PARENT-CHILD RELATIONSHIPS IN YOUNG HOMELESS FAMILIES: CO-REGULATION AS A PREDICTOR OF CHILD SELF-REGULATION AND SCHOOL ADJUSTMENT

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Abstract

Developing adaptive behaviors are particularly important for children growing up in contexts of risk and adversity. This study examined the role of effective parenting for school success in a high-risk sample of children, focusing on co-regulation experiences with parents in relation to child self-regulation skills. In early childhood, it is largely through experiences of co-regulation within the caregiver-child relationship that children develop self-regulation. These skills are carried forward into other contexts of learning and development, including the school environment. The current thesis examined parent-child relationships among 138 families residing in emergency homeless shelter prior to the children entering kindergarten and first grade. Using observational data and state space grid methodology, I examined the parent-child relationship as a dynamic system with implications for children's school success and executive function (a central component of self-regulation). Results indicated that the positive co-regulation experiences were related to executive function capabilities and IQ in the child, which in turn were related to school outcomes. Parent responsiveness in particular was related to positive school outcomes. Person-oriented cluster analyses of individual state space grids revealed distinct types of dyads among the homeless families, highlighting individual differences in dyadic functioning. Findings support theory and earlier findings in developmental and resilience science implicating effective parenting in the acquisition of adaptive skills among children who overcome adversity, in part through processes of co-regulation that shape or scaffold the development of self-regulation and related cognitive skills in young children.

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Parent-child Relationships in Young Homeless Families: Co-regulation as a Predictor of Child Self-regulation and School Adjustment

Children who experience well-established risks to healthy development, such as poverty, homelessness, and exposure to potentially traumatic life events, depend on the presence of protective influences that can support positive emotional and behavioral adaptation (Luthar, 2006; Masten, Cutuli, Herbers, & Reed, 2008; McLoyd, 1998). For young children in particular, a central protective factor can be a positive, nurturing relationship with an available parent or other caregiver. Caregivers have the potential to provide not only conditions for a child's basic survival, but also social interactions characterized by emotional warmth, sensitivity, and responsiveness that build the foundation for a secure attachment relationship (Ainsworth, Blehar, Waters, & Wall, 1978; Sroufe, 1996). In the context of such a relationship, the child develops positive expectations for social interaction that build confidence and a sense of self-efficacy (Sroufe, 1996). Furthermore, the child internalizes experiences of dyadic co-regulation, in which his or her physical, emotional, and behavioral needs are met by complementary caregiver actions (Calkins & Hill, 2007; Shipman & Zeman, 2001). As toddlers and preschool-aged children become more independent, caregivers continue to provide co-regulation through the affective tone of their interactions as well as quality and amount of structure and discipline (Eisenberg, Zhou, Spinrad, Valiente, Fabes, & Liew, 2005; Harrist & Waugh, 2002; Karreman, van Tuijl, van Aken, & Dekovic, 2006; Locke & Prinz, 2002; Garner, 2006). Children appear to internalize these co-regulation

experiences at a physiological level, affecting their gene expression and biological stress response systems, and at levels of emotion, cognition, and behavior to support the child's developing ability for more independent self-regulation (Blair, Granger, & Razza, 2005; Calkins & Fox, 2002; Gunnar & Quevedo, 2007; Porges, 1996). Self-regulation skills promote positive development for all children, and they may be crucial for children who encounter substantial risk and adversity (Eisenberg et al., 2005; Garner, 2006; Lengua, 2002; Lengua, Honorado, & Bush, 2007; Raver, 2004).

Unfortunately, not all children at risk experience optimal or even adequate caregiving. Adverse contexts tend to affect the child not only directly, but also through their impact on the family system, particularly the caregiver (Cutuli, Wiik, Herbers, Gunnar, & Masten, 2009; Gest, Neeman, Hubbard, Masten, & Tellegen, 1993; Luthar, 2006; Masten and Shaffer, 2006; Scheeringa & Zeanah, 2001). For example, parents living in poverty tend to be single mothers with low levels of education who are prone to stress and poor mental health. All of these factors can have negative implications for the quality of parenting that the parent is able to provide (Chazan-Cohen, Raikes, Brooks-Gunn, Ayoub, Kisker, Roggman, & Sidle, 2009; Dearing, 2008; Evans, Boxhill, & Pinkava, 2008). Furthermore, poor families are more likely to experience extremely stressful life events such as homelessness, exposure to violence, and other life-threatening situations that take a toll not only on the young child, but also on the caregiver. Trauma that affects a caregiver's functioning can affect the child both directly and indirectly as the child may be frightened by the situation and left with an impaired caregiver as the main resource for understanding and regulating that fear (Scheeringa &

Zeanah, 2001). Thus in contexts of high risk and high adversity, children may require and demand more positive co-regulation from their caregivers, who may be less able to provide it.

Understanding the processes through which many caregivers provide positive parenting despite adverse circumstances while some caregivers struggle with parenting in the face of adversity is important for informing efforts to intervene with high risk children and families. Also important for these efforts is research that delineates the processes through which co-regulation with caregivers influences developing child self-regulation and the child's adaptation to other important contexts such as school. The current study employed a new dynamic systems methodology to explore both the nature of co-regulation between parents and their preschool-aged children in high risk circumstances and how parenting behaviors and positive co-regulation demonstrated in the context of a family homeless shelter can promote child self-regulation and positive adjustment to school for children entering kindergarten and first grade.

Self-regulation develops in the context of the parent-child relationship

Self-regulation skills are hypothesized to arise from the coordination, interaction, and co-action of a child's developing physiological, emotional, and cognitive systems for the purpose of accomplishing goals and adapting to situational demands (Berger, Kofman, Livneh, & Henik, 2007). The better a child can monitor and manage his own behavior, the more he can benefit from future experiences in his social and physical world. Self-regulation and its more specifically defined components such as executive

function, emotion regulation, coping, and effortful control are consistently related to positive developmental outcomes across domains of academic, cognitive, social, and emotional competence. For young children, self-regulation skills are particularly important for transitioning to the school context, in which they face new demands and must function without ready access to their caregivers (Blair, 2002). In order to perform well in kindergarten, children must be able to remain in their seats, sustain attention over relatively long periods of time, refrain from talking and acting out of turn, and develop harmonious relationships with both teachers and peers. Because classrooms tend to be structured such that a single adult leads a large group of children, each child is expected to manage his or her emotions and behaviors well enough to maintain participation and benefit from the academic material presented. A child with good self-regulation skills is much more likely not only to manage his or her behavior most of the time, but also to use appropriate means of obtaining help and guidance from a teacher when task demands exceed the child's ability. Well-regulated children will likely contribute positively to the classroom environment and reap the most from school curricula (Blair, 2002; Rimm-Kaufman & Pianta, 2000; Thompson & Raikes, 2007; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008). Because self-regulation skills underlie positive engagement and readiness to learn, kindergarten teachers consider self-regulation skills as more crucial for children's school readiness than academic skills, such as counting to 10 and reciting the alphabet (Blair & Diamond, 2008).

Self-regulation abilities develop rapidly between the ages of 3-6 years with the physical maturation of the brain's prefrontal cortex and associated neural systems

(Carlson, 2005; Carlson & Wang, 2007; Casey, Tottenham, Liston, & Durston, 2005; Garon, Bryson, & Smith, 2008; Posner & Rothbart, 2000); however, the experiences that support this development begin much earlier. From infancy onward, sensitive and responsive caregiving provides dyadic co-regulation for the child, setting a foundation for the child's own developing self-regulation (Ainsworth et al., 1978; Berger et al., 2007; Bowlby, 1969/1982; 1973; Calkins & Hill, 2007; Feldman, 2007; Fox & Calkins, 2003; Harrist & Waugh, 2002; Kopp, 1982; 1989; Schore, 2001; Sroufe, 1996; Thompson, 1994; Tronick, 2006). This developmental concept was put forth first by Bowlby's attachment theory and has remained a central theorem in theories of social and emotional development, supported by a substantial body of empirical work.

Attachment theory is based on the evolutionary necessity of dyadic regulation for infant survival, both in the short- and long-term (Bowlby, 1969/1982; 1973; Sroufe, 1996). Infant behaviors such as crying and clinging serve to maintain proximity with the caregiver. The caregiver in turn responds to infant signals with physical touch, facial expressions, tone of voice, body postures, tempo of movement, and other responsive actions to address needs. According to Bowlby, these exchanges facilitate the development of a biological control system that manages state of arousal and also serves to meet survival needs of the child. Indeed, psychophysiological studies have consistently linked aspects of developing attachment relationships to development in the prefrontal cortex of the brain as well as to the development of hormonal stress reactivity and cardiac vagal regulation (Calkins, Graziano, Berdan, Keane, & Degnan, 2008; Gunnar & Quevedo, 2007; Porges, 2003; Schore, 2001). The same regulatory interactions that

influence and characterize the attachment relationship also influence the child's developing regulatory systems across levels of analysis (Schore, 2001).

Through an accumulation of countless interactive experiences with the caregiver, the infant forms an "inner working model," or mental representation, of not only the current relationship with the caregiver but also social situations more generally (Bowlby, 1969/1982; 1973; Sroufe, 1996). Attachment theory presumes that this inner working model continues to influence the child in various ways, including how the child perceives others as either trustworthy or threatening and perceives him or herself as either effective or ineffective in eliciting support and coping with stressful situations. This inner working model can be a source of confidence and security or a source of fear and anxiety, depending on the nature of the attachment relationship. Perceptions and expectations of others based on this inner working model are thought to guide behavior not only in social situations, but also in exploring and learning about the environment more broadly. Inner working models are also thought to be plastic, such that not only past but also current and future experiences with social relationships can shape expectations and behavior. The attachment relationship with the primary caregiver is not purported to be the only social influence or singular determinant of the child's future self-regulation abilities; however, the attachment relationship is thought to be a particularly central and potent aspect of developing regulation.

While foundations of co-regulation may begin in infancy, the parent's role as external regulator continues throughout childhood, changing with the developing self-regulatory capacities of the child. Even at the age of five years, children rely heavily on

their caregivers, as evidenced by a study demonstrating better vagal regulation with caregivers present than without (Calkins et al., 2008). In addition to warmth and responsiveness, parents of toddlers and preschool-age children provide regulation through teaching about emotions and emotional responses, providing structure and setting limits for appropriate child behavior, and encouraging independent problem-solving and use of self-regulatory strategies (Putnam, Spritz, & Stifter, 2002; Spinrad, Stifter, Donelan-McCall, & Turner, 2004). With their developing autonomy, children become more active participants in the co-regulation of the dyad, though parents still bear more responsibility (Diamond & Aspinwall, 2003; Harrist & Waugh, 2002). These social interactions structured by the parent, in tandem with the contributions of the developing child, form the predominant context in which young children's capacity for self-regulation is internalized. Advancements in child language abilities and cognitive sophistication also enable caregivers to teach strategy use in less emotional situations. By naming objects, demonstrating how things work, and asking questions to gauge child understanding, caregivers can encourage basic learning that supports developing executive functions. In one study, scores of maternal cognitive stimulation and maternal restrictiveness from home observations of naturalistic mother-toddler interactions were related to child self-regulation at age 8, such that more cognitive stimulation and less restrictiveness predicted better inhibitory and behavioral control as well as less attention disengagement in 8 year olds (Olson, Bates, Sandy, & Schilling, 2002).

As they are with toddlers, caregivers of preschoolers are charged with providing a balanced level of interaction such that they are available when needed but not over-

controlling or over-solicitous. Unlike in toddlerhood, when it has been observed that a large number of children use no strategies for self-regulation during a challenge task (Spinrad et al., 2004), most preschool-aged children from both middle- and low-income families do use at least one strategy in emotion regulation situations (Garner & Spears, 2000; Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002). These strategies may include those used in toddlerhood, such as distracting attention or waiting passively, as well as newer, more sophisticated strategies such as self-speech and symbolic play (Carlson, 2003). Rather than intervene directly with physical intervention or strong directives as they might with toddlers, caregivers may allow preschool-aged children more opportunities to resolve stress on their own or verbally suggest rather than command self-regulation strategies to their children (Blandon, Calkins, Keane, & O'Brien, 2008). Caregivers can also engage their preschoolers in more complex discussions of emotional experiences and appropriate conduct, guiding or scaffolding self-directed learning experiences of behavior. In situations of overwhelming stress to the child, caregivers can still provide a greater degree of co-regulation as they did at earlier developmental periods, physically and verbally comforting, soothing, and processing experiences to encourage coping both in the short term and for later stressful experiences. This aspect of caregiver co-regulation with preschoolers may be especially warranted in contexts of high risk and high adversity (Eisenberg et al., 2005; Lengua, 2002; Raver, 2004; Scheeringa & Zeanah, 2001).

In a meta-analysis of 41 studies of parenting and self-regulation in preschool-aged children, it was found that positive control by parents was related to better self-

regulation, negative control by parents was related to worse self-regulation, and that the dyadic construct of parenting responsiveness was not significantly related to self-regulation when effect sizes were analyzed across the 41 studies (Karreman et al., 2006). Parenting behaviors from these different studies that were considered positive control included teaching, encouraging, guiding, limit-setting, and directiveness with low-to-moderate power assertion whereas parenting behaviors considered negative control included anger, harshness, criticism, excessive or intrusive control, physical intervention, power-assertive control, coercive behaviors, hostility, and over-involvement. Behaviors considered responsive included positive affect, accepting behavior, sensitivity, coordination, warmth, synchronous interactions, contingent behavior, approval, and affection (Karreman et al., 2006).

In contrast, some studies of higher risk samples have found compelling effects at the level of the relationship. Children of mothers who were observed to read their preschool-aged children's cues accurately and respond appropriately were found to have more self-control and maintain persistence in laboratory problem-solving tasks than children whose interactions with mothers were less synchronous (Pianta, Sroufe, & Egeland, 1989). In a study investigating stability of conduct problems and anger regulation between preschool and early school age, Cole and colleagues (Cole, Teti, & Zahn-Waxler, 2003) found that expressions of positive emotion were generally sustained within dyadic interactions such that one partner would respond positively to the other's positive affect, producing rewarding experiences of synchrony. However, mothers of children who showed stability of conduct problems over time tended to respond to both

negative and positive affect of their children with anger. In this way, maternal contingent anger was related to stability of conduct problems; mutual anger was not characteristic of dyads in which child conduct problems improved over time. Another interesting aspect of these problem dyads was a tendency toward emotional insensitivity, such that mothers would laugh when children appeared to be experiencing frustration, and children would laugh when mothers appeared to be irritated. Thus emotion mismatches can be problematic, and positive affect in itself is not always indicative of positive co-regulation (Cole et al., 2003).

As reported in the meta-analysis described above, many studies of developing preschool regulation focus on parent contributions, such as positive or negative parenting (Karreman et al., 2006). One study found that parents who were disrespectful, hostile, and intrusive when discussing emotional experiences with their 5 year olds had children with higher elevations in cortisol, indicating greater stress reactivity to interaction (Smeekens, Riksen-Walraven, & van Bakel, 2007). Another study examined harsh, physically punitive parenting at ages 4-5 and self-regulation both concurrently and at an age 8-9 follow-up. Harsh parenting at age 4-5 was found to predict poor self-regulation at age 8-9, even when controlling for child self-regulation ability at the earlier time point (Colman, Hardy, Albert, Raffaelli, & Crockett, 2006). This finding supports the theory that parenting and co-regulation that occurs during the preschool period continues to exert influence on developing self-regulation. Similarly, preschool children of mothers who used negative control techniques had children with more externalizing and internalizing problems, worse self-regulation, and worse vagal regulation 6-10 months

later, when they were introduced to three unfamiliar peers in an experimental setting (Hastings, Nuselovici, Utendale, Coutya, McShane, & Sullivan, 2008). These findings suggest that at this age, negative control and harsh discipline by parents disrupts the development of self-regulation and may undermine social behavior with peers.

On the other hand, Garner (2006) found that mothers who used emotion-based language to regulate emotion in their preschool children had children who were more prosocial with better emotion regulation skills. Interestingly, more direct socialization behaviors by the mother such as giving praise or material rewards and showing social approval did not relate to emotion regulation in these children (Garner, 2006). This may be a result of the degree to which preschool children have already internalized standards for their behavior. Children who already understand that prosocial behavior is expected and valued by others may respond less to praise for these actions than to discussions of the emotional reactions of others, which may elicit empathy or guilt and shame (Sroufe, 1996). Positive parenting strategies such as teaching and redirecting attention may have particular importance for developing executive functions at this age. For example, children whose mothers were more engaged in attention regulation and redirection of their children towards a puzzle task when working cooperatively also performed better on independent puzzle tasks, demonstrating both persistence and attentional control (Harris, Robinson, Chang, & Burns, 2007). In a study of parenting and cumulative risk, mothers' scaffolding and limit-setting were predictive of child effortful control 6 months later (Lengua et al., 2007).

As noted by Karreman and colleagues (2006) in their meta-analysis, the majority of extant studies examining processes of parenting and self-regulation have been conducted with relatively homogeneous samples of white families from mid-to-high socio-economic status. Results of the studies that have been conducted with higher risk samples of white and minority families living in poverty suggest that the importance of the parent-child relationship for developing self-regulation may be especially crucial in conditions of risk and adversity (Eisenberg et al., 2005; Lengua et al., 2007; Raver, 2004). In particular, Karreman and colleagues (2006) suggested that the lack of findings related to dyadic responsiveness may have arisen from lack of variability in parent-child relationships among the samples in the majority of studies examined. By considering the relationship between parenting and self-regulation in families living in emergency shelters, this thesis will contribute to the understanding of these processes in families facing high levels of risk and adversity.

Risk and adversity threaten both family and child

Children growing up in contexts of poverty face substantial risk for negative developmental outcomes across domains of cognitive development, social and emotional development, and academic achievement (Buckner, Mezzacampa, & Beardslee, 2003; Dearing, 2008, Luthar, 2006; Masten et al., 2008; McLoyd, 1998). Developmental delays and maladaptation are most likely for children living in extreme poverty for long periods of time (Dearing, 2008). The processes through which poverty threatens child development are both direct, as the child copes with aspects of living in poverty, and

indirect, as the child's parents and family are affected by stress and coping processes too. Children living in poverty have access to fewer resources at home and in their communities, limiting their direct opportunities for learning and cognitive stimulation as well as basic health necessities (Chazan-Cohen et al., 2009; Crosnoe, Leventhal, Wirth, Pierce, Pianta, & NICHD Early Child Care Research Network, 2010). These children are also more likely to experience potentially traumatic events, chaos, and instability, all of which can impact the development of the physiological and behavioral capacity for self-regulation (Buckner et al., 2003, Dearing, 2008; Koenen, Moffitt, Poulton, Martin, & Caspi, 2007; Lengua et al., 2007; Raver, 2004).

In addition to its direct impact on children, poverty can impact children through parents and family. In fact, many researchers have suggested that the most potent forms of adversity are those that impact a child's caregiver and processes of the parent-child relationship (Cutuli et al., 2010; Gest et al., 1993; MacMillan & Violato, 2008). For example, traumatic events that threaten caregivers are associated with higher rates of post-traumatic stress disorder in children than are other types of trauma (Scheeringa & Zeanah, 2001). In many studies, the negative effects of risk related to poverty and adversity are mediated entirely by aspects of parent well-being and the parent-child relationship (Wyman, Cowen, Work, Hoyt-Meyers, Magnus, & Fagen, 1999). Compared to families of higher socio-economic status, parents in poor families experience more psychological distress, depression, and negative beliefs about parenting as well as lower levels of social support (Evans et al., 2008; Jackson, Brooks-Gunn, Huang, & Glassman, 2000; Kiser & Black, 2005; McLoyd, 1990; Turner & Johnson, 2003). They must cope

with daily hassles of financial stress and instability as well as negative uncontrollable life events, which can result in symptoms of trauma and feelings of hopelessness and futility (Jackson et al., 2000; Kiser & Black, 2005; Scheeringa & Zeanah, 2001). Such experiences of stress, psychological distress, and lack of support are robustly linked to compromised parenting and poor quality of parent-child relationships.

Specifically, parents of poor families under conditions of high risk and trauma are more authoritarian, more punitive, more hostile, less positive, less patient, less responsive, and spend less time talking to their children and engaging in learning or school-related activities with their children (Campbell, Pierce, March, & Ewing, 1991; Dearing, 2008; Kiser & Black, 2005; McLoyd, 1998; Morrell & Murray, 2003). As they are coping with the stressful circumstances of their lives and their own responses to potentially traumatic events, parents may have diminished capacity to respond appropriately to the needs of their children. Depression and social withdrawal are common responses to high levels of stress and trauma that threaten positive parenting behaviors and access to social support (Evans et al., 2008; Scheeringa & Zeanah, 2001; Turner & Johnson, 2003). At the same time, the children of these stressed parents may be responding to the same stress and trauma, increasing their need for affection, support, and reassurance (Appleyard & Osofsky, 2003; Kiser & Black, 2005; Scheeringa & Zeanah, 2001). Children's responses to trauma are greatly influenced by their parents' responses, and children are also sensitive to their parents' symptoms of stress (Appleyard & Osofsky, 2003). Parents may respond to dangerous and unpredictable living circumstances either with increased rigid structure or with chaos, disorganization, and

instability, either of which can put strain on children (Kiser & Black, 2005). Stressed parents judge their children's behavior more negatively and experience more negative thoughts about their ability to parent (MacMillan & Violato, 2008; Turner & Johnson, 2003). In some circumstances, stressed or traumatized parents may rely on their children for emotional support, care, and other parental responsibilities, a process known as parentification (Locke & Newcomb, 2004).

Despite these considerable challenges, many families living in conditions of great risk and adversity demonstrate resilience (Buckner et al., 2003; Luthar, 2006; Masten et al., 2008). Parents from impoverished backgrounds with limited education often show remarkable parenting characterized by warmth, nurturance, sensitivity, and positive structure (Magnus, Cowen, Wyman, Fagen, & Work, 1999; Masten & Shaffer, 2006; Wyman et al., 1999). Parents who attain employment or utilize available social services as well as their own social networks for support may provide adequate resources for the health, safety, and cognitive development of their young children (MacMillan & Violato, 2008). Even parents coping with their own symptoms of trauma and depression often successfully buffer their children from associated stress or direct experiences of adversity (Scheeringa & Zeanah, 2001). In these ways, parents in contexts of risk and adversity can serve as the most proximal and potent protective factors for the healthy development of their children.

My thesis explored aspects of parenting and the parent-child relationship that relate to positive adaptation among a very high risk group of homeless children. Such

children live in conditions of extreme poverty and residential instability that are associated with risk for negative outcomes.

The context of homelessness

According to a recent report sponsored by the Department of Health and Human Services, 326,400 children stayed in homeless shelters with their families in the year 2008, and half of these children were under the age of 6 (Samuels, Shinn, & Buckner, 2010). While family homelessness has been a recognized issue since the early 1980's, the current economic and foreclosure crisis in the United States has drawn additional attention to the needs of a growing number of children in homeless families (Buckner, 2004; Rafferty & Shinn, 1991; Samuels et al., 2010).

Children from homeless families face increased risk for a variety of negative outcomes, including physical health problems, behavioral and emotional problems, and academic failure (Buckner, 2008; Masten et al., 2008; Samuels et al., 2010). Homeless children share many of the risks of other low-income children, including fewer educational resources in the family, less social and educational support in the community, limited access to health care, and exposure to family and community violence in unsafe neighborhoods (Buckner, 2008; Luthar, 2006; McLoyd, Aikens, & Burton, 2006). Children living in poverty are much more likely than the general population to be from African American and other ethnic minority groups. Beyond those associated with poverty, episodes of homelessness pose unique risks to the development of children. Homeless children experience more negative stressful life events such as child

maltreatment, domestic violence, and parental substance use and mental illness (Gewirtz, Forgatch, & Wieling, 2008; Masten, Miliotis, Graham-Bermann, Ramirez, & Neemann, 1993; Rog & Buckner, 2007; Wilder Research, 2007). Prior to arriving at a homeless shelter, families often experience residential instability and may spend periods of time living doubled-up with friends or family. Such conditions are associated with crowding and increased levels of conflict (Samuels et al., 2010). Residential instability often precipitates school mobility, which can affect child peer relationships and learning experiences (National Research Council, 2010). The move to shelter may involve loss of possessions, and living in shelter environments has also been associated with crowding, lack of privacy, and feelings of stigma (Samuels et al., 2010).

With the combination of unique risks of homelessness and adversities associated with poverty, homeless children have been conceptualized as falling at the high end of a continuum of poverty-related risk (Buckner, 2008; Masten et al., 1993; Samuels et al., 2010). Evidence for this continuum of risk has borne out in research demonstrating differences in outcomes of homeless children compared to the general population and their poor but housed peers. In terms of physical health and development, homeless children have much higher rates of asthma (Cutuli, Herbers, Rinaldi, Masten, & Oberg, 2009) and more global health problems (Samuels et al., 2010; Weinreb, Goldberg, & Perloff, 1998). Homeless children are less likely to have regular health care and more likely to utilize emergency departments (Samuels et al., 2010). The mental health of homeless children also tends to be compromised. Studies consistently demonstrate more severe emotional and behavioral problems for homeless children compared to the general

population, and many also reveal more problems for homeless children compared to poor but housed children (Buckner, 2004; 2008; Masten et al., 1993; Samuels et al., 2010).

