BAYER, SAVANNAH. M.S. An Investigation into the Relationship between Mother-Child Co-Regulation Patterns and Self-Regulation Development. (2021)
Directed by Dr. Linda Hestenes. 60 pp.

The significance of strong, healthy self-regulation development has been highlighted by many studies. Recent work on self-regulation development in early childhood has utilized dynamic systems theory to showcase the supportive relationship between parent-child co-regulation and children's self-regulation development. Co-regulation is a socialization process by which children learn how to regulate their behaviors and emotions. Parents exercise co-regulation through modeling, coaching, and explaining their regulatory expectations. This study sought to link co-regulation and emotion related socialization behaviors (ERSB) exchanges during a mother-child interaction to that child's self-regulation abilities. Fifteen-minute video observations of 41 dyads participating in a semi-structured play task were used to track co-regulation and ERSB exchanges. The data from these observations were compared to children's self-regulation scores. Two parent-reported scores using the Emotion Regulation Checklist and a researcher assigned behavioral observation global self-regulation score were used as markers of the children's self-regulation abilities. Most dyads demonstrated high rates of engagement and co-regulation behaviors. Dyads also tended to express neutral or positive affect during the observed interaction. While direct links between the main variables were not found, findings suggest that a dynamic perspective to self-regulation development is complex and requires multiple data collection points and a longitudinal research design to best capture the impact of co-regulation processes.

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN MOTHER-CHILD CO-REGULATION PATTERNS AND SELF-REGULATION DEVELOPMENT

by

Savannah Bayer

Submitted to

the Faculty of The Graduate School at

The University of North Carolina at Greensboro

in Partial Fulfillment

of the Requirements for the Degree

Master of Science

Greensboro

2021

Approved by

Dr. Linda Hestenes

Committee Chair

APPROVAL PAGE

This thesis written by Savannah Bayer has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Chair ____________________________
Dr. Linda Hestenes

Committee Members ____________________________
Dr. Jennifer Coffman

____
Dr. Catherine Scott-Little

July 27, 2021

Date of Acceptance by Committee

July 27, 2021

Date of Final Oral Examination

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I: INTRODUCTION

Most parents and early childhood professionals hope that their young children learn healthy ways to self-regulate their emotions and behaviors. Self-regulation is the ability to control and adjust emotional and behavioral responses in a socially appropriate manner. Murray et al. (2019) define self-regulation as "the act of managing cognition and emotion to enable goal-directed actions, such as organizing behavior, controlling impulses, and solving problems constructively" (p. 372). It is important to note that self-regulation is considered a normative developmental process (Murray et al., 2019). Self-regulatory behaviors stem from learned and innate abilities (Eisenberg, Cumberland & Spinrad, 1998). Understanding how these behaviors develop is crucial for helping children reach their full potential in life through the support and scaffolding needed to maximize their social-emotional skills. Both theory and research shed light on how these processes unfold for young children.

Dynamic systems theory (DST) uses a unique perspective to understand growth and foster it in early childhood. DST also accounts for the complexity of influences on development, leading to the emergence of a new, more advanced understanding of behaviors and thought processes. How novel behaviors emerge, especially those that are adaptive and encourage resilience in times of hardship, are a focus of study for strengths-based developmental scientists. Because of work guided by DST, we know that there are multiple factors at play influencing a child's social-emotional growth. The contributors to healthy self-regulation development should be understood as a priority for practitioners, parents, and teachers to facilitate actively.

This study used secondary data to examine parent-child co-regulation between parents and their preschool children. In this context, co-regulation is the act of guiding and coaching another person through their emotions and behaviors. This study sheds light on the construction processes that contribute to the emergence of self-regulation abilities. Videos of parent-child interactions were coded and analyzed for emotion socialization and co-regulatory patterns between a parent and their child during a structured play task. An adapted version of the Dyadic Interaction Code manual was used to code mother-child behaviors and affect to capture co-regulation processes (Lougheed & Hollenstein, 2011). This study also allowed for the investigation of relationships between the child and the parent's co-regulation behaviors and self-regulation development. This study contributes to the existing literature on co-regulation by incorporating multiple self-regulation outcome measures, analyzing the content of co-regulation interactions, and utilizing videos of play interactions in a familiar setting. This paper will begin with a discussion of dynamic systems theory, a review of research related to co-regulation and self-regulation development, the methods used in the study, the delineation of the research findings based on the specific research question, and finally, a discussion of the results in relation to theory and previous research.

