Emotion Dysregulation Assessment in Young Children According to Research Domain Criteria

by

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DEDICATION

To my parents, my husband, and my siblings for teaching and supporting me every day.

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TABLE OF CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

FIGURE

ABSTRACT

Particularly in childhood, comorbid diagnoses are the rule and not the exception (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003), which has led to efforts to identify common underlying mechanisms that cut across disorders. We proposed to develop and test a behavioral assessment battery for preschool children that aligns with two NIMH Research Domain Criteria domains relevant to childhood psychopathology: 1) Positive Valence and 2) Negative Valence. We recruited participants 3-8 years old at varying risk for developing psychopathology, including children with and without familial risk for psychopathology, with and without subthreshold problem behaviors, and children with and without internalizing and externalizing disorders, with the aim of developing and validating an assessment tool. Validation included coding behaviors during mood induction tasks adapted to induce positive and negative valence and comparing behaviors to associated domains from multiple informants (parents, clinicians) and at different levels of analysis (physiology). Once standardized and validated, this battery could facilitate the identification of mechanisms of childhood-onset psychopathology critical to discovery of more effective interventions that target underlying dysfunctional processes.

CHAPTER I: Introduction

The Need

Particularly in childhood, comorbid diagnoses are the rule and not the exception (Costello et al., 2003), which has led to efforts to identify common underlying mechanisms that cut across disorders. There is growing agreement among mental health researchers and providers that current diagnostic criteria represent dysfunctional levels of traits that are characteristic of the general population (Nolen-Hoeksema & Watkins, 2011) and thus are likely to occur at different functional capacities across disorders. The NIMH has put forth the Research Domain Criteria (RDoC), which acts as a heuristic to examine mechanisms of mental illness across several domains of functioning, including Negative Valence, Positive Valence, and Cognitive, Social and Arousal Processes ("National Institute of Mental Health," n.d.). Although RDoC provides a valuable theoretical framework, the applicability of RDoC to developmental psychopathology research has been limited, primarily because there are no feasible, validated, and standardized assessment batteries to examine RDoC domains in young children. Here we proposed to **develop and test a behavioral assessment battery for preschool children that aligns with two RDoC domains relevant to childhood psychopathology: Positive Valence and Negative Valence.** The development and validation of such assessment tools can facilitate the identification of mechanisms of childhood-onset psychopathology critical to discovery of more effective interventions that target underlying dysfunctional processes.

Therefore, the overall objective of the current study was to create and validate an assessment protocol to examine the positive valence and negative valence RDoC domains in 4 to 8-year-old children. Validation included the assessment of children with and without familial risk of psychopathology, and children with and without current mental health diagnoses, as well as assessment of associated domains from multiple informants (parents, clinicians) and levels of analysis (biomarkers, behaviors). Participating children were recruited from 1) a longitudinal study of mothers with and without psychopathology/history of child maltreatment and their children and 2) pediatric and psychiatric offices as well as community-poster flyers.

The Creation of the RDoC Framework

Historically, the DSM has used symptom clusters to categorize distinct mental disorders (Clark, Watson, & Reynolds, 1995). This methodology has led to several overarching criticisms including excessive co-morbidity (Clark et al., 1995), over-creation of categories due to heterogeneity of symptoms, termed 'reification of disorders' (Hyman, 2010), and lack of mechanistic understanding due to equifinality (many different risk factors resulting in the same psychological disorder) (Luyten, Vliegen, Van Houdenhove, & Blatt, 2008). For instance, the National Comorbidity study found that 56% of individuals have 2 or more disorders, and that those individuals made up 82% of all 12 month diagnoses (Kessler, McGonagle, Zhao, & et al, 1994). Moreover, many specific disorders have excessive rates of comorbidity (i.e. PTSD and depression (Loveland, Cook et al., 2004) or GAD and depression (Johansson, Carlbring, Heedman, Paxling, & Andersson, 2013)), which questions the utility of current distinct classifications. Additionally, as Hyman (2010) points out, the creation of new disorders to fit specific contextual symptoms is highly suspect. For example, Hyman questions the utility of gambling disorder compared to excessive alcohol/tobacco use and whether they might be better researched/treated together as deficits of impulse control. Finally, it is difficult to map emerging biological data onto current disorders due to low specificity to DSM categories (Cuthbert & Insel, 2013). For example, the biological correlate of a startle response has been linked to multiple anxiety disorders (McTeague & Lang, 2012), causing one to question the utility of current DSM distinctions. Physiologically derived illnesses could enhance our research understanding, as well as clinical utility, potentially increasing the efficacy of psychopharmacological treatments (Wong, Yocca, Smith, & Lee, 2010).

The Research Domain Criteria was instituted in 2009 by the NIMH as a methodology for examining endophenotypes and biological correlates of deficits associated with mental health (Cuthbert & Insel, 2013). Unlike the top-down methodology of the DSM, one of the RDoC aims is to move forward only with mechanistic, bottom-up research, integrating across behavioral and neurological systems (Cuthbert & Insel, 2013). The RDoC is agnostic to current DSM disorder categories, and instead focuses on basic behavior and neuroscience which then may be linked to clinical occurrences ("National Institute of Mental Health (NIMH)," n.d.). It assumes that within each system of functioning there is a range from abnormally-low to normal to abnormally-high (i.e., blunted positive affect, positive affect, mania-like elation), and that although those abnormal extremes may be related to certain disorders, they are better researched and explored as dimensional scales. Creators of the RDoC incorporated five systems most germane to mental illness which make up the rows of a matrix: Negative Valence, Positive Valence, Cognitive Systems, Systems of Social Processes, and Arousal/Regulatory Processes, each broken down into several distinct subdomains (see below). Units of analysis make up the columns including, genes, molecules, cells, circuits, physiology, behavior, self-reports, and paradigms demonstrating methodologies of domain examination. Using this matrix, researchers can begin to fill in the cells with data to identify ranges of traits, and which systems interact with each other to create specific deficits. The goal of the RDoC framework is to begin in basic science and gradually move toward clinical utility as research progresses, but it should not be considered clinically useful at this time. Given the current criticisms of DSM categorizations and its limitations in mechanistic understanding, the new RDoC framework is presented as an alternative for reducing suffering by mental illness via purely mechanistic research (Cuthbert & Insel, 2013).

Figure 1. The RDoC Matrix

The RDoC Matrix*

	Unit of Analysis							
	Gene	**Molecules**	**Cells**	**Circuits**	**Physiology**	**Behavior**	**Self-Report**	**Paradigms**
Domain *(Construct)*								
Negative Valence Systems								
Acute threat								
Potential threat								
Sustained threat								
Loss								
Frustrative nonreward								
Positive Valence Systems								
Approach motivation								
Initial responsiveness to reward								
Sustained responsiveness to reward								
Reward learning								
Habit								
Cognitive Systems								
Attention								
Perception								
Declarative memory								
Language behavior								
Cognitive control								
Working memory								
Systems for Social Processes								
Affiliation and attachment								
Social communication								
Perception and understanding of self								
Perception and understanding of others								
Arousal and Regulatory Systems								
Arousal								
Circadian rhythms								
Sleep and wakefulness								

* See: http://www.nimh.nih.gov/research-priorities/rdoc/nimh-research-domain-criteria-rdoc.shtml#toc_matrix

RDoC Criticisms

Recently, RDoC has been criticized for its inattention to contextual factors. Some declare that although focusing on endophenotypes may lead to finding low-level mechanisms, it will be limited in understanding how all symptoms are shaped, or how processes like coping and communication may moderate each deficit (Kirmayer & Crafa, 2014). Those criticizing the RDoC call it “impoverished and conceptually flawed”, suggesting that it ignores adaptive functioning in one’s environment and “lived experience” by pointing out the cultural and historical bounds of many mental disorders (Gone & Kirmayer, 2010). They denounce the possibility/clinical utility of defining and examining “normal” variations of every clinically relevant deficit. They question the RDoC assumption that underlying mechanisms of deficits are homogeneous across individual, species and contexts.

Indeed, these poignant criticisms are valid limitations of the RDoC framework and thus, it is important to acknowledge these concerns and address them when possible in future studies. The first criticism (ignoring adaptive functioning) could be addressed by supplementing any RDoC matrix examination with contextual information when making claims of clinical relevance of a deficit (i.e., “abnormally high fear must be treated”). For instance, past work has noted the importance of environmental adaptation on clinical relevance such that dissociation (Perry, Pollard, Blakley, Baker, & Vigilante, 1995) is a biological deficit and yet, ecologically advantageous in certain crisis/chaotic environments. Similarly, child impulse-control deficits may arise in response to successfully attempting to attract the attention of a depressed mother (Shaw & Vondra, 1995). In these cases, collection and analysis of salient contextual information, including interactions of these variables with examined biological systems, will be crucial to understanding the clinical relevance of such deficits. Secondly, the criticism of the RDoC assuming deficit mechanisms are homogeneous is a valid one. At the same time, one pillar of the RDoC framework is continuous revision.

To address this, more research is needed to demonstrate that mechanistic deficits are not homogeneous across individuals, and if this proved true, the RDoC could be revised accordingly based on its promise to adapt to new empirical research. Also, in response to critiques that the RDoC has limited understanding of symptom origin, evidence suggests that deficits that are present in multiple disorders are better markers of functional impairment than disorder-specific symptoms (Caspi et al., 2014), thus disorder-specific symptoms may be less salient than originally thought. It is important to note that 1) the RDoC does not make claims to being clinically useful in these early stages, 2) the RDoC is open to continuous change and 3) the RDoC is not meant to replace the DSM, but to shift how we think about mental illness and rediscover which aspects are most important to ultimately ease suffering (Cuthbert & Insel, 2013).

Application of RDoC in Child Research

One necessity of the RDoC criteria is to 'develop reliable and valid measures of its fundamental components.' Not only do measures need to be adapted to fit the RDoC construct domains, but they also need to represent the normal/abnormal dimensionality of each trait. Scale development "represents a high priority for RDoC research applications" (Cuthbert & Insel, 2013). As research on RDoC progresses, measures on some domains are beginning to appear (Gold et al., 2012), however to date, there is no feasible, validated and standardized assessment battery to examine RDoC domains in young children. Thus, it is currently difficult to compare findings across differing methodologies. Developing a reliable and valid measure battery for

RDoC in children is further complicated due to the lack of feasibility of available methods. RDoC methods available for young children are currently somewhat limited. For instance, self-reports, one RDoC unit of analyses, are unreliable in children under age eight (Kaminer, Feinstein, & Seifer, 1995)(Garber & Kaminski, 2000) and parental report of child problems is often inaccurate (Herjanic & Reich, 1997; Kolko & Kazdin, 1993; Renouf & Kovacs, 1994). Other methodologies including genetic testing, and brain imaging are expensive or too cumbersome to use with young children.

Laboratory behavior tasks are currently used to identify cognitive processes and externalizing disorders (i.e. (Wakschlag et al., 2005; Yáñez-Téllez et al., 2012) however, there are a lack of validated and standardized behavior tasks used in assessment of affective processes to provide measures for Negative Valence and Positive Valence Systems in the RDoC matrix. Leaders in the field suggest that observational methodology is "increasingly imperative" (Carter, 2004) due to the focus on understanding early emerging psychopathology (Task Force, 2003). Observational methods used in assessing psychopathology are designed to 'press' for specific behaviors (C Lord et al., 2000) and have high research and clinical utility (Mash & Foster, 2001). Therefore, the proposed dissertation aims to adapt laboratory behavior tasks that can be feasibly administered to assess RDoC domains, and validate the behavioral dimensional coding of these tasks in young children.

Due to the dimensional nature of RDoC domains, studies examining the domains must consider its population sampling differently than DSM-based studies. In lieu of comparing a "healthy" (or "super-normal") sample to a sample with a specific diagnosis, RDoC developers suggest studying a sample with a "full range" of the domain dimension and with less specificity of diagnosis for the affected group. Specifically, they recommend collecting participants for a “control group” with a wider range of inclusion criteria (than “super-normal”), with some healthy, and some at-risk participants with mild deficits. They also suggest collecting participants at clinics with less specific criteria, such as a clinics “for anxiety disorders; or serious mental illness” (Cuthbert & Insel, 2013). Therefore, in the current study, we aim to assess children with and without familial risk for psychopathology to ensure a wide range of “non-clinical” participants, and clinic-referred children.

We aim to apply our assessment protocol of RDoC domains to examine underlying mechanisms in “healthy” children with and without familial risk of psychopathological behavior. By recruiting participants with mothers with and without psychopathology, and/or demographic risk, we aim to have a wide range on examined RDoC traits to aid measure validation. Pathways of familial risk transmission are multifactorial and include genetic vulnerability (Cerdá, Sagdeo, Johnson, & Galea, 2010), prenatal exposure to stress or toxins (Meaney, Szyf, & Seckl, 2007), and exposure to aversive caregiving (Kaplan, Evans, & Monk, 2008), among others. These factors have been identified as a general risk for psychopathology (multifinality) (Nolen-Hoeksema & Watkins, 2011) (Luyten et al., 2008). For example, children whose mothers have recurrent depression are at high risk for depression, anxiety and disruptive behavior disorders (Sellers et al., 2012). Furthermore, familial psychiatric history is shown to be more strongly correlated with a general risk for psychopathology, which Caspi et al. (2014) have dubbed “the p factor”, than specific factor scores for internalizing, externalizing and thought disorders (Caspi et al., 2014). Focusing our recruitment on this population allows us to investigate how this general risk factor maps onto RDoC derived domains, which may prove more useful than trying to translate specific risks onto subsequent DSM symptom clusters. This wide-inclusion “healthy” sample may provide a "normal" to "mild deficit range" of which to compare to more impaired children to understand underlying mechanisms of risk.

We also plan to recruit children with clinical levels of psychopathology from several "early childhood" clinics. In lieu of recruiting children with specific diagnoses, having children with an array of severe problems needing clinical attention will allow us to examine each "abnormal" side of the specified RDoC traits (i.e. extreme fearfulness to extreme fearlessness). Likewise, especially in young childhood, DSM disorders seem to be less distinctive and more transient than in post-pubertal samples. In the case of depression and anxiety, while there are data suggesting that childhood onsets of these disorders are distinct (Moffitt et al., 2007; Rice, van den Bree, & Thapar, 2004) and have chronic trajectories across the lifespan (Bittner et al., 2007; Jaffee et al., 2002), there is also evidence of heterotypic continuity between them. Specifically, children with anxiety at age 3 are likely to have depression at age 6, suggesting symptoms may represent different phases or presentations of a single disorder (Bufferd, Dougherty, Carlson, & Klein, 2011). Even research in slightly older children suggests that severe impairment from anxiety (Bittner et al., 2004), separation anxiety disorder (Biederman et al., 2007), and social anxiety (Beesdo et al., 2007) may all be predictive of subsequent depression. Furthermore, symptom presentation in childhood is usually quite complex. For example, in addition to having depression diagnoses, Luby and colleagues (2009) found that 43% of depressed preschoolers had at least one anxiety disorder, 51% had ODD, 35% had ADHD, and 27% had CD (Luby, Belden, Pautsch, Si, & Spitznagel, 2009). Researchers suggest that the higher prevalence of comorbidities may be an artifact of nosological considerations, overlapping diagnostic criteria, one disorder representing an early manifestation of another and/or similar underlying risk mechanisms (Nolen-Hoeksema & Watkins, 2011) (Caron & Rutter, 1991).

There is a clear need to study the underlying mechanisms of the dimensional aspects of these disorders within a developmental framework to better understand the complex interplay between them (Zahn–Waxler, Klimes–Dougan, & Slattery, 2000). For instance, deficits in childhood emotional regulation has been shown to cut across all disorder labilities (externalizing, internalizing, and thought problems) and is an important factor in the early development of general risk for psychopathology (Caspi et al., 2014). Therefore, we aim to apply our assessment protocol of RDoC domains to examine underlying mechanisms of children who have been generally 'clinically referred'.

RDoC Negative and Positive Valence Domains

Currently, there is a need to create objective assessments for valence in comparison to other RDoC domains (i.e. cognitive processes) due to the paucity of validated valence tasks available for children. The NIMH posits two valence domains, Negative and Positive. There are five subdomains under Negative Valence, which have been determined to be phenotypic expressions of negativity and aversive motivation. The subdomains include fear, anxiety, loss, frustration non-reward and sustained threat. Under Positive Valence, there are five subdomains determined to be phenotypic expressions of positivity and approach motivation. These subdomains include approach reward, initial responsiveness to reward, and sustained responsiveness to reward, reward pattern learning and habit ("National Institute of Mental Health (NIMH)," n.d.). There is a particular need to create behavioral assessment tools for Negative and Positive valance domains in young children because self-reports of emotions in young children are inaccurate (Chansky & Kendall, 1997). Behavior coding seems to be the best feasible method developed thus far to measure child emotions, however, few behavioral tasks assessing valence in childhood have been validated and/or standardized (Vasey & Lonigan, 2000). Studies that have examined valence behaviorally (without standardization) have done so through behavioral mood induction. Mood induction has been accomplished in a series of tasks including: self-statement, music, suggestion, facial expression, game feedback, social feedback, recall, imagery, administrator behavior, empathy, film, threat and public speaking (Martin, 1990). Therefore, we will use valence behaviors coded from reactions to laboratory mood induction tasks to examine RDoC domains of Negative and Positive Valence in young children.

Negative valence: tasks, behaviors and implications. The current study will focus on assessing the Negative Valence subdomains of fear and anxiety because they can be behaviorally studied in a laboratory environment. Additionally, anxiety and fear do not currently have a standardized test battery or coding system, unlike other subdomains (i.e., frustration non-reward (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). In the RDoC, fear is described as a response to an imminent, acute threat, which would be reflected by behaviors of protecting oneself from danger. Fear is differentiated from anxiety based on the presence of a stimulus at the time of the experience, whereas anxiety is described as "a vigilance response to harm that is distant or ambiguous" (i.e., knowing you have an exam to prepare for in the future or being asked to walk into a darkened room without knowing why) and therefore qualitatively different from fear. Researchers have often used the two terms interchangeably. For instance, emotional responses to a task in which a child is left in a darkened room has been coded as anxiety in some research and as fear in others (Vasey & Lonigan, 2000) (J. R Gagne, Van Hulle, Aksan, Essex, & Goldsmith, 2011). This construct that combines fear and anxiety has been coded in tasks with acute (fear-eliciting stimuli) and potential stressors (contact-with-strangers, performance tasks with concerns about social scrutiny) (e.g., Durbin, 2010; Durbin, Hayden, Klein, & Olino, 2007; Durbin, Klein, Hayden, Buckley, & Moerk, 2005; Hayden, Klein, Durbin, & Olino, 2006; Olino, Klein, Dyson, Rose, & Durbin, 2010). While this combined construct of fear and anxiety has been linked to familial risk for internalizing disorders in young children (e.g.,Olino et al., 2010), child anxiety disorders (e.g., Dougherty et al., 2011), and parent-reported child fear and anxious/depressive symptoms in a recent pilot study (Moser, Durbin, Patrick, & Schmidt, 2014), more research is needed to examine the importance of measuring anxiety and fear as separate constructs.

Research that has measured only fear or only anxiety have found that each construct is valid in and of itself, however there are no studies to date explicitly comparing and contrasting the two forms of negative valence. For instance, studies show that children with separation anxiety or phobia exhibit more *fear* (attending away from threatening faces) than children with internalizing disorders of depression, GAD, and PTSD who were more likely to attend toward threat (Salum et al., 2012). Another current study has examined *fear* operationalized by a startle response to threat in adults, a measure of defensive fear and the body's fight or flight response (McTeague & Lang, 2012). They find a U-shaped result across severity of anxiety disorders (PTSD, GAD, specific phobias, OCD, panic etc.) such that adults without disorders had low startle response, those with moderate severity disorders had heightened startle responses and adults with severe disorders (GAD, PTSD with multiple traumas) had blunted startle responses and looked similar to controls (McTeague and Lang, 2012). Authors conclude that in the face of severe and chronic anxiety, the body is overloaded and fails to exhibit a startle response. In turn, results by child disorder (Dadds, Barrett, Rapee, & Ryan, 1996) suggest that anxious children have more threatening interpretations of conflict stories than controls. Reaction to acute threat has also been coded behaviorally when children were asked to tell a story in front of a video camera (P C Kendall et al., 1997). These "*anxious*" behaviors have been operationalized by endured weariness toward a potential threat such as anxious verbalizations, shaky body movements, fingers in mouth and approach-related apprehension (P C Kendall et al., 1997). Although both fear and anxiety were behaviorally coded in these studies and were found to have important predictive or concurrent validity, it is still unclear whether having separate constructs adds incremental validity of negative valence domains as the RDoC suggests.

Often associated with childhood fear and anxiety is the construct of behavioral inhibition, which has been studied extensively in children. Behaviorally inhibited temperament (BI), defined by Fox and colleagues as “fearful responses to novelty and avoidance of social interactions” (Fox, Henderson, Marshall, Nichols, & Ghera, 2005) is typically determined through mood inducing laboratory paradigms. These behavioral measures of BI have demonstrated criterion validity such that they have been linked to fear-potentiated startle in infants (Schmidt & Fox, 1998), and approximately 40% of children characterized as behaviorally inhibited go on to develop an anxiety disorder (particularly social phobia) (see (Fox et al., 2005)(Lahat et al., 2014). However, Moser and Durbin (2014) suggest that BI is a higher-order construct than the fear or anxiety subdomains of the RDoC (Moser et al., 2014), because the temperament includes elements of high negative and low positive emotionality (Laptook et al., 2008) which are understood as distinct constructs in childhood (Higa-McMillan, Smith, Chorpita, & Hayashi, 2008). Also, when interpreting the behavioral codes used to create the BI scale, BI seems to encompass both fear and anxiety. For instance, when presented with a novel black box to put their hand in, the BI construct includes codes of “Latency to Touch Box and to Put Hand into Box”, “Number of prompts to put hand in box” and “Number of Verbal Initiations to Experimenter”. All of these codes would be within the RDoC construct of *anxiety* because the child is not faced with an acute threat, but with a potential threat of what “might” be in the box.

In contrast, when presented with an acute threat (a loud noise from a vacuum cleaner) codes fall in the RDoC construct of *fear* and include "Presence/Absence of "Freeze" and/or Startle", and "Latency to touch the vacuum". Cumulatively, this research suggests that both anxiety and fear (startle) have demonstrated strong links to psychopathology, however, to date, we do not have a reliable, standardized method for assessing these salient traits in young children. Thus, adapting mood induction paradigms, and validating behavioral coding of these particular subdomains could be key elements for creating new assessments of fear and anxiety behaviors in young children.

Measuring negative valence in the proposed dissertation. We aimed to study the constructs of fear and anxiety in two adapted behavioral tasks. The first, called the Snake task, was adapted from the LAB-TAB task (which uses a spider instead of a snake). It consisted of having the child walk slowly with an administrator into a darkened room with a terrarium covered by a blanket. This first part of this task was coded for behavioral and verbal reactions to ambiguous threat, which was conceptualized as anxiety. After the child and administrator paused within arms' length of the covered terrarium, the administrator quickly pulled off the blanket and lift a fake (realistic) snake to be eye-level with the child. The child's post-reveal behavioral and verbal reaction was conceptualized as an indicator of fear because the threat is known and acute. We adapted this particular task to be a part of the RDoC protocol for its ability to elicit both fear and anxiety separately, and specifically to provoke a startle response given its salience across psychopathologies (McTeague & Lang, 2012). Additionally, prior versions of this task have been validated as 'stressful' in terms of being able to elicit an endocrine stress response (cortisol) in young children (Lopez-Duran, Hajal, Olson, Felt, & Vazquez, 2009), and has shown to elicit behavioral reactions coded as a combined anxiety/fear score (J. R Gagne et al., 2011). We chose this particular stimulus (a snake) due to its relevance across age, gender, and context. Humans have been shown to have "fear preparedness" toward snakes, exhibiting faster fear conditioning to snakes and 6-plus legged-animals than other types of animals. This fear preparedness is not a function of the specific animal per se, but towards fear-evoking "perceptual properties and their discrepancy from the human form" (Bennett-Levy & Marteau, 1984). In this way, a snake (or a spider) would be theoretically similar for this task and could be used interchangeably.

The second task, called the Speech Task, consisted of an administrator sternly requesting the child to give a three-minute speech into a video-camera that will be later judged based on how interesting it is. The child is told they will be given three minutes to prepare for the speech, and that the speech can be about anything. The Speech tasks represents an anxiety/fear provoking based on social/performance task adapted from (P C Kendall et al., 1997) and the Trier-Social Stress Task for Children (TSST-C) (Buske-Kirschbaum et al., 1997). The TSST-C was created for children 8-14 and included a mathematical component where the child is asked to subtract by 3s from 307. Given the current study includes 4-8 year olds, this mathematical task was excluded due to it being inappropriate for all ages. Additionally, consistent with the TSST-C, children were provided with verbal and facial positive feedback at the conclusion of their speech. One modification to the current Speech Task, was that a buzzer is sounded at 1.5 and 2.5 minutes during the three minutes, with a verbal reminder from the administrator of the remaining time to increase contextual fear. Anxiety was coded using behavioral and verbal reactions observed during the preparation three minutes when the child is given the potential threat of giving a speech in the future, and fear was coded using behavioral and verbal reactions observed during the actual speech itself when the child is confronted with the acute threat of giving a speech. This particular performance task was chosen to incorporate a social aspect of fear and anxiety to add to the more 'primal/defensive' fear elicited from the Snake task. Additionally, there is evidence that this task elicits physiological stress (cortisol reactivity) (Buske-Kirschbaum et al., 1997), and behavioral anxiety symptoms which were shown to reduce post treatment and were thus deemed clinically relevant (P C Kendall et al., 1997).

Positive valence: tasks, behaviors and implications. Based on previous research, we suggest that subdomains most feasible for behavioral assessment and most clearly related to familial risk and psychopathology are initial and sustained responsiveness to reward. The NIMH defines initial responsiveness to reward as "mechanisms associated with hedonic responses—as reflected in subjective experiences, behavioral responses, and/or engagement of the neural systems to a positive reinforcer." Research has identified anhedonia, the lack of hedonic response, as salient to child anxiety and depression (Baji et al., 2012). By measuring hedonic response to reward, both in the initial minute after receiving it and the several minutes afterward, we aimed to record an indicator of child ability to feel pleasure. Anhedonia may be an indicator of severity of psychopathology such that it has been found to be a marker of treatment resistance in depressed adolescence (McMakin et al., 2012). Studies have found that low positive affect coded in dyadic interactions has been associated with high child internalizing problem scores reported by parents. During mother-child interactions, one study demonstrated that children who were referred for aggressive behaviors exhibited less positive affect than non-referred children (Tsuk, 1998). However, coding dyadic interactions has drawbacks because positive affect is coded in the contextual history of the dyad and may not reflect overall hedonic capacity. Thus, it may be more beneficial to code for positive affect in contexts where the child is alone to exclude "affiliation and attachment" components, which is a separate RDoC subdomain under "social processes". Improving positive affect and positive behaviors with intervention has been shown to mitigate depressive symptoms (Layous, Chancellor, Lyubomirsky, Wang, & Doraiswamy, 2011); which suggests salient associations between hedonic response and child psychopathology/resilience. Creating a standardized assessment of positive valence in children too young to accurately describe how they feel is an important step in identifying children with deficits, and advancing our understanding of how positive valance affects early childhood psychopathology.

Measuring positive valence in the proposed dissertation. For this task, we used the LAB-TAB "bubbles task" (J. R Gagne et al., 2011) and a "reward task". Bubbles are known to elicit extremely high positive affect in children of all ages, and are able to maintain a child's interest for long intervals. To increase interest, and to decrease issues with impulse control and administration we used a bubble machine to create and distribute bubbles. Throughout the four-minute period with bubbles, the administrator gave positive verbal and bodily feedback in playing with the child to enhance induction of positive affect. The Reward Task consisted of giving the child a small, desirable reward for their participation in the study and allowing them to play with it for 1 minute before their departure from the lab visit. Body movements and verbal positive behaviors were coded for initial response to reward (in the one minute after the reward, and the first minute of playing with bubbles) and sustained response to reward (the change score between minute 0-1 and 2-3 of playing with bubbles).

Constructs and Psychometrics of Behavior Coding

Validation of the behavior codes was centered on establishing 1) their construct validity (convergent and discriminant) and 2) their concurrent criterion validity (Smith, Fischer, & Fister, 2003)) in accordance with other test construction (Blomquist et al., 2014) and behavior coding schemes (see (Wakschlag et al., 2005)(D. V. Cicchetti, 1994). Cuthbert and Insel (2013) suggest new scales representing RDoC should incorporate continuous interval scales to help quantify subdomains. From these interval scales, cut-off points could be determined and, importantly, modified based on specific intervention needs (Cuthbert & Insel, 2013). Given this omission of predetermined "gold standard cut-offs" in the RDoC, we will explore construct validity in terms of continuous scales.

