viewed as a more appealing option as punishment, given that it has been demonstrated that CP/CU children show a preference for novel stimuli (Barry et. al., 2000), and this would confirm assertions of a hypoactive BIS. Finally, parents trained on the effective administration of TO techniques may also be able to use them within the home with similar results. Evidence has suggested that behavioral changes in the home resulting from the use of TO to control disruptive behavior have been shown to be consistent over the long term (Lavigne, Gershoff, & Peterson, 1997). This is of marked importance, as the procedure does not depend on the administration of some other stimulus, but the contingent removal of access to a demonstrated preferred stimulus already present in the environment. Thus, less effort may be needed to apply the technique since no new resources are necessary.

Frequency and Duration of Punishment as a Predictor

As the sample size was small ($N < 30$), exact logistic regression models (Zamar et al., 2009) were fit to the data in order to evaluate the associations of the total time spent in punishment, and the frequency of selected punishments, with psychopathy. Scores above 30 on the CPS were used to create a dichotomous group (Maharaj et al., 2013) of

high and low psychopathy-prone children. The results for frequency ($\beta = 1.14, p < 0.01$, CI [0.07, 4.09]) and duration ($\beta = 0.67, p < 0.01$, CI [0.16, 1.96]) indicate that both measures successfully predict group membership. Psychopathy-prone children were more likely to elect to engage in punishment, and to spend more time in the punishment condition than their CP-only counterparts. This willingness to engage in punishment supports the case for an overactive BAS being responsive to punishment, and an underactive BIS as a result of the failure to inhibit behavior in the presence of an aversive stimulus or the removal of an appetitive one (Corr, 2010; Gray & McNaughton, 2000; O'Brien & Frick, 1996). Since the contingencies for punishment and reward were clearly outlined by the procedure, it is conceivable that an alteration in the response set between selecting to engage in punishment or not was within the realm of the child's ability (Blair et al., 2001). Thus, perseveration of the punishment-selection response should not have been mediated by a misunderstanding of the situation, but rather controlled by the motivation to regain access to the reinforcer. Hence, it is unlikely that the child repeatedly reselected punishment in order to regain access to the reinforcer owing to a misunderstanding of the contingencies.

Sensitivity to Punishment as Predictor

Parent-reported scores on the SPSRQ-C for the child's sensitivity to punishment and reward were assessed using exact logistic regression models. Support for the sensitivity of the BIS to punishment was substantiated, as the sensitivity to punishment score successfully predicted elevated psychopathic traits ($\beta = 0.93, p < 0.01$, CI [0.10, 5.42]). However, no support was found for activity of the BAS as indexed by scores on the sensitivity to reward scale. Additionally, scores on the sensitivity to punishment and

sensitivity to reward scales of the SPSRQ-C were not demonstrated to predict actual performance on the behavioral task, nor were they correlated with performance ($p > 0.05$). While parental interpretations of child sensitivity may potentially be biased against their child's actual behavior, the discrepancy might be attributed to insufficient power on the basis of a small sample size. In a recent study by Briggs-Gowan et al. (2014), parental ratings of punishment insensitivity were indeed related to performance on a behavioral task that demonstrated impairment in reinforcement learning on the basis of elevated insensitivity to punishment scores. Another possibility for the discrepancy may have been the inclusion of items that reduced the accuracy of the SPSRQ-C scales, and future research may focus on a subset of the items in order to increase subscale score predictive validity.

Physiological Profile

Analyses of EDA are congruent with previous findings that indicate a hyposensitive SCR response to both types of punishment in children with psychopathic traits (Fung et al., 2012; Wang et al., 2012). Children with psychopathic traits ($H = 5.71$) had a significantly lower SCR after being exposed to punishment ($\chi^2(1, N = 16) = 4.26, p < 0.05, \eta^2 = 0.28$) in comparison to children displaying CP alone ($H = 10.67$). The lowered EDA response in the psychopathy prone group is consistent with a weak BIS as indicated by Fowles (2000) as well as Gray and McNaughton (2000), resulting in a failure to inhibit behavior in the presence of a contingent aversive stimulus or the removal of a reinforcer. Additionally, the inverse relationship between post-punishment EDA and the frequency of punishments selected ($r_s(16) = -.51, p < 0.05$) also supports the hypothesis of a weak BIS: as an inverse relationship was demonstrated between CPS

total scores and EDA activity after punishment exposure ($r_s(16) = -.60, p = 0.01$), it is implied that higher levels of psychopathic traits may be associated with lowered EDA which in turn would indicate a weak BIS, and thus leading to an insensitivity to punishment.