Research on achievement disparities in education has demonstrated that homeless children often begin school without adequate preparation, leading to poor achievement in the early years that carries forward throughout the school experience (Cutuli et al., under review; Masten, Sesma, Si-Asar, Lawrence, Miliotis, & Dionne, 1997; Obradovic et al., 2009; Rafferty, Shinn, & Weitzman, 2004; Rubin, Erickson, Augustin, Cleary, Allen, & Cohen, 1996; Samuels et al., 2010). Homelessness and related residential instability contribute to discontinuities in learning experiences, disruptions in relationships with teachers and peers, and a lack of consistent routines that support school engagement (Rafferty et al., 2004; Rog & Buckner, 2007). As a result of these and other risk factors, homeless children tend to be significantly outperformed by both non-poor and poor but housed peers (Haber & Toro, 2004; Obradovic et al., 2009*;* Rafferty et al., 2004). For example, Fantuzzo and Perlman (2007) found lower levels of literacy and science achievement among homeless students compared to their low income peers in a large second grade cohort, and Obradovic et al. (2009) found that achievement gaps of homeless and highly mobile students were apparent in 3rd grade and maintained through 5th grade. Findings related to achievement disparities for homeless children may be especially robust because academic achievement itself is a cumulative process with considerable stability within student over time (Duncan et al., 2007).

For the majority of families who experience homelessness, periods of residential instability and homelessness are episodic. Results of the few existing longitudinal studies

of homeless families suggest that children's problems may diminish over time, once families achieve more stable housing (Samuels et al., 2010; Shinn et al., 2008). For example, Buckner and colleagues found that internalizing problems associated with entry into shelter had diminished one or two years later, and that current problems were more strongly associated with current stressors than with homeless history (Buckner, Beardslee, & Bassuk, 2004). Behavior problems and poor achievement may also decrease over time (Buckner, Weinreb, Rog, Holupka, & Samuels, in press; Shinn et al., 2008), though some studies suggest stability in poor achievement for students who ever experience homelessness (Cutuli et al., under review, Obradovic et al., 2009). Thus the potential for children to recover from problems associated with homelessness certainly exists, but likely depends upon prior functioning, coping with the experience of homelessness, and the family's ability to achieve more stable housing and to avoid subsequent major adversities that could include future episodes of homelessness.

Consistent with the broader resilience literature, the existing research on resilience in homeless children suggests that positive experiences in the parent-child relationship and the development of good self-regulation skills can serve as powerful protective factors, buffering children against the deleterious effects of homeless episodes and related adversities while supporting positive adjustment and academic achievement (Buckner et al., 2003; Herbers et al., in press; Luthar, 2006; Miliotis, Sesma, & Masten, 1999; Obradovic, 2010). In a sample of school-aged homeless children, Miliotis et al. (1999) found that parenting quality predicted academic competence. Buckner and colleagues found that positive adjustment in the well-being, behavior, and competence of

very low-income students, many of whom had experienced homelessness, was most related to self-regulation skills and parental monitoring (Buckner et al., 2003). Similarly, Obradovic (2010) linked young homeless children's resilience to higher levels of effortful control, a cognitive component of self-regulation. With the same sample of children, Herbers and colleagues (2011) demonstrated that quality of parenting predicted academic functioning in kindergarten and first grade, and that the effect was mediated by child executive function and IQ. Efforts to close achievement gaps and improve the academic performance of homeless and other high risk students depend on improving our understanding of these protective developmental processes that likely relate to child and family adaptation prior to, during, and after episodes of homelessness.

Homeless children starting kindergarten face the stress of a novel school environment and the new demands for self-regulation away from caregivers just like all the other students in their classrooms. Compared to the other students, however, homeless children have likely experienced less educational instruction within their families and more chronic stress and adversity related to poverty and residential instability, both of which may hamper their learning by challenging the development of their self-regulation abilities. These additional challenges make the child's past and present experiences of co-regulation within the parent-child relationship all the more important. Experiences with good co-regulation are carried forward into the school context, giving the child a flexible framework from which to manage ongoing stress and confront new challenges. On the other hand, experiences with poor co-regulation can expose the child to the additional stress of an unsupportive parental relationship and

undermine the child's ability to cope with past and present stressors as well as new challenging experiences at school.

Methods for examining processes of parenting and co-regulation

Parenting and parent-child relationships can be measured with a variety of methods, including parent self-report, parent and/or child interviews, ratings by other informants, and observational methods. Different studies utilize different methods based on their research questions as well as practical considerations about available resources. In general, observational measures of parenting are considered the gold standard because they involve samples of actual behavior that can be examined at varying levels of analysis to address questions of process and mechanism (Aspland & Gardner, 2003; Gardner, 2000; Margolin et al., 1998). Observational data can elucidate particular behavior sequences in ongoing, moment-to-moment processes at a level not necessarily accessible to the individuals themselves (Margolin et al., 1998). Compared to self-report data, either by questionnaire or interview, observational measures are used to yield constructs that are operationalized by researchers rather than interpreted by research participants. Though easier to obtain, self-reported parenting can be vulnerable to interpretations, biases, expectations and transient mood states of parents (Aspland & Gardner, 2003; Eddy, Dishion, & Stoolmiller, 1998; Morsbach & Prinz, 2006; Richters, 1992). Furthermore, observational measures of parent-child interaction tend to be sensitive to change, an important consideration for research aimed at informing,

developing, or evaluating interventions (Aspland & Gardner, 2003; Forgatch & DeGarmo, 1999; Patterson, 1982).

Considerable variability in methods also exists among studies that utilize observational measures of parent-child interaction. Some studies conduct observations in natural settings such as the home while others take place in laboratory settings. The types of interactions between parents and children, whether structured or unstructured, also differ. While unstructured observations more accurately capture the typical behavior of individual dyads, structured observations impose more control over what types of behaviors will be observed. For example, a particular parent may not happen to give her child any directions during a 30 minute, unstructured session, which would make comparisons across dyads of directing behavior and child compliance difficult. In a structured task, however, each parent receives the same instruction for interacting with her child, improving the likelihood that certain behaviors will be observed for all dyads (Aspland & Gardner, 2003; Margolin et al., 1998). Different types of tasks can be used to elicit different types of behaviors, such as clean-up tasks, problem solving process tasks, and cooperative game tasks. Decisions regarding the method of observation depend on the resources and research question at hand.

The particular research question regarding parent-child interaction should also determine what behaviors are considered and how constructs are defined. Parent-child interactions can be considered in terms of their content, quality, frequencies of certain behaviors, and contingencies of behaviors (Aspland & Gardner, 2003). Units of analysis can be specified time intervals, specified types of events, or natural transitions in

interaction (Margolin et al., 1998). Event recording is most appropriate for studies interested in particular behaviors while specified intervals are most effective when the question does not require frequencies, durations, or sequences of behavior. When frequency, duration, and intensity are of interest, behavioral sequences coded in real time or observer ratings summarizing across behaviors can be used. Though still more labor intensive, coding of all behavioral sequences in real time have become more feasible due to advances in computer software. With these methods, all behavior can be categorized according to a hierarchical system of codes that can account for content and affective tone (Margolin et al., 1998). Such forced-choice coding systems may be more objective than global ratings of behavior, in which raters use defined scales to summarize their subjective impressions of the overall quality of interactions. Research has suggested that global ratings are more susceptible to the influence of rater expectations than are direct counts of specifically defined behaviors (Aspland & Gardner, 2003; Kent, O'Leary, Diament, & Dietz, 1974; Margolin et al., 1998; Patterson, 1982). Another crucial consideration for constructs of parent-child relationships involves the dyadic, transactional, interdependent nature of parent and child interaction behavior.

In an effort to balance all of these considerations, I developed a coding scheme for observational data that would consider parent and child behavior separately but could be analyzed at the dyadic level using state space grid methodology. My primary research questions involved dyadic parent-child co-regulation as a predictor of child self-regulation and adaptation to school. With parent and child interaction behavior coded separately, I retained the flexibility to control for child contributions to interaction to

ensure that relationships between co-regulation and child outcomes were not mere artifacts of the child's participation in both. I can also compare my findings to those in the literature suggesting that parenting behavior may be more important than dyadic responsiveness (Karreman et al., 2006). In addition, the state space grid (SSG) methodology offers unique opportunities for conceptualizing the data in line with principles of dynamic systems theory.

State Space Grids

State space grids were originally developed by Lewis, Lamey, and Douglas (1999) as a method for examining processes of social and emotional development with attention to principles of dynamic systems theory. Properties of complex systems involve self-organization of the system, nonlinear interactions among components of the system, phases of relative sensitivity or insensitivity to outside influences, and rapid transitions between stable states (Granic & Hollenstein, 2003; Hollenstein, 2007; Lewis et al., 1999). The state space grid methodology has appeal to developmental scientists as a method for representing observational data with a systems perspective, but without the mathematical complexity and need for continuous data of alternative dynamic systems methods such as phase plots, Fourier analysis, Karnaugh maps, and coupled equations (Granic & Hollenstein, 2003; Thelen & Smith, 1994; Thelen & Ulrich, 1991).

With state space grids, ordinal or categorical data can be used to define all possible "states" of an individual or a dyad. By quantifying trajectories as the sequence of behavioral states, or how the individual or dyad moves across the state space in real time,

SSGs can yield measures of contingent behavior, behavioral states of relative stability (attractor states), durations and frequencies of behavioral states, and the stability and influence (or "attractiveness") of attractor states. Variables generated by this methodology can then be analyzed with common statistical techniques appropriate for addressing questions of individual differences, group differences, and change over developmental time (Granic & Hollenstein, 2003; Lewis et al., 1999; Lewis, Zimmerman, Hollenstein, & Lamey, 2004).

In their original analysis, Lewis and colleagues (1999) were interested in observing and modeling the dynamic interplay of infant attention and arousal. Using video-taped behavioral observations, they coded attention and arousal separately into five ordinal categories each, then designed a grid with infant affect on one axis and arousal on the other. By calculating the durations within grid cells and transitions between grid cells, Lewis and colleagues (1999) were able to characterize the interaction of infant arousal and affect to define attractor states, or states of relative stability. They then tested the hypothesis that these attractor states would become more stable within individuals over developmental time.

Researchers have also used state space grids to address a variety of research questions that involve dyadic interactions by plotting behavior of dyad members on separate axes. The method has been applied to observed interactions of peers (Dishion, Nelson, Winter, & Bullock, 2004; Dishion & Piehler, 2006) and adult romantic couples (Gardner & Wampler, 2008). More frequently, state space grids have been used for the analysis of observed parent-child interactions to address questions of dyadic flexibility

(Granic, Hollenstein, Dishion, & Patterson, 2003; Hollenstein, Granic, Stoolmiller, & Snyder, 2004), dyadic conversational style (Petra, Benga, & Tincas, 2005), and individual differences in interaction style between different subgroups of externalizing dyads (Granic & Lamey, 2002). According to Hollenstein (2007), SSGs are useful as visual tools to depict behavior patterns over time, as exploratory tools for developing hypotheses about relationships and developmental processes, and as a source of measures that are not available with other methods.

The Present Study

This study examined the role of effective parenting for school success in a high-risk sample of children living in emergency shelter for homeless families, with the goal of elucidating how co-regulation experiences with parents relate to child self-regulation skills. The conceptual framework guiding the study involves attachment theory and risk and resilience literature as well as principles of dynamic systems theory. Attachment theory posits that young children develop self-regulation abilities in the context of their relationships with their parents, while evidence from decades of resilience studies underscore the importance of positive relationships and cognitive regulatory skills as protective factors in contexts of risk and adversity. Dynamic systems theory considers the interacting and transacting relationships among levels of analysis and across developmental time. By examining parent-child relationships in homeless families with a dynamic systems perspective, this thesis had the overall objective of understanding the

importance of parenting for a child's developing self-regulation and school adjustment in contexts of risk and adversity.

Participants in this study included families with a child entering kindergarten or first grade who were recruited from three shelters in a Midwestern city as part of a larger study of risk and resilience in homeless children. Families were assessed during the summer while they stayed in emergency shelter, and school adjustment was ascertained after children entered kindergarten or first grade the following school year. Measures included assessments of co-regulation with parents, executive function and IQ, history of risk, adversity, and parent psychopathology, and children's academic, social, and behavioral adaptation to school. Using observational data and state space grid methodology, I examined the parent-child relationship as a dynamic system with implications for children's school success and executive function (a central component of self-regulation).

Aim One. The first major aim of this study employed measures generated with specifically designed SSG software (Gridware 1.1: Lamey, Hollenstein, Lewis, & Granic, 2004) to test hypotheses regarding co-regulation in the parent-child relationships of homeless families. Based on the theory and literature reviewed above on the central importance of effective co-regulation directed by parents for the development of self-regulation skills in children, I expected to find that children from dyads with more positive co-regulation patterns would demonstrate better concurrent cognitive skills of executive function and IQ and would show better adjustment to school in domains of academic performance, behavior, and social interaction. I also compared results of co-

regulation analyses with analyses that focused on parent behavior only (with and without child behavior controlled) to test the hypothesis that parent control, both positive and negative, would be more predictive of child outcomes than parent responsiveness.

Aim Two. The second aim of my thesis, capitalizing on the exploratory and descriptive strengths of the SSG methodology, was to determine whether dyads could be classified into distinct and meaningful groups based on their patterns of interaction behavior. This aim had three components: (1) to identify and describe the attractor states of parent-child interaction behavior for each dyad, (2) to conduct a cluster analysis with the goal of identifying existing typologies among the dyads, and (3) to compare clusters of dyads on other key constructs of the study to determine whether these groups differed in other meaningful ways. I expected to find that parent-child dyads could be grouped by different patterns of dyadic behavior that would indicate distinct styles of interaction, and that these groups would differ on other key constructs including executive function, parent psychopathology, and family history of risk and adversity.

METHOD

Participants and Procedures

Data for this project were collected in two waves, in the summers of 2008 and 2009. Participants included 138 parents and their 4-6 year old children, each recruited while the family was residing in an emergency shelter for temporary housing. There were three shelters sites, the two largest family shelters in Minneapolis as well as a smaller shelter for young families. Research staff recruited families using a variety of methods that differed depending upon the set-up and routines of the three shelters. In the large public shelter, research staff attended scheduled meals, posted fliers in elevators and on bulletin boards, and slid recruitment letters under the doors of eligible families' rooms. In the large, privately run shelter, fliers were placed in mailboxes and phone calls were made to family rooms, the routine contact method for that shelter. In both of these large shelters, information about the study in progress was also spread informally by word of mouth by both staff and parents who had participated, leading to families approaching the research staff for information. In the small shelter, shelter staff approached the four eligible families and encouraged them to meet with researchers on site to hear about the project.

To be eligible for participation in the study, children had to be entering kindergarten or first grade the subsequent fall, and could not have a previously diagnosed severe developmental delay. Fluency in English was required for both the child and his or her legal guardian and primary caregiver. Across the two years, 13 families were excluded because they were not fluent in English and 2 families were excluded due to an

identified and severe developmental delay. Families also were not recruited until they had spent at least three nights in shelter so that they would have time to acclimate before considering participation. Because of this, children from families who stayed for only one or two nights during the period of data collection were not eligible for the study (31 families). For families with two or more children entering kindergarten or first grade, one child was selected at random for participation. When a second parent was present in shelter with the family, he or she was invited to complete the parent interview at a later time. Across the two years, 140 out of 191 eligible children and their caregivers gave consent for participation (73%). In two cases, caregivers signed consent forms but were then unable to complete the sessions, in one case because the child would not separate from the parent and in another because the caregiver realized she had a previous appointment and was unable to reschedule prior to moving out of the shelter. The overall participation rate for the study was 72% of all eligible families, with 13 (6.8%) families declining participation while the remaining failed to make appointments, could not be rescheduled in time, or never came in direct contact with research staff.

Among the 138 children who participated, 78 (56.5%) were female and 60 (43.5%) were male. This ratio was consistent with the gender ratio among the 191 eligible children. The mean age was 5 years, 9 months with a range of 4 years, 10 months to 6 years, 11 months. Ninety-two (66.6%) of the children were identified by their parents as African American, with 22 (15.9%) identified as Multiracial, 9 (6.5%) as American Indian, 6 (4.3%) Caucasian, 3 (2.1%) Asian, 2 (1.4%) Somali, and 4 (2.8%) other. The majority of the children's primary caregivers were biological mothers (92.7%).

Biological fathers made up 3.6% of the primary caregivers, with 1.4% step-mothers, 1.4% step-fathers, and 0.7% grandmothers. Primary caregivers ranged in age from 20 to 57, with a mean age of 30. Primary caregivers identified their ethnicities as African American (63.7%), Multiracial (10.9%), Caucasian (11.6%), American Indian (7.2%), Asian (2.2%), Somali (1.4%), and other (2.9%). While the majority of families were headed by single parents, 37 families had two caregivers present in shelter. A second caregiver completed the parent interview for 17 of the families; however, only data provided by the primary caregivers were included in the analyses presented in this report.

When families expressed interest in participation, they were invited to meet with research staff on site for the consent process. Researchers read consent forms aloud to parents to facilitate their understanding and opportunity for questions, and also gave children opportunities to assent and withdraw their assent at any time during the process. After completing the consent and assent process, the child went with one researcher to a separate room to complete a battery of assessments including two subtests of an IQ test, a receptive language assessment, and a series of executive function tasks (described below). Children were also asked to provide saliva samples at twenty-minute intervals to measure their levels of salivary cortisol for study analyses not included in this thesis. While children completed their sessions, which took approximately one hour, each child's primary caregiver participated in an hour-long interview with another researcher. The interview consisted of questions about demographic information as well as several different questionnaires pertaining to the child and family history of socio-demographic

risk and adversity experiences, the child's health and behavior, and parent's mental health.

Once the separate sessions were completed, each child and his or her primary caregiver were joined for a series of eight structured interaction tasks. The tasks were developed at the Oregon Social Learning Center and adapted for use with low-income families by Marion Forgatch and Abigail Gewirtz (Gewirtz et al., 2008). The children and their primary caregivers were asked to remain seated at a table or in view of a video camera for each of the tasks. In the room was a set of two shelves, with two specific sets of toys on separate shelves. During the parent interview, prior to the interactions tasks and with the child not present, parents were instructed to allow their children to touch only the toys on the bottom shelf (a stuffed guinea pig, an age-appropriate storybook, a sticker book, a deck of cards, *Jenga, Cranium* jacks, and a plastic tube filled with small plastic turtles and frogs) and to refrain from touching the more attractive toys on the top shelf (a *Bratz* doll, a Spiderman action figure on a motorcycle, a xylophone, a colorful, stretchy yo-yo, and a *Nerf* football). The structure and content of the series of eight interactions tasks are described in detail in the following section. Parents received $40 in Target gift cards and children received small toys as honoraria for their participation.

Beginning in October of each year following summer data collection, with the permission of the parents, participating children were located in schools with the help of shelter staff, Minneapolis Public School staff, and phone calls to parents. Questionnaires for teachers were mailed to school principals, along with reply forms for principals to complete indicating whether each student was indeed enrolled in that school or to provide

additional information for students who had changed schools. As expected, many of the participating families continued to be mobile and thus difficult to locate. Overall, 114 of the 138 students (82.6%) were located in schools, and 111 (97.4%) teacher questionnaires for located students were completed and returned, providing teacher outcome data for 80% of the total sample. Teachers received gift cards worth $10 for each student's questionnaire completed.

Parent-Child Interaction Tasks

The parent-child interaction session consisted of a series of eight tasks, presented in a standardized order with instructions provided prior to each task. The specifics of the eight tasks are described next.

Free Play (5 minutes). For the first task, parents and children were instructed to "take a break and talk or play with some of the toys," during which time the parent was expected to convey and enforce the rule about the "forbidden" top shelf of toys. The parent had been instructed about the toys prior to the interaction session. Dyads were alone in the room for the duration of the task.

Clean Up (5 minutes). Following free play, the researcher gave the parent a magazine that she had been previously instructed to read while asking her child to clean up the toys. Again the researcher left the room, allowing parents to enforce clean-up as they chose. The magazine had a small note on the cover to remind parents about clean-up, and the magazine also served as a potential distraction or split-attention task for parents.

Problem Solving 1 (5 minutes). At the conclusion of the parent interview, the interviewer helped the parent to select a salient issue of conflict for discussion. Commonly selected issues included cleaning up, arguing with siblings, following family rules, or bad behavior. During the first problem solving task, the parent and child were instructed to talk about the issue the parent had selected and try to figure out how to solve it.

Problem Solving 2 (5 minutes). Each child also had an opportunity to select an issue for discussion at the end of the individual child session. During the second problem solving task, the parent and child were instructed to discuss the issue that the child had selected and try to come up with a solution to the problem. Common problems selected by children were cleaning up, fighting with brothers and sisters, and spending more time engaging in fun activities. The researcher was not present in the room during either of the two problem solving tasks.

Labyrinth (3 minutes). For this game task, the researcher provided the parent and child with a modified wooden *Labyrinth* game board. The parent and child were instructed to work first cooperatively and then competitively to move marbles into holes in four corners of the board. The researcher was present for the duration of this game.

Safety Plan (5 minutes). Also at the end of the parent interview, researchers helped parents select a safety issue from a list (e.g. strangers, getting lost, bullies, crossing the street, safety in cars, drugs, guns and knives). For the safety plan task, the researcher left the room after instructing parents and children to discuss the selected safety issue and try to come up with the plan so that the child could be safe and feel safe.

Guessing Game (6 minutes). For this game task, parents and children took turns giving each other clues and attempting to guess what was pictured on a standard set of cards. Each card displayed a simple word with a picture, such as dance, vegetable, bicycle, and nail. For the first three minutes, parents gave clues and children guessed. For the second three minutes, the children had an opportunity to give clues while their parents guessed. The researcher was present in the room during this game task as well as the final one, described next.

Tangoes (4 minutes). In the final game task, children were given puzzle pieces of seven geometric shapes from the commercial game *Tangoes,* and parent were given a set of cards with designs. Parents were instructed to help the child make the specific shapes shown on the cards using the geometric shapes.

The series of tasks generally took about 50 minutes to complete, with brief breaks for instructions and cortisol sampling between tasks. All eight tasks were completed for the majority of dyads (87.7%). In five cases (3.6%), the dyad did not complete Problem Solving 2 because the child had been unable to identify an issue for discussion. In four other cases (2.9%), the final two game tasks were not administered because the family required a shortened session in order to attend a scheduled shelter meal or another important appointment. Four dyads (2.9%) were unable to complete interaction tasks at all; one child had withdrawn assent during his individual session, one family was asked by shelter administrators to leave the shelter during their individual sessions, and the remaining two had conflicts and could not be rescheduled prior to the end of the study. Two dyads (1.4%) could not be coded because they were speaking languages other than

English for majority of the tasks, and two dyads (1.4%) discontinued participation after the free play task because the children were upset and their parents chose to stop. Coded data were considered valid for the 130 dyads (94.2%) that had completed five or more of the eight interaction tasks.

Development of the Co-Regulation Coding Scheme for State Space Grid Analyses

For use with SSG analyses, data should involve a relatively small number of categorical or ordinal codes along two independent dimensions. The codes within each dimension must be mutually exclusive and exhaustive such that only one code is applied at any time and every observable behavior falls under one code. Thus a hierarchical system of codes in real time is most appropriate (Hollenstein, 2007; Margolin et al., 1998). For dyadic parent-child data, parent behavior forms one dimension while child behavior forms the other. While the existing studies reporting SSG analyses with parent-child interaction data have typically relied on affect codes, with the same coding criteria for both parents and children, I was interested in capturing processes of co-regulation beyond emotional co-regulation and considering the differential roles of parents and 5-6 year old children in co-regulation processes. Specifically, I wanted to capture more cognitive and behavioral aspects of co-regulation, such as processes in which parents provide information to teach their children and children ask questions of parents. Because behavior regulation and emotion regulation co-occur, I chose to define codes considering both affective and behavioral information.

I was also interested in defining parenting codes that could be used as separate aspects of parenting, consistent with existing literature that differentiates between positive control behaviors, negative control behaviors, and synchrony, reciprocity, or dyadic responsiveness (Harrist et al., 1994; Karreman et al., 2006). Parent behavior and child behavior were coded by independent teams so that each could be examined separately from that of the other dyadic partner. In contrast, I designed child codes to differentiate between on-task or appropriate, relatively independent behavior versus other behaviors that could indicate dysregulation, ineffective coping, or need for assistance. The early drafts of the coding scheme included four overarching categories for both parent and child behaviors as well as several subcategories in each. However, establishing interrater reliability at the level of subcategories proved to be too difficult, and the subcategories were eliminated. A later version of the coding scheme included four "event" codes for parents and four "event" codes for children, in an attempt to capture some of the information that was intended by the subcategories. For example, harsh physical contact was an event code for parent behavior, such that the code was applied at each separate instance of harsh physical contact (e.g. parent physically restrains or shoves child). Event codes also proved challenging for reliability and were discarded because they did not directly address the hypotheses of this thesis. Thus the eight codes (four for parent behavior and four for child behavior) in the final coding scheme represented durations of behavior, such that a code was applied at behavior onset and maintained until the onset of any behavior from a different category. This coding was done on computers in real time using the software program ProcoderDV (Tapp, 2003).

The coding scheme was developed and tested using a pilot sample of 39 video-taped parent-child interactions that had been conducted in one of the shelter sites with families similar to those included in the sample for this report. SSG data and analyses from this pilot sample were presented in an unpublished undergraduate honors thesis (Schmidt, 2009) for which I served as a mentor. Two teams of coders, one including myself, trained to reliability on the four parent codes and four child codes, respectively. Once the scales had been refined based on this experience, new coders were trained to reliability on the pilot sample prior to coding real cases from the sample in this report.