Despite issues with parent-reported child internalizing symptoms (Herjanic & Reich, 1997; Kolko & Kazdin, 1993; Renouf & Kovacs, 1994), parents know their children best and for children under eight years, parental reports coupled with clinician judgment has remained the gold standard for understanding child disorders. The NIHM lists self-report measures as another "unit of analysis" by which to assess negative valence, and since child report of internal states is unreliable in children eight and younger (Kaminer et al., 1995)(Garber & Kaminski, 2000), parental reports are the best measureable solution. Thus, we implemented well-validated, widely-used parent-report of child traits and symptoms (see Method for exact measures) for children 4-8 to establish construct validity for the behaviors. Additionally, we addressed criterion validity by group comparison of behaviors by familial risk type (caregiver psychopathology symptoms), caregiver reported child problems, and clinician determined diagnostic status (yes/no; type).

First, we explored construct validity using a confirmatory factor analysis of all behavior codes hypothesizing a factor solution of four: fear, anxiety, and initial and sustained response to reward. Cronbach's alphas were calculated as indicators of internal consistency within factors. To assess for convergent and discriminant validity, Pearson bivariate correlations were conducted with chosen similar and dissimilar factors from the maternal report of child behaviors on the Child Behavior Questionnaire (CBQ: explained in detail in the Measures section).

Criterion validity was explored using linear and logistic regressions to identify associations between behaviors and child risk status. We first conducted unadjusted and adjusted linear regression models predicting to caregiver psychopathology (PTSD and depressive symptoms) and to caregiver reported child problems (internalizing and externalizing). We then conducted unadjusted and adjusted logistic regressions models predicting to current child diagnosis (internalizing or externalizing) to test which behaviors helped to predict concurrent diagnoses.

In addition to behavior, and self- (or in this case parent-) report, the NIMH has designated physiology as another "unit of analysis" to aid assessment of the valence subdomains. The human body's physiological response to stress is a good indicator of negative valence. The Hypothalamic-Pituitary-Adrenal axis connects the brain with the body in order to appropriately respond to fear- and anxiety- evoking stimuli via a cascade of hormones (Aguilera, 2012). Cortisol is the HPA-axis end-product produced and released by the adrenal gland (See Gunnar & Vazquez, 2006) and aids in bodily defense and survival preparation (increases blood pressure and sugar levels and decreases immune response). Cortisol is commonly viewed as having important biopsychosocial meaning given its association with a variety of processes associated with psychopathology (see review (B. M. Kudielka, Kirschbaum, & others, 2003)). Specifically, negative valence subdomains including dysphoria (Luby et al., 2003) and loss (Kaplow et al., 2013), fear and frustration (Lopez-Duran, Hajal, et al., 2009), and anxiety (Schmidt et al., 1997)(van West, Claes, Sulon, & Deboutte, 2008) have all been associated with atypical cortisol in children. In mood induction tasks specifically, Lopez-Duran and colleagues (2009) showed that a fear inducing task yields a faster cortisol rise to cortisol peak than a task inducing frustration, suggesting a rapid activation and down-regulation of the HPA axis. Additionally, anxiety induction such as in a child-parent separation task (van Bakel & Riksen-Walraven, 2002) has been found to heighten cortisol levels for some children. Furthermore, children with anxiety (Kallen et al., 2008) and depression (Lopez-Duran, Kovacs, & George, 2009) have been shown to have atypical (heightened) cortisol reactivity. Therefore, we will examine the relatedness between cortisol reactivity in response to a stressor and our negative valence valence behaviors to help establishment of criterion validity.

The ultimate goal of RDoC is to eventually facilitate the discovery of new methods to identify and categorize disorders that share common underlying mechanisms ("National Institute of Mental Health (NIMH)," n.d.). In July, 2016, NIMH hosted a webinar entitled, Analyzing and Using RDoC Data in Your Research to broadcast ideas for analyzing RDoC constructs in research. One invited speaker, Dr. Meredith Wallace, a biostatistician, suggested clustering methods were "really relevant for RDoC" to "reveal subgroups of individuals with similar characteristics" "separated by natural boundaries". Dr. Wallace went on to suggest clustering would help researchers "generate hypotheses about underlying disease mechanisms and maybe treatments that you could develop and then target to individuals matching the characteristics of each subgroup", ending by emphasizing the exploratory nature of the methodology (M. Wallace, 2016). Clusters would allow researchers to understand the relationship among RDoC subdomains in separate subgroups. For instance, for most individuals, Anxiety and Fear may have similar means, but one small cluster may have low Anxiety and high Fear. Exposing the underlying structure of RDoC subdomains within a sample could help inform research hypotheses of how combinations of RDoC subdomains relate to each other in a general population, or how they might map onto clinical functioning/impairment. In our sample, latent profiles may then better inform intervention for young children than any one domain alone, whether that profile demonstrates children with heightened anxiety also generally have heightened fear, thus both subdomains should be targeted, or that children with heightened anxiety also generally have heightened initial hedonic reward response, and thus while targeting anxiety in intervention, clinicians could play to the children's' strengths in hedonic response to enhance that intervention.

Thus, as an exploratory measure, we will examine latent profiles of the constructs of fear, anxiety, and initial and sustained hedonic response to reward. Through k means cluster modeling (as seen elsewhere (Elklit, Hyland, & Shevlin, 2014)), we examined our data to determine if naturally-occurring latent profiles existed, and then, validated these latent clusters by statistically relating them to child risk or diagnostic status, and cortisol reactivity patterns.

Reliability of behavior coding. Two student research assistants per task were trained on coding procedures and then individually coded behavior tasks until they reached an inter-rater reliability kappa of at least 0.70. At least twenty percent of tasks were double coded to ensure coherence.

Aims and Hypotheses

The overall objective of the current study was to create an assessment protocol to examine the valence RDoC domains in 4 to 8-year-old children with and without familial risk of psychopathology, and children with a current diagnosis. We aimed to adapt several behavioral laboratory tasks to assess for domains of functioning of Negative Valence and Positive Valence. Familial risk was assessed via parental report and child diagnostic status was determined using clinical interviews. Participating children were recruited from 1) a longitudinal study of mothers with and without psychopathology/history of child maltreatment and their children and 2) the community, including University of Michigan Psychiatry and Pediatrics departments.

Our specific aims were:

Aim 1. In Aim 1, we aimed to adapt behavioral laboratory tasks to reliably assess for RDoC domains of affective processes in middle childhood. This aim would be achieved when 1) inter-rater reliability reached acceptable levels (Intraclass Coefficient (ICC) alpha 2-way mixed single measures >0.7), 2) frequency of each behavior was found in more than 15% of all participants (Durbin, Klein, Hayden, Buckley, & Moerk, 2005).

Aim 2. We aimed to assess the convergent, and discriminant validity of behaviors.

Hypothesis 1. We hypothesized that induced Fear and Anxiety (Negative Valence) would be moderately correlated with each other within tasks, as would induced Initial and Sustained Positivity (Positive Valence) given they were within the same RDoC valence domains, but in separate subdomains. We hypothesized induced Fear and Anxiety codes would be unrelated to Positivity within tasks given they are separate valence domains in the RDoC.

Hypothesis 2. Across tasks, Negative Valences would be correlated, and Positive Valences would be correlated, but Negative and Positive Valences would not be correlated with each other.

Hypothesis 3. Behaviors would be moderately and positively associated with parent report measures of corresponding CBQ temperament traits, and moderately and negatively associated with dissimilar traits. Specifically, we expected Anxiety behaviors, to be weakly, positively correlated with CBQ traits Approach Excitement, Sensory Discomfort, and Fear. We expected Approach Excitement (Amount of excitement and positive anticipation for expected pleasurable activities) given the subscale's focus on anticipation of a stimulus. We expected Sensory Discomfort (Amount of negative affect related to sensory qualities of stimulation, including intensity, rate or complexity of light, movement, sound, texture) given the subscale's focus on negative affect in response to environmental stimuli. We also expected Fear (Amount of negative affect, including unease, worry or nervousness related to anticipated pain or distress and/or potentially threatening situations) given the trait's items allude to anticipated/potential threats and not acute/imminent threats. We also expected no correlations between Anxiety codes and positive valence type traits such as High and Low Intensity Pleasure and Smiling/Laughter.

We expected Fear behaviors to be positively correlated with CBQ traits Sensory Discomfort (similar to Anxiety) and Impulsivity, and negatively correlated with Distress Recovery. We expected Impulsivity (Speed of response initiation) given the focus on speed of response, and Distress Recovery (Rate of recovery from peak distress, excitement, or general arousal) given the trait's focus on regulation from peak distress. Similar to Anxiety hypotheses, we also expected Fear behaviors to be unrelated to CBQ High and Low Intensity Pleasure and Smiling/Laughter.

We expected Initial Positivity codes to be positively correlated with Approach Excitement, Activity level, High Intensity Pleasure, Impulsivity and Smiling/Laughter. We expected Activity level "Level of gross motor activity including rate and extent of locomotion," given that playing with a reward excitedly may involve a high level of activity. We expected High Intensity Pleasure "Amount of pleasure or enjoyment related to situations involving high stimulus intensity, rate, complexity, novelty and incongruity," given its focus on pleasure in response to novelty. We expected Impulsivity given the research showing the overlap between novelty seeking and impulsive behaviors (Donfrancesco, Trani, Porfirio, Giana, Miano & Andriola, 2015), and we expected Smiling/Laughter "Amount of positive affect in response to changes in stimulus intensity, rate, complexity, and incongruity" given the focus on positive affect in response to reward. For discriminant validity, we expected Initial Positivity behaviors to be negatively correlated with Sadness "Amount of negative affect and lowered mood and energy related to exposure to suffering, disappointment and object loss" given that the hedonic response to the introduction of a reward (bubbles or a toy) is the opposite of object loss.

We expected Sustained Positivity behaviors to be positively correlated with Activity and Smiling/Laughter (similar to Initial Positivity expectations), and also Attentional Focus and Low Intensity Pleasure. We expected Attentional Focus, "Tendency to maintain attentional focus upon task-related channels," given a child may need attentional focus to the reward to maintain positivity about the reward over time. We expected Low Intensity Pleasure, "Amount of pleasure or enjoyment related to situations involving low stimulus intensity, rate, complexity, novelty and incongruity" given its focus on low stimulus intensity due to longer term exposure of the reward.

For Positivity behaviors from anxiety/fear induction tasks, analyses were more exploratory, as it was unclear if these behaviors would be associated with induced Positivity (children truly having a positive experience while being scared), or Anxiety/Fear codes (children displaying positive behaviors as a coping mechanism for their anxiety/fear). However, we hypothesized that behaviors would be positively correlated with Smiling/Laughter, and Approach Excitement, as well as negatively correlated with Discomfort and Shyness, "Slow or inhibited approach in situations involving novelty or uncertainty" given the trait's focus on approach during uncertainty.

Hypothesis 4. Behaviors would be moderately and positively associated with parent report measures of corresponding CBCL child problem scales, and moderately and negatively associated with dissimilar problem scales. We hypothesized that Anxiety behaviors would be related to all internalizing subscales, but unrelated to externalizing subscales. We expected Fear behaviors would be related to only Anxious/Depressive problems given its focus on child specific-fears, and unrelated to all other problem scales. We hypothesized that both Initial and Sustained Positivity behaviors would be positively correlated with externalizing subscales given their focus on impulsivity. Additionally, we hypothesized that Sustained Positivity would be negatively correlated with attention problems.

Hypothesis 5. We hypothesized that during the anxiety/fear-tasks, children with higher levels of fear and anxiety would be related to heightened cortisol reactivity post stressor.

Aim 3. To assess criterion validity of behaviors.

Hypothesis 1. We hypothesized that children who displayed more Anxiety and Fear, and/or less Initial and Sustained positivity would have caregivers with more psychopathology symptoms.

Hypothesis 2. We hypothesized children with more Anxiety and Fear behaviors would display more CBCL internalizing problems and be more likely to have an internalizing diagnosis. We also hypothesized children with more Initial and Sustained Positivity behaviors would predict more CBCL externalizing problems and be more likely to have an externalizing diagnosis.

Aim 4 (Exploratory). We aimed to assess latent profiles of Negative Valence and Positive Valence domains in children.

Hypothesis 1. We hypothesized there would be naturally occurring patterns of valence subdomains in children. We used the sets of four behaviors to examine possible clusters representative of RDoC subdomains. We examined the four RDoC subdomains in the current study: Anxiety, Fear, Initial Positivity, and Sustained Positivity, first, using non-verbal Positivity behaviors from Bubbles and non-verbal Speech Anxiety and Fear behaviors, and then using non-verbal Positivity behaviors from Bubbles and non-verbal Snake Anxiety and Fear behaviors. Then we examined all Negative Valence behaviors using Anxiety, and Fear from the Snake task and Anxiety and Fear from the Speech task. Then we examined all Positive Valence behaviors using Initial and Sustained Bubble Positivity and Speech Positivity behaviors. Finally, we explored Negative and Positive behaviors within the Speech task, using Anxiety, Fear, and Positivity. We examined all sets of behaviors using first non-verbal and then verbal behaviors. Examining profiles across all combinations of behaviors we hypothesized that we would be able to see how subdomains relate to each other in naturally occurring subgroups of children.

Hypothesis 2. We hypothesized that specific profiles would characterize 1) at-risk children, 2) clinically referred children, and/or 3) atypical cortisol patterns.

CHAPTER II: Method

Participant Recruitment

We recruited 96 participants ages 3 to 8 from two source samples (see Table 1 for combined participant demographic descriptives). First, we recruited 43 (44%) participants from an on-going observational study, Bonding Between Mothers and Children (BMAC), conducted in the Department of Psychiatry at the University of Michigan (PI: Maria Muzik, MD) who consented to be contacted for future research opportunities. Children included in BMAC were between 1-9 years old (M=4.7, SD=1.72), over-sampled to be at 'high-risk' for developing psychopathology. Those at high-risk had mothers with histories of child trauma (71%), PTSD (21%), and/or depression (15%). In the current study, of the 43 BMAC children recruited between ages 3 and 8 years 18 (42%) have a mother with psychopathology (PTSD or Depression) and 7 (16%) have a concurrent internalizing diagnosis. Participants recruited from BMAC were similar to the original larger BMAC sample such that the majority of participants were white (67% vs 70%), many had a household income of more than $100,000 per year (42% vs 47%), and just more than half (56% vs 54%) were female. Children eligible for the current study will be between the ages of 4 and 8, inclusively.

Secondly, we recruited 53 (55%) participants from pediatric offices (40%), psychiatric offices (4%), electronic recruitment databases (each associated with medical campuses, both general and psychiatric services, at the University of Michigan, 25%), word of mouth through study participants (6%), and community flyers (25%) seeking healthy children, those with parents with anxiety or depression (current or past), and children with clinical diagnoses.

Inclusion criteria was having a child between ages 4-8, fluency in English, and the caregiver was over age 18. Exclusion criteria was having a/suspected developmental disorder, having a serious medical condition, or taking any medications that affect the central nervous system.

Of the 91 participants with a clinical interview, 29 (32%) children had a current diagnosis (for descriptive of participant diagnoses, see Table 2). Twenty-three (24%) had a current internalizing diagnosis according to DSM-IV criteria (diagnoses included Depression-Not Otherwise Specified (NOS) (n=3), Anxiety-NOS (n=5), Generalized Anxiety Disorder (n=2), Post-Traumatic Stress Disorder (1), Separation Attachment Disorder (n=6), Obsessive-Compulsive Disorder (n=2), Specific Phobia (n=6), Adjustment disorder with anxious or depressive features (n=2), Social Phobia (n=1); 20 of these children had one internalizing diagnosis, one child had 2, one had 3, and one had 4. Eleven children (12%) had a current externalizing diagnosis (diagnoses included Attention-deficit hyperactive disorder ADHD (n= 10) and Oppositional Defiant Disorder ODD (n=1). Five children had comorbid diagnoses of at least one internalizing and externalizing disorder. Of the 95 participants with caregiver information on psychopathology, 28 (29%) children had a caregiver with a diagnosis of PTSD and/or moderate to severe depressive symptoms, half of those children had a current diagnosis themselves.

Procedure

Data was collected during part of a larger study aimed at assessing Negative and Positive Valence RDoC domains via both brain physiology and behaviors in children 4-9 years old. The larger study consisted of one 120-minute laboratory visit in our UM Child Psychiatry playroom, and one 120-minute home visit following the lab visit within 2 weeks. On arrival to the playroom, parents (one primary caregiver per child) were consented to the study, and children given a brief, age appropriate overview of planned tasks. Mothers completed the parent-reported questionnaires while children underwent an electroencephalogram (EEG) battery and the behavioral battery in an adjacent room. The EEG tasks includes 40-minutes of child adapted computer games, with set up and take down lasting approximately 120 minutes total. After the child completed the EEG tasks, they are brought into another play room to engage in the behavior tasks. The first task was designed to elicit a fear response (Snake Task), while the latter tasks were designed to elicit positive affect (Bubbles and Reward Tasks). There was a short (3 minute) free play in between the fear and the positive affect tasks to allow the child to calm down if they exhibited a fear response from the Snake Task. Tasks were shortened if the child became moderately-highly upset and were taken to their parents to be provided comfort. All tasks were video-recorded for later coding. For the laboratory data collection parents received $50, and the children a small toy ($2). At the home visit which took place within two weeks after the lab visit, then the child engaged in the Speech Task (aimed at eliciting performance anxiety) after a 30 minute period in which the administrators and child would play quietly to allow the child to become comfortable. After the Speech Task administrator would conduct the clinical interview to both the mother and child for children aged 7 or 8. The child was not interviewed if they were 6 or younger. Throughout the home visit, the child was asked to supply salivary cortisol samples (protocol is described in more detail below). For the data collection at the home visit parents receive $40, and the children a small toy ($2).

Over the course of the study, which took place over two and a half years (1/2014-4/2016), there were several changes to the protocol. Due to logistical reasons (clinician availability) the clinical interview was 1) moved from the home visit to the lab visit and the caregiver completed the questionnaires at the home visit instead and 2) the clinical interview was sometimes conducted by phone (both at home and lab visits). Additionally, the Speech Preparation phase was added to the Speech Task late (after 15 participants had completed the study), as protocol was finalized late. All following cortisol analyses controls for Preparation being present or not. Finally, several additional behavioral tasks (aimed at assessing executive functioning) were added overtime to the laboratory visit taking place after the Snake task and before the Bubbles and Reward task.

Measures

Behavior tasks.

- *Snake task. Setting/Supplies:* fake snake, terrarium, mulch. A plastic snake is in terrarium in mulch, covered with blanket in dimly lit room. Front of Chair with snake in line with back of mirror. Lamp in back left corner with 2 light bulbs on. Lights facing door. Door stays open. Procedure for *Anxiety Phase (Walk to Terrarium):* When leaving EEG task room, administrator whispered, **"There's something I want to show you".** (Could respond to child questioning with) **"You'll see".** While opening door, administrator whispered, **"It's in this room."** *Once door is fully open, videographer starts 30s timer*. When the door was fully open, the administrator whispered, **"We need to be quiet so it doesn't wake up".** The administrator then very slowly stepped forward to middle section of mirror, looking back to child and gesturing to follow. They gestured to child to stop next to them and will squat down until they hear knock on mirror from the videographer at 30s. Then the administrator whispered, **"I'm going to uncover it now"** and slowly stood and stepped forward toward the terrarium. They then put their hands on the blanket and looked back to the child for 5 seconds. *Procedure Fear Phase (Snake Reveal):* The administrator quickly uncovered the terrarium and pulled the snake head out toward the child at their eye level. The administrator then said, **"See it's fake, you can touch it"**, waited 20 seconds or until the child wanted to leave, and then move onto the next experiment. (Calkins, Graziano, Berdan, Keane, & Degnan, 2008; Lopez-Duran, Hajal, et al., 2009). Some evidence suggests that fear eliciting stimuli is related to subjective (Evans & Harmon, 1981) and psychophysiological (Lopez-Duran, Hajal, et al., 2009) measures of fearfulness, however, children may be less inhibited in an unnatural laboratory setting and should be considered in behavioral coding of 'fear'(Barrios & Hartmann, 1997).

- *Speech Task (TSST-C modified). Setting/Supplies:* set up camera on stand 1 meters in front of child and sit beside camera, writing notes, a buzzer, a timer. *Procedure Speech Preparation*: Administrator explained, **"So we're going to have you give a speech, you need to tell us about yourself for five minutes and speak into the camera. You can talk about your friends, favorite TV shows, school or anything like that. Once you're finished, the videotape will be watched by researchers who will judge it based on how interesting it is, so do your best. First, I will give you three minutes to think about what you're going to say, then I will tell you when to start. Okay, begin preparing."** Procedure for *Fear Phase (Speech Delivery):* After two minutes of preparation, administrator stated, **"Please begin your speech"** and timed three minutes allowing the child to view the timer. (If child stops, prompt: "**Please continue. You can talk about anything**.") Administrator hit buzzer at time intervals to increase fear response, prompting, **"You are halfway done"** at 1 minute 30 seconds and **"You have**

30 seconds left" at 2 minutes 30 seconds. At the end of the speech, the administrator provided the children with positive feedback as done in the Trier Social Stress Task for Children (TSST-C) (Buske-Kirschbaum et al., 1997). Note that Episode 1 (preparation time) was added late to the study, and thus 15 children were given the instruction to begin their speech immediately.

- *Bubbles*. Administrator took out a bubble machine and turned it on, putting it on a table. The administrator gave statements like, "**Here, try to pop these**!"; "**This is so fun**!" The child was in a room with a bubble machine and the administrator to play for 4 minutes. This task was adapted from the LAB-TAB (J. R Gagne et al., 2011). This task was coded in 4 one-minute segments, Initial Positivity were codes in the first minute of play, and Sustained Positivity was calculated as a change score— third minute of bubble play minus first minute. Due to protocol deviations, only a subsample of the children played with bubbles for the full 4-minute duration and thus the forth minute was excluded from analyses. The third minute was chosen to create sustained positivity scores over the second minute because it better represents the "sustained" time construct. Using one to two-minute change scores could include code differences from 60 to 61 seconds, which would not best represent sustained positivity. As minute 2 and minute 3 Positivity codes were nearly identical, minute 2 was excluded in subsequent analyses.
- *Receiving Toy reward for study participation*: Administrator brought an exciting toy to the child as a reward for participating in the study, and stated, "**Here, this is for you, thank you so much! You can play with it for a minute while I finish some paperwork"** and the child was videotaped for 60 seconds as the administrator sat in a chair looking at a notebook. This task had only one 1-minute phase, eliciting Initial

response to reward. The duration of this task had the greatest range of all tasks, and was somewhat subject to the child's willingness to stop playing with their reward and to leave the lab visit. Due to the high variance of Reward duration, we control for duration in all subsequent analyses.

Behavior codes. Behavior codes were adapted from LAB-TAB codes constructed by Dr. Emily Durbin (i.e., (Durbin, Hayden, Klein, & Olino, 2007; Moser et al., 2014)). We used codes focused on negative and positive valence (fear, positivity, anger, and sadness), in two different channels (non-verbal and verbal reactions). Behaviors were categorized in each three different intensities (low, moderate, and high) within valence and channel type (i.e., "verbal fear moderate"). Coders used behavior coding anchors to know when to code for different valence intensities (see Appendix B). Although the same behaviors were coded within valence type across all tasks and task phases, they were conceptualized as different constructs according to RDoC. For instance, "fear" codes during anticipatory phases (walking into the room until the snake is presented for the Snake Task; and preparing for the speech in the Speech Task) were conceptualized as Anxiety; and "fear" codes during acute fear contexts (startle after the snake was presented in the Snake Task; and during the speech delivery in the Speech Task) were conceptualized as Fear. Although tasks were meant to induce specific valence (i.e., Snake Task for fear and anxiety; Bubbles for initial and sustained positive response); all affect types were coded in every task. Frequency-codes were weighted by intensity (x1 for low; x2 for moderate; x3 for high) using the entire task phase duration and summed to create one score per task per valence per channel (bodily/verbalizations).

Reliability was calculated for each weighted summed score. One limitation of this reliability method is that coders may be deemed reliable as they both have a Fear Verbal code of 13, however those 13 points may be the result of separate intensities, or even separate events. For instance, for Fear Vocal codes, Coder 1 could interpret a vocalization of "I'm scared" as Moderate (fear content, without having a frightened tone) which is weighted as 2 points, and an "um" as Low which is weighted as 1 point. Coder 2 could interpret the same "I'm scared" vocalization as having a scared tone and count it as High which is weighted as 3 points, and then miss coding the "um". Both coders would have an end result of 3 and be deemed reliable in this case. These differences would likely be discovered during consensus coding where codes are discussed within intensity by time. Therefore, when available (roughly 30% of the time) consensus codes are used.

Behavior code training. Two coders coded each mood induction task. Coders established intra-correlation coefficient (two-way mixed, single measures model) at .7 or greater with coding trainer, before beginning to code independently. Coders then trained to become reliable with each other. Once reliable with ICC at .7 or greater, coders coded independently, and consensus coded at least every 5th video (at least 20% of all videos).

Training procedure was as follows:

Training Protocol:	
Step 0, alone	Watch 7-10 videos, familiarize yourself with codes/materials
Step 1, with partner	Watch video with partner and discuss aloud throughout
Step 2, without partner present	Watch video, code it, write down your questions
Step 2, with partner	Watch video again with partner, discuss aloud with them, talk through discrepancies
Step 3, without partner present	Code 2 independently, check against partner's codes, write down questions

Step 4, 3rd meeting with partner	Watch the 2 videos with partner present, talk through questions and discrepancies
Step 4, without partner present	Code 3 on own, enter codes in training database
Trainer will check your coding reliability	
Step 5	Discuss reliability (and any discrepancies) with Trainer and partner. If reliable, start coding independently. If not reliable on all codes, repeat steps 4 and 5 until reliable.
Once Reliable	Code 4 videos independently, code 5th video independently then consensus code with partner. Consensus code by discussing discrepancies in independent codes and making decisions of how best to code.

Behavior code construct validation measures.

- *Child Behavior Questionnaire.* The Child Behavior Questionnaire (CBQ; Rothbart et al. 2001) has 195 items rated on a 7-point scale from 1 "extremely untrue' to 7 "extremely true" for children 3-8 tapping into temperamental, trait-based behaviors. Kochanska and colleagues (1994) found coefficient alphas to be between .68-.93 across the 15 subscales and supplemental scores. Alphas for the current study subscales were as follows: activity level .70, frustration .86, approach .66, attention focus .77, attention shifting .68, discomfort .79, recovery .85, fear .74, high intensity pleasure .72, inhibitory control .83, low intensity pleasure .76, perception .57, sadness .73, shyness, .92, smiling .72.
- *The Child Behavior Checklist 1.5-5 and 6-18* (CBCL, Achenbach & Rescorla, 2001) is a parent-completed questionnaire designed to assess externalizing and internalizing problem behaviors in children ages 6 to 18 in both clinical and research environments (Achenbach et al., 1991a). The scale consists of 120 items related to behavior problems across multiple domains. Items are scored on a 3-point scale ranging from "not true" to

"often true" of the child. Responses result in global scores for externalizing, internalizing, and total problems, as well as a number of empirically based syndrome scales, (Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Attention Problems) and disorder-based scales (Anxiety, Depression, Attention Deficit/Hyperactivity, Oppositional Defiant Disorder). Only scales available in both versions (ages 1.5-5 and 6-18) were used in subsequent analyses. The CBCL has well established and excellent validity and reliability (see Achenbach & Rescorla, 2001). Externalizing and internalizing broadband scores standardized into 'T scores' for the respective child ages and gender. A T score of 65-69 indicates "borderline" and a T score of 70 or greater indicates "above threshold" and thus likely clinical risk. In the current sample, Cronbach's alphas for internalizing for externalizing scales were .88 and .87 for children younger than 6 years and .863 and .855 for children older than 6 years.

- *Cortisol.* HPA-axis stress functioning was estimated from cortisol levels extracted from a total of 9 saliva samples obtained during the course of the 120-minute home visit. To obtain cortisol samples, the child chewed on a cotton dental roll until soggy with saliva. The first saliva sample (Cortisol 1) was taken upon arrival of clinicians to the home visit. At this time, a stopwatch will be started and all further samples will be collected according to a strict schedule. Two more saliva samples will be taken at 30 minutes after the first sample, just prior to the Speech Preparation (Cortisol 2) and just before Speech Delivery of the Speech Task (Cortisol 3). Saliva samples were then taken at 15, 25, 35, 45, 55, and 65 minutes post the initiation of the stress task (Cortisol samples 4-9). All salivettes were centrifuged and stored in a freezer at -20^{o} Celsius until assayed. Samples were assayed at a University of Michigan Psychology Department within 6 months of collection in duplicate, and averaged using a commercial enzyme immunoassay kit (Salimetrics). The sensitivity of the assay was 0.01 μg/dl. To decrease inter-assay variability, all samples from the same child were assayed in the same batch. Duplicates varying more than 15% were re-assayed. The inter-assay and intra-assay coefficients of variability were 5% and 9% respectively.