Interestingly, no difference between groups was observed in the anticipation of the first onset of punishment, but instead only after being exposed to punishment. This would seem to indicate that the anticipation of punishment was not sufficient to have an effect on the child, but that actual exposure to punishment was related to the observed differences. The finding implies the usefulness of the current procedure for assessing individual sensitivity to punishment, particularly because behavioral techniques that utilize punishment contingencies applied across children without consideration for their personal susceptibility. The results of the physiological assessment also concur with the results from the behavioral evaluation with respect to the difference in sensitivity to TO and WN; while a clear difference was found in the sensitivity to punishment, indicating a suppression of the BIS in psychopathy-prone children, the difference was only apparent in the WN condition ($\chi^2(1, N = 16) = 4.55, p < 0.05, \eta^2 = 0.30$). Thus, TO seems to have affected both groups equally, and the physiological evidence appears to corroborate the observed behavior. The data add further support for the efficacy of TO as an applicable treatment for psychopathy-prone children, but also substantiates the disuse of punishment with aversive stimuli (Saadeh et al., 2002) as it appears that it does not have the desired effect of suppressing behavior.

Support for a link between CU traits and a hyperactive BAS (Gray & McNaughton, 2000) was also substantiated by the physiological measures, as CP/CU

children ($H = 11.83$) demonstrated significantly higher EDA ($\chi^2 (1, N = 16) = 3.01, p < 0.05, \eta^2 = 0.20$) at the onset of interaction with the reinforcer than CP-only children ($H = 6.50$). The elevated activity in anticipation of the reinforcer is congruent with the reward dominated response style suggested by O'Brien and Frick (1996), indicating that CP/CU children are more likely to demonstrate active movement toward a reinforcer, in comparison to CP-only children. Coupled with the suppression of the BIS, this suggests that CP/CU children will continue to perform behaviors in order to gain access to a reinforcer, even if punishment is contingent on the behavior. CDA profiles for each child illustrate the differences between the CP/CU group and the CP-only group, wherein the CP/CU children showed an overall lowered SCR score on the behavioral task during punishment, but a higher SCR score prior to reinforcement. This is consistent with the findings of Colder and O'Conner (2004), who determined that EDA might show an increase because of the novelty of the stimuli. They also found a general decline in EDA across a behavioral task, especially for children demonstrating hyposensitivity to punishment, but no waning in EDA during preliminary reinforcer exposure for children demonstrating hypersensitivity to reward (Colder & O'Conner, 2004), a finding consistent with the current results.

Discontinuation and Delay discounting

The behavioral task was conducted using a repeated measures trial, and with the exception of participant 2, all children showed a decreasing willingness to engage in type I and type II punishment. The highest selection of punishment for each child occurred in the first trial, and with the exception of three children, no punishment was selected by the last trial. A higher frequency of punishment selection for CP/CU children in the WN

condition ($\bar{x} = 8.50$, $SD = 6.95$) suggests that either the novelty of the stimulus, or the lack of finding the noise aversive, may have indeed contributed to continued selection, as the rate of selection for CP/CU children was considerably lower in the TO condition ($\bar{x} = 2.00$, $SD = 1.00$). If the continued selection of WN was based on a lack of history with the stimulus or its novelty, then this may have worn off as the trials progressed. As such, the BIS which is implied as being sensitive to novel stimuli (Carver & White, 1994), may have been activated, resulting in an inhibition of willingness to engage in punishment in order to regain reinforcer access. Unwillingness to continually engage in punishment may also have been the result of delay discounting (Critchfield & Kollins, 2001); the task was designed to have a progressive increase in the amount of punishment necessary in order to regain access to the reinforcer. This increase in time may have resulted in the value of the reinforcer may have been progressively reduced. Further, after the first trial the individual would have had experience with the delay and may have determined that it was not worth the effort required in order to continue to play the game.