Final Coding of Parent-Child Interaction Tasks for the State Space Grid Analyses

The coding schemes for parent and child behavior were designed such that all behavior during the 50 minute interaction sessions could be categorized into eight mutually exclusive and exhaustive behavior codes, four pertaining only to the parent and four pertaining only to the child. Because parents and young children have very different roles in co-regulation, with the parent bearing the most responsibility for structure and leadership, parent and child behavior were conceptualized separately with different categories. Brief periods between tasks during which an experimenter was interacting to give instructions were not coded, as the scheme and analyses were intended to capture dyadic co-regulation; a third party potentially changes the dynamics and meaning of the behaviors. These "transition" periods were marked prior to coding for consistency between coders on each individual case, and the durations during transitions were not considered in the calculations of inter-observer agreement. Both the parent and child

coding schemes included an additional code for "missing" behavior. This code was applied when participant behavior could not be categorized because participants were off camera, speaking too softly to be heard, or speaking in languages other than English. Like transitions, missing behavior was excluded from reliability scores and further data analysis.

All observed parent behavior was coded into one of the following four categories: positive control, non-directive responsiveness, disengaged/distracted, and negative control. The full coding criteria are presented in Appendix A. Positive control was defined as positive, constructive strategies the parent used to regulate the child's behavior or affect that were accompanied by a positive or neutral affective tone. Included in the positive control category were giving instructions, providing explanations, making requests, teaching skills, teaching about emotions, redirecting child's attention to appropriate behavior, distracting the child from disruptive or upsetting stimuli (such as the forbidden toy shelf), and comforting the child with sensitive and appropriate verbalizations or physical contact.

Non-directive responsiveness (referred to in the coding scheme as "following the child's lead") was defined as parent behaviors that were involved and responsive but not directive. In other words, these behaviors were not specifically aimed at controlling or modifying child behavior or affect. The category included attentive monitoring of child behavior, watching the child work, waiting for the child to complete a task or ask for help, and watching while the child was focused on something other than the parent. Active listening (i.e. listening to child and providing eye-contact), participating in games

or activities without providing specific structure, encouragement or acknowledgment of on-task behavior, repeating, reflecting, and responding with brief verbalizations such as "yeah" or "uh huh" were also coded as non-directive responsiveness. As with the positive control code, the non-directive responsiveness code was only applied when behavior occurred in the context of positive or neutral parent affect.

The parent code of disengaged/distracted was applied when the parent was ignoring the child, distracted by something else, preoccupied with him or herself, or simply not participating in the interaction. Examples of these behaviors included reading the magazine during the clean-up task, attending to other objects in the room, rubbing eyes, yawning, or grooming self, and pursuing a topic of conversation that was entirely parent-focused while facing away from the child. Also included in this code were leaning or looking away from the child and staring, shut down, dissociative behaviors.

Parent negative control applied to parent behaviors intended to control the child that were harsh and punitive or insensitive and intrusive. Any behaviors that were disqualified from positive control or non-directive responsiveness due to negative affective tone fell into the category of negative control. Other examples of negative control included yelling or shouting at the child, threatening the child verbally or physically, criticisms and invalidation, insults, negative questions (e.g. "Why don't you ever clean your room?"), punishing, teasing, taunting, or shaming the child, and laughing derisively at child behavior or distress. Physical aggression and harsh physical contact as well as interrupting and aggressive play (such as pushing a toy into the child's face or throwing toys at the child) were also considered negative control.

Child behavior was coded into the following four categories: on-task, signals/bids, withdrawn, and defiant/disobedient. Child on-task behavior was characterized by child engagement and constructive behavior that was consistent with task demands and parent directives. The child could be working fairly independently and confidently but attentive to signals from the parent, and child affect had to be positive or neutral. Examples of on-task behavior included active engagement, leading or following in play, following rules of games or tasks, complying with parent directives, and active listening (listening with eye-contact) while the parent was talking.

Child signals/bids were defined as verbal or nonverbal behaviors intended to get the parent's attention or indicating opportunities for the parent to help, in the absence of defiance and disobedience. A variety of different behaviors fell under this category, including verbal requests for attention, assistance, explanations, or comfort. The code was also applied when the child was struggling with a task such that he or she was misunderstanding the rules, "stumped," or not making progress, and when the child displayed emotional distress and over-arousal that was not defiant or disobedient, such as whining, crying, displaying fear, excessive silliness that interfered with task performance, or expressing frustration without defiant behavior or negative affect directed at the parent. Finally, signals/bids included nonverbal gestures such as social referencing or touching the parent in a non-aggressive way, and in rare cases, child redirecting the parent or providing comfort or caretaking to the parent.

Child withdrawn behavior was coded when the child was distracted or otherwise uninvolved in the task and with the parent but was not refusing or oppositional. This

category included the child looking away or otherwise avoiding eye-contact, turning away, fidgeting with his or her body, staring or dissociative, wary or hesitant to engage, or distracted by something other than the parent or the task at hand. Looking at toys on the shelf during tasks other than clean-up or free play was considered withdrawn, as was attending to or playing with the video camera.

Child defiant/disobedient behavior represented behavior in which the child was intentionally refusing to comply or acting in opposition to instructions, or when the child was attempting to direct the parent using hostility or aggression. Examples of these behaviors included screaming, yelling, or arguing with the parent, disobedience, cheating in games, hostility, criticisms, name-calling, inappropriate language, threatening, teasing or taunting the parent, ordering the parent around, and any aggressive or dangerous behavior towards the parent or towards objects in the room (e.g. hitting, kicking, biting, shoving, throwing objects). Any of the behaviors described under on-task, signals/bids, and withdrawn that occurred in the context of hostility, aggression, or oppositionality towards the parent were coded as defiant/disobedient.

Parent and child behavior were coded by two independent teams. Each team consisted of a primary coder and a reliability coder who completed 30% of the videos. Using ProcoderDV software (Tapp, 2003), codes were entered on computer as they were observed on video for accurate and comparable recording of timing. MOOSES software (Tapp, Wehby, & Ellis, 1995) was used to calculate frequencies, durations, and inter-observer agreement using both an agreement ratio (seconds of agreement divided by the

sum of seconds of agreement and disagreement for each code) and Cohen's kappa. Due to the nature of the data, however, each of these statistics is somewhat misleading.

Though commonly used, agreement ratios are notoriously liberal because they do not correct for chance agreement (Berk, 1979; Watkins & Pacheco, 2000). On the contrary, a standard *a priori* cut-off criterion for Cohen's kappa is likely to be too conservative when the behaviors of interest have base rates much higher or lower than .5 (Bruckner & Yoder, 2006; Kraemer, 1979; Grove, Andreasen, McDonald-Scott, Keller, & Shapiro, 1981). Because the four codes in both the parent coding scheme and child coding scheme occurred with quite different frequencies, I calculated observer accuracy based on the kappa statistic and the observed base rates of behavior in the sample (Bruckner & Yoder, 2006; Kraemer, 1979; Grove et al., 1981). Observer accuracy for all four parent codes was above .90, with accuracy of parent disengaged/distracted above .95. Observer accuracies were above .90 for child codes on-task and withdrawn, and above .85 for codes signals/bids and defiant/disobedient. All reliability statistics and calculation of the observer accuracy are presented in Table 1.

The State Space Grid

For the current study, the state space was defined as a 4x4 grid with parent behavior on the horizontal *x*-axis and child behavior on the vertical *y*-axis. Parent behavior was defined by the four categories of positive control, non-directive responsiveness, disengaged/distracted, or negative control. Child behavior was defined by the four categories of on-task behavior, signals or bids to caregiver, withdrawn, or

defiant/disobedient. Categories were not intended to be ordinal for either parent or child, and thus the locations of categories on the axes were somewhat arbitrary. They have been arranged to differentiate theoretically positive zones and negative zones and for ease of representing the seven-cell region of positive co-regulation.

Goals for state space grid analyses were twofold. First, the grid was designed to capture co-regulation processes to test the hypothesis that observed positive co-regulation with parents would moderate experiences of adversity and predict better functioning in school among homeless children. Second, the SSG methodology was also chosen for its descriptive strengths to explore individual differences in dynamic co-regulation processes as they exist in the current sample. Both goals were addressed separately with appropriate analyses, described below.

Goal #1. To address the first goal, seven cells of the SSG were designated *a priori* as the region of positive co-regulation (PCR). The cells were chosen based on ideal or preferred parent behavior in the context of the child behavior, based on the following presumptions. When the child is on-task, the parent should be giving positive direction or following the child's lead with non-directive responsiveness. When the child is signaling to the parent or otherwise struggling with a task, the parent should also be giving positive direction or responsively engaged, following the child's lead. When the child is either withdrawn from interaction or defiant and disobedient, however, the parent should make efforts to re-engage or redirect the child with positive control behaviors and should not follow the child's lead or disengage. Thus the cells representing the intersections of parent positive control with child on-task and with child signal, parent following child's

lead with child on-task and child signal, and parent positive control with child withdrawn and child defiant/disobedient were considered positive co-regulation. The seventh PCR cell involved child on-task coupled with parent disengaged/distracted. This cell was considered PCR because when children are independently and successfully engaged in appropriate behaviors, parents often use the opportunity to attend to other important matters, such as care of siblings, care of self, or other everyday chores and responsibilities. Co-regulation does not require constant engagement, and in fact may function best with periods of disengagement that promote child self-direction and autonomy (Tronick, 2006). Furthermore, in the clean-up task, parents were specifically directed to read a magazine (i.e. attend to something other than the child) while their children cleaned up. Parent disengagement/distraction was not considered PCR when it intersected with child signals, withdrawal, or defiance/disobedience. Regardless of child behavior, parent negative control was not considered PCR.

It is important to note that disproportionate parent and child roles are inherent in this conceptualization. Not only are the original codes defined differently for parent and child, but ability to ensure PCR is greater for the parent. Parent positive control is unilaterally PCR while parent negative control is unilaterally not PCR. In terms of child behavior, child on-task behavior does not guarantee PCR and child defiance/disobedience does not preclude PCR. This imbalance is intentional and presumed appropriate for the age range of children considered here. Though their interactions are dyadic, with behaviors of both partners influencing the other, parents of preschool-aged children bear greater responsibility for both self-regulation and co-regulation of the parent-child dyad.

With older or younger children, the expectations for balance of co-regulation responsibility for parent and child might be quite different. The overall state space grid and PCR region are depicted in Figure 1.

To measure individual differences in PCR, two variables were created using output from Gridware 1.1 (Lamey et al., 2004): PCR duration and PCR influence. PCR duration represents the proportion of total interaction time (in seconds) in which the dyad's behavior fell within the PCR region of the grid. PCR influence represents the likelihood that each event, or instance of paired parent-child behavior, will occur within the PCR region. Influence is calculated as the number of events within the PCR region (7 cells) divided by the total number of events in the entire state space grid (16 cells). Because the variables of PCR duration and PCR influence were extremely highly correlated (r = .94) and PCR influence had a more normal distribution, PCR influence was used in all relevant analyses.

Goal #2. To address the second goal of the SSG analyses, I conducted exploratory analyses with the SSG data according to methods established by Lewis and colleagues (1999) to identify attractor states of individual dyad trajectories. First, I applied the winnowing method in which cells of each individual grid were eliminated one at a time based on their contribution to heterogeneity in terms of duration until only one or a few cells with the longest, relatively homogenous durations remained (Hollenstein, 2007; Lewis et al., 1999). Those cells were the candidate attractor states. Next, I examined the strength or "attractiveness" of these potential attractor states to determine their potency in

terms of the consistency with which each attractor appeared across the eight different interaction tasks.

Based on the apparent number of profiles of attractor states and their consistencies within the data, I then conducted a hierarchical cluster analysis for the purpose of exploring whether different patterns of parent-child interaction emerged from the coded sample of 130, and how these patterns compared to the conceptualization of PCR. Gridware variables used to inform the cluster analysis included the full grid measure of dispersion as well as duration percentages for each parent code (columns on the grid), each child code (rows on the grid), and each grid cell (representing a specific combination of parent and child behavior). The PCR region scores were not included in the cluster analysis so that the results of the exploratory investigation could be compared to the *a priori* hypothesis regarding positive co-regulation. Additional analyses were performed to describe and characterize the clusters, and to address conceptual issues related to the original analyses and SSG methodology. Each of these analyses is described in detail in the Results section.

Other Measures

Means, standard deviations, and ranges of all study variables are presented in Table 2.

Global Parenting Quality. In addition to the duration codes for state space grid analyses, a set of global parenting codes were rated based on the parent-child interaction videos by a completely independent pair of raters. These data were included to assess the

validity of the novel SSG durations codes. Both individuals had experience working with low income children and familiarity with the shelter environments. Codes were selected based on research with low-income parents and children to represent two dimensions of parenting, structure and warmth (Sroufe, Egeland, Carlson, & Collins, 2005, Caspi et al., 2004). Parenting warmth was conceptualized as a composite of four codes including positive responsiveness, warmth, hostility (reversed), and negativity (reversed), with a factor score of $\alpha = .87$. The positive responsiveness scale was intended to assess the degree to which the parent showed concern for the child and responded to the child's positive affect by displaying warmth and positive affect in return. The hostility scale assessed the degree to which the parent depicted an angry, resentful, negative, or punitive attitude towards the child. The warmth subscale was assessed by tone of voice, sympathy, and empathy for the child, and the negativity scale described negativism expressed about the child and displays of critical or dissatisfied attitude towards the child. Positive responsiveness and hostility were each rated on five-point Likert scales while warmth and negativity were rated on six-point Likert scales, then rescaled for combination. Parenting structure included the three codes of quality of assistance, support of autonomy, and structure and limit setting, which were each coded on 5-point Likert scales and combined with a factor score of $\alpha = .84$. Quality of assistance assessed the degree to which the parent understood and adequately addressed the child's needs and was able to navigate the child through discussions and games. Support of Autonomy assessed the degree to which the parent was cognizant of the child's individual abilities, thoughts, and behaviors and provided a respectful environment relative to the child's age-appropriate skill level.

Structure and Limit-Setting assessed how well the parent established expectations for child behavior and followed-through consistently with those expectations. The two composite scales of parenting structure and parenting warmth were highly related to each other, and were thus averaged to create a single variable representing global parenting quality (α = .91).

Executive Function. During the individual session, children completed a series of four brief executive function tasks that together emphasized inhibitory control, working memory, and set-shifting. The first task was based on the game "Simon Says," in which the researcher stated and demonstrated a series of actions, half of which are preceded by the phrase "Simon says" (Kochanska, Murray, & Coy, 1997; Strommen, 1973). The child was instructed to do all the actions preceded by "Simon says" (activation trials) and refrain from doing actions that do not begin with "Simon Says" (inhibition trials). Child behavior was video-recorded and later coded by a team of raters with a reliability statistic of K = .94. Scores were based on the percentage of correct inhibition trials, except for cases in which the child failed all activation trials or failed to inhibit correctly in any of the practice trials. These children were presumed to misunderstand the demands of the task, and thus their scores were considered missing. The second EF task was the Dimensional Change Card Sort (DCCS: Zelazo, 2006) in which the children were instructed to sort cards first by color, then by shape. Scores for DCCS reflected the number of correct sorts out of six following the rule switch. In the Peg-Tapping task (Diamond & Taylor, 1996), the child was presented with two rules: tap the table with a wooden dowel twice when the experimenter tapped once and tap once when the

experimenter tapped twice. Scores were based on percentage of correct taps. The final EF task was the Computerized Pointing Stroop (Berger, Jones, Rothbart, & Posner, 2000), in which the child saw two different animals on a computer screen and heard an animal sound corresponding to one of the animals. First, in the compatible trials, the child was instructed to point to the animal that makes the sound she heard. For the incompatible trials, the child was instructed to point to the animal that does not make the sound she heard. Scores were based on percentage of correct incompatible trials. Based on our prior research with these tasks in the population of young homeless children (Obradović, 2010), scores from the four EF tasks were standardized and combined to form an EF composite, with $\alpha = .71$.

Child IQ. Estimates of child intellectual functioning were based on scores from the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-IV; Dunn & Dunn, 2007) and two subscales (Block Design and Matrix Reasoning) of the Wechsler Preschool and Primary Scales of Intelligence, Third Edition (WPPSI-III; Wechsler, 2002). The PPVT-IV is a standardized assessment of receptive vocabulary, or verbal intelligence. Raw scores are converted to scaled scores based on a distribution with a mean of 100 and standard deviation of 15. The average standardized score in the sample was 88.2, indicating that our sample was nearly a standard deviation below the mean, on average. Block Design and Matrix Reasoning are two subscales from the WPPSI-III that measure fluid intelligence and are typically correlated with a coefficient of $r = .51$ (Wechsler, 2002). Raw scores are converted to scaled scores with means of 10 and standard deviations of 3. Scaled scores from the two subscales ($r = .29$ in this sample) were

averaged as an indicator of fluid intelligence. The combined Block Design and Matrix Reasoning scores in this sample had a mean of 7.5, also nearly a standard deviation below the normative mean. Z-scores of the PPVT-IV score and the WPPSI-III composite (r = .35) were averaged to create an estimate of the child's general intellectual function (IQ).

Behavior Problems. During the parent interview, primary caregivers completed the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001), responding whether their children never, sometimes, or often demonstrated symptoms indicative of both internalizing and externalizing behavioral problems. Due to the age range of children in the sample, two different forms of the CBCL were used as appropriate. Because items differ between the two forms, however, standardized total problem scores were standardized with the Z distribution within form, then combined into a single variable. Prior to combination, the average total problem T-score for ages 1.5-5 years was 52.8 (SD = 11.5), and the average total problem T-score for ages 6-18 was 58.3 (SD = 10.0).

Parent Psychopathology. The measure of parent psychopathology was based on self-report data from two brief instruments, the Hopkins Symptom Checklist (HSCL-25; Glass, Allan, Uhlenhut, Kimball, & Borinstein, 1978) and the PTSD Checklist, Civilian version (PCL-C; Weathers, Litz, Huska, & Keane, 1994). The HSCL-25 includes 15 items related to symptoms of depression and 10 items related to symptoms of anxiety. The respondent indicates the degree to which they have experienced each symptom in the past week, on a scale from 1-4 with 1 = "not at all" and 4 = "extremely." Items include "feeling everything is an effort," "feeling no interest in things," and "feeling tense or

keyed up." The PCL-C indexes symptoms related to trauma that the individual has experienced over the past month with 17 items, rated on a 5 point scale with 1 = "not at all" and 5 = "extremely." PCL-C items include "repeated, disturbing memories, thoughts, or images of a stressful experience from the past," "avoiding activities or situations because they reminded you of a stressful experience from the past," and "feeling jumpy or easily startled." Scores for all items were totaled for each measure. Due to the high correlation between the total scores on the HSCL-25 and the PCL-C (r = .84), scores were standardized using the z-distribution and averaged as a single variable indicating parent psychopathology.

Adversity. Primary caregivers completed a short form of the Life Events Questionnaire (LEQ) developed by the Project Competence research group (Gest, Reed, & Masten, 1999; Masten, Neeman, & Andenas, 1994) that has shown reliability and validity in earlier studies of homeless families (Masten et al., 1993). The short-form is comprised of the items that have been repeatedly judged in the scale's development as independent (unlikely to result from the child's behavior), negative or ambiguous in desirability (not positive), and either chronic in nature (e.g., "during the past year, a parent had trouble with alcohol or drugs") or with discrete onset (e.g., "During the past year, one of the child's parents died"). Parents were asked whether each of 30 items had occurred during the past 12 months and answered yes or no. The measure includes independent events that have been rated by clinical judges as negative in desirability (see Masten et al., 1994) as well as events rated as ambiguous, such as the birth of another child in the family. For the purposes of this study, scores were based on a tally of the 24

negative events each parent endorsed. Counts based on the sum of dummy codes for these 24 events ranged from 0-10 with a mean of 4.2 events (SD = 2.4), with most commonly endorsed events of "the family financial situation was difficult this past year" (84.8%), "our family moved to a new home or apartment during this past year" (71.7%), and "one parent lost his or her job during this past year" (46.4%). Rates of endorsement for all items are presented in Table 3.

Risk. An index of socio-demographic risk was created from information gathered during the structured parent interview. The risk score was a count of the presence of ten well-established risk factors (Obradovic, Shaffer, & Masten, in press). The risk index included the following risk factors: primary caregiver currently unemployed; family could not afford rent at their previous residence; primary caregiver had completed less than a high school degree; the family previously lived in an unsafe neighborhood; the family previously lived in substandard or unsafe housing; family was headed by a single parent; four or more children in the household; parent history of being homeless as a child; high residential mobility during the target child's life; and high food insecurity. High residential mobility during the child's life was based on parent responses to the interview item "How many different addresses has your child lived at during his/her lifetime?" and coded 1 if the number reported was greater than 5. This cutoff was selected because it represented approximately 25% of the sample, consistent with guidelines from the risk literature (Sameroff, Seifer, Zax, & Barocas, 1987). High food insecurity was based on scores from a shortened version of the U.S. Household Food Security Survey Module (Nord, Andrews, & Carlson, 2006), on which parents respond to

a series of seven questions indicating the amount and quality of food eaten in their households over the past 12 months. The seven questions of the shortened version are those that pertain to children in the family, and scores are categorized according to standardized criteria to indicate level of food insecurity. A dummy code was assigned to indicate families categorized as either "high food insecurity" or "extremely high food insecurity." When dummy codes for presence of each of the ten risk factors were summed, risk scores ranged from 0-8 with a mean of 3.9 risk factors (SD = 1.6). The most commonly endorsed risk factors were primary caregiver unemployed (85%), single parent (73%), and could not afford rent at previous residence (50%). Endorsement rates of all risk factors are presented in Table 4.

School Outcomes. Measures of school adaptation were based on the teacher version of the MacArthur Health and Behavior Questionnaire (HBQ-T; Armstrong, Goldstein, & the MacArthur Working Group on Outcome Assessment, 2003). Subscales of interest for this report included academic competence, school engagement, externalizing symptoms, peer relations, and teacher-child relationship.

The academic competence subscale comprises 5 items ($\alpha = .96$) related to the child's academic achievement, for example, "How would you evaluate this child's current performance in reading-related skills?" Each item is rated on a 5-point scale with 1 = poor/well below grade level and 5 = excellent/well above grade level, and the items are averaged to create the academic competence composite.

School engagement consists of 8 items ($\alpha = .89$) related to the child's motivation for learning, such as "Is interested in classroom activities." These items are each rated on

a 3-point scale with 0 = doesn't apply, 1 = sometimes applies, and 2 = certainly applies then averaged to form the school engagement composite.

The externalizing symptoms composite combines four subscales measuring oppositional defiant behavior (9 items, α = .91), conduct problems (11 items, α = .86), overt hostility (4 items, α = .84), and relational aggression (6 items, α = .85) to index each child's level of behavior problems. Each item was scored on a three point scale with 0 = never/not true, 1 = sometimes or somewhat true, and 2 = often or very true. These four subscales were individually scored then combined as an average to form the externalizing behavior composite with α = .91.

The peer relations subscale is a composite of the peer acceptance/rejection and bullied by peers (reversed) subscales. Peer acceptance/rejection consists of 8 items rated on a 4-point scale with 1 = not at all like and 4 = very little like, and combined with α = .90. Bullied by peers is the mean of 3 items on the same scale, with α = .63. The two subscales were averaged with α = .67 to compose the peer relations subscale.

The teacher-child relationship composite comprises two subscales of teacher-child closeness (α = .84) and teacher-child conflict, reversed (α = .91). Both include 5 items scored on a 5-point scale from 1 = definitely does not apply to 5 = definitely applies. Scores on the two subscales were then averaged to form the teacher-child relationship composite with α = .47.

Missing Data

As is typically the case with research on high risk populations, some data were missing for many of the variables of interest. Great efforts were made to include all families and to minimize potential bias in missingness while also respecting the challenging circumstances and autonomy of the families. With good participation rates and high rates of teacher follow-up, and based on analyses of missingness, missing data conforms to standards of missing at random. Specifically, missingness for the parent-child interaction data was related to history of stressful life events and child IQ scores. Missingness for teacher outcome data was related to scores of parent psychopathology. Following best practices, data were imputed for 138 children on core analyses. Complete data were available for the following variables: child and parent age, gender, ethnicity, risk, adversity, and child IQ. Rates of missing data for other variables were as follows: .7% for parent psychopathology, .7% for CBCL child behavior problems, 1.4% for executive function, 5.8% for all parenting and co-regulation variables, and 19.6% for all school outcomes. Data were imputed using the recommended MCMC algorithm with fully conditional specification (Schafer & Graham, 2002) in PASW Statistics 18. Data were imputed 20 times to create 20 different datasets, with results of analyses on the 20 datasets combined according to Rubin's Rules (Rubin, 1987). Imputed data are presented in all tables and figures, unless otherwise noted.

RESULTS

The results section is divided into two parts consistent with the two separate aims of my thesis. The first section is focused on hypotheses concerning positive co-regulation and its relations to executive function and school success. Descriptive data are presented first, followed by analyses testing hypotheses on the significance of PCR for child function and school success. The second section presents results of exploratory analyses to identify dyadic patterns in parent-child interaction based on more detailed analyses of state space grid attractor states and clusters.

Aim 1: State Space Grid: Positive Co-regulation

Rates of observed behavior for each of the four parent and four child codes are presented in the first row of Table 5 as means and standard deviations of the percent duration of total coded time. Based on observed data only (from the 130 dyads that completed the majority of the interaction tasks and had videos that could be coded), parents demonstrated positive control 42% of the time, non-directive responsiveness 34% of the time, disengagement or distraction 13% of the time, and negative control 10% of the total interaction time, on average. Children were on-task 60% of the time, signaling or bidding to their parents 25% of the time, withdrawn or distracted 9% of the time, and disobedient or defiant 6% of the time, on average.