Measures of child risk status.

- *Maternal depression.* Depressive symptoms were assessed with the Beck Depression Inventory-II (Beck et al, 1996). It consists of 21 items scored on a 0-3 point scale and scores can be categorized into minimal, mild, moderate and severe depression. Among psychiatric samples, the internal reliability of the BDI-II has ranged 'from a =. 89 to a =. 92 (Beck et al 1996). Current Cronbach's alpha for all symptoms was .92.
- *Maternal PTSD.* Post-Traumatic Stress Disorder was assessed using the National Women's Study PTSD Module (Resnick et al., 1993) because many participants were recruited from a prior study, which oversampled for women with child trauma histories. The NWS-PTSD is a version of the Diagnostic Interview Schedule (DIS) modified for use as a phone survey with excellent psychometric properties (sensitivity .99 and specificity 0.79) compared with the SCID (Resnick et al., 1993). The NWS-PTSD measures all 17 symptoms of PTSD and yields dichotomous diagnosis and continuous symptom count. Cronbach's alpha for all symptoms was .83.
- *Family demographics.* The demographic questionnaire included questions regarding caregiver race, education level, marital status, family income, and child's race, birth date, and caregiving situations each week.

- *Clinical interview*. A structured clinical interview was conducted with the caregiver (and sometimes child if age appropriate). The Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version [54] is validated for children 5-18 with some evidence to suggest validation for preschoolers (Birmaher et al., 1996; Kaufman et al., 1997). We used a version of this interview, with prompts modified for pre-school aged children appropriateness developed by Dr. Joan Luby at the Washington University School of Medicine in St. Louis. This semi-structured clinical interview is based on DSM-IV criteria and provides reliable and valid psychiatric diagnoses. Percent agreement for all diagnoses ranges from 93% to 100%, test-retest reliability ranges from .63 to .90, and diagnostic categories are consistent with scores in the Child Behavioral Checklist (CBCL). In this diagnostic interview, the clinician spends 1-2 hours with the participant and their parent assessing symptoms of past or current mood disorders, psychosis, anxiety disorders, eating disorders, ADHD, conduct disorders, and substance use disorders. Advanced, trained clinical psychology doctoral students conducted interviews and received at least monthly supervision by a licensed psychologist and a psychiatrist, wherein all interviews were reviewed by all clinicians and the supervisor. Final diagnoses were derived via clinical consensus using the best-estimate procedures (Maziade et al., 1992) based on the child and parent report, family history, and other self-report symptom checklists.

Statistical Plan

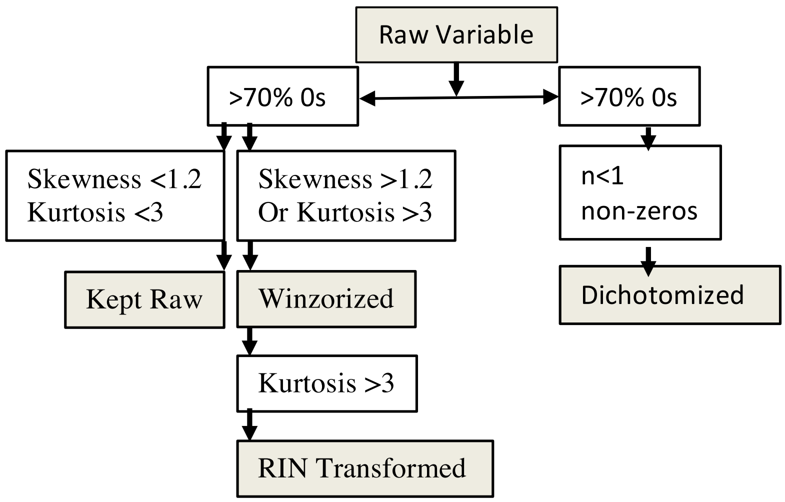
After satisfactory inter-rater reliability (intra-class coefficient two way-mixed single measures) for coding was analyzed and established, descriptive statistics were conducted on all behaviors to report means, standard deviations, distribution, kurtosis.

In order to prepare behaviors for analyses requiring normalized data, a decision tree was created to transform codes as needed for subsequent analyses. The descriptive statistics, decision tree, and final forms of all codes used in Aims 2-4 are described below.

Frequencies and descriptive statistics (mean, standard deviation, skewness, and kurtosis) of raw codes were examined to determine how whether codes were normally distributed, and if not, how to transform them into normally distributed/dichotomous variables for subsequent analyses.

A decision tree (see below) was created for this purpose: 1) If frequency of 0s was greater than 70%, the variable was dichotomized into 0s and >0s; 2) If skewness was <1.2 and kurtosis was <3, the code was left as continuous in its raw form; 3) If skewness was >1.2 and kurtosis was >3, the code was winzorized at 2 or 3% and descriptives were run again; 4) If in the winzorized descriptives, the kurtosis was still >3, the code was transformed using Rank-based Inverse Normal (RIN) transformation (i.e., transformation to rankit scores using Rankit's formula). Snake Verbal Anxiety and Bubbles Minute 1 Fear were included as dichotomous variables (Decision Tree, Item 1a). All other variables were included as continuous variables (raw, winzorized, and/or transformed). Tables 3-6 show raw descriptive statistics for each code, and the suggested variable form from this decision tree for subsequent analyses, and new descriptives of the new variable form.

Figure 2. Variable Decision Tree



For tests of correlations in subsequent analyses, Rankit's formula has been determined to maximize power while also controlling for Type 1 error rate with non-normal data (especially among variables with Chi Square (df=1) and/or Long Tail (high kurtosis) distributions most similar to our data) compared to raw scores and/or alternative transformation types (Bishara & Hittner, 2012). We performed an internal investigation into our own non-normal data forms using the Snake Non-verbal Positivity, such that we analyzed descriptive statistics (Table 3) and correlations with a CBQ child temperament trait (Table 7) as a raw, winzorized, and dichotomized variable as well as RIN transformed (by Rankit formulation) and Natural Log transformed variables. Consistent with Bishara & Hittner's findings (2012), we found RIN transformed data to best control for Type 1 error for this variable which has a Chi Square distribution.

Therefore, we used RIN transformation on all subsequent correlation tests for non-normally distributed data (with greater than 25% non-zeros) to attain maximal power while best controlling for Type I error. Tables 3-6 also show descriptive statistics for the "final forms" of each code and how it was used in all subsequent analyses.

Although task phase durations were standardized in the protocol, issues such as child refusal or administrator error caused duration deviations (see Table 8 for Episode duration descriptive statistics). Correlations were conducted to examine whether codes varied by task duration. Significant correlations are displayed in Table 9, episode durations were thus controlled for (using Partial Correlations or adjusted regression models) in all subsequent analyses for non-verbal Speech Delivery Positivity; non-verbal Snake and Verbal Anxiety and Verbal Fear, and Reward Verbal Initial Positivity.

Using these new variable forms, we assessed the internal consistency of behaviors within the same subdomain by conducting Cronbach's alphas. We then assessed convergent and discriminant validity of these behaviors compared to caregiver report of child temperament and problem behaviors by conducting bi-variate and partial correlations controlling for task duration. We assessed for concurrent criterion validity using linear and logistic regressions adjusted for child age and gender predicting to caregiver reports of caregiver psychopathology and child problem behaviors, as well as clinician rated child diagnoses.

To assess the association between behaviors and cortisol activation and recovery, we used a mixed level growth curve modeling (GCM) with landmark registration using SAS PROC MIXED (Lopez-Duran, Mayer, & Abelson, 2014a). This approach simultaneous modeled cortisol activation (pre-peak slopes), post-stressor cortisol peaks, and recovery (post-peak slopes) controlling for baseline and time to peak differences. Cortisol values were winzorized at 5%, and transformed using Box–Cox power transformation for cortisol time series $X' = (X^{26} - 1)/0.26$, which produces superior results in normalizing the distribution of cortisol values compared to traditional log transformation (Miller and Plessow, 2013). First, individual post-stressor peaks were identified from a visual analysis of the individual curves. Peaks were defined as the first point in the activation slope that was at least 40% and 20% greater than the baseline if the baseline was 0-.06 µg/dl and greater than .06 µg/dl, respectively, and was followed either by a plateau or a decline. Second, the timing of each individual peak was identified and was used to create a new time axis reflecting minutes from peak. The timing of each individual baseline was also identified as the lowest cortisol value prior to peak, which was followed by an incline to peak. Individual baselines differed due to children recovering from the initial novelty of the start of the home visit, mirroring other literature (as discussed in (Gunnar, Talge, & Herrera, 2009a) for children and (Kirschbaum, Pirke, & Hellhammer, 1993) in adults). Although the protocol anticipated 30 minutes for children to recover from initial increase in cortisol from the novelty, from plot representations of our cortisol data, it was clear novelty recovery to baseline ranged from 0 to 65 minutes (M=45m, SD=10m) post the first cortisol sample which was taken within 5 minutes of the beginning of the home visit. These individual baseline and peaks entails the adjustment of the curves so that each peak and baseline falls on the same time points. Those with an identifiable peak (i.e. responders) were analyzed separately than those without (i.e. non-responders). We then created spline time variables to represent minutes before and after the peak. We then conducted a multilevel random effects model of the cortisol pre- and post-peak trajectory with peak levels as the intercept. All models included random intercepts and slopes, while controlling for cortisol baseline levels.

Of the 96 participants in the study, 84 had at least one viable cortisol sample and were included in analyses. The 12 child without cortisol analyses either refused to give sample saliva, or their samples were too low in volume to be accurately assayed.

Finally, as exploratory analyses, K means cluster modeling using squared Euclidian distance as a proximity measures will be conducted on the behaviors in MatLab. To identify the number of naturally occurring groups, or profiles, within each set of variables, we calculated the total inter-profile distance for m profiles identified by the k-mean algorithm, where the number of clusters (m) is varied between 1 and 25. This process is repeated 10 times, and averaged to yield the scree plots shown, which illustrate the relationship between the number of clusters (x-axis) and the inter-profile distance (y-axis). This averaging approach mitigates any random effects in the inter-profile distance due to random initiation of the k-means algorithm. The optimal number of profiles was identified by the elbow in the Scree plot, where the consideration of additional profiles has little influence on the total inter-profile distance. To assign observations to groups, we ran two iterations of the K means algorithm using the optimum number of profiles, and compared the individuals included in each profile across iterations to ensure identified profile were not sensitive to random initial conditions. If profiles in both iterations were identical, the profiles were deemed reliable and are reported herein.

CHAPTER III: Results

The objective of this dissertation was to adapt mood induction tasks and to create corresponding behavioral codes to assess the RDoC valence subdomains of Anxiety, Fear, Initial and Sustained Positive Response. In order to examine the utility of these behavioral codes in assessing RDoC subdomains we had to first establish that the codes were reliable and demonstrated variance (Aim 1). Second, we needed establish convergent and discriminant validity by 1) comparing and contrasting valence codes to each other, 2) to previously validated reports of concurrent child behavior and 3) child physiology (cortisol reactivity) (Aim 2). Third, we needed to establish criterion validity (Aim 3) by comparing valence codes to child risk for disorders relevant to RDoC valence domains including 1) caregiver internalizing psychopathology as well as 2) child parent-reported problems; and clinician diagnosis. Finally, once reliability and validity were established, we explored profiles of behaviors (Aim 4) to examine how they naturally related to each other, and to investigate whether any profiles mapped onto child risk for psychopathology.

Aim 1. Behavior Inter-Rater Reliability and Variance

In Aim 1, we aimed to adapt behavioral laboratory tasks to reliably assess for RDoC domains of affective processes in middle childhood. This aim would be achieved when 1) inter-rater reliability reached acceptable levels (Intraclass Coefficient (ICC) alpha 2-way mixed single measures >0.7), 2) frequency of each behavior was found in more than 15% of all participants (Durbin et al., 2005).

Reliability and descriptive statistics were conducted on all behaviors. The Snake Task was meant to induce the RDoC subdomain of Anxiety when the child was led into a dimly lit room unsure of what was inside (1 minute 30 seconds), and the domain of Fear after the child was startled with a fake snake and was encouraged to touch it (45 seconds). The Speech Task was also meant to induce Anxiety when the child was asked to prepare a speech on which they will be evaluated (2 minutes 30 seconds), and Fear during Speech Delivery when the child delivered their 'prepared' speech (3 minutes). In both of these tasks, non-verbal and verbal *Anxiety* (anticipatory threat behaviors) were coded during the first phases, and non-verbal and verbal *Fear* (imminent threat behaviors) were coded during the second phases. Although they were differentiated conceptually and by phase, Anxiety and Fear were coded from the same behaviors (lip biting, hand fidgeting; verbal hesitations, saying "I'm scared", etc). Non-verbal and verbal Positivity were also coded in each phase of Snake and Speech tasks. However, these behaviors were not conceptualized in terms of RDoC domains because they did not represent hedonic response to a reward.

The Bubble Task was meant to induce RDoC subdomains of Initial Positivity during the first minute when the child first starts playing with bubbles, and Sustained Positivity, the difference between the level of positive affect in the third versus first minute of play. The Reward task was meant to induce Initial Positivity during its only phase (roughly 1-minute). Non-verbal and Verbal Fear were also coded in each minute of Bubble and Reward tasks. Fear behaviors during the Bubble task were not conceptualized in terms of RDoC domains because they did not represent a response to an ambiguous or acute threat. Although Verbal and Non-verbal Anger and Sadness were coded during all tasks, affect types were outside the scope of this dissertation (and variances for these codes were extremely low), thus excluded from subsequent analyses.

Intra-class coefficients were conducted for all behaviors. For the Snake Task, ICCs between coders ranged from .831 to .929 suggesting excellent reliability across behaviors. The exception was Non-verbal Positivity in Phase 1 when children were walking to the terrarium, in which all ratings were zero (ICC=0) and thus this code was excluded from further analysis. For the Speech Task, all codes had ICCs ranging from .888 to .989, suggesting excellent reliability for all behaviors. For the Bubble Task, one code was excluded for poor reliability (Verbal Fear in the first minute), but the rest of the ICCs ranged from .837-.982, suggesting excellent reliability. For the Reward Task, both non-verbal and verbal Fear exhibited poor reliability (both had very low variance with only 5 and 6 non-zero entities). Reward Verbal and Non-verbal Initial Positivity had good reliability with ICCs of .756 and .955. Is it important to note that behaviors excluded due to poor inter-rater reliability were context-incongruent (the Snake task as not designed to elicit positivity, the Bubble Task was not designed to elicit fear), and were not part of our core aims.

Frequencies were also conducted for all reliable behaviors. Only behaviors with more than 15% occurrence (participants displaying the behavior at least once during the task phase) across our sample were included in subsequent analyses. Verbal Positivity during the Snake task when children walked toward the terrarium, and non-verbal and verbal fear during the third minute of the Bubble task were each excluded from subsequent analyses due to low frequency of occurrence.

Aim 2. Behavior Convergent and Discriminant Validity

In Aim 2, we aimed to assess the convergent, and discriminant validity of the behavior codes for the various tasks.

Hypothesis 1: Within task behavior correlations assessing convergent and discriminant validity. First we examined correlations among Negative Valence behaviors within tasks, which were hypothesized to be similar and positively related (Table 12). In the Snake task (Table 12a), there were moderate positive correlations between verbal Anxiety with verbal Fear behaviors, $r(82) = .22$, $p = .05$, as well as between non-verbal Anxiety and non-verbal Fear, $r(82) = .35$, $p = .002$. Cross channel correlations (verbal to non-verbal behaviors) were absent for anxiety, $r(82) = -0.05$, $p = .62$, but moderate for fear, $r(82) = .58$, $p <.001$. In the Speech task, (Table12b), there were positive correlations between non-verbal Anxiety with non-verbal Fear, $r(72) = .44$, $p <.001$, but not verbal Anxiety with verbal Fear, $r(72) = .16$, $p =.20$. Cross channel correlations were absent for anxiety, $r(72) = .01$, $p =.95$, but moderate for Fear $r(88) = .41$, $p <.001$. There were no other significant correlations among Negative Valence behaviors within any task.

Next we examined convergent validity among Positive Valence behaviors within tasks, which were hypothesized to be similar and positively correlated (Table 13). In the Snake task (Table 13a), there was a moderate positive correlation between verbal with non-verbal Positivity $r(82) = .31$, p <.01. In the Speech task (Table 13b), there was moderate correlations between positivity behaviors over time for verbal, $r(72) = .37$, $p <.01$, and non-verbal, $r(72) = .42$, $p <.001$. Concurrent cross channel (verbal to non-verbal) correlations were weak for preparation $r(72) = .30$, $p =.01$ and delivery $r(88) = .22$, $p =.04$. Sequential cross channel correlations were moderate $r(72) = .31$, $p <.01$ for only verbal preparation to non-verbal delivery positivity and absent for non-verbal preparation to verbal delivery $r(72) = -.02$, $p=.84$. In the Bubbles task

(Table 13d), there were moderate negative correlations between Initial and Sustained Positivity for verbal $r(90) = -.53$, $p<.001$, and non-verbal $r\,(90)= -.48$, $p<.001$ such that the lower the child's initial positivity, the more they increase in positivity from minute 1 to minute 3 of the Bubble task. The only other significant correlation was moderate for cross channel for initial positivity $r(90) = .30$, $p<.01$. In the Reward task (Table 13c), cross channel initial positivity was absent $r(90) = .05$, $p=.65$.

Finally, we examined correlations between Negative and Positive Valence behaviors within tasks (Table 14), which were hypothesized to be distinct and therefore unrelated. The Snake task (Table 14a) exhibited good discriminant validity such that no Anxiety or Fear codes were significantly related to Positivity codes. In the Speech task (Table 14b), however, there was a weak positive correlation between verbal Anxiety and concurrent verbal Positivity, $r(72) = .26$, $p=.03$. In the Bubble task (Table 14c), there was also a weak, positive cross channel correlation between non-verbal Fear and verbal Initial Positivity $r(90) = .24$, $p=.02$, also inconsistent with discriminant validity.

Hypothesis 2: Between task behavior correlations assessing convergent and discriminant validity. First we examined correlations among Negative Valence behaviors across tasks, which were hypothesized to be similar and positively related. Inconsistent with convergent validity, there were no significant correlations between Anxiety behaviors or between Fear behaviors across tasks (Table 15). Specifically, Snake and Speech Anxiety were unrelated for verbal $r(58) = .04$, $p=.81$, and non-verbal $r(58) = -.17$, $p=.25$, as were Snake and Speech Fear for verbal $r(74) = -.01$, $p=.94$ and non-verbal $r(74)= -.03$, $p=.78$. There were no significant correlations cross channels between Snake and Speech tasks, nor were any Negative Valence Snake and Speech behaviors related to non-verbal Bubbles Fear.

Next we examined correlations between Positive Valence behaviors across tasks (Table 16), which were hypothesized to be similar and positively related. Consistent with convergent validity, we found several moderate correlations between verbal Initial Positivity and other Positivity behaviors. Verbal Bubbles Initial Positivity was correlated within channel with Reward Initial Positivity $r(87) = .31$, $p<.01$, and verbal Snake Positivity $r(72) = .30$, $p=.01$, and cross channel with non-verbal Snake $r(72) = .33$, $p<.01$ and non-verbal Speech Preparation Positivity $r(65) = .33$, $p<.01$. Non-verbal Bubbles Initial Positivity was unrelated to any other Positivity behaviors. Additionally, verbal Reward Initial Positivity was weakly correlated verbal Snake Positivity $r(72) = .28$, $p=.02$. Non-verbal Reward Initial Positivity was weakly correlated within channel to Speech Preparation $r(65) = .28$, $p=.03$, and Bubbles Sustained Positivity $r(87) = .24$, $p=.03$. Finally, there were weak to moderate correlations between Snake Positivity within channel with verbal Speech preparation $r(58) = .31$, $p=.02$, and cross channel with non-verbal Speech preparation $r(58) = .28$, $p=.03$. There were no other correlations among Positive valence behaviors across tasks.

Finally, we examined relationships between Negative and Positive Valence behaviors across tasks (Table 17), which were hypothesized to be distinct and unrelated. The following weak correlations were inconsistent with discriminant validity: verbal Snake Fear with verbal Reward Initial Positivity $r(72) = .26$, $p=.04$; Non-verbal Snake Fear with non-verbal Bubbles Sustained Positivity $r(68) = .26$, $p=.03$; and non-verbal Bubble Fear with non-verbal Speech preparation Positivity $r(65) = .28$, $p=.03$. There were no other significant correlations between Negative and Positive Valence.

Hypothesis 3. Convergent and discriminant validity as compared to child temperamental traits. Caregiver-reported child temperament (using the Child Behavior

Questionnaire; CBQ) was used to assess convergent and discriminant validity of task behaviors. Descriptives of trait variables are displayed in Tables 18. All variables were normally distributed.

Anxiety. In examining convergent validity, we expected Anxiety behaviors (Table 19a) code during the tasks to be weakly to moderately, positively correlated with CBQ traits of Approach Excitement, Discomfort, and Fear. The following relationships were consistent with hypotheses: Snake Verbal Anxiety was positively, moderately correlated with CBQ Approach Excitement $r(82) = .32, p<.01$, Speech Non-verbal Anxiety was moderately, positively correlated with Sensory Discomfort $r(72) = .27, p=.03$. Inconsistent with hypotheses, CBQ Sensory Discomfort was negatively correlated with Snake Non-verbal Anxiety $r(82) = -.24, p=.05$ and no behaviors were significantly correlated to CBQ Fear. There were no other hypothesized correlations to similar domains.

Consistent with discriminant validity, Anxiety behaviors were unrelated to the positive valence CBQ traits Low intensity pleasure, High intensity pleasure, and Smiling/Laughter.
We then looked at exploratory analyses of behaviors with all other CBQ subscales, and found Snake Verbal Anxiety was positively correlated with CBQ Impulsivity $r(82) = .30, p=.01$, and Non-verbal Anxiety was negatively correlated with CBQ Sadness $r(82) = -.35, p<.01$.

Fear. In examining convergent validity, we expected Fear behaviors to be positively correlated with CBQ traits Sensory Discomfort and Impulsivity, and negatively correlated with Distress Recovery (Table 19b). Inconsistent with hypotheses for Fear behaviors, there were no significant correlations with any expected subscales.

In examining discriminant validity, we expected Fear to be unrelated to the positive valence CBQ traits Low intensity pleasure, High intensity pleasure, and

Smiling/Laughter. Inconsistent with hypotheses, there was a positive correlation between Speech Verbal Fear and High Intensity Pleasure $r(88) = .23$, $p=.04$.

In exploratory analyses, we found Verbal Snake Fear was correlated with Approach Excitement $r(82) = .30$, p=.01 (similar to Verbal Snake Anxiety), as well as negatively correlated with sadness $r(82) = -.25$, $p=.04$. We also found Verbal Speech Fear negatively correlated with shyness $r(88) = -.22$, $p=.04$.

Other Anxiety/Fear behaviors. As Fear behaviors from the Bubble task were not representative of a specific RDoC subdomain (Anxiety versus Fear), they were separated from Anxiety and Fear hypotheses regarding convergent and discriminant validity based on CBQ trait relationships, and all analyses were largely exploratory. However, non-verbal Bubble Fear behaviors were unrelated to any CBQ trait.

Initial Positivity. For convergent validity, we expected Initial Positivity behaviors to be positively correlated with CBQ traits of Approach Excitement, Activity level, High Intensity Pleasure, and Smiling/Laughter (Table 20a). Expected correlations were between verbal Reward Initial Positivity with CBQ High Intensity Pleasure $r(90) = .27$, p=.02, and verbal Bubbles Initial Positivity with CBQ Activity Level $r(90) = .24$, $p=.03$. Inconsistent with convergent validity, verbal Reward Initial Positivity was negatively correlated with CBQ Low Intensity Pleasure $r(90) = -.22$, $p=.05$.

For discriminant validity, although we expected Initial Positivity to be negatively correlated with CBQ Sadness, they were unrelated.

Other exploratory analyses show that Verbal Initial Positivity in both tasks (Bubbles $r(90) = .29$, $p<.01$ and Reward $r(90) = .32$, $p<.01$) were correlated with CBQ Impulsivity. There were also several negative correlations including verbal Reward behaviors with CBQ Attentional

Focus $r(90) = -.24$, $p=.04$, Attentional Shifting $r(90) = -.26$, $p=.02$ and Discomfort $r(90) = -.25$, $p=.03$, as well as verbal Bubbles Initial Positivity behavior with Shyness $r(90) = -.30$, $p<.01$.

Sustained Positivity. For convergent validity, we expected Sustained Positivity to be positively correlated with CBQ Activity and Smiling/Laughter (similar to Initial Positivity expectations), as well as Attentional Focus, and Low Intensity Pleasure. For discriminant validity, we expected Sustained Positivity behaviors to be negatively correlated with CBQ Sadness. Inconsistent with all hypotheses, there were no significant correlations between Sustained Positivity, nor were there any correlations found in additional exploratory correlations with CBQ traits (Table 20b).

Other Positivity behaviors. As Positivity behaviors from the Speech and Snake tasks were not representative of a specific RDoC subdomain, they were separated from Initial and Sustained Positivity hypotheses regarding convergent and discriminant validity based on CBQ trait relationships (Table 21). For convergent validity, we hypothesized that Speech and Snake positivity behaviors would be positively correlated with CBQ Smiling/Laughter and Approach Excitement. As expected, verbal Snake $r(82) = .33$, $p=.003$ and non-verbal Speech Delivery Positivity $r(88) = .31$, $p=.006$ were positively correlated with Smiling/Laughter, but all Positivity behaviors were unrelated to CBQ approach excitement.

For discriminant validity we hypothesized that Speech and Snake Positivity behaviors would be negatively correlated with Discomfort and Shyness. Verbal Snake Positivity was negatively correlated with Shyness $r(82) = -.27$, $p=.02$. Inconsistent with hypotheses, non-verbal Speech Positivity during speech delivery was positively correlated with Sensory Discomfort $r(88) = .26$, $p=.02$. There were no other significant correlations with hypothesized subscales.

In exploratory analyses, we found positive correlations of verbal Snake $r(82) = .306$, $p=.006$ and non-verbal Speech Delivery Positivity $r(88)= .26$, $p=.015$ with CBQ Impulsivity (similar to verbal Snake Anxiety, and Reward/Bubbles Initial Positivity behaviors). Non-verbal Snake was weakly positively correlated with CBQ High Intensity Pleasure $r(82) = .28$, $p=.01$ (similar to verbal Speech Fear and Reward Initial Positivity behaviors) and negatively correlated with CBQ Fear $r(82) = -.23$, $p=.04$, Frustration $r(82) = -.24$, $p=.04$. Non-verbal Speech Delivery Positivity was negatively correlated with Perceptual Sensitivity $r(88) = -.29$, $p=.008$, and Inhibitory Control $r(88) = -.22$, $p=.05$ (unlike any prior behaviors), suggesting Snake and Speech Positivity may be similar to Anxiety, Fear and Initial Positivity behaviors, while also having distinct qualities.

Hypothesis 4. Convergent and Discriminant Validity as compared to child behavior problems. Caregiver-reported child problems (using the Child Behavior Checklist; CBCL) were used to assess convergent, and discriminant validity of the valence codes. Descriptives of these variables are displayed in Tables 22. CBCL subscales were RIN transformed for subsequent analyses.

Anxiety. We hypothesized that Anxiety behaviors would be related to all internalizing problems, but unrelated to externalizing problems. Consistent with hypotheses, Non-verbal Speech Anxiety was indeed positively correlated with Anxiety/Depression at trend level, r(72) = .22, p=.069, Somatic $r(72) = .30$, $p=.01$, Depression $r(72) = .31$, $p=.01$, $r(72) = .37$, $p=.002$. No other Anxiety behaviors were related to any other internalizing subscales. Inconsistent with discriminant validity hypotheses, non-verbal Speech Anxiety was also related to externalizing subscales including ADHD, $r(72) = .27$, $p=.03$, ODD, $r(72) = .24$, $p=.05$, and Aggression, $r(72)$

= .28, p=.02. Verbal Snake Anxiety was positively correlated with ADHD, $r(82) = .28$, p=.01, and Attention problems, $r(82) = .27$, p=.02.

Fear. We expected Fear behaviors would be related to only Anxious/Depressive problems given its focus on child specific-fears, and unrelated to all other problem scales. Inconsistent with discriminant validity hypotheses, Verbal Speech Fear was significantly correlated with externalizing subscales, ADHD, $r(88) = .24$, p=.03, Attention, $r(88) = .22$, p=.04, and Aggression problems, $r(88) = .29$, p=.007.

Other Negative Valence behaviors. Non-verbal Bubbles Fear was not related to any problem subscales.

Initial and Sustained positivity. For convergent validity, we hypothesized that both Initial and Sustained Positivity behaviors would be positively correlated with externalizing subscales problems given their focus on impulsivity. Additionally, we hypothesized that Sustained Positivity would be negatively correlated with attention problems. No hypothesized or exploratory correlations were statistically significant (Table 24).