Another contributing factor to the decline of punishment selection across trials may have been the child's realization that if they elected to discontinue, they would be allowed a break and then could continue on in a new trial. This would not only lead to avoidance of the punishment procedure, but also the chance to select a new game to play. Further, the same game could be selected again and as such, they may have decided to forgo the punishment trial. However, discontinuation of the trial would not lead to immediately restarting at the preference assessment phase, but instead would result in a break period during which no access to any games was provided. Additionally, the time for the break (10 minutes) was also coupled with the time taken to re-watch the video (3

minutes), which summated would be 13 minutes; thus, even electing to discontinue punishment on the sixth selection (12 minutes) would not result in quicker access to any reinforcer.

Limitations

While many of the findings in the current study are congruent with the previous literature (Fung et al., 2005; Gray & McNaughton, 2000; O'Brien & Frick, 1996), a number of possible limitations may have tempered the results, and as such should be considered. One such limitation of the current study may have been the reutilization of the five reinforcers for each repeated measures trial. An attempt was made to hold as many independent variables consistent across trials, and while the utility of this approach has been shown to have validity (Piazza et al., 1996; Tarvaella et al., 2000), it may be possible that the introduction of a revised reinforcer selection for each repeated measure may produce a stronger establishing operation (Ciccone, Graff & Ahearn, 2006). Further, if a child were able to select a different reinforcer for each re-access to reinforcement within a trial, the possible effects of delay discounting may be mediated, as the strength of a new reinforcer would theoretically be comparatively higher as a result of satiation. While internal validity may be decreased because of the introduction of a new stimulus, external validity could possibly be increased, as in a typical home environment the opportunity to select from a multitude of reinforcers based on preference may not be subject to such artificial restrictions.

A further concern that may be of significance applies to the use of preference assessments. When reinforcer preference assessments are used, there is the possibility that the resulting variation on consequences may be reinforcing (Fisher, Thompson,

Piazza, Crosland & Gotjen, 1997). Hence, if the ability to make a choice during the baseline phase provided a stronger reinforcer than the continual playing of a selected game, the child may have preferred to discontinue the trial in order to gain access to the re-selection process during baseline. While this may be unlikely, half of the subjects in the behavioral trial repeated their baseline selections before moving on to the punishment phase of the experiment; out of these children, three repeated their selection during trial two or trial three. While the ability to reselect a game during this phase was an attempt to establish the reinforcing properties of a game, the capacity to alter the consequences of the trial may have inadvertently become reinforcing. Further the ability to engage in actually making a choice may itself be reinforcing (Fisher et al., 1997) and as such, reselection during baseline or the discontinuation of a trial to have the opportunity to make a choice again may also have demonstrated reinforcing value. If the strength of this hypothesized reinforcer was greater than that of the game, it is possible that the selection of punishment within a trial may have been compromised.

Another possible area of concern may be the operationalization of type I punishment, as the condition also inherently contained characteristics of type II punishment: the removal of the reinforcer. While this was considered to be purposive and practical, it is possible that the removal of the reinforcer may have confounded the effect of the type I / aversive stimulus. It might also have been possible that the aversive stimulus functioned as a distraction while the reinforcer was removed, and this may possibly provide a partial explanation for the demonstrated equivalence of the type II / TO condition. Finally, the restrictions resultant from a small sample size and uneven groups were evidenced by the inability to evaluate multivariate regression models.

Although the predictive validity of individual variables were assessed, a comprehensive multiple regression could not be evaluated as there were insufficient observations for each variable. The possible predictors of CD, ODD, ADHD as well as the number of punishments selected may be useful in evaluating a continuous variable of psychopathic traits, as an overlap of constructs is implied, which is supported by previous research (Abramowitz et al., 2004; Becker et al., 2013; Dadds et al., 2005; Lynam, 1997; Waschbusch et al., 2004). Additionally, scores of parent-reported child sensitivity to reinforcement and punishment were not found to predict performance on the behavioral task, but this is inconsistent with findings of previous research (Briggs-Gowan et al., 2014; Hawes & Dadds, 2005). These discrepancies may be a results of the shortcomings inherent with a small size, and while the current approaches allows for in-depth considerations of each subject, the approach precludes the ability to effectively examine differences at a group level.