CHAPTER II: DYNAMIC SYSTEMS THEORY

Overview

Over time, human beings grow and develop to be more complex, both biologically and behaviorally. Dynamic systems theory guides the investigation of the various systems at play that facilitates the emergence of new behaviors from interactions among underlying variables (Thelen & Smith, 2006). Dynamic systems theory is a developmental perspective that assesses how living beings grow, learn, and adjust to the environment. According to this perspective, development is a nonlinear, complex, opportunistic, and ongoing process (Goldhaber, 2000). Unlike mechanist theories that consider development a cause-effect relationship between variables, dynamic systems theory deems development a contextual and interaction-based process between an individual and all system levels they are associated with (Goldhaber, 2000). This concept of multicausality, or the notion there is no singular cause to a developmental shift, emphasizes every influential factor on behavior over time. Emotional affect, age, interpersonal relationships, and physiological arousal are examples of forces that can influence behavior in concert (Perone & Simmering, 2017). From a dynamic systems perspective, the aggregate influence of these factors overall is of interest rather than actively seeking to separate them to test their effects individually (Thelen & Smith, 2006).

As defined by dynamic systems theory, input ranging from the microsystem to the macrosystem create collections of related elements and variables. The collections are viewed as a holistic set of contributors to the developmental process (Lewis, 2000; Thelen & Smith, 2006). Dynamic systems principles state that development is a continuous process that draws from information from all system levels. From the molecular to the macrosystemic levels, an individual continuously influences and is influenced by their environment (Thelen & Smith, 2006). As such, human beings are active participants in this bidirectional developmental process.

The complex processes associated with development seem to suggest endless possibilities due to the dynamic and flexible systems at each stage. Nevertheless, we know that human systems related to growth and development are flexible, but only to a certain extent. As babies grow during infancy, they begin to fine-tune certain behaviors and patterns that benefit them. Based on their environment, the patterns may evolve with new information and new psychomotor abilities. An individuals' physiological system begins to prefer certain patterns the more that behavior pattern is exercised. Physical and emotional development occur similar to neural growth, in that neural pathways within the brain become stronger with exercise and increased myelination (National Research Council, 2015). Eventually, these well-used neural connections grow stronger and use less energy to communicate the same amount of information (National Research Council, 2015). Our biological systems are designed to strengthen based on efficiency and necessity. If a pathway is being used, that pathway is maintained and strengthened.

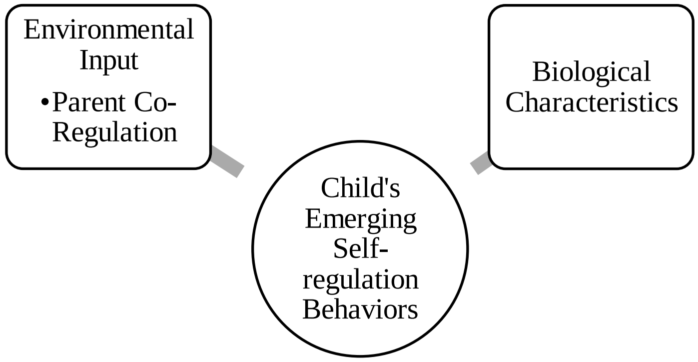
The central nervous system is an integral component in development as it grows, fine-tunes itself, and helps the human body live and adapt to its environment. Biological systems that receive maintenance and attention from the nervous system become stronger, increasing the likelihood of use (Thelen & Smith, 2006; Zeytinoglu et al., 2020). From birth to early adolescence, neural pathways form and die at the highest rates in human life, meaning that their experiences in early childhood are critical to their brain and behavior development. Patterns of thought and behavior quickly form during this period of brain and body growth. For example, when a 4-year-old is under stress and learns that their parent will respond and help when they ask for help, that behavior pattern will start to form and be strengthened if it continues to work. If a stressed 4-year-old knows that the only way they can get their parents' attention is through crying, that may become the behavior the child relies on. These have the potential to be two coping strategies: one being more adaptive and the other more maladaptive.