Other positivity behaviors. For Positivity behaviors during the Snake and Speech tasks, we did not have any *apriori* hypotheses in terms of convergent or discriminant validity based on child problem behaviors (Table 25). Interestingly, there were several correlations of behaviors across both internalizing and externalizing problem subscales. Verbal Snake Positivity was correlated with Anxiety/Depression $r(82) = .23$, p=.04, Withdrawn $r(82) = .22$, p=.05, and Attention $r(82) = .28$, p=.01, and Non-verbal Speech Preparation Positivity was correlated with Somatic $r(72) = .26$, p=.03, Depression $r(72) = .26$, p=.02, and ODD problems $r(72) = .25$, p=.04. Verbal Speech Preparation Positivity was correlated with Withdrawn problems only $r(72) = .26$, p=.03.

Hypothesis 5. Convergent validity examined via behaviors predicting to cortisol reactivity. We hypothesized that during the anxiety/fear-tasks, children with higher levels of fear and anxiety would have heightened cortisol reactivity post stressor than children with lower levels of negative valence behaviors.

Of the 84 children with valid cortisol, 52 (62%) were responders with an identifiable peak, leaving 32 (38%) were non-responders. Responders and Non-responders did not differ on any demographic, affect-valence codes, or child risk variables. In the subsequent analyses we used three cortisol values as anchors in the mixed-models, 1) initial Cortisol sampled upon home visit arrival, 30 minutes prior to the start of the stress task, 2) baseline, the lowest cortisol value prior to the rise in cortisol caused by the stressor, and 3) peak, the highest cortisol value between 15 and 45 minutes post stressor preceded by a rise from baseline. For responders, the mode baseline time was 15 minutes (38%) post stressor followed by 25 (21%) and 0 (19%) minutes, and the mode peak time was at 35 minutes post stressor (35%) followed by 45 (23%) and 25 (21%) minutes. For those without an identifiable peak (i.e., non-responders), we used the 15-minute post stressor time point (the mode baseline time) in order to model their non-response.

Responders versus non-responders: initial cortisol to baseline. Prior to hypothesis testing, we first examined non-responders to understand the cause of their non-response. It is possible these children react so highly to novelty of the research visit (with high initial cortisol values) that they do not recover in time to react again to the specific research stressor. Alternatively, they could simply not be stressed/reactive to the specific research stressor (Gunnar et al., 2009a; Suzuki, Belden, Spitznagel, Dietrich, & Luby, 2013). We examined the current sample of responders and non-responders for their initial cortisol values and recovery to baseline (i.e. over the first 45 minutes of the visit). In separate models, Responders' salivary cortisol levels decreased significantly from the start of the home visit (30 minutes pre stressor), Recovery Slope (*b* = -0.006, SE = 0.0014, $p < .001$), confirming the expected fall in cortisol levels in response to the novelty of having administrators in their home. For Non-Responders, cortisol levels remained flat from the start of the home visit (*b* = -0.0001, SE = 0.002, p =.190). In an adjusted model with Responder status as a predictor, Non-Responders had significantly lower initial cortisol values than Responders (*b* = -0.16, SE = 0.050, p = .002), and whereas Responders significantly declined from initial cortisol values (*b* = -0.006, SE = 0.0014, $p < .001$), Non-Responders displayed a flatter slope to baseline than Responders (*b* = 0.004, SE = 0.0022, p = .082 at trend level significance). Non-Responders did not differ from Responders in baseline cortisol values, $t(69)$=-.749, p=.457. Thus, it appears Non-Responders showed no reactivity to the Speech stressor due to true non-response and not due to poor recovery from heightened novelty response, as they showed lower initial cortisol values than Responders.

Predicting initial cortisol values for responders and non-responders. Although modeled separately, Responders and Non-Responders seemed to have similar patterns, such that more Anxiety/Fear predicted lower initial cortisol, and more Snake/Speech Positivity predicted higher initial cortisol. Speech Verbal Anxiety (*b* = -0.087, SE = 0.033, p = .012) and Snake Verbal Anxiety (*b* = -0.183, SE = 0.091, p = .048) predicted lower initial cortisol in Non-Responders. Among Responders only Speech Verbal Anxiety (*b* = -0.113, SE = 0.045, p = .013) again predicted lower initial cortisol in Responders. Non-verbal Speech Delivery Positivity (*b* = .083, SE = 0.032, p = .012) and Verbal Snake Positivity (*b* = .029, SE = 0.013, p = .034) both predicted higher initial cortisol in Responders, and Non-verbal Speech Delivery Positivity (*b* = 0.104, SE = 0.041, p = .014) predicted higher initial cortisol in Non-Responders. None of the behaviors predicted trajectory from initial values to baseline values.

Models of cortisol responses from baseline. We next modeled cortisol reactivity for Responders only from baseline onward. An unconditional model demonstrated that from baseline, Responder cortisol levels increased (b = 0.012, SE = 0.003, p < .001), and a significant negative quadratic term suggested that increased decelerates over time (b = -0.0002, SE = 0.000, p = .005), indicating the expected rise and fall of the cortisol response after stress.

Adding behavior predictors in separate unadjusted models, we found that Speech Fear (Verbal: b = -0.0073, SE = 0.004, p = .075; Non-verbal: b = -0.0049, SE = 0.003, p = .099) decreased baseline at trend level, whereas Speech Verbal Positivity (Preparation: b = 0.145, SE = 0.052, p = .005; Delivery: b = 0.075, SE = 0.042, p = .077) increased baseline at trend level. No predictors significantly impacted reactivity shape from baseline.

Predicting cortisol responses to and from peak. Finally, we conducted a model that simultaneously examined peak levels as well as the activation (baseline to peak) and recovery slopes (peak to the post-peak recovery) for Responders only. Different than the previous model, which addressed baseline values and general trajectory of cortisol reactivity, this model predicts each segment of reactivity separately in turn, activation, peak, and recovery. In an unconditional model, salivary cortisol levels increased significantly towards peak, Activation Slope (b = 0.014, SE = 0.002, p < .001), and then declined significantly after reaching peak, Recovery Slope (b = -0.011, SE = 0.002, p < .001), confirming the expected rise and fall in cortisol levels in response to the social-evaluative stress of the Speech task.

Adding behavioral predictors to this model, Verbal Speech Anxiety was associated with greater Peak (trend level: b = .006, SE = .003, p = .090), but not Activation, (b = .002, SE = .004, p = .622), or Recovery Slopes, (b =-0.002, SE = .004, p = .641). Next we ran models with behaviors predicting cortisol reactivity induced from the Snake task. Verbal Snake Fear was associated with greater Peak at trend level, (*b* = .015, *SE* = .008, *p* = .069), but not Activation, (*b* = .000, *SE* = .0008, *p* = .960) or Recovery Slopes, (*b* =-0.0002, *SE* = .0008, *p* = .788). Non-verbal Snake Fear was also associated with greater Peak, (*b* = .016, *SE* = .005, *p* = .004), but not Activation, (*b* = .0004, *SE* = .0005, *p* = .377) or Recovery Slopes, (*b* =0.0002, *SE* = .0005, *p* = .693). No other Speech or Snake behaviors impacted cortisol reactivity.

We then conducted some post-hoc analyses using child risk indices to predict cortisol reactivity (activation, peak, and slope). Although previous literature describes child internalizing risk to be associated with altered cortisol reactivity in general, few have used our specific analytic methods (see (Lopez-Duran, Mayer, & Abelson, 2014b)) to analyze which piece (activation, peak, or slope) of reactivity is altered. By examining this phenomenon within the current study, we are able to make more precise comparisons to the negative valence behaviors - cortisol reactivity link and the internalizing risk -cortisol reactivity link. Thus, in paralleled analyses predicting to and from peak, we also fit separate models of child internalizing risk status variables (caregiver psychopathology symptoms, CBCL internalizing and externalizing problems, current internalizing diagnosis) on cortisol reactivity. Neither caregiver PTSD nor depressive symptoms impacted child cortisol reactivity. Caregiver-reported child internalizing problems, controlling for externalizing symptoms (which was not significant), were associated with greater Peak (*b* = .008, *SE* = .003, *p* = .005), and flatter Recovery Slope (at trend level: *b* =-0.0005, *SE* = .0003, *p* = .056), but were not associated with Activation slope (*b* = .0002, *SE* = .0003, *p* = .487). Caregiver-reported child externalizing symptoms, controlling for internalizing symptoms did not significantly impact any part of child cortisol reactivity. Having a current internalizing diagnosis (n=10 of 47 Responders with diagnostic information) was associated with greater Peak (*b* = .145, *SE* = .063, *p* = .024), but was not related to Activation (*b* = .0062, *SE* = .006, *p* = .309) or Recovery Slopes (*b* =-0.006, *SE* = .007, *p* = .357).

AIM 3: Criterion Validity Examined via Behaviors Predicting to Child Risk Indices

Aim 3 was focused on assessing criterion validity of behaviors by linking them to indices of child risk. We compare behaviors to familial risk (caregiver psychopathology), child problem behaviors and diagnostic status, and atypical cortisol patterns. As additional exploratory analysis, we also compare behaviors to child demographic characteristics.

Hypothesis 1*:* Criterion validity examined via behaviors predicting to familial risk. To assess the associations between behaviors with child familial risk, we conducted unadjusted models of behaviors predicting caregiver PTSD and depressive symptoms, controlling for phase duration. For descriptives of caregiver psychopathology symptoms see Table 26. We hypothesized that children who displayed more Anxiety and Fear, and/or less Initial and Sustained positivity would have caregivers with more psychopathology symptoms. Inconsistent with hypotheses, no Anxiety, Fear, Initial or Sustained Positivity behaviors were related to caregiver psychopathology.

In exploratory analyses, we found many positivity behaviors during the Snake and Speech tasks were predictive of caregiver psychopathology symptoms. Prior to regression models, in correlation analyses we found several weak to moderate positive correlations between Snake and Speech Positive behaviors with PTSD clusters, and PTSD total symptoms and depressive total symptoms, see Table 27. In unadjusted models controlling for task duration, we found the following behaviors were significantly predictive of total PTSD symptoms: Verbal, *b* = .674, *t*(66) = 3.274, *p* = .002 and Non-verbal, *b*=2.85, *t*(66)=3.885, p<.001 Snake Positivity, as well as Verbal, *b*=1.54 *t*(68)=2.596, p=.012, and Non-verbal, *b*=1.31 *t*(68)=2.253, p=.028, Speech Preparation Positivity. We also found the following behaviors were significantly predictive of total depressive symptoms: Non-verbal, *b*=4.416 *t*(68)=3.022, p=.004, and Verbal, *b*=.930 *t*(68)=2.257, p=.027, Snake Positivity, as well as Verbal Speech Preparation Positivity *b*=3.40 *t*(69)=2.774, p=.007.

Hypothesis 2: Criterion validity examined via behaviors predicting to child problems and diagnoses. We hypothesized children with more Anxiety and Fear behaviors would predict more CBCL internalizing problems and be more likely to have an internalizing diagnosis. We also hypothesized children with more Initial and Sustained Positivity behaviors would predict more CBCL externalizing problems and be more likely to have an externalizing diagnosis. We performed linear and logistic regressions predicting to 1) current child problems as reported by caregiver and 2) current diagnostic status as reported by clinician in separate models behaviors controlling for task phase duration. All models were first run including both child gender and child age as controls. These demographic variables were not significant in any models, and thus behaviors were each modeled in separate models only controlling for task phase duration.

We first ran models predicting to total caregiver reported internalizing problems from Fear, Anxiety, and Initial and Sustained Positivity, and Positivity during the Snake and Speech tasks. Consistent with hypotheses, the more non-verbal Speech Anxiety behaviors, the more internalizing problems the child was reported to have, *b*=.314 *t*(68)=2.73, *p* =.008. However, no other Anxiety or Fear behaviors, or Positivity behaviors predicted internalizing problems.

We next conducted a model predicting total caregiver reported externalizing problems. Non-verbal Speech Anxiety, *b*=.253 *t*(68)=2.24, *p*=.028, also predicted externalizing problems. Inconsistent with hypotheses, no Initial or Sustained Positivity behaviors were significantly predictive. In exploratory analyses of separate models, more verbal Snake Positivity *b*=1.24 *t*(66)=2.418, *p* =.018, and non-verbal Speech Preparation Positivity, *b*=3.43 *t*(68)=2.23, *p*=.029, predicted more externalizing problems.

Next, we ran similar models predicting clinician reported child internalizing diagnosis (versus no internalizing diagnosis). In separate models, Non-verbal Speech Anxiety, (*b*=.057, SE=.024, *p*=.019, OR=1.06), predicted greater likelihood of an internalizing diagnosis. No other behaviors predicted current internalizing diagnosis.

Then, we ran similar models predicting clinician reported child externalizing diagnosis (versus no externalizing diagnosis). In separate models, the following Fear behaviors predicted greater likelihood of having an externalizing diagnosis: non-verbal Snake Fear, (*b*=.227, SE=.090, p=.012, OR=1.255), verbal Snake Fear, (*b*=.272, SE=.134, *p*=.042, OR=1.31), as well as the following Positivity behaviors: Non-verbal Bubbles Initial, (*b*=.155, SE=.061, *p*=.010, OR=1.17), verbal Bubbles Initial Positivity, (*b*=.202, SE=.076, *p*=.008, OR=1.22), verbal Reward Initial Positivity (*b*=.318, SE=.042, *p*=.042, OR=1.375) and non-verbal Reward Initial Positivity (*b*=3.27, SE=.002, *p*=.002, OR=26.33). In exploratory analyses of Positivity behaviors during Negative Valence induction tasks, non-verbal Speech Delivery Positivity, (*b*=.873, SE=.393, *p*=.026, OR=2.39) predicted greater likelihood of having an externalizing diagnosis.

Finally, we ran similar models predicting to clinician reported child diagnosis (any internalizing/externalizing diagnosis versus no diagnosis). There were no significant behavioral predictors when running separate unadjusted models. However, several trend level significant behaviors led us to conduct models adjusted for child age, gender, and other behaviors within the task and channel. In a non-verbal Snake behavior model (R^2=.17), Anxiety predicted lesser likelihood of diagnosis (trend level: *b*=-.156, SE=.094, *p*=.095, OR=.855), whereas Snake Fear predicted greater likelihood of diagnosis (*b*=.163, SE=.073, *p*=.026, OR=1.177). In an adjusted model with non-verbal Speech behaviors (R^2=.19), non-verbal Anxiety (at trend level: *b*=.051, SE=.027, *p*=.060, OR=1.052), and non-verbal Speech Delivery Positivity (*b*=1.097, SE=.480, *p*=.022, OR=2.994) predicted a higher likelihood of having a diagnosis. No other behaviors predicted current diagnostic status.

Exploratory: Child demographic characteristics. Pearson correlations were conducted between behaviors and child demographics including child age, caregiver education level, and household income, as well as Spearman correlations with race (minority vs not), and gender (male vs female). Results show a few weak to moderate correlations. Child age was positively correlated with Speech Verbal Fear, r(87)=.315, p=.003, and Non-verbal Fear, r(87)=.244, p=.022, and child gender was positively correlated with Speech Preparation Verbal Positivity, r(72)=-.234, p=.048, and Snake Reveal Non-verbal Positivity, r(79)=-.324, p=.004, such that girls display slightly more positivity than boys. Additionally, child minority, r(79)=.246, p=.029, was related to Snake Non-verbal Fear such that non-White children displayed more non-verbal fear after the snake was revealed. No other correlations were statistically significant.

AIM 4: (Exploratory) Behaviors Latent Profiles

In Aim 4 we focused on assessing latent profiles of Negative Valence and Positive Valence domains in children. We hypothesized that there would be naturally occurring profiles of valence subdomains based on RDoC subdomains. We also hypothesized that these profiles will characterize child risk.

Groupings of behaviors representing Negative and Positive Valence subdomains were entered into a K-Means Cluster Analysis model in Matlab (Mathworks, Inc., Natick, MA). Individuals could only be included in the analyses if all variables were valid and present, thus due to technical difficulties with some videos across tasks, total n was only 59. As the preferred n was much lower than the preferred 5*2^k (k being number of variables, equal to 4 in the current study), which would yield a suggested n of 80 in current analyses for cluster analyses (as cited by Forman, 1984 in a review by (Dolnicar, 2002)), we imputed all valence codes using Expectation-Maximization (EM) imputation which uses tertiary variables to impute a value and then evaluates (and increases if possible) the likelihood of that imputed value occurring (Dempster, Laird, & Rubin, 1977).

Missingness analyses. The following data was imputed Speech Preparation n=24 (25%), Speech Delivery n=8 (8%), Snake n=17 (18%), Bubble n=15 (15%), Reward n=17 (18%). Attritional analyses revealed that although there were some associations between child demographics (age, income) and missing data (those missing Snake and Speech Preparation were younger and older, respectively; Reward, Bubble and Snake missing IDs all had lower income), there were no associations among missing data and child risk variables including caregiver psychopathology, internalizing/externalizing symptoms, or current diagnoses with one exception. The one exception was that Speech Delivery missing variables (n=8) were related to a higher level of caregiver PTSD symptoms, however, we continue with analyses and interpret any results with caution.

Using the ‘exploratory’ correlation analyses with CBQ child temperament, demographics, and inter-correlations between codes we conducted EM imputation for all variables. Scores were transformed into Z-scores for ease of interpretation. With a new imputed n of 96, we could reveal underlying structure within the dataset using k-means cluster analysis. Based on RDoC construct-driven hypotheses, we entered four behaviors into cluster analyses at a time.

Hypothesis 1. Profiles of valence subdomains naturally exist. In Aim 4, hypothesis 1, we looked at profiles of children across RDoC subdomains, examining across four behaviors each time (see Table 28). We first investigated child profiles across Initial and Sustained Positivity, and Anxiety and Fear behaviors. As we had multiple codes for each RDoC subdomain, we analyzed several combinations of codes that represented each RDoC subdomain. First, we used non-verbal Bubbles Initial and Sustained Positivity, and non-verbal Speech Anxiety and Fear to analyze for naturally occurring profiles (see Figure 3). Analyses revealed the best model involved three child profiles. Profile 1 (31% of children) was characterized by atypically high Initial Positivity (2 standard deviations (SDs) above the mean), atypically low Sustained Positivity (at -1.5 SDs), and average Anxiety and Fear (both around mean levels). The other two profiles both exhibited low-average Initial Positivity (between average and -.5 SDs) and high-average Sustained Positivity (between average and .5 SDs), however Profile 2 differed from Profile 3 on Anxiety and Fear. Profile 2 (12.5% of children) had atypically low Anxiety and Fear (both between -.5 and -1 SDs) whereas Profile 3 (56% of children) had atypically high Anxiety and Fear (both between .5 and 1 SDs).

We then substituted in verbal behaviors to analyze profiles across verbal Bubbles Initial and Sustained Positivity, and verbal Speech Anxiety and Fear and ran the same profile analyses (see Figure 4). Finally, we substituted in non-verbal Snake behaviors, using non-verbal Bubbles Initial and Sustained Positivity, and non-verbal Snake Anxiety and Fear to analyze for naturally occurring profiles (see Figure 5). In both of these sets of behaviors, each representing the four RDoC valence subdomains examined in the current study, we found similar profiles to the first set, suggesting profiles were relatively robust. No other combination of behaviors representing all four RDoC subdomains revealed reliable profiles.

We then examined profiles across four behaviors representing RDoC Negative Valence subdomains: non-verbal Snake Anxiety and Fear, and non-verbal Speech Anxiety and Fear, Figure 6). The Negative Valence behavior set revealed three reliable profiles. Profile 1 (50% of children) exhibited low negative valence across behaviors with Snake Anxiety and Fear between 0 and -.5 SDs, and atypically low Speech Anxiety and Fear (between -.4 and -.7 SDs). Profile 2 (27% of children), had atypically low Snake Anxiety and Fear (both between -.4 and -.7 SDs), and atypically high Speech Anxiety and Fear (both around +1 SD). Profile 3 (23% of children) had atypically high Snake Anxiety and Fear (both just above +1 SDs) and about average Speech Anxiety and Fear (at -.2 and +.2 SDs, respectively).

We next examined profiles across four Positivity behaviors: non-verbal Bubbles Initial and Sustained Positivity, Speech Preparation Positivity and Speech Delivery Positivity (Figure 7), including induced and unanticipated positivity. For the Positivity set of behaviors, results mirror the three profiles of Initial and Sustained Positivity, and Anxiety and Fear such that in Profile 1 (16% of children) Initial Positivity was very high, Sustained was very low, and Unanticipated Positivity behaviors were average. In Profile 2 and 3, Initial Positivity was low-average, Sustained Positivity was high-average, however Profile 2 (59% of children) had low-average Anxiety and Fear, whereas Profile 3 (25% of children) had high Anxiety and fear.

Finally, we performed examined profiles across Negative and Positive valence codes all within one task- the Speech task (see Figure 8). This set included non-verbal Speech Preparation Positivity, Speech Delivery Positivity, Speech Anxiety and Speech Fear. Again, three profiles were revealed. Profiles 1 (25% of children) had average Positivity (at +.3 and 0 SDs respectively by phase), and atypically high Anxiety and Fear (at about +1 SD). Profiles 2 (53% of children) had low Positivity (-.5 SD) and Anxiety/Fear (about -.3 SDs), and Profile 3 (22% of children) was at atypically high Positivity (+.8 and +1.5 SDs) and low Anxiety/Fear (about -.6 SDs).

Alternate sets of task/channel behaviors representing similar domains were also analyzed for profiles, but none resulted in reliable profiles.

Hypothesis 2: Profiles characterized by child risk. The final stage of Cluster analyses was to conduct Multivariate ANOVAs to examine whether there were differences in child risk (caregiver psychopathology, child problems, child diagnoses, cortisol initial, baseline, and peak values) by Profiles for each set of four behaviors. For Set 3 (non-verbal Bubbles Initial, Sustained Positivity and Snake Anxiety, Fear), Profile 2 had greater child risk than Profile 3 for Aggression ($t(78)=3.06$, $p=.003$), and Externalizing problems ($t(78)=2.94$, $p=.004$). As these Profiles only differed in mean levels of Non-verbal Snake Anxiety/Fear (and not Positivity), these two behaviors may be better predictors of child problems in these areas than the Profiles. For Set 5, Positivity across : non-verbal Bubbles Initial and Sustained Positivity, Speech Preparation Positivity and Speech Delivery Positivity, Profile 1 (with mostly higher than average Positivity codes) had more externalizing (trend level: ($t(77)=1.96$, $p=.053$) and Total problems ($t(77)=2.26$, $p=.027$) than Profile 2 (with all just lower than average Positivity codes). There were no other differences by Profiles in any other set.

CHAPTER IV: Discussion

This research was focused on determining the reliability and validity of behaviorally coded mood induction tasks in the assessment of RDoC Negative and Positive Valence domains in young children with a range of risk for internalizing disorders. Mood induction tasks focused on assessing the RDoC Negative Valence subdomains of Anxiety and Fear, as well as the Positive Valence subdomains of Initial and Sustained response to reward. Anxiety and Fear were induced during the Snake and the Speech tasks. Coded fear behaviors when the task's threat was ambiguous or distant (walking towards a covered terrarium/ preparing for a speech) were conceptualized as Anxiety, and coded fear behaviors when the task's threat was present (after the snake was revealed/speech delivery) were conceptualized as Fear. Initial and Sustained Positivity (hedonic response to reward) were induced during the Bubbles and Reward tasks. Coded positive behaviors in the first minute of the tasks were conceptualized as Initial Positivity, and changes in positivity from minute one to minute three were conceptualized as Sustained Positivity. The Reward task, with a duration of only one-minute was conceptualized as Initial Positivity only. Although tasks were meant to induce these specific moods, each task was coded for Fear/Anxiety and Positivity.

Aim 1: Behavior Inter-Rater Reliability and Variance

Our first aim was to achieve acceptable inter-rater reliability and variance on all behaviors and internal consistency of RDoC based subdomain scales. For the Snake Task, all behaviors were highly reliable. However, Positivity behaviors during the phase in which children walked to terrarium were excluded from analyses due to low variance. In the Speech task, Fear and Positivity codes in both episodes demonstrated excellent reliability and variance, allowing all codes to be analyzed as continuous variables. For the Bubbles task, Positivity had excellent reliability across time, whereas Fear behaviors were less reliable and/or frequent. Only non-verbal Fear codes in the first minute were included in analyses and dichotomized. For the Reward task, Positivity behaviors were included in analyses, but Fear behaviors had to be excluded due to low variability. Overall, reliability and variance analyses of the mood-induction tasks suggest that the Speech task successfully induces anxiety, fear and positivity in ways that can be coded reliably, and that the Snake task is able to induce anxiety, fear and some late emerging positivity. The Bubbles task is able to induce initial and sustained positivity with some initial non-verbal fear behaviors. The Reward task seems to only induce positivity, as fear behaviors exhibited extremely low variance.

These findings, demonstrating most behaviors have acceptable reliability and variance, validate task choice in inducing expected mood behaviors (Snake and Speech for anxiety/fear; and Bubbles and Reward for positivity) and demonstrate the ability for blind coders to reliably detect these behaviors. This coding system was adapted from previously established manuals used to code the LAB-TAB (Durbin et al., 2007, 2005; Hayden, Klein, Durbin, & Olino, 2006). Previously reported inter-rater reliabilities using similar codes show a range of ICCs from .66-.96 for Fear to .90-.94 for Positive Affect across 3 ages (3, 5-6, and 7 years), similar to our ICC ranges. It is of note that our behavior codes demonstrated comparable reliability to previous research despite differences in behavioral constructs (anxiety and fear vs Anxiety/Fear, and initial and sustained positivity vs Positive Affect).

Aim 2: Behavior Convergent and Discriminant Validity

Our second aim was to assess convergent and discriminant validity to other established measures of child behavior. We first examined behavior associations within and between mood induction tasks, then with established measures of child temperament and child behavior problems as reported by the child's primary caregiver. Generally, there was good convergent validity within Negative Valence and within Positive Valence domains, and good discriminant validity between Negative and Positive Valence domains. Snake and Speech Positivity, which were not representative of specific RDoC subdomains, were often the exceptions to the good discriminant validity, and are discussed separately below, coined as "Unanticipated Positivity".

We also hypothesized that behaviors would be moderately correlated with similar temperament (Child Behavior Questionnaire) and problem constructs (Child Behavior Checklist) as reported by caregivers about the child's behaviors during the six months prior to the visit. Overall, there were few *hypothesized* significant results between behaviors and child temperament or problem scales, however there were several significant *exploratory* correlations. Generally, this might suggest that although behaviors do not represent specific traits well, these laboratory tasks can elicit valence-linked behaviors that underlie a complex combination of traits and general functional impairment.

Anxiety and fear. We examined associations among non-verbal and verbal Anxiety and Fear behaviors within the Snake and Speech tasks. Consistent with convergent validity hypotheses, Anxiety and Fear behaviors were weakly to moderately correlated within both the Snake and Speech tasks, despite the quick transitions from 'anxiety' to 'fear' phases. These correlations may suggest that these tasks were measuring two separate RDoC constructs of ambiguous/distant threat and acute threat (only weak to moderate correlations), while also supporting that these constructs are both a part of the Negative Valence domain (significant and positive correlations). Prior work has also supported "uncertain" (anxiety) and "certain" (fear) threat phases as separate, but similar (Bradford, Kaye, & Curtin, 2014). Eye blink startle reactivity during an uncertain threat condition demonstrated significantly greater magnitude than during a certain threat condition, suggesting distinct constructs, and yet both threat phases were similar in that they elicited higher magnitude eye blinks than no threat. Apart from this study, little research has compared and contrasted anxiety and fear responses in the same sample, many combining anxiety and fear responses into one construct (Durbin, 2010; Durbin et al., 2007; Jeffrey R Gagne, Van Hulle, Aksan, Essex, & Goldsmith, 2011; Hayden et al., 2006; Olino, Klein, Dyson, Rose, & Durbin, 2010) thus it is difficult to compare our results to other prior research.

Inconsistent with convergent validity hypotheses, we found that *between*-task Anxiety and Fear behaviors were unrelated. Context is largely omitted from the RDoC matrix, which has been identified as a general limitation of RDoC (Gone & Kirmayer, 2010). In our current study, the lack of associations between Snake and Speech Anxiety, or Snake and Speech Fear, may suggest that Anxiety induced by a safety/survival/physical threat such as walking toward a terrarium in a dimly lit, novel room is inherently different from Anxiety induced by social pressure such as being told you will be judged on what you say by a seemingly uncaring administrator. Previous research demonstrating poor stability of observed fear behaviors in children from 3 to 7 years old speculate that it may be due to context differences in methodology. At age 3, researchers coded behaviors for "Fear of Novel Situations", whereas at age 7 they code for fear/anxiety during an interpersonal helplessness task (Durbin et al., 2007). Where the RDoC does not currently cover these potential contextual differences in threat responding, the DSM-5 diagnostic categories may better reflect these distinct contexts. For instance, Specific Phobias (including fear of snakes) and Social Anxiety Disorder (including fear of social evaluation) are separate disorders. However, as noted by Perusini and Fanselow (2015), these DSM definitions do not help distinguish between anxiety and fear (Perusini & Fanselow, 2015). The lack of associations across tasks observed herein could also be due to logistical differences including location (novel lab room compared to in the home), relationship to task administrator (a guide/companion role compared to uncaring/enforcement role), and/or elicited behaviors (walking and large startle movements compared to asking the child to stand still for the speech). In future studies, focus on attempting to make these two tasks more logistically similar may be helpful in determining the root of potential contextual differences. It would also be interesting to examine larger groups of children with specific phobias versus social anxiety and explore whether they had any transdiagnostic displays of anxiety and fear, or if these children were completely separate by context.