Rates of coordinated parent and child behavior on the state space grid for all observed dyads are depicted graphically using Gridware output in Figure 2. In the left portion of the figure, the most densely populated grid cells can be identified visually

based on the density of nodes. Each node represents a visit (single instance of behavior for a single dyad within that cell), and the size of the node represents the relative duration of time for that visit. Clearly, the majority of parent-child behavior across all dyads fell within the top right portion of the grid, positive parent behaviors of positive control and responsiveness combined with child behaviors on-task and signaling/bidding. The cell representing the combination of parent disengaged/distracted with child on-task is also densely colored compared to all remaining cells. Considering the visual display of node density along with means and standard deviations of percent duration for each grid cell, presented on the right portion of the figure, all cells in the SSG are occupied for some amount of time by at least one dyad. Though the average durations in some grid cells are quite low (1-2% of time in six of the cells), variability is high and many nodes do appear. This indicates that individual dyads vary in the distribution of their behaviors across the grids, and that different dyads may have different attractor states. State space grid trajectories of individual dyads will be considered further in relation to the cluster analysis presented later.

Also apparent in Figure 2 is the concentration of behavior within the predefined positive co-regulation area of the grid. All of the most densely colored cells fall within the PCR area, along with two cells in which behavior is less common (parent positive control combined with child withdrawn behavior and child disobedient/defiant behavior). Based on both how PCR was conceptualized and how actual observed dyadic behavior was distributed, PCR influence was more related to some parent and child codes than to others. Specifically, PCR had high positive correlations with parent positive control and

child on-task behavior, and PCR had high negative correlations with parent negative control and child disobedience/defiance. Correlations were low to moderate between PCR and parent responsiveness and child signals/bids, in a positive direction, and between PCR and parent disengaged and child withdrawn behavior, in a negative direction. These correlations are presented in Table 6, along with correlations between the SSG codes and the independently coded global parenting quality variable.

The correlation between PCR and global parenting quality was high (r = .71, p < .01), indicating that PCR as defined in the state space grid approach was strongly related to observational judgments of good parenting quality. This result cross-validates both coding schemes. Global parenting quality was highly correlated with parent positive control but only moderately correlated with parent negative control, parent disengagement, child on-task, and child defiant/disobedient. Correlations were low between global parenting quality and parent responsiveness and child withdrawn, and global parenting quality was unrelated to child signals/bids. Thus, though they were separately conceptualized and coded, judgments of global parenting were sensitive to many of the same discrete parent and child behaviors. With only the global parenting codes, however, these discrete behaviors could not be examined separately.

Consistent with developmental conceptualizations at the organizational level of relationships, amounts of discrete parent and child behaviors were also related to each other. Among parent variables, some level of negative correlation was likely between all mutually exclusive codes. The negative relationships were particularly high between positive control and disengagement, positive control and negative control, and parent

responsiveness and negative control. Disengagement and negative control were not significantly related. Among child codes, child on-task behavior was negatively related to all other child codes, particularly signals/bids and disobedient/defiant, but the other three child codes were not significantly correlated with each other. Correlations between parent and child codes are more interpretable, given that parent and child behavior were coded independently. These correlations reveal that parent positive control was positively related to child on-task behavior and negatively related to child disobedience/defiance. Parent negative control was more strongly related to both child on-task behavior and disobedience/defiance, in the opposite directions compared to positive control. Parent disengagement was related only to child withdrawn behavior, and parent non-directive responsiveness was not significantly correlated with any of the child codes.

Correlates of Parenting Behavior and Co-regulation

Bivariate correlations for PCR, individual parent and child codes, and other variables of interest are presented in Table 7. Among this high risk group of homeless dyads, differences in PCR were not significantly related to differences in the index of socio-demographic risk, differences in number of stressful life events experienced in the past twelve months, or parent symptoms of psychopathology. The same pattern was true for individual parenting variables. Parent's report of child total behavior problems was negatively related to PCR and positive control and positively related to parent disengagement and parent negative control. Interestingly, parent-reported child behavior problems had a small negative association with child on-task behavior and a small

positive association with child withdrawn behavior, but it was unrelated to child disobedience/defiance. PCR was also correlated with child executive function skills. EF skills were correlated with parent responsiveness and parent negative control as well as child on-task behavior, child signals/bids, and child disobedient/defiant behavior. For the most part, the five school outcome variables were unrelated to PCR and individual parent and child codes. Only parent non-directive responsiveness was significantly related to school engagement, peer relationships, and teacher-child relationship.

Correlations among the other study variables appear in Table 8. As expected, child executive function was correlated with child age and child IQ as well as school outcome variables of academic competence and teacher-child relationship. School outcome variables, all based on teacher report, were significantly related to each other in expected directions. As with PCR, levels of risk, adversity, and parent psychopathology were related to each other but not significantly correlated with child IQ, child EF, or any of the teacher-reported school outcomes.

Independent samples T-tests revealed some important differences between participants from the two years of the study and between the two main research sites. Participants from the summer of 2008 were significantly younger, had lower IQ scores, had more parent-reported behavior problems, and had lower average rates of PCR than participants from 2009. Participants at the largest shelter site had lower average PCR, lower EF, and lower parenting quality from global ratings than participants from the privately run shelter. Many of these differences likely arose from variation in structure and routine of the two sites, as one site was more represented in the first year. Site and

year of participation were thus included as control variables in study analyses. Child age, gender, and socio-demographic risk were included as control variables in all path analyses (described next) but are not represented in Figures 3-6.

Co-regulation Models

Hypotheses about PCR were tested through a series of path models. The PCR variable was included in a series of path analysis models along with child executive function, child IQ, child age, child gender, and socio-demographic risk to predict teacher-reported school outcomes of academic competence, school engagement, externalizing behavior, peer relationships, and teacher-child relationship. I used the SEM program LISREL (Jöreskog & Sörbom, 1996) for path analyses with maximum likelihood estimation. All outcomes were tested in the same model so that errors could be correlated to capture shared method variance. The models estimated error variances for all variables, and these errors were allowed to correlate between predictors and between outcome variables. The first model included direct pathways from PCR to each of the school outcomes as well as pathways from EF, IQ, age, gender, and risk to each of the school outcomes. In subsequent models, I first freed an indirect path from PCR through EF, then from PCR through IQ to each of the five school outcomes. By comparing AIC values of model fit, I determined whether these indirect paths from PCR made significant contributions to model fit. The criteria for contributions to model fit was a change in AIC greater than 2, based on standards suggesting that changes of 0-2 indicate no difference in model fit, changes greater than 10 indicate significant improvement in model fit, and

changes between 3 and 10 are ambiguous (Burnham & Anderson, 2004). I retained pathways that made "ambiguous" individual contributions to model fit because I was interested in estimating total effects in the final model.

By constructing the model this way, I could evaluate overall models based on model fit, then obtain estimates for direct effects of PCR, indirect effects of PCR through EF and IQ, and total effects of PCR on each of the outcomes in the single model. It should be noted that significance of individual path estimates within a complex model may not be reliable indicators, and thus should be interpreted with caution and only in the context of an overall good model fit. I describe them here as possible explanations for overall model fit and indications of the relationships among model variables.

The first model, with only direct pathways to outcomes, had poor model fit, with $X^2 = 36.6$ ($p < .001$) with 13 degrees of freedom and an *AIC* of 192.1. The second model, which included an indirect pathway of PCR through EF, had much better model fit, with $X^2 = 14.3$ ($p = .28$) with 12 degrees of freedom and an *AIC* of 172.6. The model fit improved additionally with the path open from PCR to IQ, for $X^2 = 8.66$ ($p < .01$) with 11 degrees of freedom and an AIC of 169.1. This final model had good model fit, with *RMSEA* < .01, and an *NNFI* of 1.0. The final model and standardized estimates for each of the pathways are displayed in Table 9 and also represented in Figures 3 and 4.

As expected, pathways from PCR to both EF and IQ were significant (.41, $p < .01$ and .20, $p < .05$, respectively). The model revealed significant pathways from EF to school outcomes of academic competence (.39, $p < .01$), peer relationships (.22, $p < .05$), and teacher-child relationship (.43, $p < .01$). From IQ, the only significant pathway

emerged for academic competence (.35, $p < .01$). Though none of the direct paths from PCR to school outcomes were statistically significant, there were significant indirect paths from PCR to academic competence (.23, $p < .01$), externalizing behavior (-.11, $p < .05$), and teacher-child relationship (.18, $p < .01$). Taken together, the direct and indirect effects of PCR accounted for significant total effects for academic competence (.21, $p < .05$), school engagement (.25, $p < .01$), and teacher-child relationship (.21, $p < .05$).

Parenting Behavior Models

In a second series of path analysis models, I included variables of parenting behavior in place of PCR to determine whether similar effects would appear without child behavior during interaction tasks influencing the measures. Because percent durations of the four parenting variables (positive control, negative control, non-directive responsiveness, and disengagement) were mutually exclusive and thus linearly related, I included only two variables of parenting to avoid over-control. I was mainly interested in comparing predictive effects of parental control versus responsiveness, consistent with prior literature indicating that positive control and negative control are more predictive of child self-regulation than dyadic responsiveness. Because positive control and negative control were highly related to each other, I combined them into a single index by calculating the average duration of positive control and negative control, reversed. This index was unrelated to the second parent variable, percent duration of non-directive responsiveness ($r = .007$, $p = .95$).

The approach to evaluating model fit was the same as that used for models with PCR. All direct paths to school outcomes from the two parenting variables (positive control composite and non-directive responsiveness), EF, IQ, site, year, age, gender, and risk to the five school outcomes were included in the first model. Indirect paths were freed, first to EF then to IQ. Model fit was evaluated by comparing change in AIC, and only indirect paths that accounted for changes of AIC greater than 2 were retained in subsequent models. As before, the first model with only direct paths specified had poor model fit ($X^2 = 28.5$, $p < .05$ with 17 degrees of freedom) and an AIC value of 204.5. Indirect pathways through EF and IQ both contributed to model fit, with AICs of 196.9 and 193.8, respectively. The final model had excellent fit, with $X^2 = 8.9$, $p = .76$, RMSEA < .001, and NNFI = 1.

In the final model, there were no significant direct pathways from the positive control composite to the five school outcomes, but the path from positive control to EF was significant (.26, $p < .01$). Positive control had significant indirect effects on outcomes of academic competence (.14, $p < .01$) and teacher-child relationship (.12, $p < .05$), though the total effects of the positive control composite were not statistically significant. In contrast, parent non-directive responsiveness had significant direct effects on school engagement (.22, $p < .05$), peer relationships (.30, $p < .01$), and teacher-child relationship (.27, $p < .01$). Non-directive responsiveness also had significant indirect effects on academic competence (.14, $p < .01$) and school engagement (.06, $p < .05$), as well as accumulated total effects for all five of the school outcomes: academic competence (.19, $p < .05$), school engagement (.29, $p < .01$), externalizing symptoms (-

.22, $p < .05$), peer relationships (.32, $p < .01$), and teacher child relationship (.35, $p < .01$). All coefficients are presented in Table 10 and the final model is depicted in Figures 5 and 6.

Additional Analyses

In anticipation of potential confounds, I ran additional analyses to support the validity of my findings. First, because the family structures of dyads in the sample differed, I ran analyses to determine whether these differences influenced the results described above. There were no differences in pattern of significant findings when analyses included only mothers, only single parents, or only biological parents. Next, to further support my hypotheses and theoretical claims that co-regulation represents an important relationship construct beyond its obvious overlap with child functioning, I ran additional regression analyses with percent duration of child on-task behavior during parent-child interaction tasks as a control variable. This analysis revealed positive co-regulation as a significant predictor of child EF even when child on-task behavior was statistically controlled.

Aim 2: State-Space Grid: Attractor States and Cluster Analysis

Attractor states for each individual dyad's trajectory for each of the eight interaction tasks were determined using the winnowing procedure described by Lewis and colleagues (1999). For each grid, cells with high durations were identified as possible attractors. Heterogeneity of the initial 16-cell grid was calculated as the sum of squared

deviances from the mean duration of all visited cells. Next, cells were eliminated one by one, beginning with the cell of lowest duration. For each successive run, the drop in heterogeneity was recorded and examined for percent accounted for, or "scree" value. Based on recommendations, only drops in scree of 50% or less were considered noteworthy (Hollenstein, 2006; Lewis et al., 1999). The potential attractor cells were those remaining after the largest drop (greater than 50%) in heterogeneity such that the remaining cells were considered homogeneous, with relatively equivalent durations. The winnowing procedure was completed for dyads' overall trajectories and for the trajectories of dyads for each individual interaction task.

Considering full grids, the winnowing procedure yielded many different profiles for attractor states among the 130 dyads with valid SSGs, though the majority of these dyads (n = 95, 73.1%) fell into one of two large groups. The largest group with 63 dyads (48.5%) appeared to have two attractor states of equal duration: parent positive control with child on-task and parent non-directive responsiveness with child on-task. A second group of 32 dyads (24.6%) had a single primary attractor state: parent positive control with child on-task. In addition to these two large groups, there were 20 other observed configurations of attractor states. Sixteen dyads had a single attractor other than positive control/on-task: 9 were non-directive responsiveness/on-task, 2 were disengaged/on-task, 2 were non-directive responsiveness/signals, 1 was positive control/signals, 1 was disengaged/defiant, and 1 was negative control/defiant. Eight dyads had two homogeneous attractors other than the ones described above. Two dyads were positive control/signals and responsiveness/signals, 2 were responsiveness/signals and

responsiveness/on-task, and there was one dyad each with combinations of the following: positive control/on-task and disengaged/on-task, responsiveness/on-task and positive control/signals, disengaged/withdrawn and responsiveness/on-task, disengaged/withdrawn and negative control/defiant, negative control/defiant and disengaged/on-task, and negative control/signals and positive control/on-task. Six dyads had three homogeneous attractor states: 3 were positive/on-task, responsive/on-task, and disengaged/on-task; 2 were positive/on-task, responsive/on-task, and positive/signals; and 1 was positive/on-task, responsive/on-task, and responsive/signals. The remaining three dyads had different configurations of four homogeneous attractor states; positive/on-task, responsive/on-task, positive/signals, and responsive/signals; positive/on-task, responsive/on-task, disengaged/on-task, and negative/signals; and positive/on-task, responsive/on-task, disengaged/on-task, and disengaged/withdrawn. In general, most dyads had positive/on-task or responsive/on-task as one of their primary attractor states.

While the winnowing procedure described above identifies potential attractor states, it provides no information regarding the 'attractiveness' or strength of these states. In fact, for trajectories with very little heterogeneity among cells, the cell of highest duration will be identified as a single attractor even if its duration is only higher by a small increment (Lewis et al., 1999). The literature on SSGs recommends methods for evaluating the strength of attractor states, including considering the influences and return times for attractor states relative to expected values based on the entire grid (Hollenstein, 2006; Lewis et al., 1999). For my data, however, I was interested in evaluating the consistency of attractor states across the eight different interaction tasks to determine

whether the behavior of the dyads was drawn to specific cells regardless of task demands, or whether dyads varied in their behavior when task demands changed. Given the high correlations among durations, influence, and return time, I assumed that a consistency score would better indicate the stability and strength of attractor states.

Consistency scores were calculated by first identifying potential attractor states for each trajectory in each interaction task with the winnowing procedure then creating a count for each attractor for each dyad indicating the number of times that the specific cell acted as an attractor state across the different interaction tasks. Because some dyads were missing one or two of the interaction tasks, the counts were then divided by the total number of tasks completed. Thus for a dyad that completed all eight interaction tasks, if the cell of positive control/on-task emerged as an attractor in four of the eight tasks, the consistency score for that attractor state would be four divided by eight, or 0.5, indicating that the cell acted as an attractor in 50% of the tasks. With simultaneous attractors possible in every task, a dyad could theoretically have non-zero consistency scores for all 16 grid cells if each of the cells emerged as an attractor state in at least one of the eight tasks.

Once consistency scores were obtained for the 130 dyads with valid SSG data, the variables for the 16 attractor consistency scores were entered into a hierarchical cluster analysis for the purpose of identifying typologies of dyads. I chose a hierarchical cluster analysis because I had no *a priori* hypothesis regarding the number of clusters in the data and was interested in describing the hierarchical structure of resulting groups. The dendrogram illustrating the factor structure is shown in Figure 7. Distances to cluster

combine were substantial for five distinct clusters, thus I examined differences among the clusters at each level of hierarchical structure, when the total 130 dyads were divided into two groups, three groups, four groups, and five groups. This structure and the number of cases in each group are also depicted in Figure 8, along with descriptive labels to distinguish the groups for ease of interpretation. Means and standard deviations for the durations of the four parent codes and four child codes for each set of clusters is presented in Table 5, and means and standard deviations of attractor state consistency by cluster are presented in Table 11.

According to the hierarchical structure resulting from the cluster analysis, the full sample of 130 dyads first divides into two groups of 98 dyads and 32 dyads. These two groups differ significantly on all but one of the eight SSG codes. The larger group of 98 dyads has a much higher average of parent positive control and child on-task behavior, and thus I labeled this group "Positive/On-task." The Positive/On-task group also had significantly more non-directive responsiveness, while the smaller group of 32 dyads, labeled "Negative/Dysregulated," had significantly higher rates of parent disengagement, parent negativity, child signals, and child defiance. The groups did not differ based on duration of child withdrawn behavior. It is important to note that the labels I have assigned to groups are intended to distinguish them by the variables on which they differ, not to describe their predominant behaviors. In fact, the group labeled "Negative/Dysregulated" demonstrates more parent positive control than negative control, on average, as well as more child on-task behavior than each of the other child

categories. However, the dyads appear negative and dysregulated compared to the group that I labeled Positive/On-task.

At the next level of the hierarchy, the positive/on-task group was divided into two smaller groups of 73 and 25 dyads, which I have labeled "directive/on-task" and "responsive/on-task," respectively. These two groups did not differ significantly on average durations of any of the four child codes, nor did they differ on average durations of parent disengagement or parent negativity. However, the directive/on-task group had higher average rates of parent positive control and lower average rates of parent non-directive responsiveness. For the directive on-task group, parents demonstrated positive control an average of 49% of the time and non-directive responsiveness 37% of the time. Parents in the responsive/on-task group demonstrated positive control 33% of the time and non-directive responsiveness 44% of the time, on average. Thus parent control and responsiveness were considerably more balanced in the responsive/on-task group. Both of these groups differed significantly from the negative/dysregulated group on all codes but child withdrawn behavior, in the same pattern as their super-ordinate group of positive/on-task.

To form four groups, the directive/on-task group was divided into two smaller groups of 35 and 38 groups, labeled "directive/independent" and "directive/needy," respectively. These two groups differed from each other on all four child codes, with the directive/independent group demonstrating higher average rates of child on-task behavior and the directive/needy group demonstrating higher average rates of child signals, withdrawn behavior, and defiance. The groups differed on only one parent code, with the

directive/independent group demonstrating higher average rates of parent positive control. Compared to the responsive/on-task group, the directive/independent group had significantly higher rates of parent positive control and child on-task behavior and lower rates of parent non-directive responsiveness and child signals. In contrast, the directive/needy group also had higher rates of parent positive control and lower rates of parent non-directive responsiveness than the responsive/on-task group, but also had lower rates of child on-task behavior and higher rates of child signals and child withdrawn behavior than the responsive/on-task group. Compared to the negative/dysregulated group, the directive/independent group had higher rates of parent positive control, higher rates of child on-task behavior, and lower rates of parent disengagement, parent negativity, child signals, and child defiance. The directive/needy group had higher rates of parent positive control and child on-task behavior as well as lower rates of parent disengagement, parent negativity, and child defiance than the negative/dysregulated group, but did not differ from the negative/dysregulated group on rates of child signals, child withdrawn behavior, and parent non-directive responsiveness.

Finally, to form five groups, the negative/dysregulated group was divided into two smaller groups of 22 and 10 dyads, labeled “negative/needy” and “negative/defiant,” respectively. These two groups differed from each other only on child on-task behavior and child defiance, with higher rates of defiance in the negative/defiant group and higher rates of child on-task behavior in the negative/needy group. Both groups had significantly lower rates of parent positive control and child on-task behavior and higher rates of parent negative control, parent disengagement, and child defiance than the three positive

groups, directive/independent, directive/needy, and responsive/on-task. The negative/defiant group had higher rates of child signals than the three positive groups. Both negative groups had significantly less non-directive responsiveness than the responsive/on-task group.

ANOVAs to test implications of cluster membership

Several analyses of variance were run to test whether cluster membership in the final five groups would predict differences in risk, adversity, parent psychopathology, child EF, child IQ, parent-reported child behavior problems, and the five teacher outcomes of academic competence, school engagement, externalizing symptoms, peer relations, and teacher-child relationship. The overall ANOVA was not significant for group differences in risk ($F_{(4,125)} = 1.31$, *n.s.*). However, there was evidence of a risk gradient across the five groups (see Figure 9), suggesting that individuals at the highest level of socio-demographic risk were more likely to be clustered with the negative/needy or negative/defiant dyads while the individuals at lowest levels of risk were more likely to be clustered with directive/needy or responsive/on-task dyads, with directive/independent dyads at middle levels of risk. The overall ANOVA was not significant for cluster group differences in adversity ($F_{(4,125)} = 0.57$, *n.s.)*, and there was no evidence of a meaningful gradient by group for this variable.

For parent psychopathology, there was a trend toward significance among the five cluster groups ($F_{(4,125)} = 1.32$, *n.s.*). Post-hoc contrasts revealed that this trend was driven by higher levels of parent psychopathology for the negative/needy group compared to the

directive/needy group and the responsive/on-task group. As with risk, there was evidence of a possible gradient across the groups, with parents with higher levels of psychopathology more likely to cluster with dyads in the negative/needy and negative/defiant groups while parents with lower levels of psychopathology were more likely to cluster with dyads in the directive/needy and responsive/on-task groups.

The overall model was significant for child EF, with $F_{(4,125)} = 4.28$, $p < .01$. These differences are displayed graphically in Figure 10. Post-hoc simple contrasts revealed that child EF was significantly higher for children of directive/independent dyads compared to children of directive/needy dyads and negative/defiant dyads, and significantly higher for children from responsive/on-task dyads compared to directive/needy dyads, negative/defiant dyads, and negative/needy dyads. A similar pattern was apparent for the overall model for child IQ, which was significant with $F_{(4,125)} = 4.47$, $p < .01$. Child IQ scores higher in directive/independent dyads compared to directive/needy dyads and negative/needy dyads as well as higher in responsive/on-task dyads compared to negative/defiant dyads, negative/needy dyads, and directive/needy dyads.

Parent-reported child behavior problems were also related to differences in cluster membership, with $F_{(4,125)} = 3.58$, $p < .01$. Simple contrasts revealed that parents from negative/needy dyads reported more child behavior problems on average than those from directive/independent dyads, directive/needy dyads, and responsive/on-task dyads. No other post-hoc contrasts were significant.

The overall models were not significant for academic competence ($F_{(4,100)} = 1.39$, *n.s.*), school engagement ($F_{(4,100)} = 0.91$, *n.s.*), teacher-child relationship ($F_{(4,100)} = 1.63$,

n.s.), or externalizing symptoms ($F_{(4,100)} = 1.12$, *n.s.*). The overall model was significant for peer relations ($F_{(4,100)} = 2.63$, $p < .05$), with higher scores for children from responsive/on-task dyads than from negative/needy dyads and directive/independent dyads, and higher scores for children from directive/needy dyads than from negative/needy dyads.

Cluster membership, positive co-regulation, and global parenting quality

Two final ANOVAs were conducted to determine whether the clusters would differ in terms of the construct of positive co-regulation and the independently coded construct of global parenting quality. For PCR, The overall model was significant ($F_{(4,125)} = 32.4$, $p < .001$), and post-hoc contrasts revealed that the directive/independent had higher average PCR than all the other clusters. The directive/needy and responsive/on-task clusters both had higher average PCR than negative/defiant and negative/needy, but did not differ from each other. Negative/needy dyads had higher average PCR than negative/defiant dyads. These differences are depicted in Figure 11. For global parenting quality (PQ), the overall model was also significant ($F_{(4,125)} = 21.7$, $p < .001$). Post-hoc contrasts revealed a similar pattern of differences as with PCR. Again, the directive/independent cluster had higher average PQ than all other dyad clusters. Negative/defiant and negative/needy dyads had significantly lower PQ than the three other clusters but did not differ from each other, and directive/needy and responsive/on-task clusters did not differ from each other significantly. These results are displayed in Figure 12.

DISCUSSION

This investigation utilized a recently-developed dynamic systems methodology of state space grids (Lewis et al., 1999) to examine dyadic co-regulation among currently homeless parents and their young children. Parent and child behavior were rated by independent teams based on a standardized series of video-recorded interactive tasks, which varied in structure and content of task demands. The interaction data as well as individual parent interviews and child assessments were collected on-site in three emergency shelters for homeless families, allowing for good participation rates and ecological validity. Once the children began school, their teachers completed questionnaires for an additional perspective on child functioning and adaptation to the kindergarten or first grade context. Data analyses involved testing hypotheses regarding positive dyadic co-regulation and its importance in relation to child executive function skills and intellectual skills for academic, behavioral, and social competence at school. I conducted a second set of analyses examining parenting behavior independent of child behavior, using the same parent measures from the state space grid to predict EF and school outcomes. Finally, I followed recommendations from the SSG literature to identify attractor states of individual dyads in an effort to categorize meaningful typologies of dyads within the sample. This exploratory, person-centered analysis was intended to characterize different styles of interaction among this high risk group in the context of potential crisis. In this discussion section, I first consider the results of hypotheses tested and their importance for understanding the development of young

homeless children. Next I discuss the exploratory analyses and further evaluate the utility of SSG methodology for this thesis specifically and for similar research endeavors.