Thelen and Smith (2006) outline various physiological and biological influences on development within dynamic systems theory. The self-organization of cells and structures is designated as a cornerstone of dynamic systems theory. Lewis (2000) defines self-organization as "the spontaneous emergence of coherent, higher-order forms through recursive interactions among simpler components" (p. 36). Humans are biologically programmed to self-organize information to allow for growth (Lewis, 2000). Automatic organization of information from the environment and active cognitive structures helps individuals make sense of their world. Self-organization encourages the dynamic growth of more complex cognitive-behavioral structures by building a strong foundation. A strong foundation comprised of biological and experiential information allows for growth. Self-organization also allows for developing an individual's ability to link and organize different pieces of information to increase the system's efficiency (Lewis, 2000). These processes are ongoing, albeit usually occurring outside of an individual's awareness.

Dynamic systems theory is a bottom-up developmental process because self-organization occurs, beginning with the smallest pieces of information to help consolidate the information to make space for new growth and learning. As a bottom-up developmental process, dynamic systems theory outlines the trajectory of behavior emergence using self-organization as a significant contributor to growth (Lewis 2000; Hollenstein, 2013). DST emphasizes that self-organization is a critical concept in understanding how knowledge and behavior patterns work together to encourage the emergence of new structures and new behavior. To this point, the culmination of information and ability collected through experience leads to the outgrowth of simpler structures for more complicated, efficient ones. Information about the social world, for example, is continuously assembled and accommodated to adjust for changes in context. Following the flow of new information and responses to behaviors, otherwise known as streams of behavior, responses may stabilize. "Structure is emergent" in that some behaviors can be learned, but others are the result of the self-organization of all an individual's experiences (Lewis, 2000, p.39).

Dynamic systems theory maintains that nature-nurture influences play a vital role in development (see Figure 1.). The emergence of new novel forms of behavior is more organized and complicated than merely being a product of a cause-effect relationship (Goldhaber, 2000). Dynamic systems theory asserts that development is a hierarchically organized process and is comprised of multiple components to cover the complexities that exist in developmental systems. Streams of behavior, attractor states, repellor states, state spaces, and control parameters are the main process variables involved with the emergence of more complex behaviors and abilities. Each component is uniquely designed to follow a developing structure's adjustment process over time (Newtson, 1993).

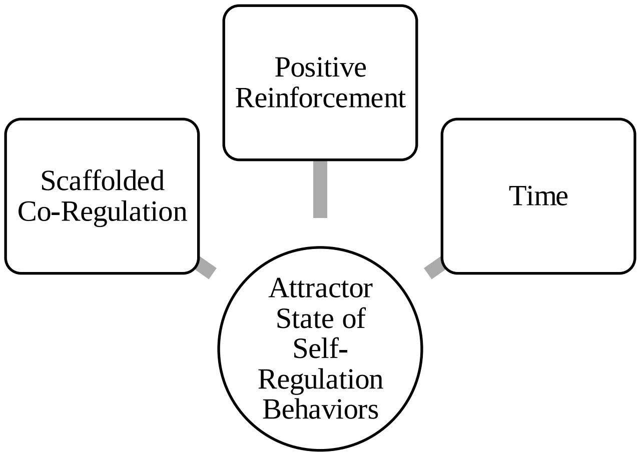
Figure 1. Initial Contributors to Emerging Self-Regulation Behaviors