This is the first study to compare and contrast anxiety and fear behaviors elicited in structured laboratory tasks, thus hypothesized associations with separate groups of specific CBQ traits were conceptual and not necessarily based on previous evidence. Past studies using combined anxiety and fear behaviors have shown mixed results. In one small study (N=15), anxiety/fear behaviors were not significantly related to CBQ fear (r(15)=.12 p=ns) or CBCL Anxiety/Depression subscale (r(15).05, p=ns) (see Table 1 in (Moser et al., 2014)), however in a larger sample (N=70) discussed in the same article, coded "fear proneness" was moderately positively correlated with several internalizing subscales (Moser et al., 2014).

In terms of convergent validity in the current study, Anxiety and Fear never mapped on to CBQ Fear described as "Amount of negative affect, including unease, worry or nervousness related to anticipated pain or distress and/or potentially threatening situations". Instead, Snake

Anxiety and Fear were moderately correlated with CBQ Approach Excitement (positive anticipation), and Impulsivity, and negatively correlated with CBQ Sadness and Sensory Discomfort (negative affect in response to sensory qualities). Speech Anxiety was positively correlated with CBQ Sensory Discomfort, and Speech Fear was negatively related to CBQ Shyness and positively related to CBQ High Intensity Pleasure. None of these associations suggest strong convergent validity of a fearful temperament according to the CBQ.

These associations between anxiety and fear with impulsivity, excitement, and sociability-type traits are surprising given past links between combined anxiety/fear with inhibition (positive correlations), and positive emotionality (negative correlations) behaviors (Durbin et al., 2005). Thus our tasks, and behaviors, are clearly inducing and capturing a different perspective on anxiety and fear than previously studied despite the current coding system being closely adapted from the same authors that published those findings. It may be that in the contexts of these tasks, with friendly staff administrators present and comfort in knowing their caregivers were nearby, children reacted with more excitement, sociability and impulsivity than with anxiety and fear to stimulus that was meant to be threatening. This possible "over/excitement" response induced by our anxiety/fear tasks is also reflected in Snake and Speech Verbal Anxiety codes being positively correlated with several externalizing (but not internalizing) subscales including externalizing, ADHD, attention and aggression problems. Prior literature demonstrates that traits like (low) Shyness and (high) High Intensity Pleasure are markers of "Surgency" (high activation and low inhibition), and when a child high in Surgency is faced with a challenge or frustration, the likelihood of externalizing problems increases (Oldehinkel, Hartman, De Winter, Veenstra, & Ormel, 2004). Thus, these anxiety and fear codes may be markers of Surgency during a particular challenge.

Although literature tends to focus on connections of emotional dysregulation/fear with internalizing problems, and executive functioning problems with externalizing problems (i.e. (Eisenberg et al., 2001a; Oldehinkel et al., 2004), researchers have also found some traits, such as frustration, to be markers of problem severity regardless of problem type (Oldehinkel et al., 2004). Other research finds early childhood frustration to be highly correlated with fear (Rothbart & Putnam, 2002). In the current study, it is possible that coded anxiety and fear may be capturing some frustration, and thus behaviors may be acting as markers of problem severity (instead of problem-specific type) at this point in early development (Rothbart & Putnam, 2002). It may be that later in childhood, our anxiety/fear behaviors would more specific to internalizing problems.

Alternatively, prior literature suggests high heterotypic continuity (switching from externalizing to internalizing problems over time and vice versa) in preschool aged children, and also demonstrate that pure internalizing latent profiles do not emerge until about 6 years old (Basten et al., 2015). Thus, we could speculate that the current subset of children showing anxiety/fear behaviors in the laboratory at a young age may display high externalizing problems now, but may present as having more internalizing problems later in childhood and/or adolescence.

The only anxiety/fear behavior that was consistent with hypotheses in being positively correlated with internalizing subscales was non-verbal Speech Anxiety. However, it was also related to most externalizing subscales (except attention). Non-verbal Anxiety during the Speech task was often characterized by child swaying, lip biting, and hand fidgeting behaviors, in anticipation of being judged on speech performance. Its broad underpinnings to both internalizing and externalizing problems may be due to the heightened heterotypic comorbidity/continuity in young children (Basten et al., 2015),(Racine et al., 2016) anticipatory distress as a distal risk marker for several types of disorders (multi-finality, (Nolen-Hoeksema & Watkins, 2011), or even that separate aspects of the anxiety behaviors are relating to each type of problems in turn (i.e., hand fidgeting to ADHD problems, and lip biting to anxiety problems).

It is particular interesting that an Anxiety behavior (and not Fear) was significantly related to internalizing problems because prior works suggest that preschooler age positively predicts anticipatory distress (to pain: (Racine et al., 2016), which authors speculate may be due to older children's abilities in understanding and expressing of complex emotions. It might be that children high in problem behaviors have learned to respond with anticipatory distress earlier due to an earlier developmental understanding of anticipatory distress, or earlier biological/learned detection of threatening environmental cues. Response to anticipatory distress has been linked to child internalizing traits in young children at least once before. One study of seven-year-olds found that highly-shy children showed different changes in physiological (heart rate, vagal tone) than low-shy children over an "anticipatory-only" challenge, in which children were told they would have to give a speech, without requiring children to actually give the speech (Schmidt, Fox, Schulkin, & Gold, 1999). Therefore, anticipatory anxiety may be a good marker of internalizing problems in early childhood.

Initial and Sustained Positivity. We examined associations among Initial and Sustained positive behaviors within and between tasks. Within the Bubbles task, Initial and Sustained Positivity were moderately negatively correlated, such that the higher the initial positivity the less likely the child was able to sustain that level of positivity two minutes later. This result supports previous literature suggesting a "fading" of positive response over time (Myers & Diener, 1995). However, past literature cites fading over days, weeks and years after a positive life event and our study regards minutes, while the reward is still present. In the RDoC Initial versus Sustained Responsiveness to Reward Attainment are not clearly defined in terms of timing, duration, nor whether the reward should still be present when examining Sustained Responsiveness.

In the RDoC, Initial responsiveness is described as behavioral responses to a positive reinforcement (e.g. "taste reactivity"), whereas Sustained responsiveness is described as "satisfaction" and "satiation" (e.g. "nipple cessation", "meal refusal"). The RDoC-lists "self-report assessment" for sustained responsiveness as the Snaith-Hamilton Pleasure Scale (SHAPS; (Snaith et al., 1995)), which includes 14 items such as "I would enjoy seeing other people's smiling faces", "I would enjoy my favorite television or radio program" and "I would find pleasure in my hobbies and pastimes". These items seem to target sustained positivity from a couple of seconds to observe someone's smile, 30 minutes to watch a television program, or several hours of time to enjoy a hobby of building model airplanes. Thus, there seems to be a wide range of what may, or may not, constitute sustained responsiveness in the current matrix. Yet, in order to adapt a mood induction task to elicit behavioral responses described in the RDoC (excluding food paradigms), we had to take liberties in interpreting these RDoC construct boundaries in terms of timing and reward type. For example, in our Bubbles task sample, although Initial and Sustained codes seem to be somewhat distinct from each other as suggested by RDoC (given their moderate correlations, and the statistically significant difference in mean behaviors from minute one to minute three), convergent validity needs to be examined further using different timing definitions of the constructs.

In our study, using a 2 minute difference between constructs, across the Bubbles and Reward tasks, Initial Positivity and was moderately positively correlated for verbal, but not non-verbal behaviors. Non-verbal Reward Initial positive behaviors were weakly and positively correlated with Bubbles Sustained positive behaviors. These two significant, positive correlations suggest some similarities between tasks, as participants were given a novel stimulus (bubbles or a toy) and engaged in play within each task. However, the fact that correlations are few and low in strength may have been due to logistical differences such as administrator engagement. The Bubble task included more social interaction than the Reward task such that the administrator encouraged the child to pop bubbles throughout and engaged in back and forth conversation. The Reward behaviors' associations with Bubbles Initial (verbal) and Sustained (non-verbal) behaviors may suggest that the Reward task is functioning in dual roles, inducing both Initial and Sustained Positivity. This idea is reinforced by the result that verbal and non-verbal Reward Initial Positivity were unrelated. While the Reward task was meant to induce only an Initial response to reward, it occurs after the 5-minute Bubble task, potentially eliciting Sustained Positivity from the sustained response of playing with the administrator in general instead of initial response to the new reward toy. An Initial response to reward may still have been elicited verbally due to a renewed social pressure to speak (i.e., thank the administrator for the gift), which was not held throughout the Bubble task. In future studies, these tasks should be counter balanced and/or a neutral task should be imposed between the two for better separation.

This is the first study to compare and contrast Initial and Sustained positive behaviors, thus separate hypothesized correlations with CBQ scales were conceptual and not necessarily based on previous evidence. However, past studies using observed behaviors that encompassed both initial and sustained demonstrated that "positive emotionality" were not significantly related to CBQ smiling/laughter ($r(95)=.00$ $p=ns$) (see Table 1 in (Hayden et al., 2006).

In the current study, for Bubbles and Reward tasks, positivity behaviors were positively correlated with CBQ traits of Impulsivity, Activity, and Smiling and negatively correlated with CBQ traits of ease of Attentional Shifting, Shyness and Sensory Discomfort. Overall, positive behaviors, when purposefully induced in these tasks, again related to generally active, sociable, happy, impulsive children, supporting prior literature demonstrating connections between high activity levels in young children and positive emotionality (Durbin et al., 2007)

No induced positive behaviors in either the Bubbles or Rewards tasks were related to any problem behavior CBCL subscales. This is somewhat surprising given the relationship between low observed Positive Emotionality and risk for depressive problems demonstrated in prior literature (Dougherty, Klein, Durbin, Hayden, & Olino, 2010), and high surgency (low shyness and high intensity pleasure) with externalizing problems (Oldehinkel et al., 2004), as well as the established high activity-positivity link (Durbin et al., 2007), positing that observed positive behaviors may have been loosely associated with externalizing problems.

Other Positivity behaviors. We did not attempt to induce positive behaviors during the Snake and Speech tasks, thus positive behavior elicited during these tasks will hereby be referred to as *Unanticipated Positivity*. As some sociable children may have enjoyed aspects of telling a story to a camera, and some children may have enjoyed snakes, we also did not want to pathologize positive behaviors during these anxiety/fear inducing tasks *apriori* either, hence the name *Unanticipated* and not *Inappropriate* Positivity.

In several cases within and between tasks, these Unanticipated Positivity behaviors were positively associated with induced Positivity (with non-verbal Reward Initial Positivity, and verbal Bubble and Reward Initial Positivity), and in other cases, with Anxiety or Fear (with verbal Speech Anxiety and non-verbal Bubble Fear). Unanticipated Positivity behaviors were positively correlated between the Speech Anxiety phase and Snake Fear phase, which we could be due to both phases pulling for child positivity as a coping mechanism (Fredrickson, 2001) or both highlighting a trait in select children who enjoy risky/pressured situations. It is unclear at this point whether Unanticipated Positivity may be somewhat indicative of anxiety, anxiety/fear behaviors may be somewhat indicative of positivity, or that either behavior type is capturing some of each affect, given the small shared variance (weak to moderate correlations) between them.

We are also the first study to separate purposefully induced from unanticipated positivity behaviors based on task mood induction in children. Previous studies using the coding manuals we adapted from (Durbin et al., 2007; Hayden et al., 2006; Moser et al., 2014) combined Positivity behaviors from all types of mood induction tasks (Durbin et al., 2007, 2005). One study did separate "Incongruous Negative Affect" or context-inappropriate negative affect, a sum of anger, sadness and fear that were not purposefully induced in tasks, from separate codes of anger, sadness and fear from mood induction tasks corresponding to those affect type (Durbin et al., 2005). Interestingly, they found this Incongruous Negative Affect was positively correlated with maternal depression, whereas induced Negative Affect was not. Their finding potentially supports the salience of context-inappropriate affect, as seen in results of Unanticipated Positivity in the current study.

As reported above, our Unanticipated Positivity behaviors were correlated with some induced positivity *and* some anxiety behaviors. When comparing behaviors to CBQ traits found paralleled results, such that Unanticipated Positivity behaviors were sometimes associated with the temperament traits that were correlated with anxiety/fear behaviors, and sometimes associated with the temperament traits that were correlated with induced positive behaviors. For instance, Snake Unanticipated Positivity was positively correlated with impulsivity (which was also linked to both Anxiety and induced Positivity behaviors), smiling and high intensity pleasure (both also linked to induced Positivity behaviors) and negatively correlated with shyness (which was also linked to Fear and induced Positivity behaviors), fear (uniquely correlated with unanticipated positivity), and frustration (also unique). However, Speech Unanticipated Positivity had all unique associations with traits such as a positive correlation with distress recovery, and negative correlations with perceptual sensitivity and inhibitory control.

In relation to child problems, Unanticipated Positivity behaviors from the Snake reveal and Speech preparation phases were weakly, positively associated with an array of internalizing (anxiety/depression, somatic, withdrawn, depression) and externalizing (ODD, and attention) and total problems as reported on the CBCL. It was surprising that Unanticipated Positivity behaviors were positively associated with internalizing problems, especially as they were negatively associated with CBQ reported fear, frustration, and shyness, which in turn, were positively correlated with CBCL reported internalizing problems. These seemingly opposite associations may be possible due to the weak strength of unanticipated positive behaviors with the CBCL, suggesting that although significant, there is only little shared variance between the two measures.

Unanticipated Positivity during both anxiety/fear induction tasks, and non-verbal Speech Anxiety, were all correlated with internalizing problem behaviors. It is notable that all of these behaviors that were correlated with internalizing problem subscales were also correlated with externalizing subscales, even though there were some behaviors that were only related to externalizing subscales. This again supports prior work noting that young children are more likely to have heterotypic internalizing and externalizing problems than to have internalizing problems alone (Basten et al., 2015), and that some child behaviors may underlie general child functioning instead of problem-specific behaviors (Oldehinkel et al., 2004). We find a mirrored phenomenon in the associations between CBQ temperament traits and CBCL problem behaviors. With the exception of CBQ Fear and Sensory Discomfort, all other CBQ subscales that are associated with internalizing subscales (Approach Excitement, Distress Recovery, Sadness, Frustration, Attentional Focus, Impulsivity, Activity, Attentional Shifting, and Inhibitory Control) are also associated with externalizing subscales in the current study. However, there are several CBQ subscales significantly associated with at least one externalizing subscale (Maintain Attention, Impulsivity, Low Intensity Pleasure, Smiling, and High Intensity Pleasure) that were not associated with internalizing subscales.

Given their associations with a range of internalizing and externalizing problems, unanticipated positivity and non-verbal Speech anxiety behaviors may be especially useful markers in identifying early childhood functional impairment (Caspi et al., 2014), instead of specific problem-type behaviors.

Hypothesis 3: Behaviors convergent with child cortisol reactivity. To further examine convergent validity, we compared behaviors to not only parent report and clinician reported measures of child risk, but also objective physiological measures of stress response. There has been a range of studies finding behavioral codes during child stress tasks are related to cortisol response (i.e., (Buss, Davidson, Kalin, & Goldsmith, 2004; Gunnar, Sebanc, Tout, Donzella, & van Dulmen, 2003; Mackrell et al., 2014)), however, in part due to different methodological and analytical approaches it is difficult to compare across studies. One common phenomenon that has emerged in the literature is the separation of responders versus non-responders, or those who physiologically react to the stressors versus those who do not. It is important to note results may differ for the individuals for whom the stress paradigm did not engage their HPA-axis compared to those who it did.

Responders vs non-responders. Prior studies have shown that a portion of individuals (i.e., 30% in adults: (Foley & Kirschbaum, 2010; Schwabe, Haddad, & Schachinger, 2008) and more (50% in preadolescents, 72% in 6-11 year olds and 91% in 2-5 year olds children: (Gunnar, Talge, & Herrera, 2009; Lopez-Duran et al., 2015)) do not exhibit a significant increase in cortisol after even the standardized singular stressor paradigms. Studies of healthy young children have found quadratic reactivity curves across stressful laboratory periods such that children peak at the beginning of the visit- responding to the stress of novelty- as well as after the intended stress paradigm (Dougherty, Klein, Congdon, Canli, & Hayden, 2010; Dougherty, Klein, Rose, & Laptook, 2011; Suzuki et al., 2013). Researchers have suggested that shorter timing between cortisol samples could make it appear as though children have persistently elevated cortisol levels, when allowing a longer duration between child stressors would allow a fuller picture of children recovering, and then reacting again (Suzuki et al., 2013). To better understand our non-responders, we examined whether they were not increasing in cortisol after the Speech task due to poor recovery from initial novelty stress or simply not being activated by the stressor, we analyzed models comparing responders and non-responders cortisol from arrival to their baselines.

First, non-responders were found at rates (38%) slightly higher than adults studies (15-30%) of the TSST (Brigitte M. Kudielka, Hellhammer, Kirschbaum, Harmon-Jones, & Winkielman, 2007), but comparable to child and preadolescent studies (Gunnar, Talge, & Herrera, 2009b; Lopez-Duran et al., 2015). Findings suggest that Responders were characterized by having heightened initial cortisol, and significant recovery to baseline in addition to their post stressor peak, whereas Non-Responders exhibited lower initial cortisol with no change to baseline in addition to having no change after the stressor. Thus, Non-Responders seem to be truly having no HPA-axis engagement throughout the home visit and Responders seem to be sensitive to both the stress of new administrators in their homes, as well as the stressor paradigm. There were no significant differences between Responders and Non-Responders based on child characteristics (age, gender, symptoms), consistent with other child studies (Lopez-Duran et al., 2015).

For both groups of children, Anxiety and Fear behaviors were associated with lower initial cortisol/less novelty reaction, and Unanticipated Positivity codes were associated with higher initial cortisol/more novelty reaction. This pattern is mirrored when we moved to analyzing baseline cortisol for Responders only. However, when we modeled reactivity to the stressor paradigm in Responders, we found the opposite finding such that Anxiety and Fear behaviors were associated with heightened cortisol peak. This could suggest that although Responders reacted with increased cortisol to both novelty and induced stress, the two contexts are different in terms of engaged cognitive coping strategies (which have been linked to cortisol peaks in the past, (Abelson et al., 2014; Abelson, Khan, Young, & Liberzon, 2010). For instance, studies show that coping by thinking of helping others reduced HPA axis activity (Abelson et al., 2014). Fearful children may have been more conscientious of helping the researchers when they arrived, but were focused on themselves when reacting to the Speech itself. As mentioned previously, past studies have linked experimentally induced positivity with selfishness (Forgas, 1998), thus it's possible that children with Unanticipated Positivity were not coping by thinking of helping others in response to the novelty and thus exhibited higher initial and baseline cortisol.

As noted in the results, the heightened peak response without differences in activation or regulation slopes suggest that the duration of activation is longer (Lopez-Duran et al., 2014b) in responder children with more anxiety and fear. The association between increased cortisol peak and anxiety/fear valence domains is consistent with our findings that having an internalizing disorder, and higher reported internalizing problem behaviors are also associated with increased cortisol peaks. This longer duration of activation is also consistent with previous literature of depressed male preadolescents (Lopez-Duran et al., 2015). Several constructs of anxiety (i.e., behavioral fear, internalizing problems) have been associated with heightened cortisol reactivity to Speech tasks in older children and adults (Laurent, Vergara-Lopez, & Stroud, 2016; Lerner, Dahl, Hariri, & Taylor, 2007) as well as in reactivity to other stressful paradigms in preschoolers (Luby et al., 2003; Talge, Donzella, & Gunnar, 2008), consistent with our research. However, there is also literature suggesting blunted cortisol reactivity in anhedonia/internalizing preschoolers (Hankin, Badanes, Abela, & Watamura, 2010; Suzuki et al., 2013). Mixed results may be due to differences in internalizing symptomology (anhedonia specifically vs internalizing/fear, and methodology- as most preschool studies use several different stressful behavioral paradigms and not necessarily one standardized validated.

This is the first study to examine a speech paradigm in children younger than 7 years old, and findings demonstrating similar results to older children and adults suggest good validity of the task in young children. We also compared objective behaviors not only from the stressor paradigm from which the cortisol was collected, but an additional stressful paradigm (the Snake task) occurring two weeks prior to the home visit. That one-minute duration Snake codes predict cortisol responses in other time and context speak to the salience of the codes to a child’s biological sensitivity (Boyce & Ellis, 2005). The consistency of the association of objective anxiety/fear codes from two contexts and time points, as well as clinician rated, and caregiver-reported child internalizing diagnoses/problems suggests a robust effect of anxiety/fear constructs on cortisol reactivity peaks.

In our study, specifically, Verbal Speech Anxiety and Verbal Snake and Non-verbal Fear impacted cortisol peak values, without differences in activation or recovery slopes. These are the only constructs to impact child physiology in response to threat, and interestingly, these were similar codes (Speech Anxiety and Snake Fear) to those linked to general impairment (having any current diagnosis). Speech Anxiety and Snake Fear codes were not correlated with each other and yet, they both seem similarly important to physiology and functional impairment measures of child risk. Perusini and Faneslow (2015) note that the size of the threat matters in measuring Anxiety and Fear, such that greater threats are considered as "closer" (more imminent), and thus may be responded to with more Fear than Anxiety behaviors than minor threats. Young children in this study could have experienced the Speech as a greater threat than the covered terrarium, thus responding with Fear behaviors during the Speech Preparation suggesting similar underlying physiology and behavioral implications of Speech Anxiety and Snake Fear behaviors.

Aim 3: Criterion Validity with Child Risk for Psychopathology

In Aim 3, we assessed how behaviors predicted familial risk for psychopathology (caregiver PTSD and depressive symptomatology), current child diagnoses (internalizing, externalizing, and both types), and abnormal cortisol reactivity.

Hypothesis 1. Behaviors predicting to familial risk. In relation to caregiver PTSD and depressive symptoms, we see an interesting phenomenon expanding upon our previous discussion of Unanticipated Positivity, and whether it is better understood as an anxiety-induced positivity, or true positivity. Specifically, child verbal and non-verbal Positivity during Snake Reveal, and verbal and non-verbal Positivity during Speech Preparation significantly predicted caregiver total PTSD symptoms (all) and depressive symptoms (except non-verbal Speech) in unadjusted separate models. These associations are especially notable given that neither PTSD nor depression was related to any 'purposefully induced' positivity behaviors, however, nor were they related to any induced anxiety and/or fear behaviors.

This discrepancy may suggest several possibilities. One speculation is that child positivity displayed during anxiety/fear inducing tasks may be the child exhibiting 'over-bright' coping methods such that they mask their fear with positivity. Over-bright emotional displays are sometimes seen in children with attachment disorders (more common in children of parents with psychopathology), and young children with trauma history and/or PTSD (Scheeringa, Zeanah, & Cohen, 2011; Zeanah & Gleason, 2015). Alternatively, it may be that caregivers with PTSD are resilient and have learned to find positivity in the face of anxiety (Agaibi & Wilson, 2005), and their children are modeling these behaviors. It also could be that children with higher unanticipated positivity also might have trouble with emotional regulation due to sub-optimal parent-child attachment (Cassidy, 1994), or biological sensitivity (of cognitive abilities or neural pathways) (Gross, 2002; Kim & Hamann, 2007). Considering the moderate nature of the associations between unanticipated positivity with both caregiver psychopathology and induced positivity, it is also possible that we are capturing some true excitement and some over-bright/coping/confused behaviors, or subgroups of each, in unanticipated positivity codes.

Whereas previous research has not separated induced and unanticipated Positivity, the study which separated induced versus "incongruous" Negative Emotionality (Durbin et al., 2005) found that only Incongruous Negative Emotionality, and not induced Negative Emotionality, was correlated with maternal depression. This phenomenon might be similar to our unanticipated or incongruous Positivity being correlated with caregiver depression, and PTSD in our study, but not induced Positivity, or induced Anxiety or Fear. In our study, there was not high enough reliability and/or variance to study incongruent fear and anxiety behaviors (besides Fear/Anxiety during the first minute of the bubble task). However, Bubble Fear/Anxiety was a dichotomous code with 80% 0s and (n=72 vs n=18), thus it was potentially due to lack of power that it was unrelated to all other established measures in the study. It may be that incongruous, versus congruous, valence may be a good predictor of familial risk. While much previous literature focuses on the positive consequences of positive emotions see (Cohn & Fredrickson, 2009), with only brief mention of negative consequences of positive emotions in certain contexts. The one study they cite suggests that extreme positive emotion during high-performance stats can be disruptive and has been linked to lack of self-focus (Csikszentmihalyi & Csikszentmihalyi, 1992). It is possible that in our study, children with high unanticipated positivity behaviors have underlying poor attention to their role in the tasks.

Another line of research about negative consequences of positive affect is found in adult bipolar disorder populations. Gruber (Gruber, 2011a, 2011b) coined the term Positive Emotion Persistence (PEP) to describe a type of context-inappropriate positive affect he noticed in adults suffering with bipolar disorder. People with PEP displayed elevated positive behaviors across positive, neutral, and negative (inappropriate) contexts (Gruber, Eidelman, & Harvey, 2008; Gruber, Johnson, Oveis, & Keltner, 2008; Johnson, Gruber, & Eisner, 2007). Given the positive correlations between Unanticipated and Induced Positivity, there might be a profile of children with this 'inflexible' positive affect, which can be discussed more in Aim 4.

Hypothesis 2: Behaviors predicting to child symptoms and diagnosis. We next examined which behaviors predicted caregiver-reported child problems and/or current child diagnoses. We found that non-verbal Speech Anxiety predicted both internalizing problems and diagnosis. We found that verbal Snake Unanticipated Positivity, non-verbal Speech Anxiety and Unanticipated Positivity, and verbal Speech Fear predicted externalizing problems and verbal Snake Fear, and non-verbal Speech Unanticipated Positivity predicted current externalizing diagnosis. In addition, induced Initial Positivity (non-verbal Bubbles and Reward Verbal) predicted current externalizing diagnosis. However, upon further examination, the high predictive value of Reward on externalizing diagnosis was driven by three outliers with very high Verbal Initial Positivity and externalizing diagnoses, and thus results are interpreted here with caution. On the presumption that general functional impairment may be a helpful way to understand young children in lieu of problem-specific impairment, we also analyzed models of codes predicting to any current internalizing or externalizing diagnosis. Non-verbal Snake Fear, as well as non-verbal Speech Anxiety and Unanticipated Positivity predicted to having any current diagnosis.

Non-verbal Speech Anxiety was the only code to predict internalizing symptoms and diagnosis, suggesting anticipatory anxiety in a pressured social context may be particularly telling of anxiety. This supports previous literature demonstrating coded anxiety during a speech task is associated with social anxiety disorders in adults (Rowa et al., 2015) and with severity of anxiety disorders (over-anxious, separation, and avoidant) in children 9-13 years old (Philip C. Kendall, 1994). Developmentally, separation anxiety is most prominent during ages 6-9, then danger fears from 10-13, and social anxiety (rejection and criticism fears) from 14-17 years (Weems & Costa, 2005). It is possible that young children who exhibit more anxiety in response to criticism fears (speech anxiety) before may be developmentally appropriate, are at highest risk for internalizing disorders due to biological/learned sensitivity. Children with anxiety/fear reactions to the Snake task may not significantly indicate anxiety disorders because it may be more developmentally appropriate, or for logistical reasons such as the tasks taking place in the child's home (likely a comfortable setting) versus a novel lab room. It may be that child anxiety displayed in a comfortable setting is more indicative of anxiety compared to a low comfort context.

In previous research (Moser et al., 2014), coded "fear proneness" has been related to total internalizing, and internalizing subscale problems 6 months later (rs=.31 to .42) in 70 children ages 3 to 6.5. Most of the tasks included in the code of fear proneness used fear eliciting stimuli such as "scary objects, animals, ambiguous stimuli" as well as physical caution (walking across a balance beam). In contrast, we find anticipatory social anxiety is related to concurrent internalizing problems/disorders. Our anxiety code may have been an element of the previously studied "fear proneness", thus both codes were associated with internalizing symptoms, or it is possible that when fear and anxiety were separated in the current study, it was anxiety and not fear that was associated to internalizing symptoms. Alternatively, it might be that speech anxiety is most similar to overall "fear proneness", which is averaged across multiple tasks and most likely to reflect a fear temperament than anxiety and fear in the Snake task and fear in the Speech task all separately.