Future Directions

Future research utilizing extensions of the current paradigm may benefit from several improvements, or alternate courses of direction. One possible starting point may be an attempt to replicate the findings using a similar single-case approach with other children, which would allow for a continuation of meticulous evaluation at the level of the individual. The ability to predict contributions of the variables of interest at the group level could then be attempted by increasing the size of the sample to sufficient quantities that would enable evaluation via group statistics. Any generalizability of the current data must be made with extreme caution, as the sample cannot be demonstrated to be representative of the wider population. Future research may thus attempt to utilize an

increased number of participants stratified to meet population characteristics. A further extension to increasing the number of participants would also be the inclusion of typically developing children in order to evaluate possible differences that may be a result of conduct problems alone. It is possible that the effects observed in the current sample may not hold for typically developing children, and the broad application of TO procedures as recommended may not be justified for use with these children. If the application of TO was found to be inappropriate, or resulted in a difference in effectiveness with typically developing children, it would also have implications for group treatment such as in a classroom setting.

A modification of the task to include additional preference assessments prior to each repeated measures trial would allow the child the opportunity to select a new set of hypothesized reinforcers, possibly resulting in the maintenance of an elevated reinforcer magnitude. Additionally, the stimuli selected as reinforcers may also be altered to include video games on different gaming platforms, or other topographically distinct stimuli. This would enable generalizability across reinforcers, as video games may not always be functionally appropriate. A replacement stimulus for WN may also be selected; it has been demonstrated that air puffs provide a sufficient alternative to WN for startle probes, and it is possible that it may also provide a less aversive substitute while retaining the desired effect (Lissek et al., 2005). Finally, further physiological measures may be incorporated to examine the impact of other neurological systems that may also contribute to reinforcement sensitivity, such as the cortical areas outlined by Garavan et al. (2002) and Cherbuin et al. (2008). Incorporation of these measures may benefit early

identification of psychopathic propensity prior to the ability to observe performance on behavioral tasks.

Summary

The present study examined the impact of punishment on children exhibiting psychopathic traits, within the constructs of the BIS, BAS and FFFS as outlined by Gray and McNaughton (2000). Utilizing a dynamic systems approach, children previously assessed as displaying conduct problems were evaluated. Multiple measures such as psychometric parent-reports including psychopathy, punishment sensitivity and callous and unemotional traits were examined; along with performance on a behavioral task designed to assess response to hypothesized punishment conditions, and physiological measures in the form of electrodermal activity and skin conductivity response. Results indicated that Gray's model of reinforcement sensitivity (Gray & McNaughton, 2000) provides an appropriate methodology for encapsulating the contributions of a wide variety of variables conglomerated by a common thread. The model allows for effects at one level of analysis to be examined as predictors or outcomes at multiple levels, while maintaining heuristic integrity. This approach to the analysis of the callous and unemotional traits, and the effect that punishment may have on children displaying these traits, resulted in a more complete evaluation than would have otherwise been afforded by analysis at any singular level. It is my hope that a valuable contribution to the methods used to shape and correct maladaptive behaviors in the CU population may be informed by the current work.

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VITA

ANDRÉ V.M. MAHARAJ

2005	Bachelor in Science, Psychology, University of the West Indies.
Trinidad and Tobago
2008	Master in Science, Clinical Psychology. University of the West Indies,
Trinidad and Tobago.
2009	Certified Hypnotherapist, National Guild of Hypnotists, Merrimack,
New Hampshire
2009-2014	Doctoral Candidate, Psychology, Florida International University.
Miami, Florida.

PUBLICATIONS AND PRESENTATIONS

Breakwell, G., Smith, J.A., & Wright, D.B. (Eds) (2012). Research methods in psychology (4th ed). London: Sage Publications. Chapter 2: Multiple Choice Questions

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