The Attractor State

An attractor state describes behaviors and responses that a person prefers to exercise in an interaction. Researchers can identify behavior patterns by tracking streams of behavior repeatedly and analyzing changes or shifts in behavior within a context. Streams of behavior become preferred patterns of behavior repeated in similar contexts (Thelen & Smith, 2006). When a stream of behavior is repeated enough in contextually relevant situations, the pattern is considered an attractor state (Newtson, 1993). Physiological explanations of behavior development identify attractor states as states in which a person automatically adheres to in a specific context (Thelen & Smith, 2006). Attractor states are measured by time spent in a particular behavior or emotion and repeated expression of behaviors and emotions. Individuals become more likely to revisit those attractor sets, allowing for the development of more complex, related behaviors to emerge (Shaw, 1981). A child's developing self-regulation skills begin to become regular and predictable, indicating an attractor state of regulatory behaviors. A parent's scaffolding and reinforcement of self-regulation skills help stabilize the attractor state of self-regulation behaviors (see Figure 2.).

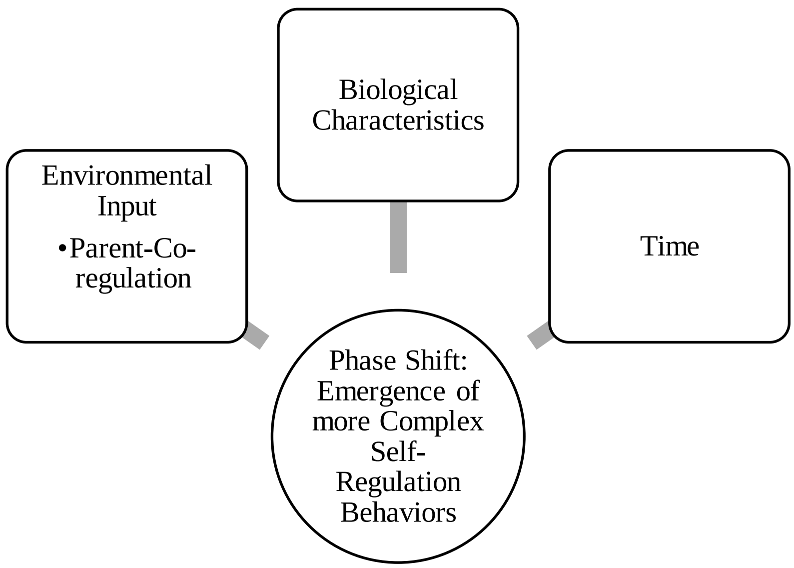
Figure 2. Co-Regulation's Role in the Formation of a Self-Regulation Attractor State



Phase Shifts

Over time an attractor state of behavior can build up enough physiological, socioemotional, and biological ability to overrun control parameters and cause a developmental phase shift. A phase shift leads to the emergence of a more efficient and organized behavior. Skills and abilities have developed to such an extent that the previously common behavior set is less useful, and behavior sets are more equipped to handle these changes. During a phase shift from crawling to walking, children begin to prefer walking over less efficient modes of movement like crawling. Individuals are often not motivated to revert to less efficient and less effective behavior patterns, reinforcing the use of their most updated stream of behavior, which is thought of as an attractor state within dynamic system theory. Loss of flexibility comes with more efficiency and opportunity for more complex behaviors (Thelen & Smith, 2006). Once an attractor state has developed and time has passed, children become more capable of self-regulating. They also now have the potential to transition to an attractor state of more complex, efficient, and self-sufficient self-regulation skills and behaviors (see Figure 3.). For example, a child may rely on their parent to help them calm down when distressed. This parent may tell the child to take deep breaths while they count it aloud. Over time, with increased math skills and the knowledge of this self-regulatory tactic, that child may begin to count out their deep breaths independently. This transition from parent-guided regulation to self-regulation is considered a phase shift.