Many codes across valence types, channels, and tasks (Snake Verbal Unanticipated Positivity and Fear, non-verbal Speech Anxiety and Unanticipated Positivity, and Verbal Speech Fear and non-verbal Bubbles Initial Positivity) predicted externalizing symptoms and/or diagnosis. Whereas most previous studies of preschool behaviors and externalizing problems find that more obvious/specific behaviors such as non-compliance and aggression were predictive of teacher reports of child externalizing problems (Hinshaw, Han, Erhardt, & Huber, 1992), other studies suggest links between positive mood induction and surgency/disinhibition, which were in turn linked to externalizing problems. For instance, experimentally induced positive moods have been linked to high selfishness (Tan & Forgas, 2010), and high likelihood of cognitive reasoning errors (Forgas, 1998), as well as low social politeness (Forgas, 1999), attention to detail (Forgas & Fiedler, 1996). In turn, observed preschool "disinhibition" during laboratory tasks uniquely predicts oppositional defiant disorder and ADHD (Dougherty, Bufferd, et al., 2011). In earlier analyses, we find that many of these significant codes here are also associated with excitement, sociability, and impulsivity and thus these separate codes might represent a latent variable of surgency or disinhibition, instead of reading in to the specific contexts of the codes themselves. Perhaps any heightened movements and vocalizations displayed in front of a novel person(s) (i.e. administrator), in a novel situation (mood induction tasks) suggest more difficulties with disinhibition, attention and aggression.

Non-verbal Snake Fear, as well as non-verbal Speech Anxiety and Unanticipated Positivity predicted having any current diagnosis. Whereas non-verbal Speech Anxiety predicted both internalizing and externalizing diagnoses separately and non-verbal Speech Positivity predicted externalizing disorders, non-verbal Snake Fear did not significantly predict either disorder type separately. With this set of analysis, we aimed to find transdiagnostic valence markers of child impairment whether externalizing or internalizing. Prior research finds that "general psychopathology" combining internalizing, externalizing and thought disorders is distinctly characterized by high neuroticism, low agreeableness and low conscientiousness (Caspi et al., 2014). Snake Fear and Speech Anxiety and Unanticipated Positivity may be most representative of low impulse control and high neuroticism, and thus best predictors of having any current diagnosis. It may also be that a child's bodily fear reactions to being startled with a fake snake or threatened with giving a speech may be a marker of physiological impairment which is in turn, associated with functional impairment in general.

As previously stated, Research Domain Criteria is not meant to replace or be compared to the current clinical diagnostic framework at this time. However, given mental health research and assessment has centered around diagnostic criteria, to establish criterion validity, RDoC researchers are somewhat forced into making comparisons of their findings to diagnostic criteria. Perhaps better comparisons for the RDoC would be to validate subdomains against individual adaptive functioning. Unfortunately, general adaptive functioning (GAF) scores have been found to be unreliable and no other measures have been able to validate adaptive functioning without implying problem-type specificity. Ergo, there remains a conundrum of having to validate RDoC assessments and profiles, without comparing them to current research on diagnostic categories. In the current dissertation, we aimed to combat this conundrum by establishing criterion validity on more broad measures of child functioning including the CBCL syndromes, as well as to having 'any diagnosis' versus 'no diagnosis'. By decreasing the emphasis of problem/diagnostic specificity, in both how we measure and operationalize functioning, as well as in the children we recruited, we hoped to demonstrate the potential future clinical utility of RDoC domain assessment separately from diagnostic criteria. Despite our best efforts, it is difficult to ignore the current mental health framework and its utility in defining individual functioning, thus we did make direct comparisons to broad diagnostic problem sets. This is a current limitation of RDoC research at this time which has been shared by other researchers. Future studies operationalizing and assessing general functional impairment may better serve future RDoC research in establishing convergent and criterion validity.

Demographics. First, we compare behaviors to child demographics and did not find many significant associations. Only Fear (Non-verbal and Verbal) during the speech task was related to age, and even they were weak to moderate correlations. This was the only task to require speaking. Other tasks had no child age correlations thus it appears that spontaneous speech was not correlated with age, only expected speech. Interestingly, Speech Verbal Positivity was not correlated with age, thus age seemed to be only related to fear in general during speech delivery. Older children displaying more fear (non-verbal and verbal) behaviors during speech delivery perhaps suggests they are wearier of social pressure than younger children, however there was no association with speech anticipation behaviors.

Girls displayed more Unanticipated Positivity (verbal during speech preparation and non-verbal during snake reveal), consistent with prior research of behavioral codes showing three-year-old girls display higher positive affect than same-aged boys (during positive affect inducing LAB-TAB tasks) (Olino, Durbin, Klein, Hayden, & Dyson, 2012). However, it is unclear why girls displayed higher unanticipated, and not induced, positivity. As prior works combined unanticipated and induced positivity, we cannot compare results directly, and future studies should try to replicate our findings prior to interpretation.

Finally, racial minority status was related to more fear behaviors in response to the snake. Literature supports this finding (Chapman, Vines, & Petrie, 2011) suggesting that racial minorities (African Americans especially) are more likely to live in urban areas with less exposure to animals, or exposure to animals bred for ferocity (as guard dogs). Alternatively, if children do not have increased exposure to these cases themselves, they are more likely to learn fear behaviors from their parents who were more likely to have those urban exposures, and thus more likely to exhibit fear behaviors toward animals themselves (Chapman et al., 2011).

Aim 4: Exploring Behavioral RDoC Profiles

For our final aim, we examined naturally occurring profiles of behaviors across RDoC constructs. The NIMH has suggested clustering methods as an excellent form of exploratory analysis to aid hypotheses about the RDoC matrix using RDoC focused studies. Clustering methods have recently been utilized for the purpose of exploring naturally occurring continuous problems associated with RDoC criteria (M. Wallace, 2016; M. L. Wallace et al., 2016). We first found distinct profiles across behaviors representing Initial Positivity, Sustained Positivity, Anxiety and Fear RDoC subdomains. We also found distinct profiles across Negative Behaviors (Snake Anxiety and Fear, Speech Anxiety and Fear); and across Positive Behaviors (Bubbles Initial and Sustained Positivity, Speech Preparation and Delivery Unanticipated Positivity), as well as across Speech behaviors (Anxiety and Fear, and Preparation and Delivery Unanticipated Positivity).

In all sets of behaviors, Anxiety and Fear behaviors within tasks tended to have similar means to each other. This may suggest that there are similar underlying mechanisms for Anxiety and Fear responses, despite the RDoC subdomains, that cause children to respond similarly to Anxiety and Fear situations, or alternatively, that our tasks did not differentiate well between Anxiety and Fear constructs. In a review by Perusini and Faneslow (2015), authors describe a breadth of literature using Anxiety versus Fear models demonstrating distinct neurobiological processes, but they determine that only one model can differentiate Anxiety and Fear constructs behaviorally: Predatory Imminence (Perusini & Fanselow, 2015), which we used in the current study. In this model, Anxiety is conceptualized as behavior occurring “pre-encounter” in which they give the example of rats behaving atypically to meal-taking when they learned a threat is near, and Fear behavior is “post-encounter” to a threat, characterized by freezing and strike behaviors. In their example, although differentiated neurobiology and behaviors are observed and measured during Anxiety and Fear time periods, the relative connectedness between the separate neurobiological mechanisms or behaviors are not commented on. In our study, although standardized means were similar between Anxiety and Fear behaviors, the behaviors themselves could have changed (i.e., from lip-biting in the Anxiety phase to jumping back in fear in the Fear phase) as all potential behaviors were included in all valence coding.

Models of threat response in humans suggest that if an individual is more sensitive in detecting environmental cues to a threat (anxiety), they are capable of more reactivity when the threat is presented (fear) (Gross, 2002). This connection between anxiety and fear may be evolutionary advantageous if the environmental cues and threat are congruous, and presumably in our study, they were. Anxiety and fear are likely each comprised of multiple mechanisms as we see in our profiles that the amount of anxiety shown pre-encounter is proportional to the amount of fear shown post-encounter, however we see in our correlations matrixes that anxiety and fear are only weakly to moderately correlated and exaggerated expressions of only one or the other (Anxiety or Fear, depending on the task) predicts child risk.

In post-hoc analyses, we conducted correlations between anxiety to fear “change scores” and child risk variables (child CBCL problems, current diagnosis, caregiver psychopathology, cortisol values). In the Snake task, children with more fear than anxiety had more internalizing problems (at trend level: $r(90)=.199$, $p=.057$), were more likely to have a current diagnosis (internalizing or externalizing, at trend level: $r(88)=.176$, $p=.097$) and also had higher baseline cortisol values (r(68)=.230, p=.055). There were no significant correlations in the Speech task. These results might suggest that incongruous anxiety to fear behaviors may be disadvantageous in some contexts, such as not detecting and responding appropriately to pre-threat cues and thus being overly 'surprised' by the threat. Future studies should examine this phenomenon further in an array of both task-congruous and task-incongruous proportions of threatening environmental cues to acute threats.

Interestingly, looking at profiles across tasks, children who displayed Anxiety/Fear in the Speech task, did not show Anxiety/Fear in the Snake task and vice versa. There was also a profile of children who did not display Anxiety/Fear to either task, but no group of children displayed atypically high anxiety/fear across both tasks. This may suggest separate underlying mechanisms of survival/startle responses compared to responses to social pressure. Prior literature reviewing the transdiagnostic nature of anxiety and fear does suggest that context between evolutionary based danger and social phobias differ (Öhman, 2008). Although Snake Fear and Speech Anxiety both predicted general functional impairment and heightened cortisol reactivity peaks, it may be that these behaviors were detecting separate mechanisms underlying the same risk. It is somewhat surprising that children high in anxiety and fear in one task were not high in the other task, which would might reflect a sensitivity to general anxiety and fear. In previous works, Durbin and colleagues (2007) give the alpha coefficient for fear codes from different mood induction tasks as .59 (compared to positive emotionality which was much higher at .90). Their relatively low comparative fear alpha may be consistent with our findings, together suggesting that fear differs more than positive emotionality across contexts.

For Initial and Sustained Positivity behaviors, when paired with either Snake (Set 3) and Speech (Sets 1 and 2) Anxiety and Fear, two of the profiles were relatively similar, with Initial

Positivity being about average with slightly increased Sustained Positivity over time. Children in these profiles were split between having atypically high or low Anxiety/Fear. However, children in the final profile had atypically high Initial Positivity followed by atypically low Sustained Positivity, suggesting that they were not able to sustain those levels of Positivity over time. Interestingly, these were children likely to have average Anxiety and Fear. These disconnects between Positive and Negative behaviors confirm that they should be understood as separate constructs and separate domains in the RDoC (Cohn & Fredrickson, 2009; Kim & Hamann, 2007).

Next, we looked at the model with all Positive constructs (induced and unanticipated). When compared to Induced Positivity in the Bubbles task, Unanticipated Positivity appears to act similarly in to Speech Anxiety/Fear in the previous sets, consisting of high, medium, and low means across both Speech phases. These disconnects between induced Positive and unanticipated Positivity suggest they be understood as separate constructs. Previous research on Positivity tends to focus on its positive biopsychosocial health (Tugade, Fredrickson, & Feldman Barrett, 2004), however, studies have measured positive emotionality as a general temperament (Lengua & Long, 2002) or specifically post stressor (Tugade et al., 2004) (Eisenberg et al., 1993) and not *during* a stressor. Fewer studies have look specifically at positivity during an acute stress task, and ones that did have combined induced and unanticipated Positivity codes (Durbin et al., 2007, 2005). Thus this is the first time positivity during different contexts has been profiled, and suggested to have different profiles in Positive versus Negative mood induction tasks.

When compared to Induced Positivity in the Bubbles task, both Speech Anxiety/Fear and Unanticipated Positivity appear to act similarly in separate models. However, in the Speech model, when Speech Anxiety/Fear is compared to Speech Unanticipated Positivity, we can see that children atypically high in Anxiety/Fear have average Unanticipated Positivity, those high in Unanticipated Positivity have atypically low Anxiety/Fear, and then there are some children low exhibiting low frequency in all behaviors types. Surprisingly, there were no children atypically high in both Unanticipated Positivity and Anxiety/Fear. These separate profiles for Anxiety/Fear and Unanticipated Positivity also suggest differential mechanisms. Again, it is difficult to compare unanticipated positive valence profiles to previous literature because previous literature has not specifically examined the construct. There is, however, a large literature on emotion regulation in children suggesting that emotion expression inappropriate to the context in type or intensity yields poor mental health adjustment in later childhood (Cole & Zahn-Waxler, 1992; Fernandez, Jazaieri, & Gross, 2016; Gee, 2016; Graziano, Reavis, Keane, & Calkins, 2007; Gross, 2002; Kovacs, Joormann, & Gotlib, 2008; Mathews, Koehn, Abtahi, & Kerns, 2016; McLaughlin, Hatzenbuehler, Mennin, & Nolen-Hoeksema, 2011; Rubin, Coplan, Fox, & Calkins, 1995). Whereas, in the face of threat, children displaying anxiety and fear may be regulated to the context, displaying positivity may be considered poor regulation in the same context. Thus, the two valence types (anxiety/fear and unanticipated positivity) would act differently when combined in the same profile models as we have found.

Although a few profiles mapped on to child risk, risk seemed mostly to be driven by single constructs, and not the full profiles (i.e., differences were found between two profiles with similar means for at all behaviors except one (or two that were similar). Thus, although it is interesting to explore how subgroups of children present across behaviors, and which codes "hang" together, the cross-sectionally utility of these profiles has not yet been determined, and future studies should examine their utility in longitudinal analyses.

General Discussion

The purpose of this dissertation was to adapt an assessment battery and valence coding for Research Domain Criteria valence domains. Our behaviors reliability and variance suggest good reliability; our intra-task code correlations suggest that the different phases of the task are eliciting different valence subdomain types. Our evaluation of convergent and criterion validity suggests complexities beyond the *apriori* hypotheses of this dissertation. 1) Behaviors are not simply behavioral representations of temperamental traits, nor do are they necessarily comprised of the traits one might expect. Overall, valenced behaviors elicited during Anxiety, Fear, and Positivity task phases may be better linked to surgency-related traits than their temperament-specific counterparts, suggesting tasks are eliciting general physiological arousal.

Although behaviors are not temperament-specific, the significant associations of behaviors with child problems signify that Anxiety, Fear and unanticipated Positivity behaviors are tapping into mechanisms that are important to child risk. Interestingly, behaviors may not be problem-type specific, underlying both internalizing and externalizing symptoms. This phenomenon may be due to the high comorbidity in young children, or perhaps it suggests the represented RDoC subdomains as distal risk factors (Nolen-Hoeksema & Watkins, 2011), yielding generalized functional impairment.

Anxiety and Fear codes are unrelated between the social-performance Speech task and the survival/safety threatening Snake task, suggesting the constructs may be context-dependent, or simply that procedural logistical differences were too great to compare these tasks. Whereas within task, Anxiety and Fear seemed to be proportional to one another and weakly to moderately correlated, children were either high in Snake *or* Speech negative valence. Future research comparing more procedurally-similar tasks across contexts may help to identify the cause of the differences between tasks. Additionally, future studies better addressing Anxiety to Fear ratios may help identify whether these subdomains are truly separate behavioral constructs in a way which can be measured outside of time-to-threat. Despite task differences, and construct similarities, Speech Anxiety and Snake Fear behaviors were similar in both predicting child general diagnosis, as well as heightened cortisol reactivity. Whereas Speech Anxiety also predicted internalizing and externalizing each separately, Snake Fear only predicted externalizing separately. Future studies should examine potential similarities between these task phases when tasks are more logistically similar in order to identify overlapping, underlying mechanisms yielding general functional and physiological impairment.

Induced Positivity codes were somewhat related across Bubbles and Reward tasks, and Initial and Sustained Positivity hung together for most children with a subtle increase in Positivity over time. However, there were a subgroup of children with extremely high initial Positivity that they could not sustain over time. High initial positivity in both tasks predicted externalizing diagnosis, but was unrelated to any other type of child risk. No profiles representing high induced positivity, low anxiety/fear or vice versa was expressed in the current study, which was somewhat surprising given the literature demonstrating these combinations yield specific problem types (Eisenberg et al., 2001b; Oldehinkel et al., 2004). Future studies should aim to adapt multiple tasks to elicit sustained positivity to be able to compare across tasks, and procedurally administer tasks on different days. In our study, the Reward behaviors may have been identifying sustained positivity due to its procedural position at the end of the lab visit, and our issues with duration variance.

Unanticipated Positivity during the anxiety/fear induction tasks were unexpected, but seemingly salient to child risk. These behaviors had some weak to moderate associations with induced positivity, and traits associated with induced positivity, but also a few associations with anxiety and fear, and traits associated with anxiety and fear. In profile analyses, unanticipated positivity did not seem to overlay with either induced positivity nor anxiety and fear, and had some unique associations with unexpected traits. However, when it came to risk, unanticipated positivity was positively related to internalizing and externalizing problems, internalizing, externalizing and overall diagnoses, similar to anxiety and fear codes, and some induced positivity codes (with externalizing diagnoses) and were the only valence type that was associated with caregiver PTSD and depressive symptoms. Interestingly, unanticipated positivity was, like anxiety and fear, predictive of cortisol reactivity, but in the opposite direction. These results suggest that unanticipated positivity is important to child functional and physiological impairment, with both shared and unique variance to anxiety and fear in the same task. In the current study, we can only speculate what unanticipated positivity is a maker of, and future studies should continue to examine unanticipated separately from induced positivity, and compare to established measures of coping, emotional flexibility, and regulation. In the current RDoC matrix, it is unclear where unanticipated positivity would fit, and future studies could shed light on this construct.

In some ways, it is surprising that contrived, one to two-minute long, valenced behaviors are related to several separate established measures of child risk observed in the home over six months. The results demonstrating convergent and discriminant validity among behaviors, and between measures suggests RDoC valence subdomains can be behaviorally measured reliably and are validly measuring continuums of risk. However, results also suggest that their validity is not based in the hypothesized "high fear, low positivity leads to internalizing; and low fear, high positivity leads to externalizing problems" way documented in temperament literature. These behavioral representations RDoC subdomains seem to have more nuanced, complex connections to child risk. RDoC subdomains as measured here, seem to capture temporal, contextual aspects of arousal that can assess child risk and potentially yield intervention-specific targets of underlying risk for general impairment in early childhood. This study demonstrates a start to the creation of an RDoC valence assessment battery, yet procedures must be revised, replicated, and examined with additional manipulations to investigate the salience of these codes incrementally to standardized assessment procedures, and longitudinally to subsequent child outcomes.

What should future iterations of the RDoC Assessment battery look like? This dissertation sought to adapt an assessment battery for examination of valence subdomains of the RDoC. Ultimately, final iterations of a valence assessment battery would be expected to yield clinical utility. Adding a behavioral supplemental component to child assessment observed by the clinician during intake would help examine child strengths and challenges, which in turn, could be applied to personalize their intervention. An observational valence assessment could add information to caregiver-report, much like how the Autism Diagnostic Observational Schedule (ADOS: (C Lord et al., 2000) is currently used supplemental to the Autism Diagnostic Interview-Revised (Catherine Lord, Rutter, & Couteur, n.d.).

This first iteration allowed for insight into the salience of task context, phase timing, and task procedural logistics in valence assessment. Thus, in addition to expanding future iterations to cover other valence subdomains, they must also address these issues. Future iterations should aim to make tasks more similar in terms of context (social vs evolutionary threat), timing (add tasks with varying task durations to better understand initial vs sustained positivity as well as the imminence of anxiety vs fear), and logistically similar tasks (in terms of expected child movement, and relationship to clinician).

Additionally, like the ADOS, there must be a shift from post-assessment video coding to immediate coding that could be accomplished by the clinician. The results from the current iteration can be used to identify the most salient behaviors associated with child risk and resiliency (namely non-verbal Speech Anxiety, Snake Fear, and Unanticipated Positivity) and focus on their real time-coding. Additionally, future iterations could also focus on real-time indicators of physiological risk for more clinical utility such as movement-based techniques (McGinnis et al., 2016) (based on the importance of the non-verbal behaviors) and/or heart rate in lieu of cortisol which takes months to collect, assay, and analyze.

Finally, more attention should be focused on unanticipated positivity, and how it relates to the RDoC. For instance, should it be added as a subdomain? Or does it already exist in the RDoC as a combination of valence and another domain such as arousal, social, and/or cognitive functioning? Regardless of their RDoC connection, these behaviors indicate risk, can be easily observed in a clinical assessment setting and thus demonstrate some clinical utility. Additionally, we should work to include other domains of the RDoC matrix. For instance, given our findings of the importance of impulsivity and surgency to our studied subdomains, cognitive control in the Cognitive Systems domain should be assessed and added to this RDoC battery for young children. For similar reasons, arousal in Arousal and Regulatory systems should be added to the battery. Finally, Social communication, affilliation and attachment, and perception and understanding of others- all part of the Social Processes domain, would aid our understanding of Negative and Positive Valence domains in how they were studied here. We discussed the probable influences of social communication and understanding on the child’s behaviors in the context of their novel relationship with the experimenter walking them through the studies, and their understanding of socially appropriate behavior and emotional displays depending on the context (such as unanticipated positivity). It would be incredibly interesting and telling to be able to evaluate all of these subdomains on each child, and observe natural profiles, and how subdomains influence and relate to each other.

There is much work to be accomplished prior to clinical utility of this valence assessment battery, but it has the potential to be extremely useful in young childhood where there is a dearth of validated assessment tools directed towards the child.

Limitations. Several limitations are associated with the current study. First, the sample size was small considering the exploratory nature of many of the analyses. We had many hypotheses and while our sample was diverse, there were far too few children to make any confirmatory conclusions mixed modeling and subgroup profile analyses. All analyses should be replicated with larger samples to be conclusive. Additionally, while the chosen participant sample provides us with a breadth of risk, the sample is unique in many ways. Almost half of participants have been enrolled in research since birth or shortly after. Families who participate in research and who are able to maintain communication with study coordinators and most likely different (have higher education, less poverty, more interested in helping their communities) than other community members (Bocknek, Brophy-Herb, & Banerjee, 2009). In addition, many of the mothers in the sample are child trauma survivors and thus the generalizability of findings in the sample may be limited. Over the 2 year course of this cross-sectional study, changes were made to the protocol including 1) when (home visit or lab visit) and how (by phone or in person, with or without the child present) the clinical interview was conducted, 2) the addition of the speech preparation (anxiety) phase after 12 participants and 3) the addition of new mood induction and executive functioning tasks between the Snake and Bubble tasks. These changes in protocol were confounded with participant family demographics as many of them were implemented at the same time as participant recruitment changed from recruiting from the past study to recruiting from the community and psychiatric/pediatric offices. Thus it is unknown whether any differences in affect-behaviors are due to protocol changes, or to demographic differences. Future iterations should be standardized from the onset, and be counterbalanced. Finally, future studies with additional participants should examine the reliability of behavior-affect code profiles, and whether these profiles map on to important risk characteristics in children, cross-sectionally or longitudinally.

Strengths. This study also had several strengths, such that it included mixed-methods from multiple reporters (clinician-report, caregiver report, child behavior, and hormone reactivity), that it included nine cortisol data samples to measure reactivity to one stressor which is a novel addition to the literature, and that we included children with a large range of risk for internalizing disorders.

Table 1.

Demographic Characteristics of Sample (N=96)

Characteristic	Range	N (Percentage) or Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)
Primary Caregivers	Mother	90 (94%)		
	Father	3 (3%)		
	Grandmother	3 (3%)		
Annual Household Income	<25k	13 (14%)		
	25-50k	14 (15%)		
	50-100k	30 (32%)		
	>100k	37 (39%)		
	0-100+	70k (27k)	-.67 (.25)	-.99 (.49)
Caregiver Age Winzorized	25-49 (1 83 year old)	37.05 (5.73)	.15 (.25)	-.42 (.49)
Caregiver Education	High school	4 (4%)		
	Some College	20 (21%)		
	Bachelor's Degree	37 (40%)		
	Graduate Degree	33 (35%)		
Child Age (Months)	45-99	72.47 (13.59)	.14 (.25)	-.84 (.49)
Child Race	White	62 (65%)		
	African American	11 (11%)		
	Multi-racial	18 (19%)		
	Other	5 (5%)		
Child Gender	Female	50 (52%)		

Table 2.

Diagnostic Characteristics of Sample (n ranges from 91-95)

Caregiver Psychopathology N=95	N (%)
PTSD Diagnosis	25 (28%)
Caregiver Depression (Moderate or Severe)	10 (11%)
PTSD or Depression	28 (29%)
Child CBCL Psychopathology n=91	
Internalizing T>65	8 (9%)
Externalizing T>65	5 (5%)
Both T>65	2 (2%)
Present Child KSADS Diagnoses n=91	
Internalizing Diagnosis	23 (25%)
Externalizing Diagnosis	11 (12%)
Int and Ext Diagnoses	5 (5%)
Past Child KSADS Diagnoses n=91	
Internalizing Diagnosis	27 (30%)
Externalizing Diagnosis	11 (12%)
Int and Ext Diagnoses	5 (5%)

Note: Int = Internalizing; Ext= Externalizing

Table 3.

Descriptives of Snake Task Behaviors (N=82)

Raw Scores					Decision Tree Form				
Phase 1	Range	Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)		Range	Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)
Anxiety Verbal	0-9	.73 (1.57)	3.00 (.27)	10.64 (.53)	Dichotomized	0-1	59 (72%)	23 (28%)	
Anxiety Non-verbal	0-18	8.85 (4.23)	.15 (.27)	-.74 (.53)	Raw				
Phase 2									
Fear Verbal	0-31	3.67 (4.51)	3.31 (.27)	16.87 (.53)	Winzorized	0-10	3.30 (3.02)	.64 (.27)	-.70 (.53)
Fear Non-verbal	0-22	7.68 (4.77)	.911 (.27)	.999 (.53)	Raw	0-22	7.68 (4.77)	.911 (.27)	.999 (.53)
Positivity 2 Verbal	0-12	2.73 (2.99)	1.94 (.27)	.60 (.53)	Winzorized	0-10	2.71 (2.91)	1.10 (.27)	.17 (.53)
Positivity 2 Non-verbal	0-4	0.51 (0.89)	1.99 (.27)	3.70 (.53)	RIN Transformed	-.43-2.51	.07 (.76)	1.24 (.27)	.43 (.53)

Table 4.

Descriptives of Speech Task Behaviors (Phase 1: n=72; Phase 2: n=88)

Raw Scores					Decision Tree Form				
Phase 1	Range	Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)		Range	Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)
Anxiety	0-22	3.16	5.33	4.34	RIN	-.71-2.47	.06	.76	-.41
Verbal		(5.33)	(2.22)	(.57)	Transformed		(.86)	(.28)	(.56)
Anxiety	1-59	19.26	1.14	1.85	Raw				
Non-verbal		(11.06)	(.28)	(.57)					
Positivity	0-22	1.84	3.45	12.77	RIN	-.50-2.47	.07	1.09	.08
Verbal		(4.06)	(.29)	(.57)	Transformed		(.80)	(.28)	(.56)
Positivity	0-21	3.13	2.11	3.65	RIN	-.62-2.47	.06	.87	-.30
Non-verbal		(5.59)	(.29)	(.57)	Transformed		(.84)	(.28)	(.56)
Phase 2									
Fear	0-33	13.32	.26	-.928	Raw				
Verbal		(9.18)	(.26)	(.52)					
Fear	3-80	28.32	.89	2.23	Winzorized	3-57	28.20	.04	-.11
Non-verbal		(12.88)	(.26)	(.52)			(12.12)	(.25)	(.51)
Positivity	0-67	10.83	2.02	5.06	RIN	-1.21-	.02	.34	-.54
Verbal		(13.56)	(.26)	(.52)	Transformed	2.53	(.94)	(.26)	(.51)
Positivity	0-35	2.54	3.81	16.48	RIN	-.48-2.12	.07	1.08	-.93
Non-verbal		(6.23)	(.26)	(.52)	Transformed		(.79)	(.26)	(.51)

Table 5.

Descriptives of Bubble Task Behaviors (Phase 1: n=90; Phase 2: n=86)

Raw Scores					Decision Tree Form				
Phase 1	Range	Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)		Range	Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)
Fear Non-Verbal	0-6				Dichotomized	0-1	72 (80%)	18 (20%)	
Initial Positivity Verbal	0-24	5.73 (4.78)	1.23 (.25)	1.93 (.50)	Winzorized	0-18	5.67 (4.57)	.950 (.26)	.47 (.50)
Initial Positivity Non-Verbal	0-29	6.06 (6.60)	1.52 (.25)	1.61 (.52)	Winzorized	0-20	5.83 (5.96)	1.18 (.26)	.55 (.50)
Phase 2									
Positivity Verbal	0-18	6.53 (4.76)	.75 (.27)	-.06 (.51)	Raw				
Positivity Non-Verbal	0-36	8.92 (7.25)	1.09 (.26)	1.57 (.51)	Winzorized	0-23	8.68 (6.58)	.58 (.26)	-.56 (.51)
Sustained Positivity									
Sustained Positivity Verbal					Computed Change Score	-17-14	.81 (5.22)	-.25 (.26)	1.74 (.51)
Sustained Positivity Non-verbal					Computed Change Score	-15-19	2.72 (6.73)	.23 (.26)	.40 (.51)

Note: Sustained Positivity is the difference between Phase 2 and Phase 1.