Positive Co-regulation and Parenting Behavior

The construct of positive co-regulation was conceptualized as a region of cells on the SSG which represented appropriate parent behavior in the context of child behavior. When child behavior was on-task, appropriate parent behavior could be positive control, non-directive responsiveness, or disengagement. When child behavior involved bids and signals to the parent, appropriate parent behavior could be only positive control or non-directive responsiveness. When child behavior was either withdrawn or disobedient/defiant, the only appropriate parent behavior was positive control. These combinations were considered positive co-regulation (PCR). Individual differences in PCR were evaluated using PCR influence, the likelihood of a dyad's trajectory moving to the PCR region after leaving it. Scores on this novel measure were highly correlated with scores from independent global codes of parenting warmth and structure.

Results of the path analysis with PCR revealed a good fitting model when indirect pathways were freed from PCR to academic competence through child EF and child IQ and to the teacher-child relationship through child EF. Though neither the direct nor indirect path from PCR to school engagement was statistically significant, the model revealed a significant total effect in the context of the whole model. PCR was strongly related to child EF and child IQ, which in turn were related to important school outcomes. However, total effects of PCR were not significant for outcomes of peer

relations or externalizing behavior. In general, the findings are consistent with theory and previous research suggesting that positive co-regulation experiences within the context of the parent-child relationship support the development of child self-regulation, which the child carries forward into the school context (Blair, 2002; Herbers et al., 2011; Thompson & Raikes, 2007).

Based on existing literature of parenting behaviors related to self-regulation in preschool-aged children, I conducted a second set of path analyses with variables based only on the parent codes from the SSG. Results were somewhat different from those in the extant literature, perhaps in part because few studies to date have involved samples of very high risk, low income populations such as the homeless families represented in this thesis (Karreman et al., 2006). While previous studies have identified positive and negative control as critical parenting behaviors for developing self-regulation, with limited evidence for effects of responsiveness, these data revealed stronger findings for parent non-directive responsiveness than for a composite of positive control and negative control (reversed). Positive control was indeed related to child EF, with evidence for indirect effects on academic competence and teacher-child relationship; however, there were no significant total effects of the positive control composite on any of the five school outcomes. In contrast, parent non-directive responsiveness was related to both EF and child IQ, directly predicted school engagement, peer relations, and the teacher-child relationship, and had significant total effects for all five school outcomes, including academic competence and externalizing behavior.

The developmental literature clearly demonstrates longitudinal relationships between history of positive co-regulation experiences and developing child self-regulation. With co-regulation and self-regulation measured concurrently, however, it is more difficult to discern direction of effect. It is plausible to assert that the children who perform best on behavioral tasks of executive function are also performing well in the contexts of the parent-child interaction tasks, essentially "making it easy" for their parents to demonstrate positive co-regulation. Without repeated measures of co-regulation and self-regulation over time, this study cannot directly test whether child self-regulation or parent-child co-regulation drives the effect. However, I did conduct several analyses attempting to parse concurrent child-driven and parent-driven effects. Results showed that positive co-regulation was related to child executive function even when child on-task behavior during interaction tasks was controlled. Furthermore, I found that parent responsive, non-directive behavior predicted teacher-reported school outcomes of externalizing behavior, peer relationships, and teacher-child relationship beyond the effects of child executive function and positive co-regulation. Thus parents who demonstrated more responsive, non-directive behavior while interacting with their children had children who were less disruptive, more prosocial with peers, and closer to their teachers in their kindergarten and first grade classrooms. These findings are consistent with results from several other studies indicating that co-regulation and parenting behavior predict change in child self-regulation, even when controlling for prior child self-regulation (Bernier et al., 2010; Cole et al., 2003; Colman et al., 2006; Kochanska & Knaack, 2003).

By design, the PCR construct emphasized parent positive control and negative control more than responsiveness and disengagement. PCR was conceptualized on the basis of literature suggesting that positive and negative control were more influential than responsiveness for child self-regulation (Karreman et al., 2006). On one hand, these data confirm the importance of positive and negative control in relation to self-regulation in the form of child executive function. On the other, however, my analyses revealed differential importance of parent non-directive responsiveness for school outcomes related to social and emotional self-regulation in the forms of relationships with teacher and peers as well as externalizing behavior. Together, these findings support the necessity of positive and negative control behaviors as foundations for child EF while also demonstrating the importance of responsive parent behavior, regardless of child behavior.

Parent non-directive responsiveness was unrelated to measures of child positive and negative behavior during the interaction tasks, and it was only moderately correlated with the overall construct of PCR. Thus non-directive responsiveness may be a unique aspect of parenting behavior that is particularly beneficial for this age group in this high risk context. Children who experience more non-directive responsiveness from their parents may have unique opportunities to explore their own perspectives, skills, and regulatory capacities compared to children whose parents predominantly take charge of interaction. Such opportunities could support the developing sense of autonomy and self-efficacy that supports prosocial behavior and adaptation to new contexts. Too much control, even when positive or neutral in tone, may be detrimental if not balanced with autonomy support and responsiveness. This concept has been put forth by other

researchers interested in understanding how parents may respond differently and with differential outcomes for children who vary in individual characteristics such as temperament (Belsky, Bakermans-Kranenburg, & van Ijzedoorn, 2007; Dennis, 2006; Rubin, Cheah, & Fox, 2001).

Attractor States

In addition to testing hypotheses of positive co-regulation, I explored individual differences in the data with recommended techniques for state space grid dynamic systems analyses (Granic & Hollenstein, 2003; Hollenstein, 2006; Lewis et al., 1999). First I identified the attractor states of each dyad overall and in each interaction task using the winnowing procedure described by Lewis and colleagues (1999). I then measured the stability of attractor states with a count of the number of tasks in which each attractor emerged divided by the total number of tasks each dyad completed. Variables indicating patterns of the attractor states present and their relative stabilities were included in a hierarchical cluster analysis in an effort to determine whether dyads could be grouped based on the organization of their interaction behavior on the SSG. Finally, I conducted simple analyses to explore whether such groupings were meaningful in relation to the other central constructs of the study.

When attractor states were identified for durations of the grids overall, across all interaction tasks, the majority of dyads had either a single attractor state of parent positive control combined with child on-task behavior or two relatively equivalent attractor states of parent positive control/child on-task behavior and parent non-directive

responsiveness/child on-task behavior. Of the remaining dyads, many were characterized by the presence of one or both of those cells as attractor states in addition to others, most often combining parent positive control or parent non-directive responsiveness with child bids and signals. Only seven dyads had patterns of attractor states across the whole interaction that involved parent negative control, child disobedience/defiance, or parent disengagement and child withdrawal. These results indicate that the vast majority of homeless parent-child dyads in this sample demonstrated positive, constructive behavior for the majority of their observed interaction time. Among the few dyads that did not demonstrate consistent positive interaction behavior, the profiles of attractor states varied considerably.

While the overall profiles of attractor states for each dyad across the entire interaction session give a general impression of patterns of behavior, they lack the precision to illustrate how dyads may respond to varying demands of the different interaction tasks and whether these attractor states show stability within dyads in terms of their likelihood to recur across situations. To better characterize these processes, I also identified attractor states for each dyad in each interaction task and calculated stability (or frequency of recurrence) of those attractor states. As expected based on the overall patterns described above, the most consistently identified attractor states within dyad across tasks were parent positive control and parent non-directive responsiveness combined with child on-task behavior. The least consistent were parent negative control/child withdrawn and parent disengaged/child defiant. However, there was

considerable variation across dyads in stability of attractor states and the specific attractor states that arose in any of the tasks.

Stability and consistency of attractor states across tasks for individual dyads is interesting in light of the observation that different tasks, because they differ in amount of structure and expectations as well as whether the parent and child are alone or in the presence of an experimenter, may have demand characteristics that pull for different combinations of parent and child behavior. On average, rates of positive co-regulation differed by task, with high durations in the PCR region for Free Play, Labyrinth, Guessing Game, and Tangoes and considerably lower average durations in the PCR region for Clean Up, Parent Issue, Child Issue, and Safety Plan. In general, dyads maintained positive co-regulation more consistently in game tasks with either little structure or with structure imposed by an experimenter also in the room. When parents were required to provide the structure, either by getting the child to clean up or by facilitating problem-solving discussions, durations of PCR behavior were lower on average. These differences are shown visually in Appendix B.

Beyond durations alone, the consistency of attractor states across tasks can illuminate the flexibility (or ability of a dyad to maintain patterns of interaction in the face of differing task demands) and organization of the behavior of individual dyads. On a more challenging task such as the Safety Plan, in which the parent must provide structure of the discussion and convey certain information that could be emotionally arousing, dyads with less established patterns of positive behavior and less flexibility might be expected to show less optimal attractor states (those outside the PCR zone).

Thus meaningful clusters should be distinguished not only by the different attractor states that characterize their interaction, but also by the consistency of those attractor states across different tasks. Thus the hierarchical cluster analysis was based on patterns and consistencies of attractor states across the eight interaction tasks rather than percent durations alone.

Cluster Analysis

Five distinct groups of dyads emerged from the hierarchical cluster analysis. All groups involved attractor states of parent positive control combined with child on-task behavior; however, the average duration and consistency across tasks of that attractor state and the presence and consistency of other attractor states differed. Again, it is important to note that nearly all dyads spent significant amounts of their interaction time in positive, constructive interaction. I labeled the five clusters according to the patterns of behavior that distinguish them from each other, with attention to the hierarchical structure of the clusters overall. The five clusters were thus named Directive/Independent, Directive/Needy, Responsive/On-task, Negative/Needy, and Negative/Defiant. In terms of hierarchical structure, Negative/Needy and Negative/Defiant were the most similar clusters, forming a higher order cluster called Negative/Dysregulated. Directive/Independent and Directive/Needy were also similar to each other, forming the next higher order cluster of Directive/On-task. Following that, Directive/Independent and Directive/Needy joined with Responsive/On-task for the next higher order cluster of

Positive/On-task. The higher order clusters of Positive/On-task and Negative/Dysregulated were most different from each other.

Most notably, the Positive/On-task clusters had stronger, more consistent attractor states in a few cells on the grid, within the predefined positive co-regulation region, while the Negative/Dysregulated clusters were characterized by a greater number of attractor states of lower consistency in both PCR and non-PCR grid cells. From a dynamic systems perspective, the Positive/On-task dyads were more organized and stable in their behavioral profiles. Based on this alone, it might be expected that children from Negative/Dysregulated dyads would be at higher levels of risk for poor developmental outcomes as well as associated risk factors. Mean group comparisons showed that to be generally, though not exclusively, the case. On average, Negative/Dysregulated dyads had higher rates of socio-demographic risk, parent psychopathology, and parent-reported child behavior problems and lower average scores for child executive function than Positive/On-task dyads. In terms of school outcomes, children from Positive/On-task dyads had higher teacher ratings of peer relations than children from Negative/Dysregulated dyads but did not differ on other teacher-reported constructs. Further delineation of clusters revealed three types of Positive/On-task dyads and two types of Negative Dysregulated dyads. Interesting differences also emerged among these groups.

Among the three clusters that made up the higher order group of Positive/On-task, average positive co-regulation was higher for Directive/Independent dyads than for Directive/Needy and Responsive/On-task dyads. Directive/Independent dyads also had

the highest rates of parent positive control and child on-task behavior coupled with the lowest rates of child signals/bids and child disobedience/defiance. Child EF scores were higher among Directive/Independent dyads than Directive/Needy dyads and Negative/Defiant dyads, and IQ scores were higher among Directive/Independent dyads than Directive/Needy and Negative/Needy dyads. Within Directive/Needy dyads, parent behavior was similar to that in Directive/Independent dyads, with somewhat lower levels of parent positive control. In contrast, children from Directive/Needy dyads demonstrated significantly more signals/bids, withdrawn behavior, and defiance with much lower levels of on-task behavior. Their EF and IQ scores were significantly lower than those of children from Directive/Independent dyads. Interestingly, the Directive/Needy dyads had the lowest average levels of socio-demographic risk and parent psychopathology compared to the other four clusters. Thus while parents of both Directive/Independent and Directive/Needy dyads had very similar behavior profiles in the parent-child interaction, their children differed significantly in intellectual and executive function ability level. These groups did not differ on any relevant teacher outcomes, perhaps indicating this style of parenting as protective.

Parents from Responsive/On-task dyads demonstrated less positive control than Directive/Independent and Directive/Needy dyads, but much higher rates of non-directive responsiveness. Interestingly, the children from Responsive/On-task dyads had rates of both on-task behavior and signals/bids that were significantly higher than children from Directive/Needy dyads but significantly lower than Directive/Independent dyads, perhaps representing a mid-point between the other two groups of children. Children from

Responsive/On-task dyads had the highest average scores for EF and IQ as well as the highest levels of teacher-reported peer relations. It is possible that these children's parents were less directive because their children were generally more competent; however, these children demonstrated less independent on-task behavior and more signals/bids than Directive/Independent children during the actual interaction tasks. In some conceptualizations of self-regulation, the Directive/Independent children might be considered "over-controlled" while the Directive/Needy children could be "under-controlled," thus both achieving lower EF scores than Responsive/On-task children. It is also possible that the high rates of positive control in both Directive groups represented too much parent control that prohibits opportunities for children to practice self-regulation (Rubin et al., 2001; Schore, 2001). Again, it is important to note that differences in school outcomes were not significant for these groups, except for higher ratings of peer relations for Responsive/On-task children than Directive/Independent children. In general, all three of the Positive/On-task clusters appear to represent cases of good or "good enough" parenting.

In contrast, the much lower rates of positive parent and child behavior coupled with higher rates of parent negative control and child signals/bids and defiance among the two Negative/Dysregulated clusters indicate potential for concern. At the same time that these two clusters differ greatly from the three Positive/On-task clusters, they also differ from each other. Parents from the Negative/Needy and Negative/Defiant dyads had similar rates of behavior in all four categories, with significantly more disengagement and negative control than the three Positive clusters. However, child behavior between

the two Negative clusters showed two distinct profiles. Negative/Needy children were actually quite similar to the children from Directive/Needy dyads, with slightly higher rates of defiant child behavior. Negative/Defiant children, however, had the highest rates of defiant behavior and signals/bids compared to all other clusters. The Negative/Defiant children had lower rates of withdrawn behavior and significantly lower rates of on-task behavior than children from Negative/Needy dyads. The two Negative clusters did not differ from each other on levels of socio-demographic risk, though the Negative/Defiant cluster only had significantly higher average risk level than Responsive/On-task and Directive/Needy dyads. Similarly, the two Negative clusters did not differ from each other on parent psychopathology, though only the Negative/Needy dyads had significantly higher levels of parent psychopathology than Responsive/On-task and Directive/Needy dyads. Thus there is some indication that risk may be more characteristic of Negative/Defiant dyads while parent psychopathology may be more characteristic of Negative/Needy dyads. Because each of the clusters has a fairly small sample size, there is limited statistical power to detect differences. Group differences in teacher-reported outcomes could also be obscured by the lack of power.

As indicated by the attractor states identified based on overall interaction session durations, results of the cluster analysis emphasized the high rates of positive, constructive behavior by both parents and children in the majority of dyads. The relatively small number of dyads who did not conform to patterns of stable, positive behavior formed small groups with varying profiles, suggesting that struggling dyads may present idiosyncratic patterns of interaction behavior. Still, even the dyads that fell

into the two clusters characterized by parent negativity and child defiance demonstrated many positive and constructive interactions. This is consistent with findings from other studies using cluster analyses in high risk dyads (McGroder, 2000). From an intervention point of view, these notable strengths could be used as foundations for encouraging more positive interactions in response to challenging situations. Efforts to encourage nurturing parent-child relationships in homeless shelters or other high risk, high stress contexts could utilize SSG methods to identify the areas of strength and weakness for individual dyads then incorporate these concepts into skills training for children and parents.

Families in Crisis

While I assumed that observed parent-child interaction behavior over a fifty minute session with a variety of tasks provides a reliable and valid window on the actual day-to-day interactions and functioning of these homeless dyads, it also is important to keep in mind that important mitigating factors could be at play. The participating families were certainly aware that they were being observed, both by video camera and by the examiner who was in the room during some of the tasks. This awareness could have altered their behavior, although results of previous research have suggested that this effect is minimal and that distressed dyads in particular are generally not adept at altering their typical patterns of behavior to fit contexts (Aspland & Gardner, 2003). Perhaps a more important consideration within this sample is the likelihood that the samples of interaction behavior represent the adaptation of these parents and children to a situation of crisis. For many families, a stay in emergency shelter is a significant departure from

their typical lives, accompanied by acute disruptions and a period of particularly high stress.

From a dynamic systems and SSG methodology point of view, the behavior observed in these interaction sessions may capture systems in flux, or temporary periods of reorganization following a significant perturbation to the systems' typical patterns of behavior and functioning. Dyads in acute stages of system re-organization could appear quite disorganized and even maladaptive, but this would not necessarily represent the level of stability of the system prior to and following the adjustment to such a perturbation. To address this concern, future studies could incorporate multiple observations of parent-child interaction during the course of a shelter stay and beyond, into their subsequent housing situations. Some families would likely achieve more stable housing with less chaotic living conditions while others might continue to experience high levels of chaos and instability in other settings. The longitudinal changes in dyadic behavior for such families could differ in informative ways. Such a study would be particularly challenging with this population, however. These challenges are further discussed in the limitations section.

State Space Grid Methodology

In this study, I first used SSG methodology to address a specific hypothesis about dyadic co-regulation and then conducted exploratory analyses to capitalize on strengths of this methodology. There are relatively few published studies that have utilized SSGs for dyadic parent-child interaction, and mine is the first conducted with homeless families

in shelter. My study is also unique in the quantity of SSG data used (130 dyads, each with approximately 45 minutes of interaction) and the application of a novel coding scheme designed specifically to capture co-regulation, with different behavioral categories for parents and children.

In general, I found the conceptualization based on principles of dynamic systems to be useful for generating testable hypotheses and producing simple visual illustrations of observational data. Because parenting and parent-child relationships are best conceptualized as dynamic systems, a methodology that considers and measures dynamic systems processes has great appeal. Further, the SSG method encourages the consideration of all observed behavior rather than limiting constructs to particular behaviors of interest while disregarding the majority of interaction. Without such a conceptualization, it is unlikely that I would have identified the potential importance of parent non-directive responsiveness as an indicator of supportive parenting that predicts child school functioning. Perhaps some of the most critical aspects of parent-child relationships are the more subtle, mundane interactions that may be overlooked in studies emphasizing very specific, discrete behaviors.

With parent and child interaction behavior coded independently, the resulting data were flexible, lending themselves to analyses that consider aspects of parenting and child behavior separately as well as in combination. Though the codes were conceptualized for the purpose of creating a state space grid, with mutually exclusive and exhaustive categories on two orthogonal axes, the data are also amenable to sequential analyses and more traditional methods that consider durations and frequencies of discrete parent and

child behavior. Advantages of the SSG method involve capturing the inherent properties of the dynamic system of parent-child interaction. By plotting trajectories of dyadic behavior over time, the SSG method illuminates the attractor states, or relatively stable and frequent co-occurrences of parent and child behavior, as well as the general level of organization and predictability the dyads demonstrate. Both parent and child are active participants in the creation of the SSG such that their interactions co-create the properties at the level of the relationship.

The challenges I encountered in employing this methodology began with decisions about the specificity of behavioral codes. With fairly long samples of interaction behavior and a range of activities, I found it necessary to simplify my constructs into broad categories. Thus I sought to characterize differing styles of parent-child interaction that existed among homeless dyads rather than to focus on particular parent or child behaviors that could be important. I also chose to employ different categories for child behavior versus parent behavior, consistent with my conceptualization of appropriate co-regulation roles for dyads involving 4-6 year old children. In contrast, most of the extant studies using SSGs for dyadic behavior have used the same categories for each dyad member.

Parent and child behavior codes for state space grid analyses were designed to capture co-regulation as a broad construct, incorporating aspects of emotional co-regulation and behavioral co-regulation. Positive and negative affect were components of the different codes but were not separable from the behaviors they accompanied. For example, a parent who gave clues for the guessing game in a neutral, even tone would

receive the same code as a parent who gave clues with a great deal of warmth and positive affect. Similarly, a child who explained his point of view on a problem solving issue with no eye-contact and little expression would be coded "on-task" in the same way that a child who engaged in discussion with appropriate smile and laughter would be. This was done deliberately to capture basic co-regulation with a small number of codes. As a result, however, emotion regulation and the dyadic exchange of affect cannot be examined independently with these data. Findings from several other studies using affect codes for SSGs indicate the importance of affect regulation in itself for characterizing parent-child relationship quality and for predicting child outcomes such as externalizing behavior problems (Granic, et al., 2003; Granic & Lamey, 2002). Future efforts with homeless and other high-risk populations might benefit from a more specific definition of co-regulation, focusing on either behavior regulation or emotion regulation rather than combining the two.

Other challenges involved generating testable *a priori* hypotheses and plans for analysis that were specific and focused rather than capitalizing on the vast wealth of variables generated by the SSG. While I hoped to explore the data for more person-focused dyad typologies, I wanted to preserve the conceptualization of positive co-regulation for which the SSG codes were originally developed. Presenting the data with visual output from Gridware 1.1 also proved somewhat challenging. In contrast to many of the existing studies that used SSGs, I had a greater volume of data both in terms of sample size and duration of observation time. This presented challenges both for examining the data with an eye to individual differences as recommended by champions

of this methodology (Granic & Hollenstein, 2003; Hollenstein, 2007) and for generating grids with an appropriate amount of visual information to be readily understandable. Some examples are shown in Appendix B.

Even with the considerable amount of work presented here, I have only scratched the surface of the potential for applying SSG methodology to these data as well as other investigations of dyadic parent-child interaction. Other investigations could consider contingencies of parent-child behavior to determine which dyad member is driving interactions and whether individuals respond similarly to different behaviors from their dyadic partners. As mentioned previously, this methodology could also be employed to examine changes in the organization of dyadic behavior over time and in different circumstances. With careful planning and execution, the SSG methodology has much to offer studies of dyadic parent-child interaction across a range of contexts and populations. Furthermore, the coding scheme that I developed to capture parent-child co-regulation proved reliable and valid. This coding could be applied in future studies to further explore the construct of co-regulation as well as the individual child and parent components.

Limitations

By design, participants in the study were limited to those families residing in emergency shelter during the summer. Though a significant percentage of homeless children and families in the Twin Cities do appear in the three urban homeless shelters included in the study, there are many homeless children who do not stay in shelters but

instead live doubled-up with family and friends or in other non-permanent arrangements such as hotels, motels, campgrounds, or even vehicles. Results and implications of the current study may not apply to homeless families in other circumstances, and more research is needed that incorporates broad definitions of homelessness (Samuels et al., 2010). Unfortunately, these families are particularly difficult to locate, recruit, and retain in research studies.

Similarly, recruiting and following up with families initially located in homeless shelters, who also tend to be highly mobile and residentially unstable, is a challenge. Despite considerable effort and good participation rates, a number of eligible families were not able to participate. Furthermore, data from the current study are largely concurrent, particularly with regards to measures of parent-child interaction and child executive function and IQ skills. Because these data were collected concurrently, the indirect effects of parenting through EF and IQ can only be assumed by theory and findings from previous longitudinal investigations. Future studies with longitudinal data are warranted to address whether the temporal relationships observed in other literature, particularly literature demonstrating effects of parenting on child self-regulation even with prior self-regulation controlled (e.g. Colman et al., 2006), hold up in the population of homeless dyads as well. Also informative would be studies that involve longer-term school outcomes to determine whether parent-child co-regulation and child EF measured in shelter predict child school adjustment beyond the subsequent year. Such investigations will require substantial resources and careful planning to retain mobile families.

Another important consideration for the results of this study involves the lack of a genetically informed design. Associations between parent behavior and child behavior are likely influenced to some degree by the shared genetic material between biological parents and their children. As illustrated through results of the cluster analysis, certain combinations of parent and child behavior simply were not observed. For example, dyads with high rates of child defiance also had lower rates of parent positive control. These associations may arise in part due to shared genetic predispositions. Efforts were made in this investigation to limit the impact of such associations, by measuring both child and parent behavior independently and controlling for these associations when possible. When considering behavior at the dyadic level, however, such associations inevitably influence the data. Additional studies and investigations with similar data that focus on other levels of analysis are essential for a better appreciation of all the developmental factors at play.

Conclusion and Implications

In summary, this study of parent-child relationships predicting concurrent child self-regulation and subsequent child adaptation to the school context among a high risk group of homeless dyads revealed findings consistent with the study hypotheses. Positive co-regulation in parent child interactions were related to child IQ and executive function, both of which carried indirect effects of co-regulation on school outcomes. Furthermore, parent non-directive responsiveness independently predicted positive school adjustment beyond the indirect pathways through child IQ and EF. These findings support the central

role of parents as protective factors for shaping development of child self-regulation in contexts of significant risk and adversity.

The study also utilized a dynamic systems method, state space grids, to measure dyadic co-regulation and to identify distinct typologies of dyadic behavior within the sample using attractor states of behavior. The person-focused cluster analyses underscored the predominance of positive interaction between parents and their children, even among dyads with relatively high rates of negative interaction. These findings in particular have implications for identifying dyads at risk and for intervening by augmenting the positive interactions in place of more negative behaviors by both parents and children. The observational methods and measures employed have potential to translate to intervention and prevention contexts where observed behavior could be used to assess response to intervention and change over time.

Findings also underscore the importance of the parent-child relationship for young children developing in contexts of risk and adversity. The links among parenting, self-regulation, and school adjustment suggest that interventions aiming to improve child functioning at school would benefit from parent involvement. Children develop self-regulation in the context of their social relationships, with parents or alternate caregivers as their most proximal and influential social partners. Contexts of risk and adversity affect children directly and through their impact on parent-child relationships, and effective interventions to support positive development can do the same.