Figure 3. Contributors to a Phase Shift (Less Complex to More Complex Self-Regulation Behaviors)



Repellor State

A state, behavior, or emotion that individuals tend to stay away from in certain interactions or time periods are known as repellors. Systems draw individuals away from behavior patterns because they are not as efficient. Patterns of avoidance of behaviors or emotions in situations then become defined as repellor states. Repellor states are identified using information about the frequency of behavior on a spectrum to identify avoided behavior states. It should also be considered by context. Repellor states can be identified based on environmental input and situational factors (Newtson, 1993). The combination of repellors and attractors compose the structures and patterns of life experiences. Patterns of emotional affect within a context, for example, can be depicted by contrasting the attractor and repellor states (Newtson, 1993). Ranging from negative to neutral to positive, measurements of affect can pick up moment-to-moment shifts. During an interaction, changes in affect can provide information about engagement and each person's general emotional state. A parent-child dyad who tends to have moderate to high positive affect during the beginning of an observation and low to moderate positive affect towards the end will likely form a positive affect attractor state, with most of their interactions falling into a positive grouping. In this case, researchers may see negative affect as a repellor state for both the parent and the child.

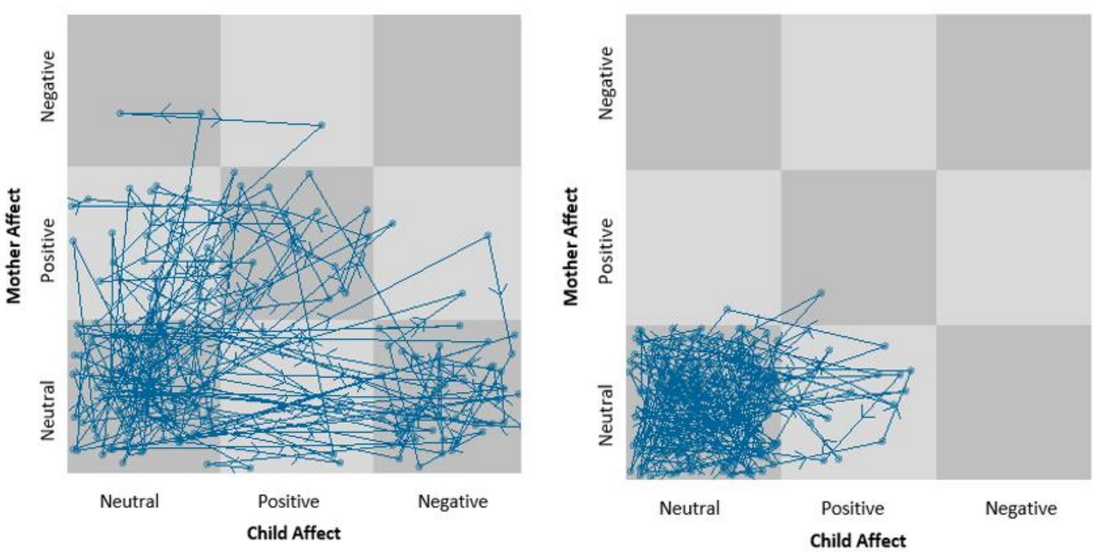
Control Parameter

Control parameters determine the set of possible behaviors that can be exercised in any given moment. They outline the maximum range of behaviors available to a person. The possible behaviors are based upon the prior development of behavior, current context, and all other factors operating during a moment in time (Alibali et al., 2019). These parameters outline the possible expressions of emotion and behavior within a situation. Like the developmental stage of a child, control parameters explain why, for example, a child may not communicate their frustration using words. The child may not have the expressive language ability to communicate their feelings with words. In terms of physical development, a child may not yet have the muscle strength or balance to walk, and thus the control parameters limit the child to crawling. Control parameters are measured by examining the context that behavior exists within across microsystem to macrosystem levels. Individual characteristics are also important to account for when investigating control parameters. Individual characteristics, including genetics, contribute to the developmental process, so they are important to acknowledge within dynamic systems theory (Thelen & Smith, 2006). Examples of the types of individual characteristics that are often studied include age, sex, and temperament. Behaviors have been coded by researchers into a 'state space' to examine patterns.