Table 6.

Descriptives of Reward Task Behaviors (n=90)

Raw Scores					Decision Tree Form				
Episode 1	Range	Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)		Range	Mean (S.D.)	Skew (S.E.)	Kurtosis (S.E.)
Initial Positivity Verbal	0-10	2.81 (2.58)	1.04 (.25)	.63 (.50)	Raw				
Initial Positivity Non-Verbal	0-11	1.41 (2.53)	2.03 (.25)	3.65 (.50)	RIN Transformed	-.51-2.54	.07 (.80)	1.06 (.25)	.02 (.50)

Table 7.

Correlations for Snake 2 Non-verbal Positivity Using Different Behavior Variable Types (n=75)

Snake 2 Non-verbal Positivity	Maintain Attentional Focus
Pearson Correlations	
Raw	-.318
	.005
Winzorized	-.303
	.008
RANKIT Transformation	-.236
	.041
Natural Log Transformation	-.265
	.022
Spearman Correlation	
Dichotomized	-.064
	.584

Table 8.

Task Phase Duration Descriptives

Task Durations	Range	Mean (Std. Dev)
Speech 1	1:00-4:38	2:53 (0:28)
Speech 2	1:19-3:65	3:00 (0:17)
Snake 1	0:25-0:49	0:38 (0:05)
Snake 2	0:17-1:20	0:43 (0:10)
Reward	0:13-3:05	1:13 (0:32)
Bubbles (Full Task)	2:24-6:22	3:45 (0:46)

Table 9.

Significant Correlations Between Task Phase Durations and Behaviors

Behaviors	Task Phase Duration r p value
Speech 2 Positivity Non-verbal	**.227** **.034**
Snake 1 Anxiety Non-verbal	**.291** **.014**
Snake 1 Anxiety Verbal	**-.250** **.038**
Snake 2 Fear Verbal	**.246** **.039**
Reward 1 Initial Positivity Verbal	**.252** **.016**

Note: All following correlations of these significant codes will control for episode time.

Table 10.

Aim 1: Inter-rater Reliability of Behaviors using Intra-class Coefficients 2-Way Mixed Single Measures

			Snake Task	Speech Task	Bubble Task	Reward Task
			n= 20	n=16	n=28	n=31
Phase 1	Anxiety	Verbal	0.831	0.989	0.173	0.338
		Non-verbal	0.929	0.983	0.839	0.271
	Positivity	Verbal	0.892	0.984	0.889	0.756
		Non-verbal	0	0.987	0.982	0.955
Phase 2	Fear	Verbal	0.924	0.888	0.972	
		Non-verbal	0.874	0.935	0.846	
	Positivity	Verbal	0.928	0.945	0.913	
		Non-verbal	0.86	0.979	0.93	

Table 11.

Aim 1: Non-Zero Frequency of Behaviors

			Snake Task n= 82; n=82	Speech Task n=72; n=88	Bubble Task n=90; n=86	Reward Task n=90
Phase 1	Anxiety	Verbal	23 (28%)	50 (54%)		
		Non-verbal	81 (99%)	71 (99%)	18 (20%)	
	Positivity	Verbal	3 (4%)	31 (43%)	80 (88%)	71 (79%)
		Non-verbal		46 (64%)	76 (84%)	35 (39%)
Phase 2	Fear	Verbal	59 (72%)	83 (94%)	6 (7%)	
		Non-verbal	79 (96%)	87 (98%)	12 (14%)	
	Positivity	Verbal	59 (72%)	71 (80%)	78 (94%)	
		Non-verbal	27 (33%)	35 (40%)	74 (89%)	

Table 12.

Aim 2: Hypothesis 1-Convergent Validity of Negative Valence Behaviors within the a) Snake and b) Speech Tasks

Snake Task				Speech Task			
a.	Non-verbal Anxiety	Verbal Fear	Non-verbal Fear	b.	Non-verbal Anxiety	Verbal Fear	Non-verbal Fear
Verbal	-0.056	**0.221**	-0.016	Verbal	0.007	0.156	0.142
Anxiety	0.627	**0.05**	0.89	Anxiety	0.951	0.195	0.233
Non-verbal		0.102	**0.350**	Non-verbal		0.116	**0.438**
Anxiety		0.373	**0.002**	Anxiety		0.335	**0.000**
Verbal			**0.589**	Verbal			**0.410**
Fear			**0.000**	Fear			**0.000**

Table 13.

Aim 2: Hypothesis 1-Convergent Validity of Positive Valence Behaviors within the a) Snake, b) Speech, c) Reward, and d) Bubble Tasks

a. Snake Task

	Non-verbal 2 Positivity
Verbal 1 Positivity	
Non-verbal 1 Positivity	
Verbal 2 Positivity	**0.313** **0.005**

b. Speech Task

	Non-verbal 1 Positivity	Verbal 2 Positivity	Non-verbal 2 Positivity
Verbal 1 Positivity	**0.298** **0.011**	**0.368** **0.002**	**0.305** **0.009**
Non-verbal 1 Positivity		-0.024 0.843	**0.420** **0.00**
Verbal 2 Positivity			**0.217** **0.043**

c. Reward Task

	Non-verbal Sustained Positivity
Verbal Initial Positivity	0.049 0.65
Non-verbal Initial Positivity	
Verbal Sustained Positivity	

d. Bubble Task

	Non-verbal Initial Positivity	Verbal Sustained Positivity	Non-verbal Sustained Positivity
Verbal Initial Positivity	**0.304** **0.004**	**-0.53** **0.00**	-0.034 0.769
Non-verbal Initial Positivity		-0.028 0.808	**-0.476** **0.00**
Verbal Sustained Positivity			0.158 0.146

Table 14.

Aim 2: Hypothesis 1-Discriminant Validity of Negative vs. Positive Valence Behaviors within the a) Snake, b) Speech, and c) Bubble Tasks

a. Snake Task

	Verbal 2 Positivity	Non-verbal 2 Positivity
Verbal	0.055	0.011
Anxiety	0.630	0.925
Non-Verbal	0.081	0.215
Anxiety	0.480	0.057
Verbal	0.011	0.162
Fear	0.926	0.154
Non-Verbal	-0.138	0.126
Fear	0.227	0.268

b. Speech Task

	Verbal 1 Positivity	Non-verbal 1 Positivity	Verbal 2 Positivity	Non-verbal 2 Positivity
Verbal	**0.257**	0.074	-0.118	0.042
Anxiety	**0.03**	0.539	0.327	0.723
Non-Verbal	-0.21	0.000	-0.127	-0.105
Anxiety	0.076	0.998	0.291	0.38
Verbal	-0.03	-0.018	0.024	0.053
Fear	0.802	0.88	0.824	0.623
Non-verbal	-0.213	-0.018	-0.063	-0.096
Fear	0.073	0.882	0.560	0.372

c. Bubble Task

Task	Verbal Initial Positivity	Non-verbal Initial Positivity	Verbal Sustained Positivity	Non-verbal Sustained Positivity
Non-verbal	**0.242**	0.066	-0.168	-0.018
Fear	**0.022**	0.539	0.145	0.876

Table 15.

Aim 2: Hypothesis 2-Convergent Validity of Negative Valence Behaviors between the Snake, Speech, and Bubble Tasks

	Snake Task				Bubble Task
Speech Task	Verbal Anxiety	Non-verbal Anxiety	Verbal Fear	Non-verbal Fear	Non-verbal Fear
Verbal Anxiety	0.036	-0.038	-0.174	-0.043	0.164
	0.812	0.798	0.241	0.746	0.215
Non-verbal Anxiety	-0.169	-0.17	-0.009	-0.086	0.016
	0.256	0.253	0.952	0.522	0.902
Verbal Fear	-0.028	-0.025	-0.011	-0.081	-0.166
	0.853	0.868	0.943	0.494	0.195
Non-verbal Fear	-0.107	-0.097	-0.064	-0.032	-0.041
	0.473	0.515	0.668	0.784	0.73
Bubble Task					
Non-verbal Fear	.128	-.015	.016	0.157	
	.284	.900	.895	0.194	

Table 16.

Aim 2: Hypothesis 2-Convergent Validity of Positive Valence Behaviors between the Snake, Speech, Reward, and Bubble Tasks

	Snake Task		Reward Task		Speech Task			
Speech Task	Verbal 2 Positivity	Non-verbal 2 Positivity	Verbal Initial Positivity	Non-verbal Initial Positivity	Verbal 1 Positivity	Non-verbal 1 Positivity	Verbal 2 Positivity	Non-verbal 2 Positivity
Verbal	**0.313**	0.124	-0.069	0.055				
1 Positivity	**0.017**	0.353	0.62	0.687				
Non-verbal	**0.282**	0.238	0.148	**0.247**				
1 Positivity	**0.032**	0.072	0.287	**0.047**				
Verbal	0.139	0.103	-0.004	-0.053				
2 Positivity	0.241	0.384	0.987	0.661				
Non-verbal	0.209	0.129	-0.017	0.125				
2 Positivity	0.103	0.319	0.905	0.333				
Bubbles								
Verbal	**0.304**	**0.334**	**0.307**	0.192	0.039	**0.325**	-0.002	0.221
Initial Positivity	**0.01**	**0.004**	**0.004**	0.09	0.767	**0.008**	0.989	0.287
Non-Verbal	0.145	0.047	0.143	-0.013	-0.015	0.185	0.117	-0.025
Initial Positivity	0.232	0.702	0.191	0.902	0.91	0.161	0.326	0.905
Verbal	0.125	-0.206	-0.051	0.04	0.109	-0.177	0.01	-0.087
Sustained Positivity	0.317	0.092	0.667	0.714	0.419	0.188	0.933	0.475
Non-Verbal	-0.017	-0.016	0.054	**0.236**	0.239	0.034	0.181	0.015
Sustained Positivity	0.892	0.896	0.648	**0.029**	0.060	0.803	0.137	0.903
Reward								
Verbal	**0.275**	0.207						
Initial Positivity	**0.019**	0.081						
Non-verbal	0.12	-0.031						
Initial Positivity	0.328	0.801						

Table 17.

Aim 2: Hypothesis 2-Discriminant Validity of Negative vs. Valence Behaviors between the Snake, Speech, Reward, and Bubble Tasks

	Snake Task		Reward Task		Bubbles Task				Speech Task			
Speech Task	Verbal 2 Positivity	Non-verbal 2 Positivity	Verbal Initial Positivity	Non-verbal Initial Positivity	Verbal initial Positivity	Non-verbal initial Positivity	Verbal sustained Positivity	Non-verbal sustained Positivity	Verbal 1 Positivity	Non-verbal 1 Positivity	Verbal 2 Positivity	Non-verbal 2 Positivity
Verbal Anxiety	0.022	0.067	0.047	0.09	0.027	0.158	0.107	-0.072				
	0.872	0.618	0.734	0.505	0.838	0.232	0.429	0.597				
Non-verbal Anxiety	-0.032	0.014	-0.072	0.012	-0.229	-0.176	0.027	-0.055				
	0.814	0.917	0.605	0.928	0.081	0.182	0.84	0.687				
Verbal Fear	0.069	-0.047	-0.118	0.013	0.041	0.015	-0.046	0.039				
	0.563	0.694	0.396	0.916	0.735	0.902	0.71	0.748				
Non-verbal Fear	0.03	0.055	-0.012	0.05	0.089	0	-0.147	0.097				
	0.797	0.641	0.929	0.677	0.451	0.999	0.225	0.423				
Snake												
Verbal Anxiety			0.092	0.033	-0.037	-0.046	0.018	-0.14	0.159	-0.193	0.085	0.062
			0.48	0.802	0.867	0.835	0.897	0.299	0.284	0.193	0.568	0.678
Non-verbal Anxiety			0.213	0.058	0.215	0.183	0.1	0.134	-0.102	-0.049	0.032	0.078
			0.099	0.656	0.324	0.403	0.459	0.321	0.495	0.745	0.828	0.603
Verbal Fear			**0.261**	0.008	0.299	-0.07	0.028	0.035	-0.049	-0.034	0.098	0.087
			0.042	0.954	0.166	0.75	0.834	0.793	0.744	0.823	0.514	0.561
Non-verbal Fear			-0.076	-0.01	0.112	0.002	0.066	**0.264**	0.025	-0.113	0.057	-0.04
			0.61	0.932	0.354	0.984	0.597	**0.03**	0.853	0.399	0.63	0.756
Bubbles												
Non-verbal Fear	0.029	0.032	0.13	-0.065					0.119	**0.277**	0.142	-0.052
	0.813	0.795	0.252	0.572					0.37	**0.026**	0.235	0.903

Table 18.

Descriptive Statistics of Caregiver Reported Child Behavior Questionnaire (n=92)

Child Behavior Traits	Range	Mean (Std. Dev)	Skewness (Std. Error)	Kurtosis (Std. Error)
Approach Excitement	3.62-6.69	5.18 (.67)	.11 (.25)	.01 (.50)
Attentional Focus	2.33-6.44	4.68 (4.95)	-.35 (.25)	-.17 (.50)
Recovery from Distress	3.00-6.64	4.95 (.81)	-.35 (.25)	-.40 (.50)
Fear	2.08-6.09	3.86 (.97)	.12 (.25)	-.61 (.50)
Impulsivity	2.38-6.23	4.45 (.83)	.04 (.25)	-.43 (.50)
Low Intensity Pleasure	3.00-7.00	5.70 (.64)	-.90 (.25)	2.73 (.50)
Sadness	1.83 -5.50	3.88 (.77)	-.24 (.25)	-.09 (.50)
Smiling	4.23-7.00	6.01 (.53)	-.79 (.25)	1.11 (.50)
Activity	2.69-6.85	4.91 (.80)	-.16 (.25)	.44 (.50)
Frustration	2.23-6.85	4.41 (.93)	-.15 (.25)	-.06 (.50)
Attentional Shifting	2.20-7.00	4.08 (.92)	.45 (.25)	.22 (.50)
Sensory Discomfort	1.55-6.25	4.03 (1.00)	.06 (.25)	-.22 (.50)
High Intensity Pleasure	2.31-6.46	5.08 (.78)	-.60 (.25)	.46 (.50)
Inhibitory Control	2.62-7.00	5.09 (.82)	-.21 (.25)	.13 (.50)
Perceptual Sensitivity	2.75-6.91	5.05 (.71)	-.54 (.25)	1.18 (.50)
Shyness	1.08-6.31	3.19 (1.18)	.43 (.25)	-.40 (.50)

Table 19.

Aim 2: Hypothesis 3-Convergent and Discriminant Validity between Negative Valence Behaviors and Caregiver Reported Child Temperament

a. Anxiety Behaviors

	Snake Task		Speech Task	
Trait	Verbal Anxiety	Non-verbal Anxiety	Verbal Anxiety	Non-verbal Anxiety
Convergent				
Approach	**0.323**	-.081	.001	.083
Excitement	**0.008**	.512	.927	.498
Fear	-0.205	-.132	-.079	.219
	0.096	.285	.520	.071
Sensory	-0.121	**-0.241**	-.014	**.267**
Discomfort	0.331	**0.050**	.912	**.027**
Discriminant				
Smiling/	0.179	.045	-.044	.089
Laughter	0.149	.715	.719	.467
Low Intensity	-.001	.111	-.027	.093
Pleasure	.994	.372	.823	.445
HighIntensity	.137	.069	.055	.081
Pleasure	.270	.581	.652	.507
Exploratory				
Distress	.052	.233	-.101	-.01
Recovery	.679	.058	.409	.932
Impulsivity	**0.303**	.013	.037	-.060
	0.013	.919	.766	.626
Perceptual	-.094	-.034	.039	.160
Sensitivity	.447	.785	.75	.191
Activity	.135	-.02	.079	-.011
Level	.277	.87	.518	.927
Sadness	-.109	**-0.350**	.200	.170
	.380	**0.004**	.099	.164
Attentional	-.037	-.132	-.034	.009
Focus	.769	.286	.778	.943
Shyness	-.114	-.177	-.029	.033
	.360	.151	.812	.787
Frustration	.030	-.181	.188	.102
	.808	.142	.122	.406
Attentional	-.046	.061	-.032	.047
Shifting	.714	.625	.793	.703
Inhibitory	-.136	.046	-.022	-.088
Control	.272	.715	.855	.473

b Fear Behaviors

	Snake Task		Speech Task		Bubble
Trait	Verbal Fear	Non-verbal Fear	Verbal Fear	Non-verbal Fear	Non-verbal Fear
Convergent					
Sensory	.078	.088	-.094	.088	.067
Discomfort	.530	.442	.395	.442	.546
Distress	.071	.010	-.037	.010	-.005
Recovery	.566	.298	.735	.928	.961
Impulsivity	.178	-.055	.129	-.055	.024
	.149	.629	.242	.629	.831
Discriminant					
Smiling/	.007	-.117	.080	-.117	.061
Laughter	.953	.306	.467	.306	.583
Low Intensity	-.158	.055	-.114	.055	-.071
Pleasure	.202	.629	.302	.629	.521
HighIntensity	.237	-.026	**0.227**	-.026	.024
Pleasure	.053	.819	**0.038**	.819	.831
Exploratory					
Approach Excitement	**0.299**	.096	.021	.096	.020
	0.014	.402	.853	.402	.861
Fear	.007	.217	-.077	.217	.181
	.952	.054	.488	.054	.102
Perceptual	-.001	-.036	-.189	-.036	.114
Sensitivity	.994	.752	.086	.752	.304
Activity	.216	.011	.149	.011	.184
Level	.079	.926	.176	.926	.095
Sadness	**-0.248**	-.188	-.082	-.188	.033
	0.043	.097	.46	.097	.767
Attentional	-.108	-.025	-.149	-.025	-.005
Focus	.382	.829	.176	.829	.965
Shyness	-.049	.003	**-0.223**	.003	.038
	.693	.981	**0.042**	.981	.730
Frustration	-.031	.039	-.031	.039	.078
	.800	.733	.778	.733	.486
Attentional	-.023	.026	-.012	.026	.073
Shifting	.855	.823	.914	.823	.509
Inhibitory	-.109	.012	-.133	.012	.013
Control	.830	.915	.226	.915	.904

Table 20.

Aim 2: Hypothesis 3-Convergent and Discriminant Validity between Induced Positive Valence Behaviors and Caregiver Reported Child Temperament

a. Initial Positivity

	Reward		Bubbles	
Trait	Verbal	Non-verbal	Verbal	Non-verbal
Convergent				
Approach	.016	-.033	.175	.09
Excitement	.886	.764	.114	.418
Activity	.191	.106	**0.240**	.129
Level	.090	.340	**0.029**	.246
High	0.267	-.181	.040	.006
Intensity Pleasure	0.016	.101	.717	.954
Low Intensity	**-0.222**	.060	.096	-.019
Pleasure	**0.048**	.509	.386	.863
Smiling/	0.187	.097	.134	.068
Laughter	0.096	.384	.226	.540
Discriminant				
Sadness	-.108	.025	-.005	-.013
	.338	.825	.967	.907
Exploratory				
Attentional	**-0.235**	-.178	-.13	-.1
Focus	**0.036**	.107	.24	.37
Fear	-.171	.117	-.008	.018
	.129	.291	.946	.875
Shyness	-.166	-.055	**-0.299**	-.092
	.142	.623	**0.006**	.410
Frustration	.062	-.091	.034	.082
	.584	.414	.762	.460
Attentional	**-0.261**	-.067	-.050	-.180
Shifting	**0.022**	.548	.656	.103
Inhibitory	-.104	.138	-.171	-.077
Control	.357	.212	.122	.491
Sensory	**-0.246**	.004	.043	-.018
Discomfort	**0.028**	.975	.699	.872
	0.316	.008	**0.286**	.127
Impulsivity	**0.004**	.946	**0.009**	.251
Distress	.064	.017	-.025	-.064
Recovery	.576	.880	.822	.566
Perceptual	-.090	.016	-.085	-.107
Sensitivity	.426	.882	.444	.335

b. Sustained Positivity

	Bubbles	
Trait	Verbal	Non-verbal
Convergent		
Attentional	.001	-.103
Focus	.990	.365
Activity	-.142	.021
Level	.211	.857
Low Intensity	-.089	.080
Pleasure	.433	.481
Smiling/	-.105	.097
Laughter	.357	.395
Discriminant		
Exploratory		
Approach	-.166	-.027
Excitement	.144	.811
HighIntensity	-.094	.058
Pleasure	.410	.614
Sadness	.014	-.08
	.900	.481
Fear	-.071	-.037
	.532	.744
Shyness	.090	-.014
	.430	.903
Frustration	.076	.056
	.505	.621
Attentional	-.007	.023
Shifting	.950	.839
Inhibitory	.118	-.012
Control	.302	.916
Sensory	-.123	-.007
Discomfort	.279	.950
	-.155	.035
Impulsivity	.171	.759
Distress	.029	.117
Recovery	.799	.305
Perceptual	.039	-.026
Sensitivity	.734	.817

Table 21.

Aim 2: Hypothesis 3-Convergent and Discriminant Validity between Exploratory Positive Valence Behaviors and Caregiver Reported Child Temperament

	Snake Task		Speech Task		Speech Task	
Traits	Verbal 2	Non-verbal 2	Verbal 1	Non-verbal 1	Verbal 2	Non-verbal 2
Convergent						
Approach Excitement	0.025	0.098	0.002	0.041	0.045	0.065
	0.824	0.392	0.989	0.741	0.686	0.552
Smiling/ Laughter	**0.329**	**0.306**	-0.029	-0.037	0.083	-0.043
	0.003	**0.006**	0.815	0.761	0.451	0.698
Discriminant						
Sensory Discomfort	-0.193	-0.083	-0.011	0.045	-0.087	**0.262**
	0.089	0.469	0.931	0.715	0.433	**0.015**
Shyness	**-0.267**	-0.209	-0.067	-0.091	0.141	-0.072
	0.017	0.064	0.584	0.456	0.201	0.512
Exploratory						
Fear	-0.139	**-0.227**	0.056	0.018	-0.014	0.077
	0.220	**0.044**	0.647	0.881	0.897	0.483
Distress Recovery	0.126	0.158	-0.085	-0.149	0.136	0.002
	0.267	0.163	0.487	0.222	0.218	0.987
Perceptual Sensitivity	-0.101	0.117	-0.094	-0.063	-0.069	**-0.285**
	0.374	0.305	0.444	0.609	0.531	**0.008**
Activity Level	0.040	0.054	0.01	0.161	0.068	0.192
	0.728	0.636	0.932	0.186	0.539	0.079
High Intensity Pleasure	0.108	**0.284**	0.051	0.131	-0.036	0.184
	0.343	**0.011**	0.678	0.284	0.747	0.092
Attentional Focus	-0.200	-0.110	-0.132	-0.069	0.023	-0.084
	0.078	0.334	0.280	0.572	0.838	0.444
Low Intensity Pleasure	0.031	0.15	-0.109	-0.033	0.005	-0.109
	0.788	0.186	0.373	0.787	0.964	0.322
Frustration	-0.063	**-0.235**	0.056	0.025	-0.188	-0.004
	0.581	**0.037**	0.647	0.836	0.087	0.973
Attentional Shifting	0.012	0.166	0.051	-0.156	0.094	-0.117
	0.913	0.145	0.677	0.200	0.393	0.286
Inhibitory Control	-0.118	0.049	-0.106	-0.169	0.079	**-0.217**
	0.302	0.670	0.386	0.165	0.476	**0.046**
	0.085	-0.063	0.189	0.109	-0.045	-0.149
Sadness	0.458	0.583	0.120	0.371	0.682	0.173
	.306	0.186	0.163	0.174	0.055	**.262**
Impulsivity	**.006**	0.100	0.181	0.153	0.617	**.015**

Table 22.

Descriptive Statistics of Caregiver Reported Child Behavior Problems (n=93)

Child Behavior T Scores	Range	Mean (Std. Dev)	Skewness (Std. Error)	Kurtosis (Std. Error)
Broadband Scales (RAW)				
Internalizing	29-70	45.67 (10.80)	.58 (.25)	-.40 (.50)
Externalizing	28-79	46.09 (10.97)	.36 (.25)	-.39 (.50)
Total Problems	24-74	45.01 (11.10)	.42 (.25)	-.42 (.50)
Subscales (RANKIT)				
Anxious/Depressed	-2.95	.07 (.83)	.91 (.25)	-.46 (.50)
Somatic	-2.96	.04 (.85)	1.04 (.25)	-.07 (.50)
Withdrawn	-3.24	.06 (.84)	.97 (.25)	-.02 (.50)
Attention	-3.45	.02 (.89)	.73 (.25)	-.31 (.50)
Aggression	-3.24	.07 (.86)	.96 (.25)	-.16 (.50)
Diagnostic Scales (RANKIT)				
Depression	-3.07	.11 (.87)	.71 (.25)	-.45 (.50)
Anxiety	-3.28	.08 (.86)	.82 (.25)	-.35 (.50)
ADHD	-3.21	.03 (.83)	1.11 (.25)	.27 (.50)
ODD	-3.49	.05 (.91)	.61 (.25)	-.52 (.50)

Table 23.

Aim 2: Hypothesis 4-Convergent and Discriminant Validity between Negative Valence Behaviors and Caregiver Reported Child Problems

Anxiety Behaviors

	Snake Task		Speech Task	
Problems	Verbal	Non-verbal	Verbal	Non-verbal
Convergent				
Anxiety/Depression	0.073	-0.045	0.112	0.22
	0.526	0.717	0.359	0.069
Somatic	-0.002	-0.214	-0.070	**0.301**
	0.985	0.080	0.570	**0.012**
Withdrawn	0.049	-0.114	0.108	0.200
	0.675	0.353	0.376	0.100
Depression	0.108	-0.120	0.059	**0.309**
	0.348	0.330	0.630	**0.010**
Anxiety	0.131	-0.184	-0.003	**0.368**
	0.258	0.133	0.980	**0.002**
Discriminant				
ADHD	**0.281**	-0.098	-0.013	**0.265**
	0.013	0.425	0.914	**0.027**
ODD	0.202	-0.111	-0.023	**0.237**
	0.078	0.366	0.850	**0.050**
Attention	**0.269**	-0.07	0.036	0.184
	0.018	0.570	0.767	0.130
Aggression	**0.224**	-0.154	0.008	**0.278**
	0.050	0.211	0.947	**0.021**

b. Fear Behaviors

	Snake Task		Speech Task		Bubbles Task
Problems	Verbal	Non-verbal	Verbal	Non-verbal	Non-verbal
Convergent					
Anxiety/Depression	-0.044	0.030	-0.079	0.034	.161
	0.720	0.790	0.475	0.757	.144
Discriminant					
Somatic	0.042	0.051	-0.029	-0.043	.140
	0.736	0.655	0.795	0.695	.205
Withdrawn	-0.125	-0.026	-0.073	-0.083	.066
	0.309	0.821	0.506	0.449	.548
Depression	-0.174	-0.014	0.12	-0.020	.094
	0.157	0.900	0.272	0.853	.394
Anxiety	0.030	0.080	-0.08	0.043	.050
	0.806	0.48	0.468	0.696	.653
ADHD	0.110	0.031	**0.235**	0.008	.053
	0.371	0.786	**0.030**	0.941	.635
ODD	-0.105	-0.102	0.209	-0.05	-.041
	0.394	0.370	0.055	0.648	.711
Attention	0.176	0.086	**0.223**	-0.002	.121
	0.151	0.448	**0.041**	0.988	.274
Aggression	-0.033	-0.104	**0.292**	0.007	.004
	0.786	0.357	**0.007**	0.947	.972

Table 24.

Aim 2: Hypothesis 4-Convergent and Discriminant Validity between Induced Positive Valence Behaviors and Caregiver Reported Child Problems

a. Initial Positivity

	Reward Task		Bubbles Task	
	Verbal	Non-Verbal	Verbal	Non-Verbal
Convergent				
ADHD	.006	.172	0.097	0.108
	.959	.117	0.378	0.326
ODD	.028	.029	-0.022	-0.021
	.800	.790	0.839	0.848
Attention	.080	.161	0.172	0.164
	.470	.144	0.118	0.135
Aggression	.041	.015	-0.043	-0.005
	.713	.892	0.699	0.963
Discriminant				
Anxiety/ Depression	.040	.163	-0.008	0.054
	.718	.138	0.941	0.626
Somatic	-.072	-.004	0.032	-0.121
	.516	.971	0.775	0.273
Withdrawn	.020	.138	0.005	-0.067
	.854	.209	0.967	0.547
Depression	-.053	.104	-0.027	-0.103
	.631	.347	0.809	0.353
Anxiety	-.065	.111	-0.111	-0.015
	.557	.314	0.314	0.892

b. Sustained Positivity

	Bubbles Task	
	Verbal	Non-Verbal
Convergent		
ODD	0.067	0.121
	0.556	0.286
Aggression	0.111	0.166
	0.327	0.142
Discriminant		
Attention	0.056	0.156
	0.623	0.168
ADHD	0.028	0.082
	0.804	0.471
Anxiety/ Depression	0.085	-0.074
	0.453	0.511
Somatic	-0.113	0.136
	0.318	0.23
Withdrawn	0.056	0.111
	0.621	0.326
Depression	-0.102	0.094
	0.369	0.408
Anxiety	0.097	-0.035
	0.394	0.758

Table 25.