Table 1

Reliability, base rates, and estimated accuracy for SSG codes

	% Agree	Kappa	Baserate	Accuracy
Parent				
Positive control	.86	.67	.42	>.90
Non-directive responsiveness	.88	.68	.34	>.90
Disengaged/distracted	.96	.70	.12	>.95
Negative control	.82	.59	.12	>.90
Child				
On-task	.83	.63	.62	>.90
Bids/signals	.85	.41	.21	>.85
Withdrawn/distracted	.93	.43	.11	>.90
Defiant/disobedient	.96	.34	.06	>.85

Table 2

Means, standard deviations, and range for all study variables.

	M(SD)	Min	Max
Positive Co-regulation (PCR)	0.76(0.11)	0.40	0.92
Global Parenting Quality	3.54(0.77)	1.29	4.93
Risk Index	3.93(1.61)	1.00	8.00
Adversity (LEQ)	4.22(2.35)	0.00	10.0
Parent Psychopathology	0.05(0.94)	-1.07	2.97
Child Behavior Problems	0.00(1.00)	-1.63	3.43
Child IQ	-0.01(0.83)	-2.22	3.06
Child Executive Function (EF)	-0.05(0.80)	-2.11	1.02
Academic Competence	2.48(0.92)	1.00	5.00
School Engagement	4.29(0.81)	2.00	5.00
Externalizing	0.34(0.38)	0.00	2.00
Peer Relations	3.43(0.49)	2.00	4.00
Teacher-child Relationship	3.95(0.78)	2.00	5.00

Table 3

Rates of Endorsement on Life Events Questionnaire (LEQ).

Event (during past 12 months)	**n**	**%**
Family financial situation was difficult	117	0.85
Parent lost his/her job	64	0.46
Family evicted from house or apartment	53	0.38
Family had government funds cut off	47	0.34
Many arguments between adults in home	43	0.31
Parent had problems at work	36	0.26
Many arguments between parent and former spouse	29	0.21
Parent arrested or went to jail	27	0.20
Parents separated	25	0.18
Family member developed severe emotional problems	25	0.18
Grandparent died	22	0.16
Parent became seriously ill or was injured	19	0.14
Family member was victim of violence	19	0.14
Brother/sister seriously ill or injured	10	0.07
Family member ran away from home	10	0.07
Brother/sister arrested or went to jail	10	0.07
Parent had trouble with alcohol or drugs	8	0.06
Brother/sister became involved with alcohol or drugs	6	0.04
Family member attempted suicide	4	0.03
Child's close friend died	3	0.02
Child was victim of violence	2	0.01
Child's parent died	2	0.01
Parents divorced	1	0.01
Brother/sister died	0	0.00

Table 4

Rates of endorsement for items included in risk index

Risk factor	**N**	**%**
Parent unemployed currently	118	85%
Couldn't afford rent	70	50%
Parent education < HS degree	42	30%
Unsafe neighborhood	28	20%
Substandard/unsafe housing	24	17%
Single parent	101	73%
4 or more children in shelter	28	20%
High food insecurity	46	33%
High residential mobility	60	44%
Parent history of homelessness	28	20%

Table 5

Means and standard deviations for duration codes overall and by cluster

		Parent Codes				Child Codes			
	n	Positive Control	Responsive-ness	Disengage-ment	Negative Control	On-Task	Signals/ Bids	Withdrawn	Defiant
Full Sample	130	.42(.12)	.34(.08)	.13(.08)	.10(.08)	.60(.15)	.25(.09)	.10(.06)	.06(.10)
Two Clusters									
Positive/On-task	98	.45(.10)	.36(.08)	.11(.06)	.08(.06)	.64(.12)	.24(.08)	.09(.06)	.03(.06)
Negative/Dysregulated	32	.32(.09)	.31(.07)	.20(.10)	.18(.10)	.47(.17)	.30(.11)	.10(.08)	.13(.14)
Three Clusters									
Directive/On-task	73	.49(.09)	.33(.06)	.11(.06)	.08(.06)	.64(.12)	.24(.08)	.10(.06)	.03(.05)
Responsive/On-task	25	.37(.08)	.44(.07)	.12(.05)	.08(.05)	.64(.12)	.23(.08)	.08(.06)	.04(.09)
Negative/Dysregulated	32	.32(.09)	.31(.07)	.20(.10)	.18(.10)	.47(.17)	.30(.11)	.10(.08)	.13(.14)
Four Clusters									
Directive/Independent	35	.52(.10)	.32(.06)	.09(.06)	.07(.04)	.71(.10)	.19(.07)	.08(.04)	.02(.02)
Directive/Needy	38	.46(.08)	.34(.07)	.12(.07)	.08(.07)	.57(.08)	.28(.07)	.11(.07)	.04(.06)
Responsive/On-task	25	.37(.08)	.44(.07)	.12(.05)	.08(.05)	.64(.12)	.23(.08)	.08(.06)	.04(.09)
Negative/Dysregulated	32	.32(.09)	.31(.07)	.20(.10)	.18(.10)	.47(.17)	.30(.11)	.10(.08)	.13(.14)
Five Clusters									
Directive/Independent	35	.52(.10)	.32(.06)	.09(.06)	.07(.04)	.71(.10)	.19(.07)	.08(.04)	.02(.02)
Directive/Needy	38	.46(.08)	.34(.07)	.12(.07)	.08(.07)	.57(.08)	.28(.07)	.11(.07)	.04(.06)
Responsive/On-task	25	.37(.08)	.44(.07)	.12(.05)	.08(.05)	.64(.12)	.23(.08)	.08(.06)	.04(.09)
Negative/Needy	22	.32(.08)	.30(.08)	.21(.12)	.17(.10)	.54(.13)	.27(.10)	.12(.08)	.07(.07)
Negative/Defiant	10	.31(.10)	.31(.06)	.18(.06)	.20(.09)	.30(.09)	.35(.11)	.07(.04)	.28(.15)

Table 6

Correlations of positive co-regulation (PCR) with individual SSG codes and global parenting quality

		2	3	4	5	6	7	8	9	10
1	Positive co-regulation	.71**	.66**	.31**	-.40**	-.82**	.71**	-.21*	-.30**	-.69**
2	Global parenting quality	-	.63**	.24**	-.54**	-.56**	.44**	-.10	-.20*	-.43**
3	Parent – POS		-	-.26**	-.60**	-.49**	.37**	-.13	-.14	-.32**
4	Parent – RES			-	-.19**	-.35**	.14	.06	-.15	-.18
5	Parent – DIS				-	.06	-.15	-.12	.32**	.12
6	Parent – NEG					-	-.50**	.25*	.02	.51**
7	Child – ONT						-	-.60**	-.30**	-.73**
8	Child – SIG							-	-.18	.15
9	Child – WTH								-	.05
10	Child – DEF									-

Note. POS = positive control, RES = non-directive responsiveness, DIS = disengaged/distracted, NEG = negative control, ONT = on-task, SIG = signals/bids, WTH = withdrawn/distracted, DEF = defiant/disobedient
* $p < .05$, ** $p < .01$

Table 7

Bivariate correlations of PCR and SSG codes with study variables

	PCR	P-POS	P-RES	P-DIS	P-NEG	C-ONT	C-SIG	C-WTH	C-DEF
Risk Index	.09	.09	-.01	-.05	-.07	-.01	.02	-.03	.02
Adversity (LEQ)	.09	.06	.09	-.17	.00	-.01	.07	-.06	-.02
Parent Psychopathology	-.12	-.03	-.13	.02	.15	-.09	.01	.09	.06
Child Age	.09	-.07	.18	-.02	-.07	.32**	-.40**	-.03	-.10
Child Gender	.07	.05	.11	-.17	-.02	.08	-.12	.09	-.07
Behavior Problems	-.35**	-.29**	-.11	.25**	.28**	-.19*	-.03	.25**	.16
Child IQ	.20*	.08	.21*	-.21*	-.11	.24*	-.15	-.13	-.14
Child EF	.42*	.18	.19*	-.14	-.31**	.48**	-.35**	-.16	-.31**
Academic Competence	.16	.05	.12	-.07	-.12	.12	-.08	-.01	-.11
School Engagement	.20	.02	.21*	-.10	-.13	.12	.01	-.12	-.12
Externalizing	-.01	.11	-.16	.05	-.04	-.02	-.01	.06	.00
Peer Relations	.16	-.03	.31**	-.09	-.17	.11	-.05	-.03	-.10
Teacher-child Relationship	.14	-.06	.25*	-.05	-.11	.07	.10	-.15	-.09

Note: PCR = positive co-regulation, P = parent, C = child, POS = positive control, RES = non-directive responsiveness, DIS = disengaged/distracted, NEG = negative control, ONT = on-task, SIG = signals/bids, WTH = withdrawn/distracted, DEF = defiant/disobedient
* $p < .05$, ** $p < .01$

Table 8

Bivariate correlations among study variables

		2	3	4	5	6	7	8	9	10	11	12	13
1	Risk Index	.35**	.23**	.09	-.08	.14	.12	.10	.04	.00	.10	-.03	-.09
2	Adversity (LEQ)	-	.40**	.04	-.11	.33**	.17*	.12	.02	.08	.10	.11	.05
3	Parent Psychopathology		-	.02	.02	.57**	-.01	.06	.06	.01	-.12	-.06	.14
4	Child Age			-	.01	-.02	.17	.46**	-.09	-.06	.05	.05	-.08
5	Child Gender				-	.14	-.02	-.07	-.06	-.04	.19	.03	-.12
6	Behavior Problems					-	-.14	-.16	-.04	-.12	.04	-.15	-.06
7	Child IQ						-	.51**	.48**	.22*	-.19	.05	.14
8	Child EF							-	.40**	.19	-.18	.19	.28**
9	Academic Competence								-	.51**	-.28**	.28**	.39**
10	School Engagement									-	-.57**	.52**	.74**
11	Externalizing symptoms										-	-.46**	-.59**
12	Peer Relationships											-	.52**
13	Teacher-child Relationship												-

* $p < .05$, ** $p < .01$

Table 9

Path estimates for positive co-regulation (PCR) model

	EF	IQ	Aca	SchEng	Ext	Peer	Tcrel
PCR	.41(.07)**	.20(.08)*	-.02(.08)	.15(.09)	.06(.09)	.08(.10)	.04(.09)
EF			.39(.10)**	.16(.11)	-.20(.12)	.22(.12)	.43(.11)**
IQ			.35(.08)**	.16(.09)	-.14(.09)	-.07(.10)	-.01(.09)
Age			-.32(.08)	-.16(.09)	.14(.09)	-.04(.09)	-.25(.09)**
Gender			-.02(.07)	-.05(.08)	.18(.08)*	.03(.08)	-.10(.08)
Risk			-.01(.07)	-.04(-.08)	.14(.08)	-.04(.08)	-.13(.08)
Year			-.04(.07)	.06(.08)	.03(.08)	-.03(.09)	-.05(.08)
Site			-.03(.07)	-.17(.08)*	.02(.08)	.02(.09)	-.13(.08)
PCR indirect			.23(.06)**	.10(.05)*	-.11(.05)*	.08(.05)	.18(.05)**
PCR total			.21(.09)*	.25(.09)**	-.05(.09)	16(.09)	.21(.09)*

Chi-Square = 8.66, df=11, p = .65 RMSEA < .01, NNFI = 1.0, AIC = 169.1
PCR = positive co-regulation, EF = executive function, Aca = academic competence, SchEng = school engagement, Ext = Externalizing behavior, Peer = Peer relations, Tcrel = Teacher-child Relationship

Table 10

Path estimates for parenting behavior model

	EF	IQ	Aca	SchEng	Ext	Peer	Tcrel
Positive Control (POS)	.26(.08)**	.11(.08)	-.05(.07)	.03(.09)	-.07(.08)	.02(.09)	-.07(.08)
Responsiveness (RES)	.19(.08)*	.21(.08)**	.04(.07)	.22(.08)*	-.17(.08)	.30(.08)**	.27(.08)**
EF			.40(.09)**	.22(.11)*	-.15(.11)	.25(.11)*	.48(.10)**
IQ			.34(.08)**	.11(.09)	-.12(.09)	-.13(.09)	-.07(.09)
Age			-.33(.08)**	-.21(.09)*	.13(.09)	-.09(.09)	-.31(.09)**
Gender			-.02(.07)	-.06(.08)	.21(.08)**	.01(.08)	-.13(.08)
Risk			-.01(.07)	-.03(.08)	.14(.08)	-.03(.08)	-.11(.08)
Year			-.03(.07)	.08(.08)	.04(.08)	-.01(.08)	-.03(.08)
Site			-.03(.07)	-.19(.08)*	.05(.08)	-02(.08)	-.16(.07)*
POS indirect			.14(.05)**	.07(.03)	-.05(.03)	.05(.03)	.12(.04)**
POS total			.09(.09)	.10(.08)	-.13(.08)	.07(.08)	.05(.08)
RES indirect			.14(.05)**	.06(.03)*	-.05(.03)	.02(.03)	.07(.04)
RES total			.19(.09)*	.29(.08)**	-.22(.08)**	.32(.08)**	.35(.08)**

Chi-Square = 8.9, df=12, p = .76 RMSEA < .001, NNFI = 1.0, AIC = 193.2
PC = positive control composite, PR = parent responsiveness, EF = executive function, Aca = academic competence, SchEng = school engagement, Ext = Externalizing behavior, Peer = Peer relations, Tcrel = Teacher-child Relationship

Table 11

Means and standard deviations for attractor consistency by cluster, with attractor states in boldface

	Cluster				
	Directive/ Independent	Directive/ Needy	Responsive/ On-task	Negative/ Needy	Negative/ Defiant
	n = 35	n = 38	n = 25	n = 22	n = 10
Positive/on-task	**.90(.08)**	**.65(.14)**	**.51(.14)**	**.41(.19)**	**.18(.15)**
Positive/signals	.07(.10)	**.20(.12)**	.08(.11)	.03(.07)	**.25(.21)**
Positive/withdrawn	.01(.03)	.08(.12)	.02(.05)	.01(.04)	.01(.04)
Positive/defiant	.00(.02)	.01(.03)	.03(.07)	.00(.00)	**.10(.13)**
Responsive/on-task	**.51(.17)**	**.41(.11)**	**.73(.12)**	**.38(.13)**	**.22(.09)**
Responsive/signals	.04(.08)	**.10(.11)**	**.15(.12)**	.08(.11)	**.18(.18)**
Responsive/withdrawn	.00(.02)	.03(.07)	.01(.03)	.00(.00)	.00(.00)
Responsive/defiant	.00(.00)	.01(.04)	.01(.03)	.01(.03)	**.12(.13)**
Disengaged/on-task	.08(.08)	.07(.07)	.10(.10)	**.22(.20)**	.05(.06)
Disengaged/signals	.00(.02)	.03(.05)	.02(.05)	.01(.03)	.06(.07)
Disengaged/withdrawn	.01(.03)	.03(.06)	.02(.04)	**.09(.14)**	.04(.06)
Disengaged/defiant	.02(.05)	.01(.03)	.00(.00)	.01(.04)	**.08(.11)**
Negative/on-task	.01(.04)	.02(.07)	.03(.05)	**.08(.10)**	**.07(.11)**
Negative/signals	.02(.05)	.02(.06)	.01(.03)	**.07(.14)**	.06(.09)
Negative/withdrawn	.00(.00)	.01(.02)	.00(.00)	.01(.03)	.00(.00)
Negative/defiant	.01(.03)	.00(.02)	.01(.05)	.03(.07)	**.10(.16)**

Table 12

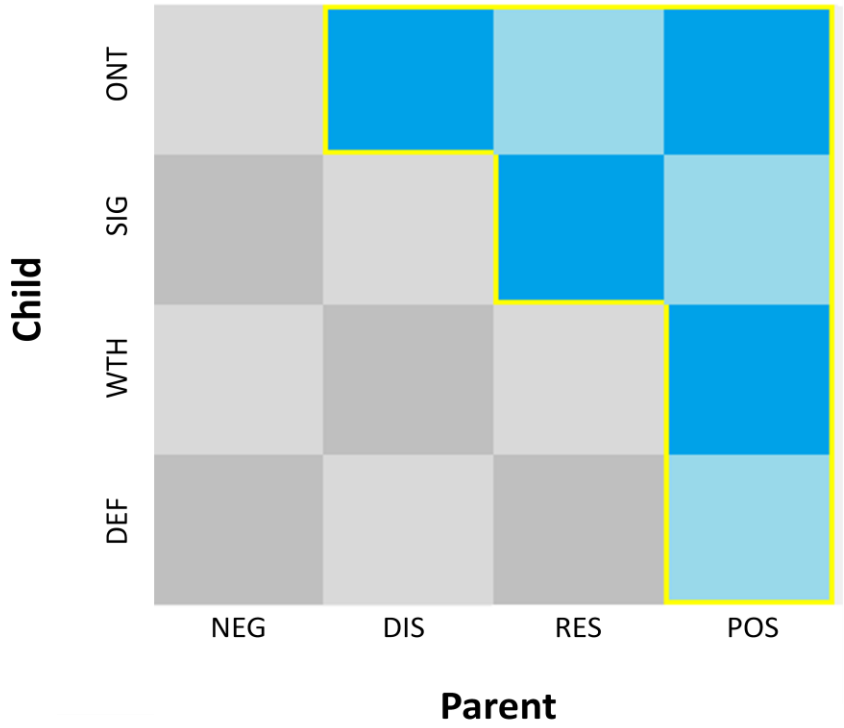
Means and Standard Errors for Study Variables by SSG Cluster

	Cluster				
	Directive/ Independent	Directive/ Needy	Responsive/ On-task	Negative/ Needy	Negative/ Defiant
	n = 35	n = 38	n = 25	n = 22	n = 10
PCR*	0.83(0.00)	0.78(0.01)	0.71(1.29)	66.7(0.02)	0.58(0.03)
Global Parenting Quality*	4.03(0.10)	3.74(0.10)	3.64(0.10)	2.74(0.11)	2.75(0.27)
Risk Index	4.14(0.26)	3.63(0.28)	3.88(0.31)	4.18(0.31)	4.80(0.57)
Adversity (LEQ)	4.69(0.41)	3.92(0.37)	4.44(0.51)	4.59(0.50)	4.20(0.61)
Parent Psychopathology	0.10(0.16)	-0.22(0.10)	-0.06(0.16)	0.47(0.26)	0.26(0.29)
Child Age	69.7(1.35)	67.8(1.12)	71.3(1.29)	68.8(1.43)	67.8(1.66)
Child Gender (% male)	45.7	47.4	48.0	31.8	40.0
Behavior Problems*	-0.13(0.13)	-0.24(0.13)	-0.06(0.18)	0.67(0.29)	0.41(0.37)
Child IQ*	0.19(0.11)	-0.23(0.13)	0.50(0.18)	-0.21(0.15)	-0.21(0.33)
Child EF*	0.19(0.10)	-0.26(0.13)	0.28(0.13)	-0.15(-.20)	-0.61(0.30)
Academic Competence	2.42(0.15)	2.38(0.18)	2.83(0.22)	2.45(0.23)	2.21(0.36)
School Engagement	4.21(0.16)	4.38(0.16)	4.56(0.16)	4.25(0.20)	4.13(0.32)
Externalizing Symptoms	0.45(0.09)	0.34(0.08)	0.25(0.08)	0.39(0.08)	0.35(0.14)
Peer Relationships*	3.38(0.10)	3.49(0.09)	3.67(0.10)	3.17(0.14)	3.35(0.21)
Teacher-child Relationship	3.77(0.16)	3.93(0.15)	4.29(0.13)	3.85(0.20)	3.87(0.28)

*ANOVA difference $p < .05$

Figure 1

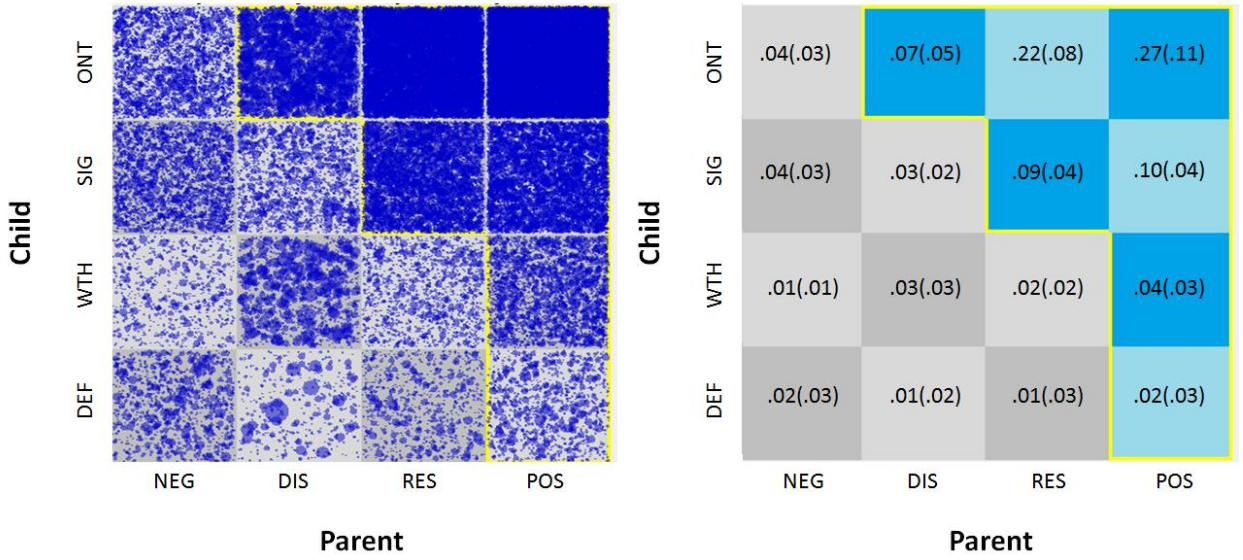
State space grid with PCR region shown in blue



Note. POS = positive control, RES = non-directive responsiveness, DIS = disengaged/distracted, NEG = negative control, ONT = on-task, SIG = signals/bids, WTH = withdrawn/distracted, DEF = defiant/disobedient

Figure 2

Rates of SSG grid durations overall



Note. POS = positive control, RES = non-directive responsiveness, DIS = disengaged/distracted, NEG = negative control, ONT = on-task, SIG = signals/bids, WTH = withdrawn/distracted, DEF = defiant/disobedient

Figure 3

Path diagram for final PCR model
Chi-Square = 8.66, df=11, p = .65 RMSEA < .01, NNFI = 1.0, AIC = 169.1