Aim 2: Hypothesis 3-Convergent and Discriminant Validity between Exploratory Positive Valence Behaviors and Caregiver Reported Child Problems

Positivity						
Problems	Snake Task		Speech Task			
	Verbal 2	Non-verbal 2	Verbal 1	Non-verbal 1	Verbal 2	Non-verbal 2
Exploratory						
Anxiety/Depression	**0.233**	0.203	0.127	0.04	-0.002	0.004
	0.037	0.077	0.297	0.747	0.987	0.969
Somatic	-0.007	.007	-0.023	**0.258**	0.011	0.115
	0.949	.951	0.852	**0.032**	0.92	0.295
Withdrawn	**0.221**	.129	**0.262**	0.166	0.06	0.152
	0.049	.262	**0.03**	0.172	0.588	0.164
Depression	0.068	-0.041	0.146	**0.273**	-0.071	0.089
	0.546	0.720	0.23	**0.023**	0.52	0.42
Anxiety	0.107	.099	0.017	-0.082	-0.002	0.001
	0.343	.390	0.888	0.504	0.988	0.995
ADHD	0.162	-0.047	0.086	0.074	-0.003	0.064
	0.151	0.688	0.483	.543	0.975	0.56
ODD	0.218	0.034	0.172	**0.247**	-0.083	0.096
	0.052	.766	0.156	**0.041**	0.449	0.38
Attention	**0.28**	0.001	0.189	0.113	0.027	0.11
	0.012	0.996	0.119	0.356	0.805	0.316
Aggression	0.187	-.009	0.148	0.22	-0.041	0.1
	0.096	.938	0.226	0.069	0.711	0.363

Table 26.

Caregiver Psychopathology Symptom Descriptives (n=91)

	Range	Mean	Skewness	Kurtosis
		(Std. Dev)	(Std. Error)	(Std. Error)
PTSD Total Symptoms	0-17	4.70 (4.39)	.87 (.25)	.07 (.50)
Re-experiencing Symptoms	0-5	1.11 (1.42)	1.36 (.25)	.87 (.50)
Avoidance Symptoms	0-7	1.76 (1.88)	.91 (.25)	.04 (.50)
Hyperarousal Symptoms	0-5	1.83 (1.60)	.44 (.25)	-.86 (.50)
Depressive Symptoms	0-37	7.47 (8.56)	1.46 (.25)	1.59 (.50)

Table 27.

Aim 3: Hypothesis 1-Correlations of Caregiver Psychopathology and Child Behaviors

Positivity						
	Snake Task		Speech Task			
Symptoms	Verbal 2	Non-verbal 2	Verbal 1	Non-verbal 1	Verbal 2	Non-verbal 2
PTSD Total Symptoms	**0.299**	**0.305**	**0.308**	**0.259**	.072	.098
	0.007	**0.006**	**0.01**	**0.031**	.514	0.374
Re-experiencing Cluster	.204	**0.231**	.117	.213	.062	.062
	.069	**0.039**	.337	.078	.574	.575
Avoidance Cluster	**0.258**	**0.295**	**0.368**	.217	.130	0.033
	0.021	**0.008**	**0.002**	.073	.237	0.763
Hyper-vigilance Cluster	**0.324**	**0.274**	**0.31**	**0.268**	-.009	0.168
	0.003	**0.014**	**0.009**	**0.026**	.932	0.125
Depressive Symptoms	.194	**0.241**	**0.314**	.172	.081	.054
	.081	**0.029**	**0.008**	.154	.458	.623

Table 28.

Aim 4: Sets Behaviors for Cluster Analyses

Set	Channel	Task	Variables	Constructs
Set 1	Non-Verbal	Speech	Anxiety	All 4 RDoC Subdomains (with Speech)
		Bubbles	Fear	
			Initial Positivity	
			Sustained Positivity	
Set 2	Verbal	Speech	Anxiety	All 4 RDoC Subdomains (with Speech)
		Bubbles	Fear	
			Initial Positivity	
			Sustained Positivity	
Set 3	Non-Verbal	Snake	Anxiety	All 4 RDoC Subdomains (with Snake)
		Bubbles	Fear	
			Initial Positivity	
			Sustained Positivity	
Set 4	Non-Verbal	Speech	Anxiety	Negative Valence (with Snake vs Speech)
			Fear	
		Snake	Anxiety	
			Fear	
Set 5	Non-Verbal	Bubbles	Initial Positivity	Positive Valence (Induced vs Unanticipated)
			Sustained Positivity	
		Speech	Preparation Positivity	
			Delivery Positivity	
Set 6	Non-Verbal	Speech	Preparation Positivity	Speech Behaviors (Positive vs Negative Valence)
			Delivery Positivity	
			Anxiety	
			Fear	

Figure 3.

Profiles for Set 1: Four RDoc Subdomains using Bubbles and Speech Tasks

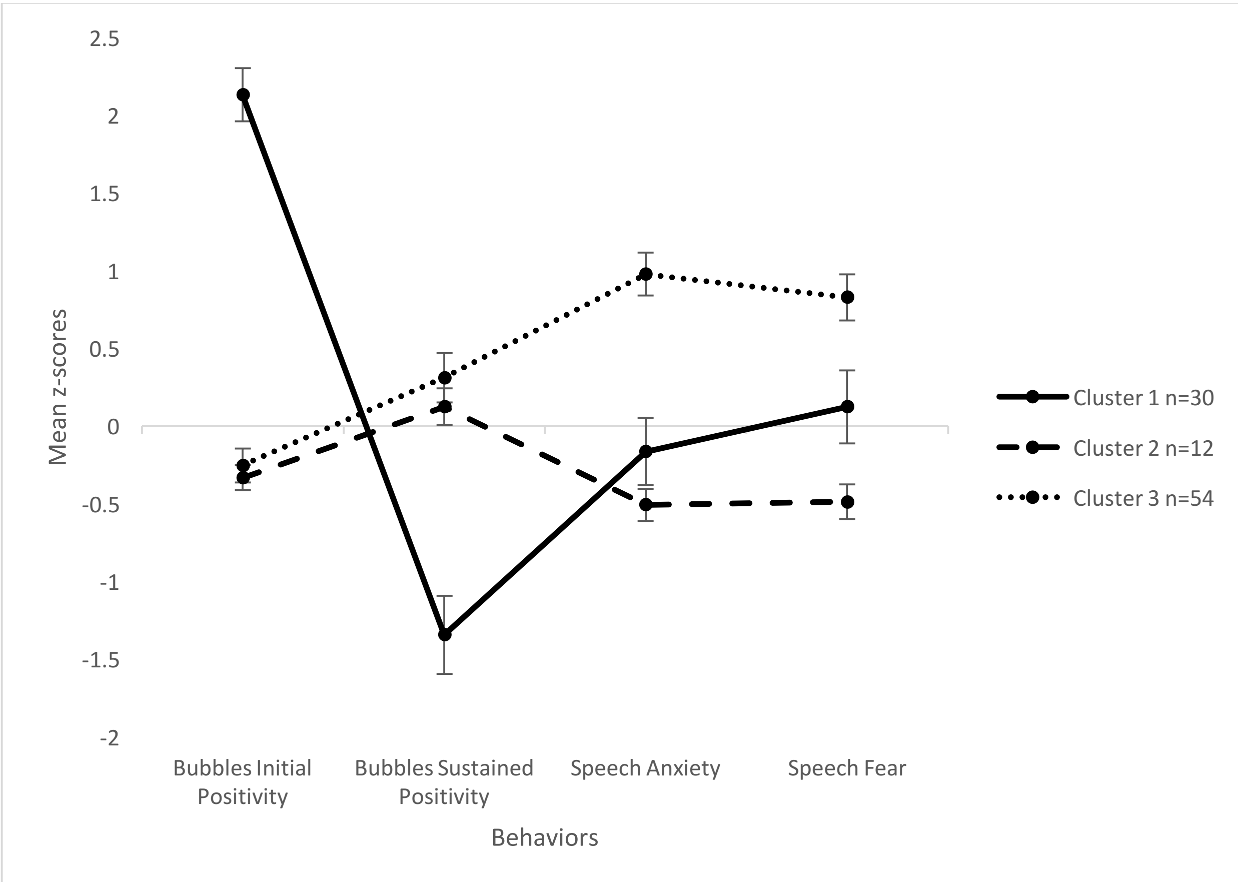


Figure 4.

Profiles for Set 2: Four RDoc Subdomains using Verbal Bubbles and Speech Task Behaviors

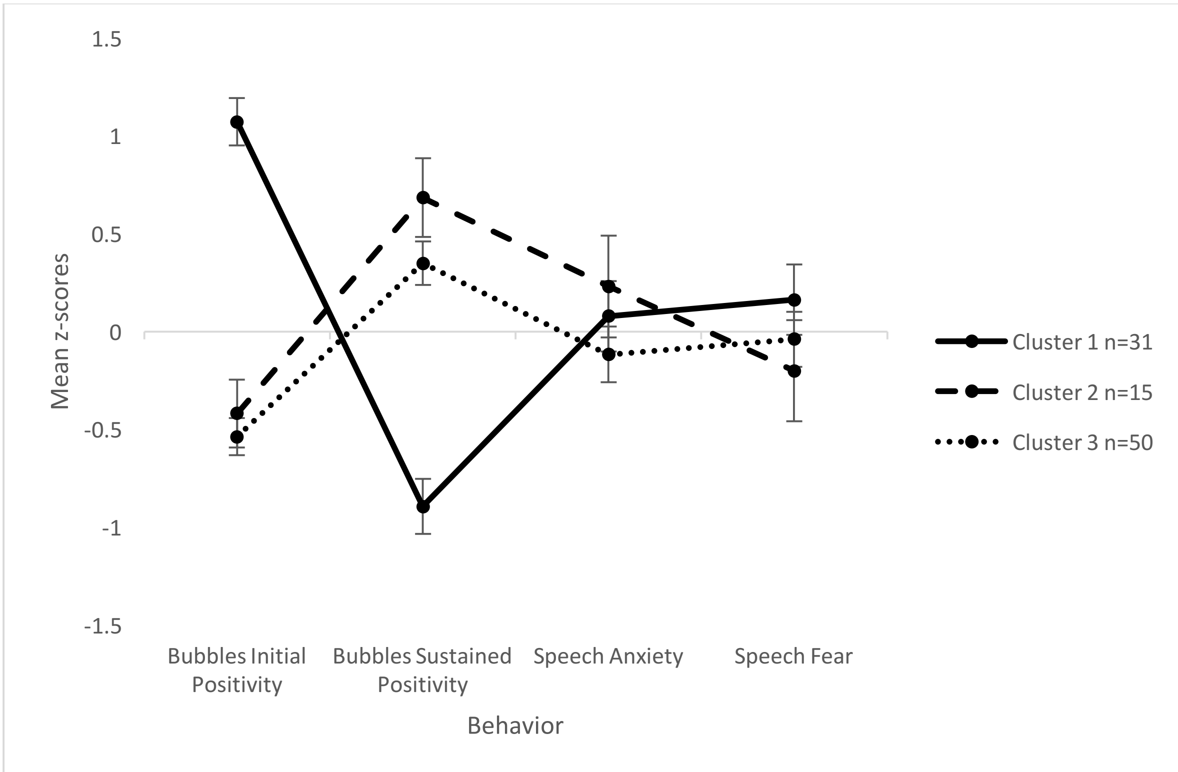


Figure 5.

Profiles for Set 3: Four RDoc Subdomains using Bubbles and Snake Behaviors

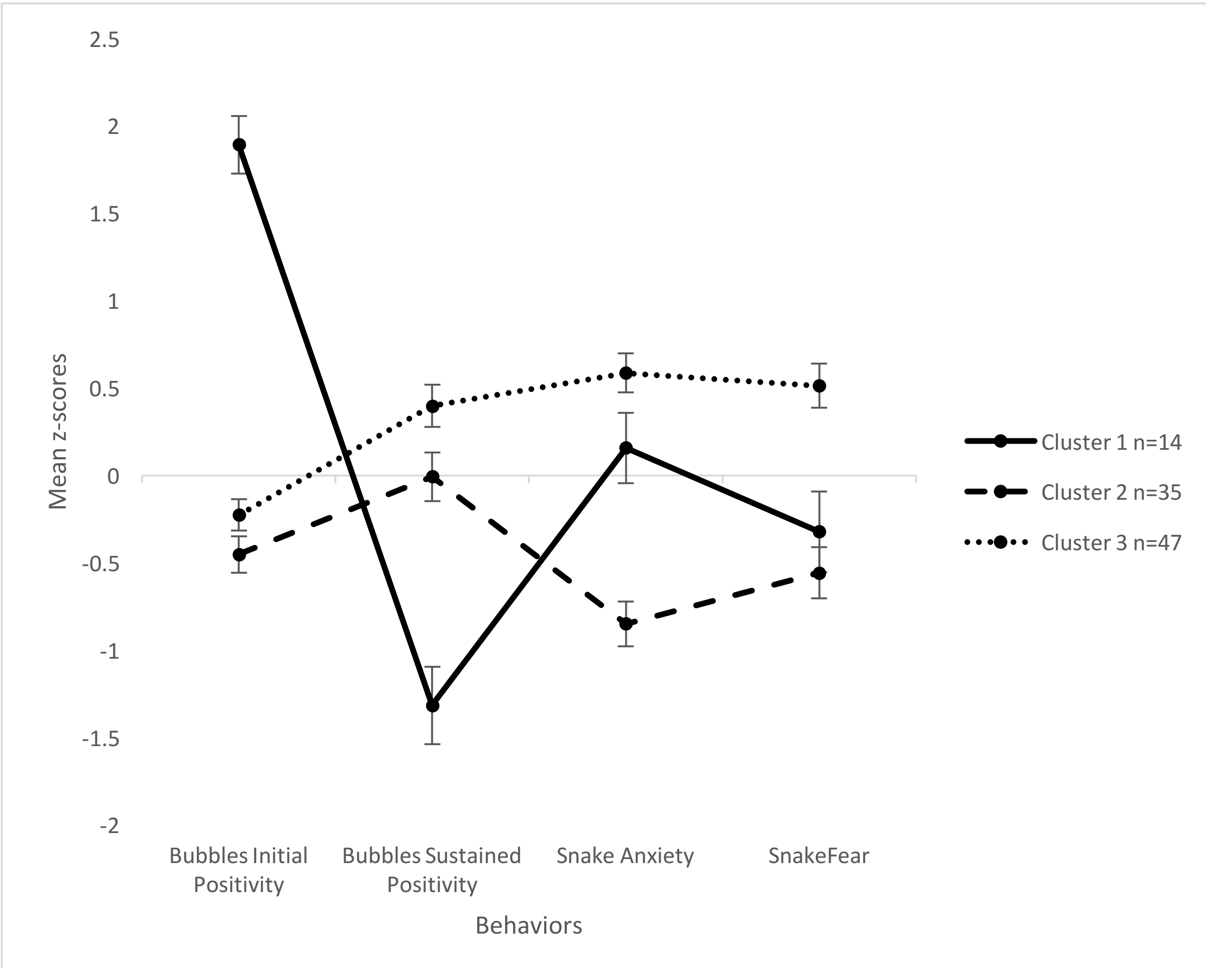


Figure 6.

Profiles for Set 4: Negative Valence using Speech and Snake Tasks

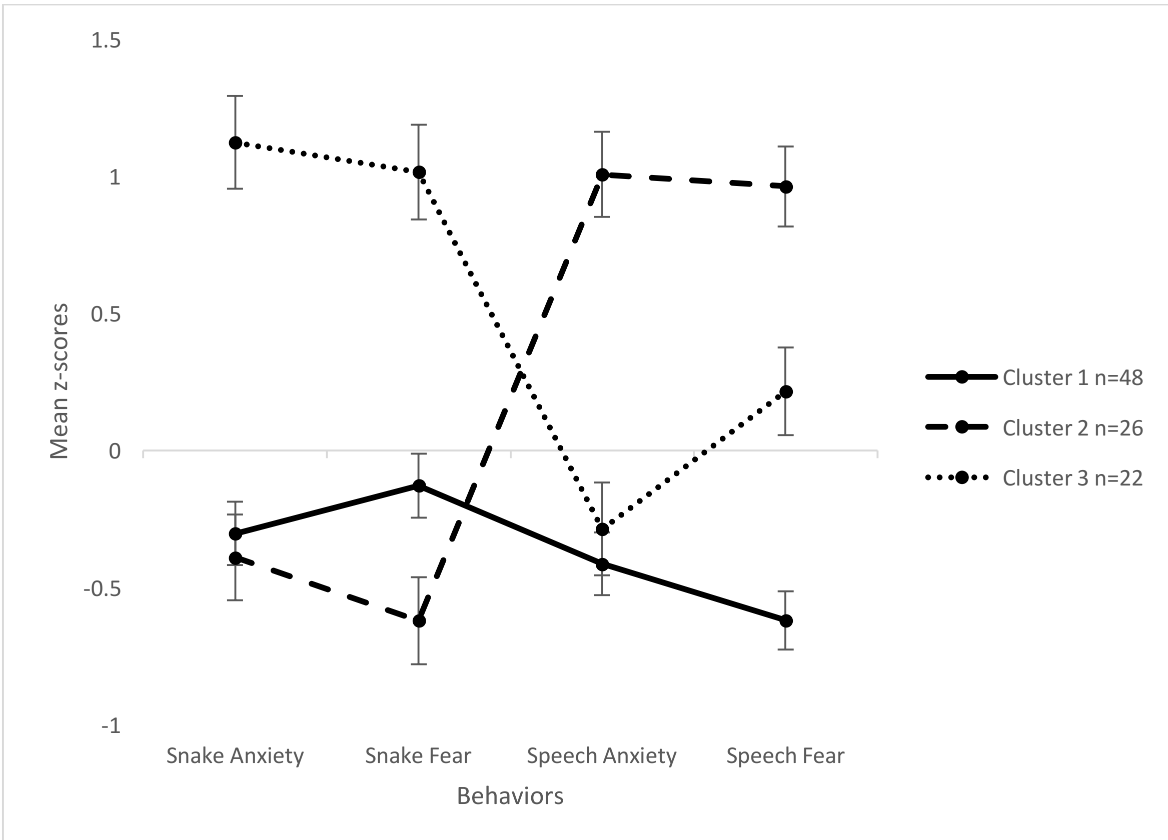


Figure 7.

Profiles for Set 5: Positive Valence using Bubble and Speech Tasks

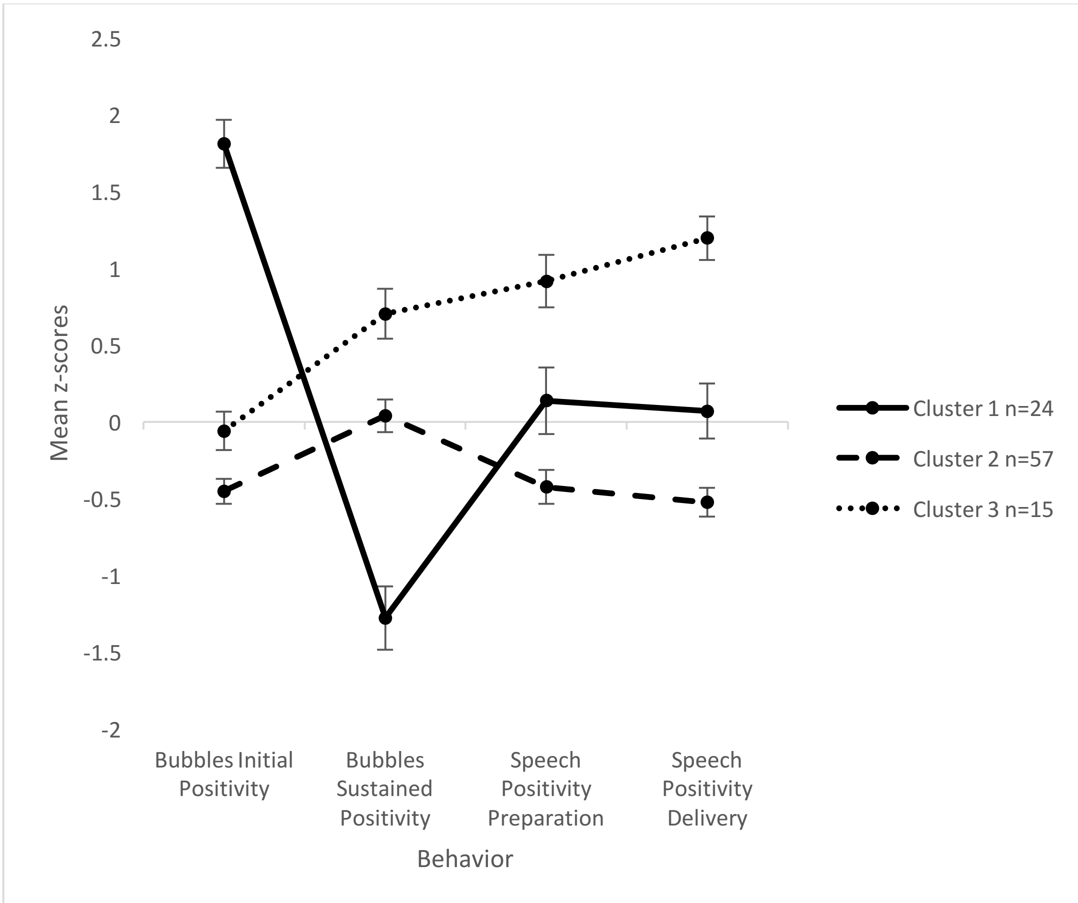
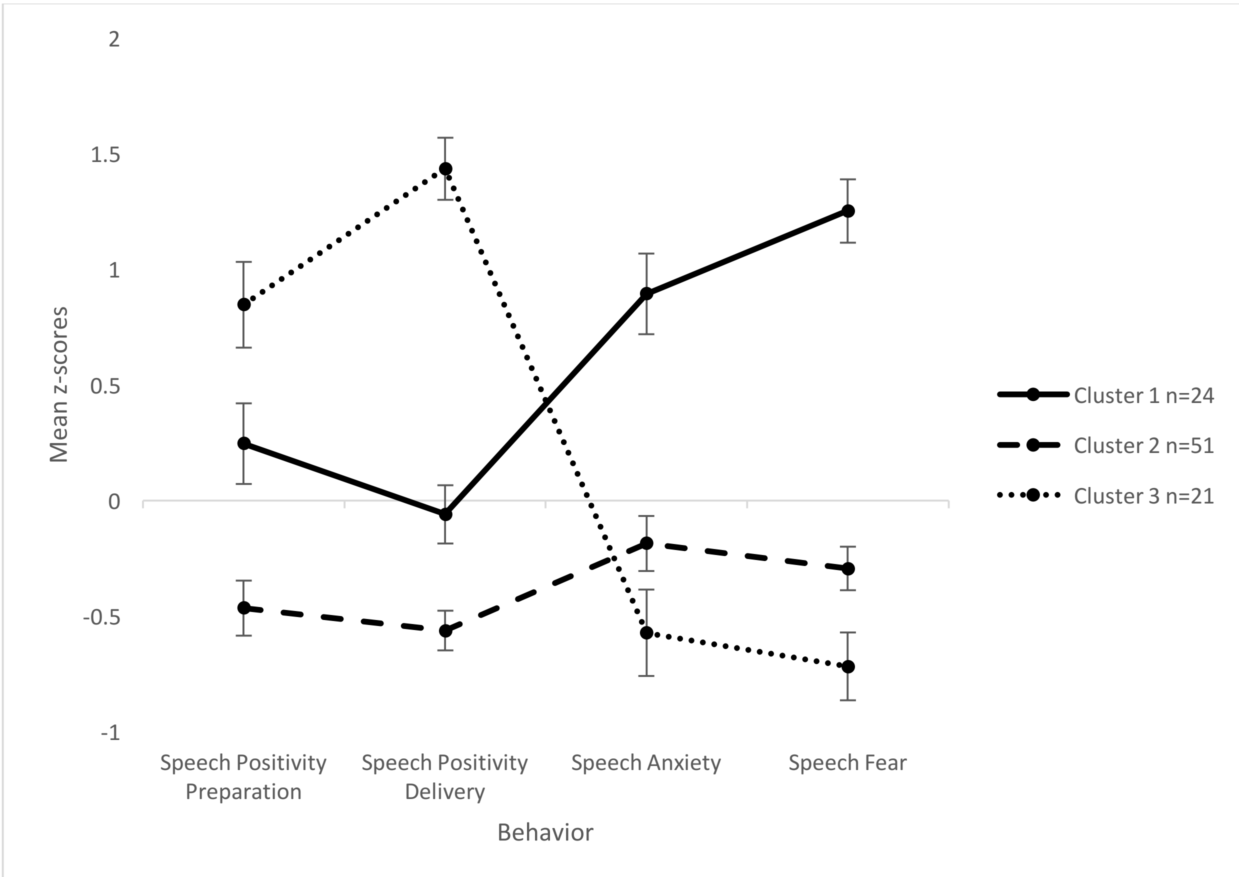


Figure 8.

Profiles for Set 6: Negative and Positive Valence using Speech Task Behaviors



APPENDIX: Anchors of Low, Moderate, and High Intensity Behaviors

Positive affect
Vocal:

LOW = somewhat sing-songy/rhythmic tone of voice; brief giggle or hiss; singing or humming, exclamation of positive tone without content (e.g. "Woah!")
MODERATE = giggle or extended laugh; clearly exuberant tone of voice; statement clearly showing positive content (e.g., "This is cool," "Neat")
HIGH = full, extended laugh; excited screech/shriek, or whoop; statement with both overtly positive content and positive tone (e.g., "This is so fun!," "I like this!")

Bodily:

LOW = perky/snappy movement; floating motion of arms or hands; ambiguous hop/skip
MODERATE = brief hop or skip with clearly positive tone; slight wiggle or bounce
HIGH = jubilant motions *NOT just for sake of popping bubbles, "dance of joy", clapping, arm shaking/quivering, knee slap

Sadness
Vocal:

LOW = slightly whiny or dejected tone; slight sigh
MODERATE = definite sigh; definite whiny or dejected tone; statement with possible/probable sad content (e.g., "oh no")
HIGH = deep sigh; crying sound; statement with obvious sad content and sad tone (e.g., "Nobody likes me")

Bodily:

LOW = somewhat slumped posture; lifeless motion with arms, dejected gait/walk
MODERATE = definitely slumped posture; shoulders slumped; dejected kick of feet or dropping of arm
HIGH = head in hands; head slump; clearly dragging feet, crying

Anger/Resistance
Vocal:

LOW = irritable or cranky tone; slight grunt
MODERATE = definite grunt, groan, or sharp exclamation; statement with possible/probable angry content or resistance to completing task (e.g., "I don't' want to")
HIGH = statement with definite angry content; definite angry/irritable tone; yelling about resistance to complete task (e.g., "I'm not doing that!," "This is stupid!")

Bodily:

LOW = slight tension in neck or shoulders; irritable/forcible foot tapping or shaking
MODERATE = definite tension in neck or shoulders; arms crossed, forceful movements; arm shaking
HIGH = kicking, punching or other aggressive motion; fists balled; stomping, intentional turning of body away from task/examiner in refusal to comply

Fear
Vocal:

LOW = slightly quavering tone of voice; whispering or cautious tone; stuttering ("uhhh"s, "I, I I", "uum"- code 1 for each 5 seconds of stuttering; vocal hesitation (deep inhalation)

MODERATE = statement with possible fearful/wary content (e.g., "What am I supposed to do?"); frightened "oh", "yikes", questioning that is done to delay task/seek reassurance
HIGH = "eek", yelp; statement with definite fearful/wary content AND tone (e.g., "I'm scared!")

Bodily:

LOW = cautious or wary gait; slight tension; nervous twitching, hand tapping, foot swinging, etc.; diminished activity level or stilling; nervous facial movements (other than prototypical fear facial expressions) such as playing with lips (biting, pursing, pressing together), chewing on nails; hand movements such as wringing hands, playing with hands, covering mouth with hands/playing with facial features
MODERATE = slight defensive body posture; fearful tension; slight withdrawal/move backward with defensive body posture; prolonged anxious hand movements
HIGH = definite defensive body posture, jumping back in fear; definite retreat; definite freezing, covering eyes, hiding behind examiner or furniture

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