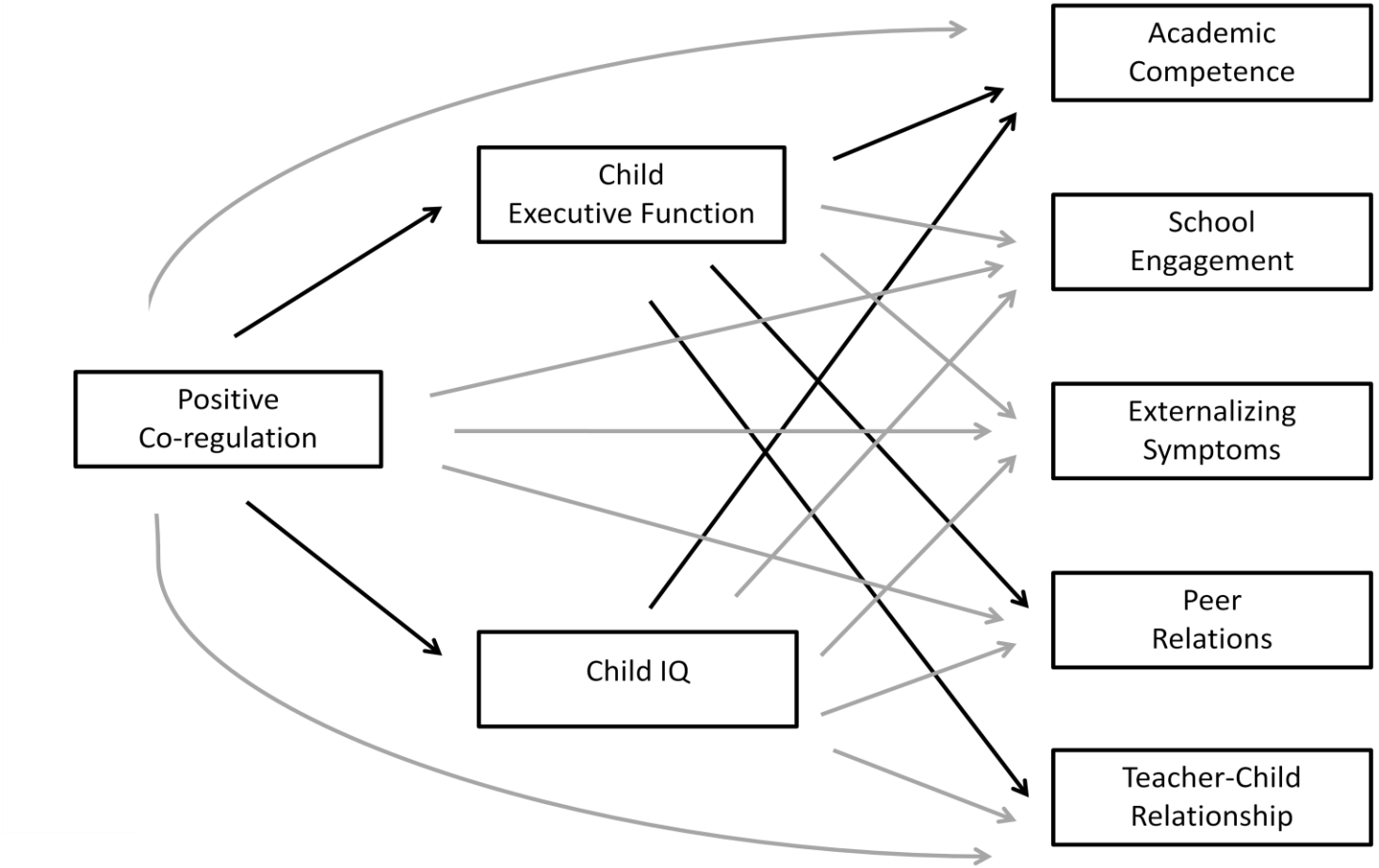


Figure 4

PCR model path diagram divided by outcomes

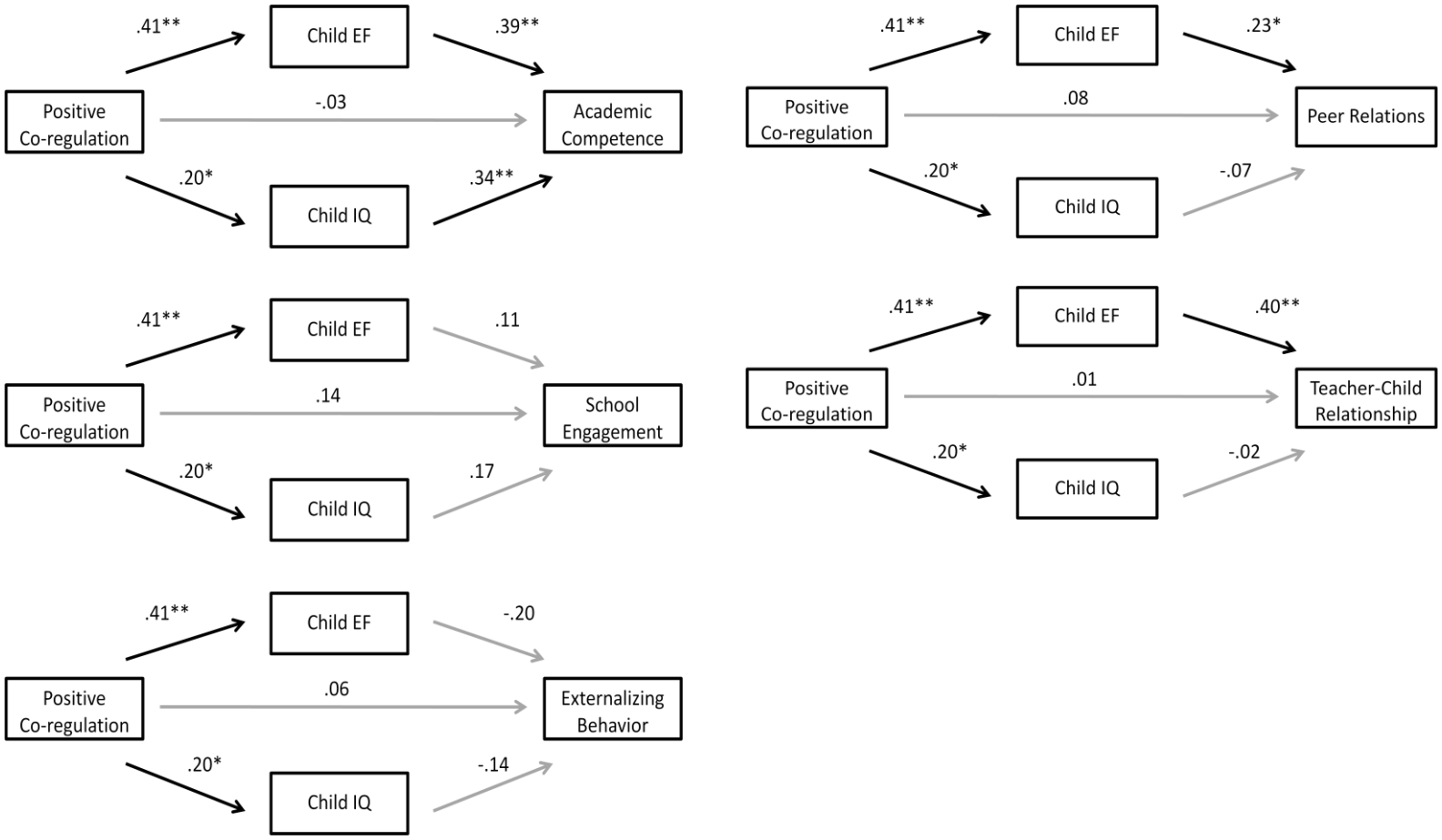


Figure 5

Path diagram for final parenting model
Chi-Square = 8.9, df=12, p = .76 RMSEA < .001, NNFI = 1.0, AIC = 193.2

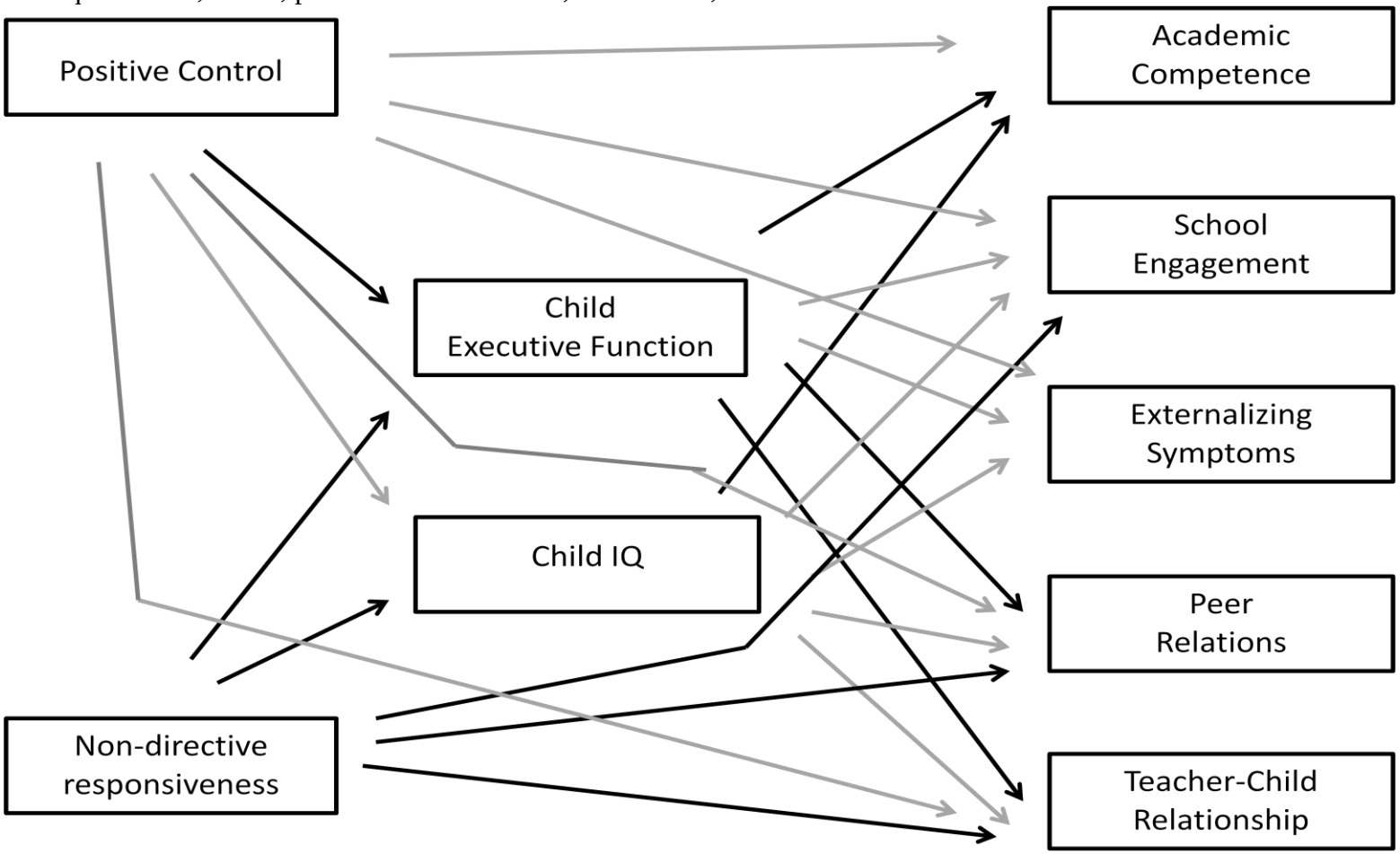


Figure 6

Parenting model path diagram divided by outcomes

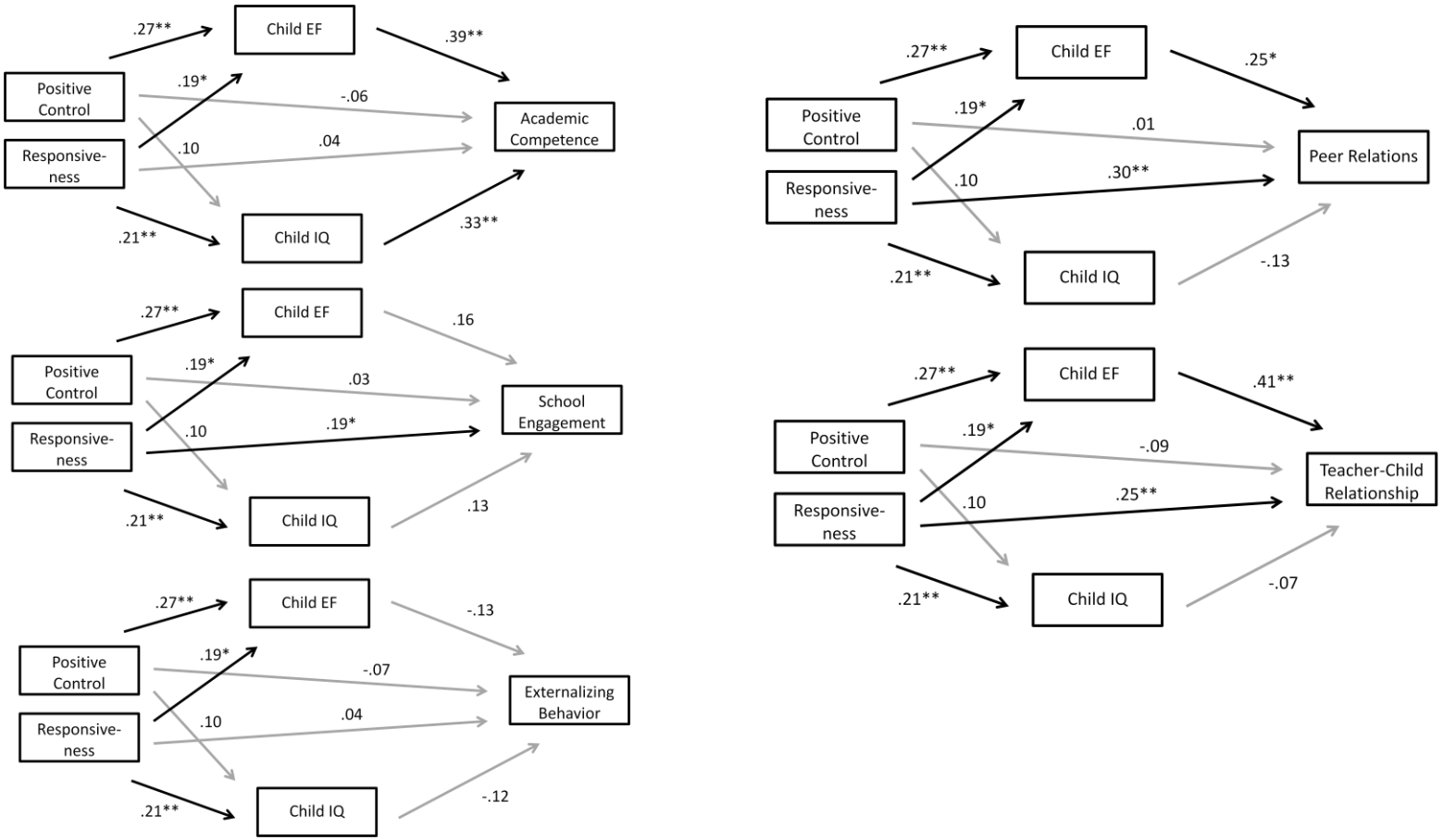


Figure 7

Dendrogram for hierarchical cluster analysis

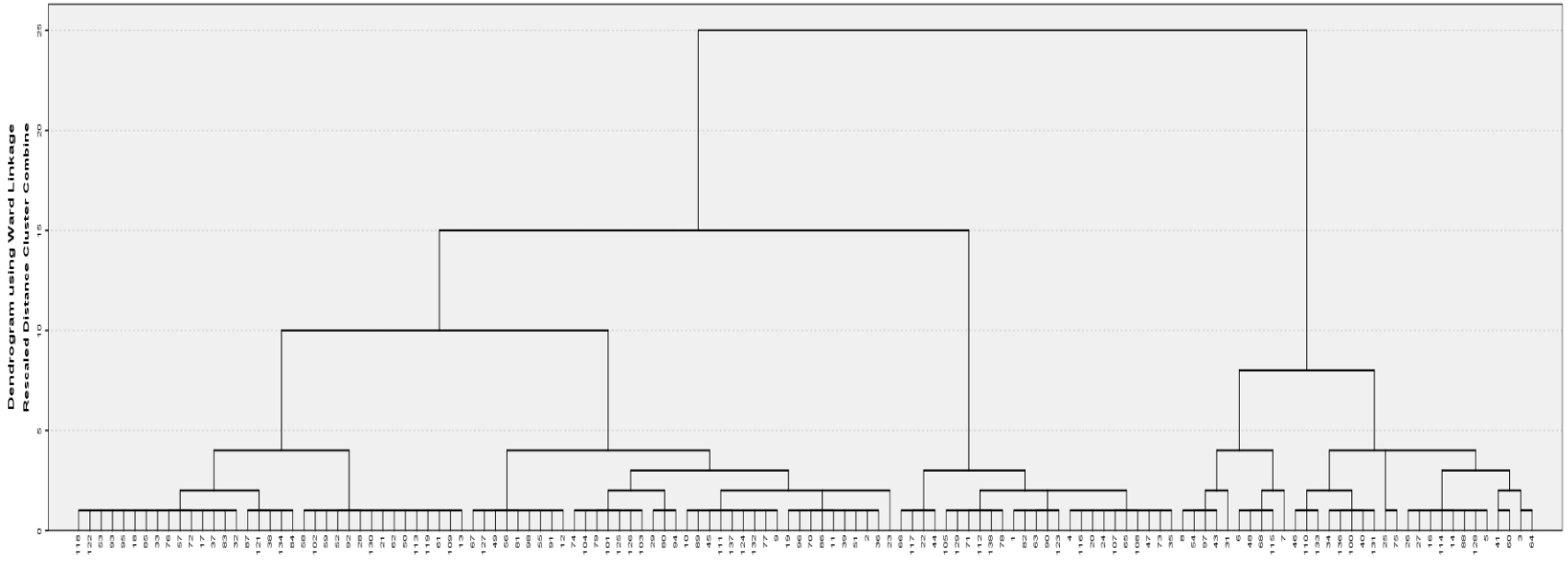


Figure 8

Hierarchical structure of cluster analysis groups

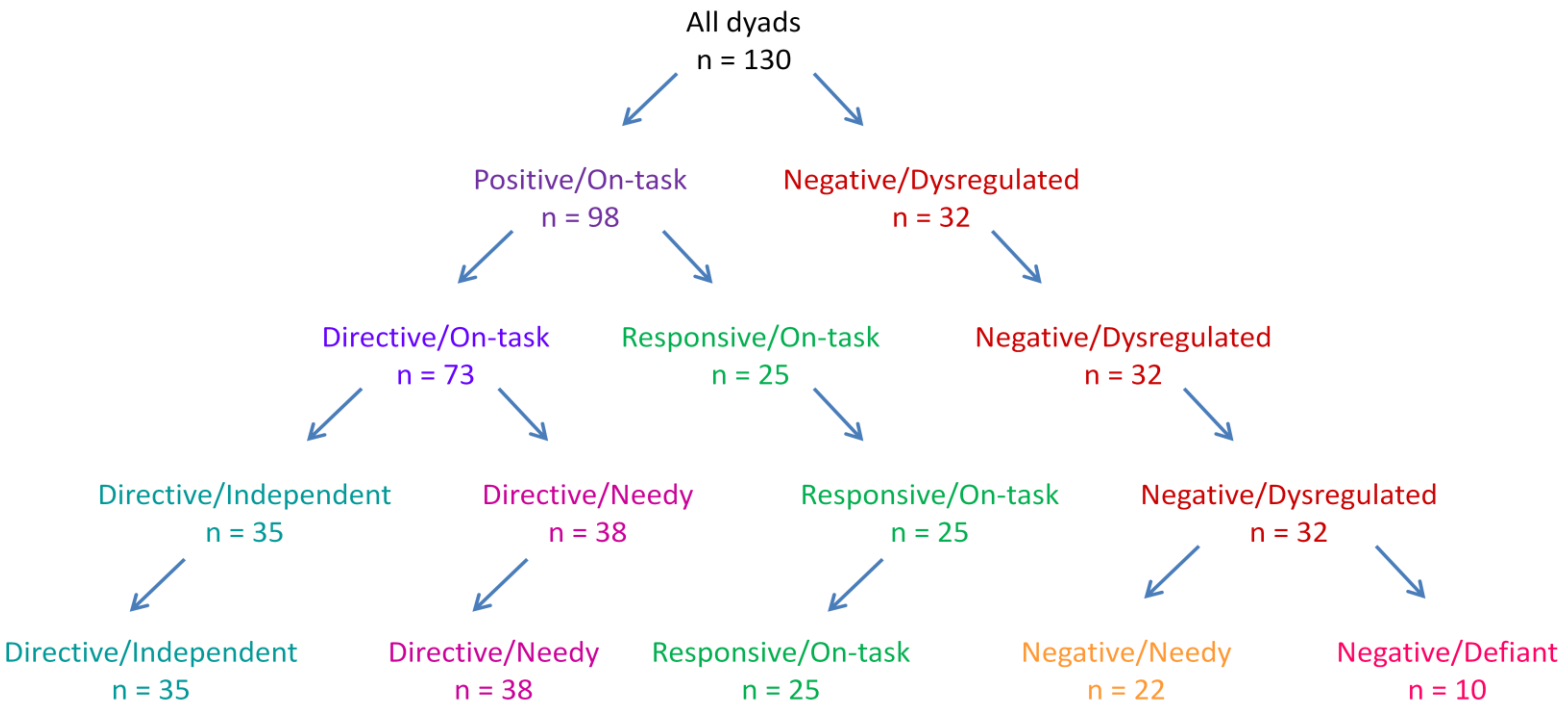


Figure 9

Average risk index scores by cluster

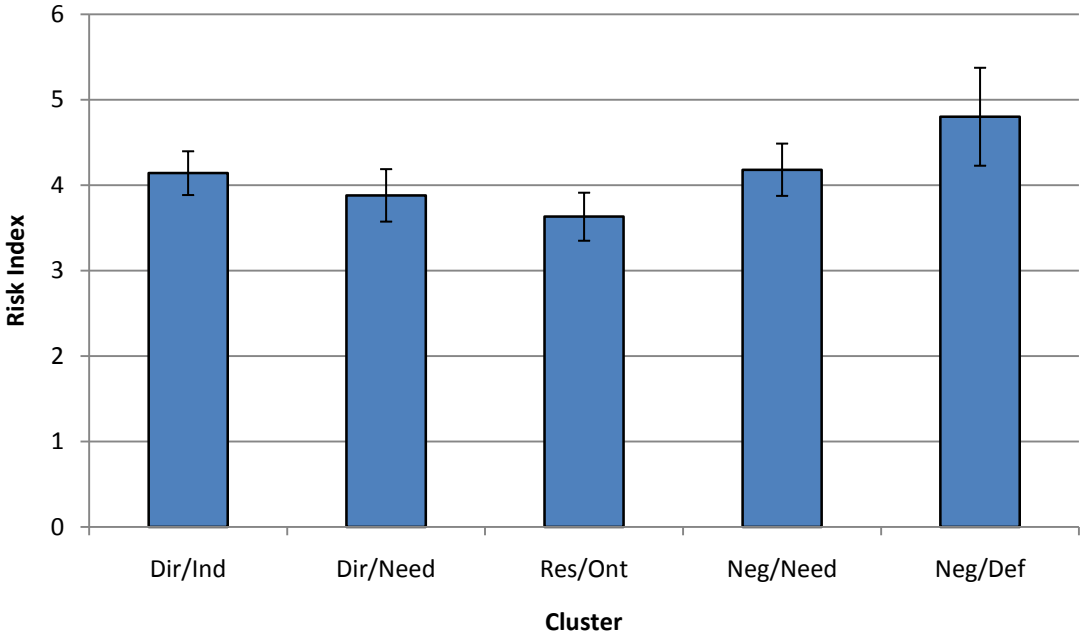


Figure 10

Average executive function (EF) scores by cluster

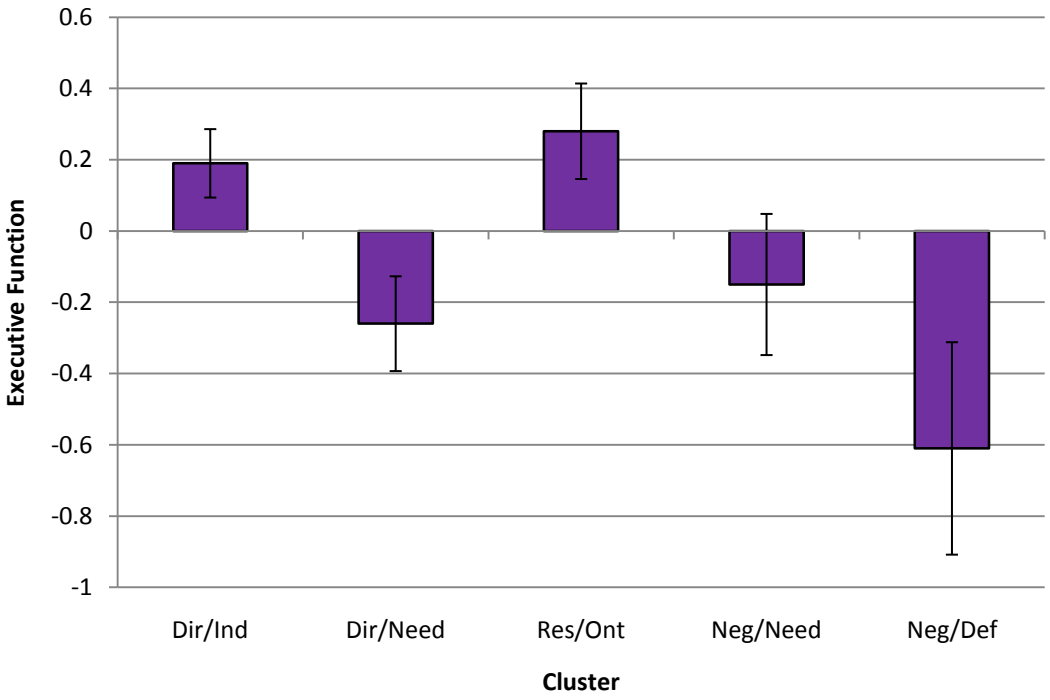


Figure 11

Average PCR scores by cluster

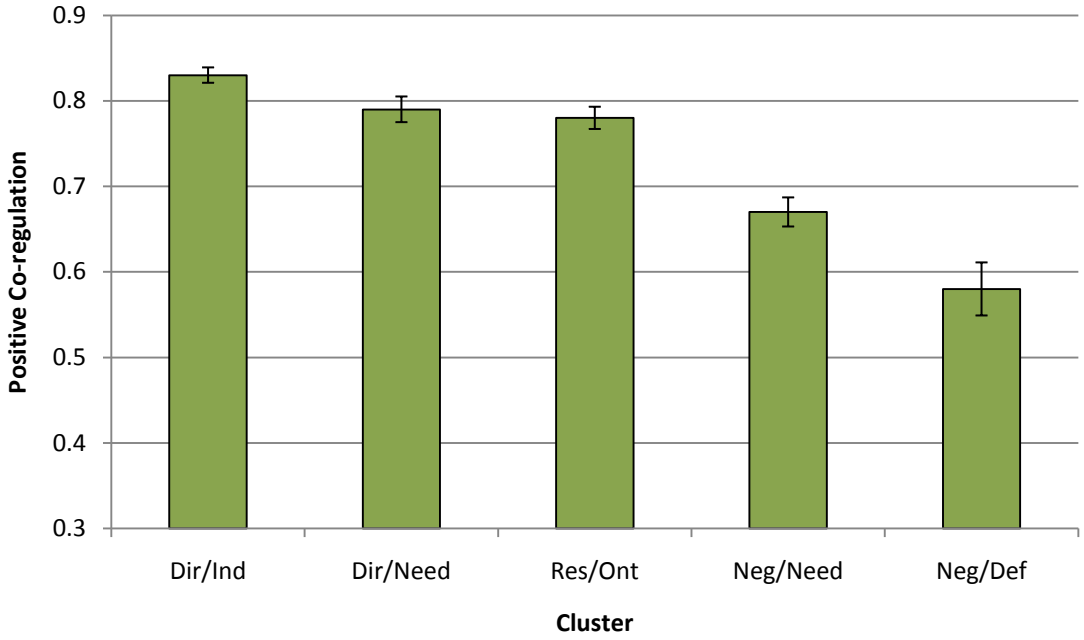
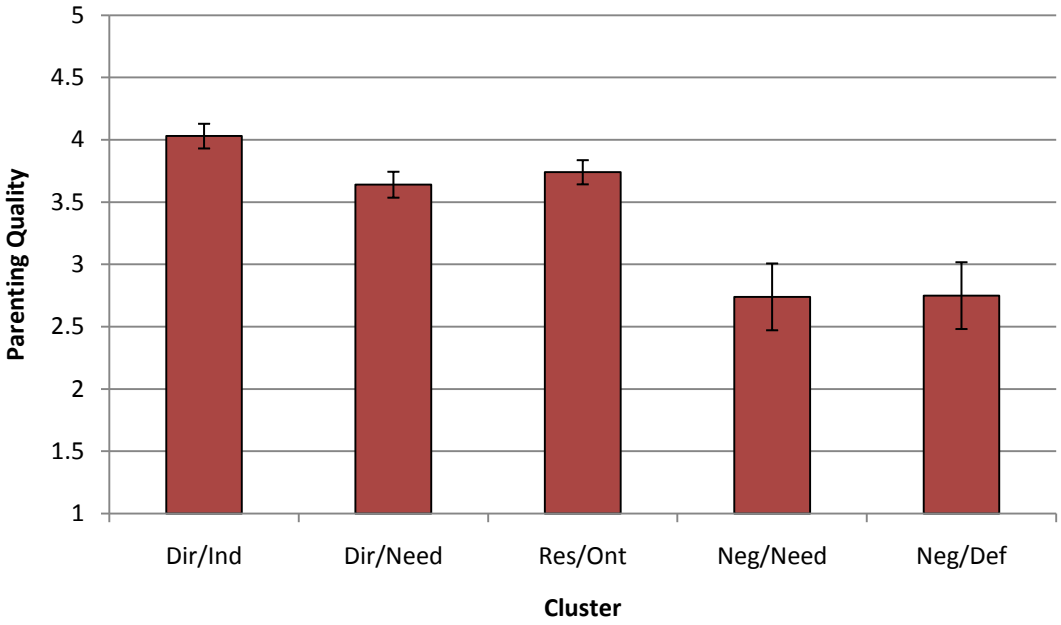


Figure 12

Average global parenting quality scores by cluster



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Appendix A

SSG Coding Criteria

Transition – when experimenters are giving instructions or taking cortisol such that they are actively involved in the interactions

Missing – when the nature of parent behavior cannot be coded, because parent is out of the room, off the camera, speaking too softly, etc. (but if you can make a judgment in these situations, e.g. parent is off camera but is clearly shouting at child, do so)

Parent Duration Codes:

1. **Positive Control** – positive, constructive strategies the parent uses to regulate the child. The following behaviors should be coded only when done with positive or neutral affect, and *without* harsh tones, criticism, or any of the other factors described in Negative Control.
    a. **Instructions/Expectations/Requests/Skills Teaching** appropriate to task demands and situation (e.g. parent shows or tells child how to operate labyrinth knobs, parent explains why doing homework is important, parent tells child to clean up, parent quizzes child on numbers or pictures in a book). **Questions** to gauge child's understanding. **Explanations or corrections** such as saying "No" when the child puts Tangoes together incorrectly, as long as emotional tone is positive or neutral. **Suggestions/ideas** that are directive in planning or problem solving. Also code here when parent is giving clues in Guessing Game, as long as words used and emotional tone are positive or neutral
    b. **Emotion explanations/teaching about emotions** (such as "I know you feel sad when…" or "Does it make you angry when…" or "How did that make you feel?" or "Are you excited?" or "That makes me happy"… also include scared, afraid, nervous, upset, irritated, frustrated)
    c. **Redirecting** child's attention to appropriate or on-task behavior (note that child does not have to be off-task to be redirected, parent could be asking "anything else?" after a period of silence) or **distracting** child from disruptive or upsetting stimuli (e.g. parent distracts child from forbidden toys using permitted toys)
    d. **Comforting verbalizations** ("It's okay,") or **physical contact/affection** intended to comfort that is sensitive and appropriate

2. **Non-directive Responsiveness**– parent behaviors that are *involved* and *responsive* but not *directive*, i.e. not specifically aimed at controlling or modifying child behavior or emotions. Parent should display positive or neutral affect, and may use appropriate and sensitive physical affection, along with the following:
    a. **Attentive monitoring** of child behavior, **watching** child work, **waiting** for child to complete a task or ask for help, any **watching** while child is focused

on something other than the parent; **Involvement**, either **conversational** without teaching or instructions including commenting on what child is saying or doing, asking a follow-up **question to clarify or elaborate** something the child is saying or doing (e.g. "anything else?" when child has previously been talking), or **active listening** while child is speaking. Also include **playing games** when not specifically structuring/guiding (e.g. giving answers in guessing game, laughing/enjoying labyrinth, setting up toys for play, following child's lead or maintaining interaction while playing with other toys, watching when the child is focused on the parent)

b. **Encouragement or acknowledgment** of child's on-task behavior or speech, or the dyad's success in a task (particularly if accompanied by positive affect, can include **repeating** or **reflecting** what the child is saying, **responding** with "mm-hm," etc.).

3. **Disengaged/Distracted** – parent is ignoring the child, distracted by something else, preoccupied with self, and/or not participating at all
    a. **Shut down**, **staring**, or **dissociative**, **leaning or looking away** (even briefly)
    b. **Focusing entirely on something other than the child** such as reading the magazine or playing with other objects, attending to baby if one is in the room during the session; **focusing on self** (e.g. rubbing eyes or yawning, grooming self) or pursuing a topic of conversation that is entirely parent-focused while looking away from child

        NOTE: code looking at book during clean-up task here, even though parent has been instructed to do this by experimenter

        NOTE: code looking at (or just brief glances to) the experimenter

4. **Negative Control** – parent behaviors intended to control the child that are harsh and punitive, or insensitive and intrusive
    a. **Yelling** or **shouting** at the child, teaching or giving instructions with **harsh** or **sarcastic tone, threatening** the child (either verbally or physically, e.g. getting up out of chair to approach noncompliant child0
    b. **Criticism, invalidation** ("it's not nice to talk about when someone dies")**, insults,** (e.g. "You're cheating" or "You're not cooperating") or **negative questions** (e.g. "Why don't you ever clean your room?") or **punishing**, **teasing, taunting,** or **shaming** child, or **laughing derisively** at child behavior/distress. Note that parent may be sarcastic in teasing and appear to show positive affect, e.g. "If only you could be this nice at home."
    c. **Pleading with** or attempting to **manipulate** the child ("seductiveness"), looking to child for guidance or comfort, **behaving in a child-like way** that is not playful/appropriate (include anti-social behavior)
    d. **Physical aggression/harsh physical contact** (e.g. pushing child into chair, yanking child's arm, holding child's face), also include any **physical intervention** that is not soothing/affectionate, such as taking something from child's hand, pushing child's feet off table, grooming that seems intrusive/insensitive, etc.

e. **Taking over** tasks completely, **hovering** over the child, or **interrupting/intruding,** also code **aggressive play** (e.g. pushing toy in child's face)

Parent Events:

- **Emotion/Feelings words** – Parent uses words referring to emotions or feelings states when talking to the child or talking about self. Emotion and feelings words include (but are not limited to) the following: happy, sad, angry, mad, scared, afraid, lonely, annoyed, irritated, tired, bored, hungry, thirsty, hurt, pain.
- **Positive reinforcement** – Parent responds to appropriate, positive, or compliant behavior by the child either verbally (e.g. "good job/hooray/awesome/that's right/you're smart/ way to go/all right") or nonverbally (e.g. giving a high-five, smiling/nodding, or pat on the back). NOTE: do not code as positive reinforcement if the above are done with teasing, hostility, or sarcasm.
- **Harsh physical contact** - (e.g. pushing child into chair, yanking child's arm, holding child's face), also include any physical intervention that is not soothing/affectionate, such as taking something from child's hand, pushing child's feet off table, grooming that seems intrusive/insensitive, etc. NOTE: This code should ALWAYS overlap with "negative control"
- **Inappropriate Behavior –** Parent is behaving inappropriately for parenting role by demonstrating the following: pleading with child, attempting to manipulate the child ("seductiveness" or "shaming"), looking to child for guidance or comfort, behaving in a child-like way (excessive silliness, off-task), anti-social behavior that is not aggressive (i.e. encouraging child to misbehave, playing with forbidden toys, damaging property, swearing)

Child Duration Codes:

1. **<u>On-Task</u>** – child is engaged in appropriate and constructive behavior that is consistent with task demands. Child may be working fairly independently and confidently but should be attentive to signals from the parent. Child's affect should be positive or neutral.
    a. **Active On-task –** child is **actively engaged**, either **leading** play/interaction, **talking appropriately** about problems during problem-solving (e.g. expressing opinions such as "I don't like it when…" or "I think we should…" or responding to questions with more than just "uh-huh" or nodding), giving clues/answers during guessing game, manipulating the board during labyrinth, etc. Includes playing with *PERMITTED* toys (from bottom shelf) during Free Play, cleaning up toys, f**ollowing the rules** of guessing game, labyrinth, and Tangoes *note:* If child is unintentionally playing incorrectly (e.g. saying the name of the word on guessing game cards), this should be coded as "misunderstanding" (2b).
    b. **Passive On-Task –** child is engaged, focused, and attentive but is **following parent's lead** rather than leading or self-directing. Includes **complying** with verbal directives, **active listening** when parent is talking (eye-contact,

nodding or giving brief responses like "uh-huh" or "yeah"), responsive positive affect

NOTE: child may be fidgeting/playing with toys *while also listening to parent* and still be considered passive on-task. Must judge whether child is listening or is truly distracted by toys; also note that child may begin by listening then *become* distracted (code 3b)

2. **Bids/Signals** – behaviors, either verbal or nonverbal, intended to get the parent's attention, or indicates an opportunity for parent to help for any reason (e.g. need for assistance, questions, emotional distress) that do NOT involve indicators listed under Defiance.
   a. **Verbal requests** for attention, assistance, explanations, comfort or **verbally expressing a feeling state** in the absence of defiance or strong negative affect. *Requests:* "Help me," "What's this?" "I don't get it", *Feelings:* "I'm sad/tired/hungry," "It's not funny," or "I don't like this game…"
   b. **Struggling with task** - looks **"stumped"** or confused and is not making progress, but has not completely withdrawn or disengaged, **misunderstanding** or doing a task *wrong* (e.g. telling parent the word written on the card during the guessing game – must *not* be intentionally oppositional)
   c. **Emotional distress** or **over-arousal** that goes beyond frustration with task such as: whining, crying or displaying fear, expressing anger that is not directed towards the parent, crying while talking, **excessive silliness** (giggling, clowning) that interferes with task performance and seems to warrant regulation, **expressing frustration** (but not in words, and without defiant behavior or negative affect directed at parent)
   d. **Redirecting parent** to task (e.g. "Mom, we're supposed to be talking about the problem"), **comforting** or other **caretaking** of parent
   e. **Nonverbal gestures** for attention, including **checking** with parent (social referencing), nonverbally questioning a rule, or **touching** the parent in a non-aggressive way (tap on arm, lean in for hug)

3. **Withdrawn** – child is uninvolved in the task but not clearly refusing/oppositional
   a. **Not engaged** in task at hand or other self-directed activity – code here only if child is doing these behaviors while NOT engaged.
      - **avoiding eye-contact** with parent
      - **turning away**
      - **fidgeting** with body or **self-stimulating**
        - If participating in discussion while fidgeting with body, code as **1 (on-task)**
      - **staring/dissociative**
      - **wary** and **hesitant** to engage (i.e. watching intently but not making bids to parent or any actions to engage).
        - NOTE: if child is expressing or displaying fear, should be coded as **2 (bids/signals)**
   b. **Distracted** by something other than the parent or the task at hand, or **self-directed**, independent activity that is not on-task or responsive to parent

- E.g. looking at toys on the shelf when not instructed/expected to
- playing with toys *and not participating* during problem solving task,
- preoccupied with video camera, etc

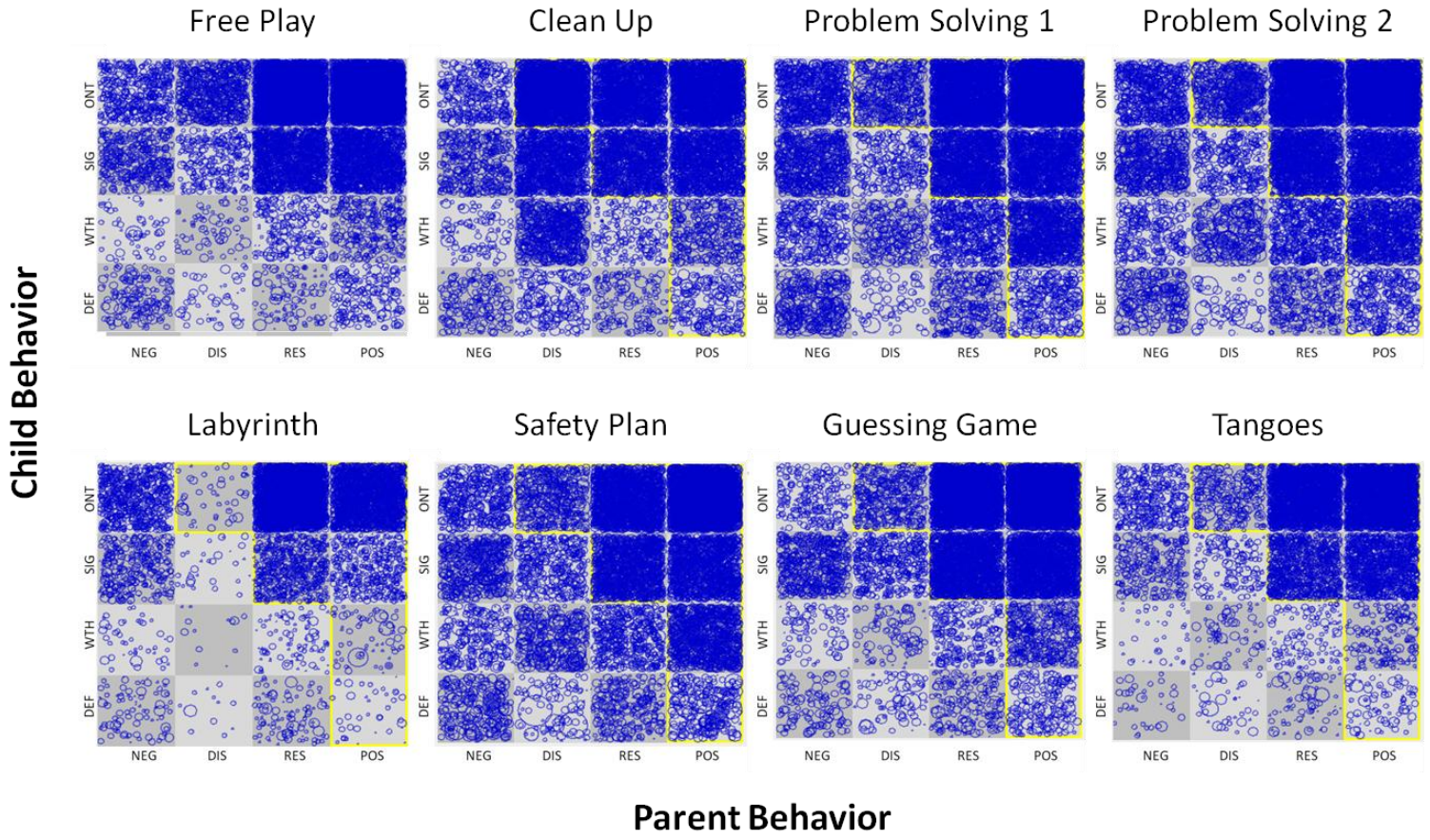
4. **Defiant** – child is intentionally refusing to comply or acting in opposition to instructions by parent and/or experimenter, or child is attempting to direct the parent with hostility/aggression
   a. **Verbally refusing** (e.g. "No" or "I don't want to"), **screaming, yelling,** or **arguing** with parent or experimenter ***NOTE:*** child expressing concerns or opinions during the problem solving or safety plan task should not be coded as arguing UNLESS the tone is angry/hostile towards the parent. Discussing the problem, even if it includes some disagreement, should be coded as **1a**.
   b. **Disobedience** (playing with forbidden toys, **breaking rules** set out by parent or experimenter, **cheating** during games, **lying** about activities) or using **active body language** to convey refusal (e.g. crossing arms; stamping feet; turning away to refuse, not because something else was distracting). ***NOTE:*** child could turn away in defiance then quickly BECOME distracted by something else. The initial turn away should be coded here. ***NOTE:*** Touching FORBIDDEN toys should only be considered defiant when parent has clearly instructed the child not to touch them. When parent has given this instruction, any touching of FORBIDDEN toys should be coded as Defiant UNLESS parent or experimenter has given a more recent directive saying it is okay
   c. **Hostility**, **criticisms**, **name-calling**, use of **inappropriate language, threatening**, **teasing** or **taunting** the parent or experimenter, **interrupting** and **disregarding** what the parent says or **bossing** the parent around, "**attitude"**
   d. **Aggressive or dangerous behavior** towards objects in the room, physically aggressive behavior towards the parent (e.g. **hitting, kicking, biting, shoving, throwing objects at parent**)

Child Events:

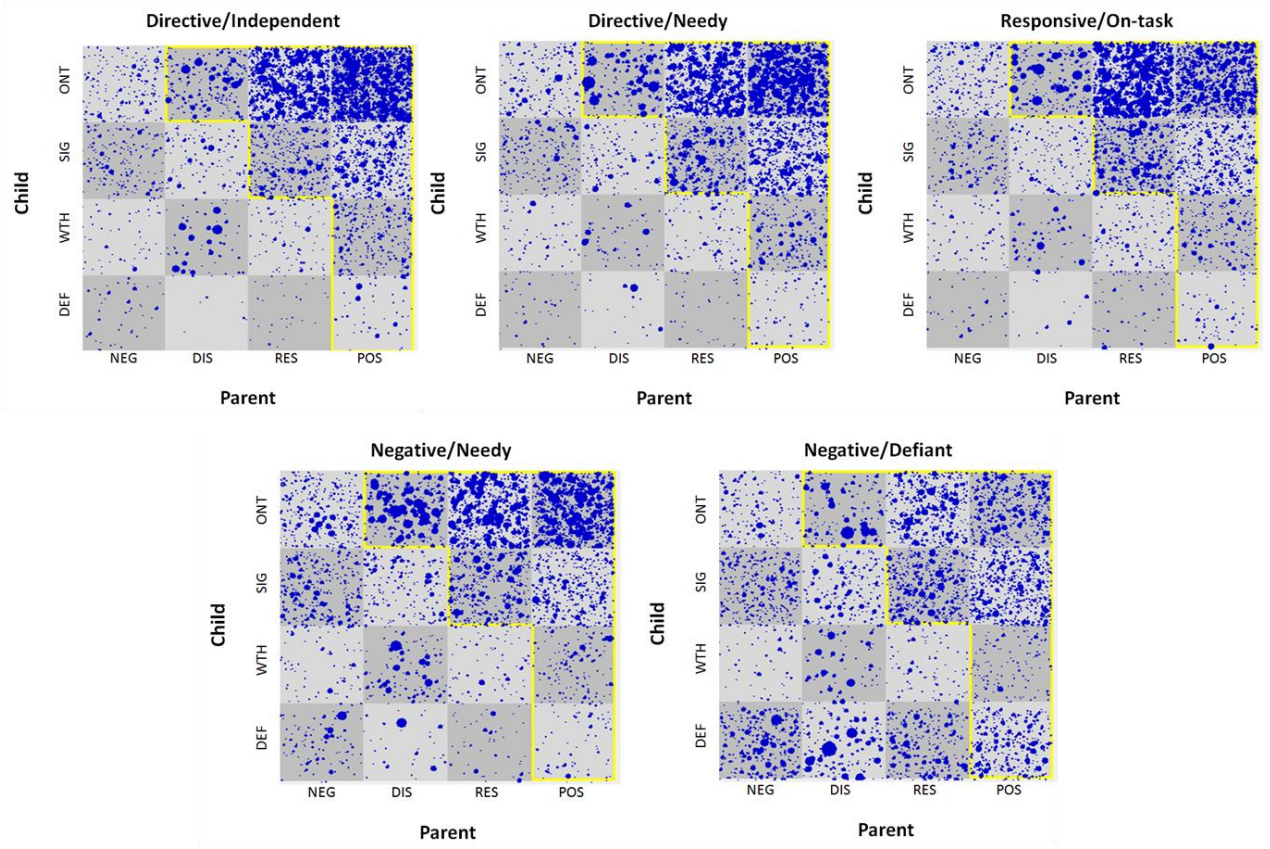
- **Emotion/Feelings words -** Child uses words referring to emotions or feelings states when talking to the parent or talking about self. Emotion and feelings words include (but are not limited to) the following: happy, sad, angry, mad, scared, afraid, lonely, annoyed, irritated, tired, bored, hungry, thirsty, hurt, pain.
- **Care-taking of parent –** Child is comforting, reassuring, or "parenting" the parent either with verbalizations ("It's okay/don't cry/it will be all right") or actions (touching/hugging parent when parent is distressed).
- **Physical aggression towards parent** – Child demonstrates physical aggression aimed at the parent, such as kicking, hitting, biting, or throwing objects. Code clear attempts, even if the parent is able to get out of the way.
- **Non-aggressive physical contact –** Child initiates physical contact that is not aggressive and would not be considered care-taking behavior (e.g. touching parent when parent is not upset, asking for a hug or climbing into lap, leaning against parent when NOT attempting to comfort an upset parent).

Appendix B

SSGs for all dyads divided by interaction task

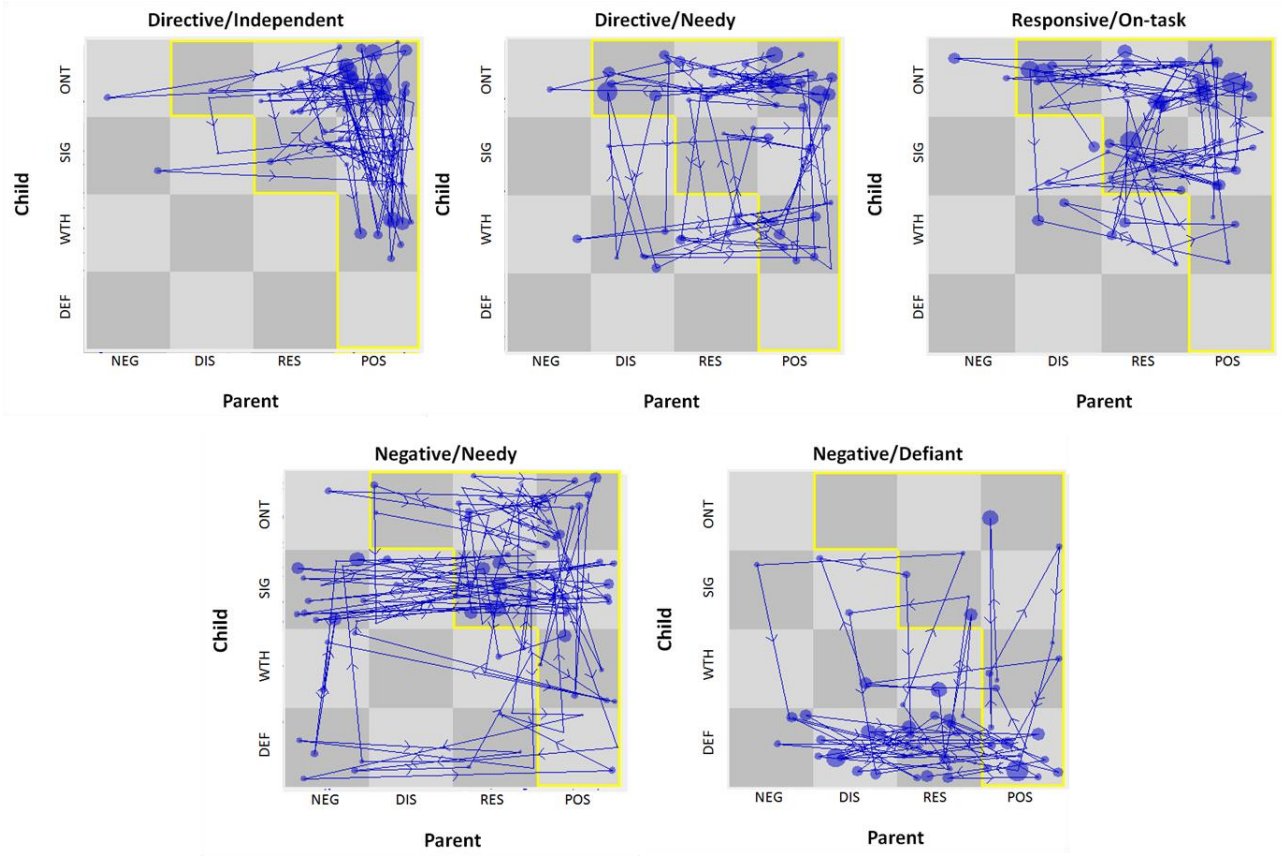


Overall SSGs for 10 dyads from each cluster



Note. POS = positive control, RES = non-directive responsiveness, DIS = disengaged/distracted, NEG = negative control, ONT = on-task, SIG = signals/bids, WTH = withdrawn/distracted, DEF = defiant/disobedient

SSGs for the Safety Plan task for one member of each cluster



Note. POS = positive control, RES = non-directive responsiveness, DIS = disengaged/distracted, NEG = negative control, ONT = on-task, SIG = signals/bids, WTH = withdrawn/distracted, DEF = defiant/disobedient

Appendix C

Bivariate correlations among EF and IQ measures

	2	3	4	5	6	7
1. WPPSI Block Design	.29**	.32**	.30**	.32**	.23*	.22*
2. WPPSI Matrix Reasoning	-	.26**	.31**	.29**	.18*	.26**
3. PPVT		-	.37**	.26**	.32**	0.14
4. Computerized Stroop			-	.49**	.47**	.55**
5. Simon Says				-	.32**	.46**
6. DCCS					-	.26**
7. Peg-Tapping						-

* $p < .05$, ** $p < .01$