Measurement of Dynamic Systems Theory: The Use of State Space

Researchers can make sense of the multiple variables needed to understand behavior and development based on DST by analyzing the data using what is known as a 'state space grid' (See Figure 4; Hollenstein, 2013). Figure 4 displays two sample state space grids from the current study, depicting two dyad's affect expressions every 5-seconds in a sequential manner. State spaces help organize data about behaviors, emotions, and other variables studied from a dynamic systems point of view. State spaces are a snapshot of a person's patterns of behavior and emotion over a segment in time (Hollenstein, 2013). For developmental research, state spaces can present the patterns of behavior, emotion, and affect in interactions between a child and their parent. One option for examining these patterns is by studying state spaces with different pairs of individuals. Behavior, emotion, and affect can be analyzed as a pattern and compared across a parent-child dyad sample. The combination of attractor states, streams of behavior, and control parameters contribute to forming a state space. The structure, content, and general patterns of interactions combine to produce a state space (Thelen & Smith, 2006). The structure refers to the flow of interactions across repellors and attractors. For example, a four-year-old child who had learned to walk a few years ago will likely display a preference for walking over crawling when responding to a parent's bid to "come here." In this case, walking is an attractor state, and crawling is a repellor state. Content refers to the behaviors and the meaning behind interactions. Following the previous example, the content of that interaction would include the input from the parent and the child's plan and execution of moving towards the parent. The pattern or flow shows a change in behavior over time and bidirectional information exchanges between multiple systems (Hollenstein, 2013). Before the child could walk, the child likely crawled in response to their parent's bids. With time and the growth of muscles, balance, and coordination, children begin incorporating standing into their crawling movements. The emergence of the ability to walk is quick to follow. Then, parent-child interaction patterns would show that walking became the child's movement preference and thus an attractor state. In addition to standard variable analyses, state space grids do this by mapping out streams of behaviors and calculating attractor states based on statistical relevance in a graphic format (Hollenstein, 2013). The components of a state space account for variations in behavioral or affect states sequentially over time.

Figure 4. State Space Grids: Sample Sequences of Mother-Child Expressions of Affect Every 5-Seconds During a 15-Minute Interaction



Guided by the concepts presented by DST, self-regulatory abilities can be considered as behaviors that emerge using a solid foundation laid by parents and caregivers. This solid foundation comes from strong co-regulation of emotions and behaviors. Co-regulation is effortful guidance, teaching, and modeling positive and healthy ways to work with one's own emotions and behaviors (Gillespie, 2015). Developmental time paired with the knowledge and experience collected through positive co-regulation should lead to the emergence of healthy self-regulation behaviors. In the present study, what is of interest are the attractor states that children develop concerning self-regulation. Parents are most likely to help their children turn healthy self-regulation behavior patterns into an attractor state through positive co-regulation and the exercise of positive emotion socialization (Lunkenheimer et al., 2020). Children exercise their understanding of emotion through social behaviors, primarily with their early childhood caregivers in regular interactions (Eisenberg et al., 1998). The following literature review will break down the concepts of self-regulation development from a dynamical systems perspective, and emotion control processes present in emotion socialization and co-regulation.

CHAPTER III: LITERATURE REVIEW

The development of self-regulation in young children is an important occurrence as it connects to a range of social and emotional outcomes. There are a variety of psychological and physiological structures involved in the development of self-regulation. All systems that play a role in emotion and behavior self-regulation are often categorized under the concept of emotion control processes (Leerkes & Bailes, 2019). Self-regulation is recognized as an active exertion of control over emotions and behavior within emotion control processes based on one's context. Emotion control processes also account for the emotion socialization from parents and caregivers that contribute to a child's socioemotional competencies and how self-regulation is exercised (Leerkes & Bailes, 2019). Co-regulation, the responsive interactions that help children understand and process their emotions and behaviors, is an active demonstration of emotion socialization between a parent and their young child. The concepts of self-regulation and emotion socialization contribute to an approach to studying those co-regulatory interactions. This approach proposes that these emotion control processes can help predict healthy self-regulation development over time.

Self-Regulation

Self-regulation processes are a focal point of research within the realm of emotion control processes (Lobo et al., 2020). The dynamic emergence of emotion and behavior self-regulation abilities is recognized as a normative developmental process that contributes significantly to healthy social and emotional skills (Murray et al., 2019). As predicted by dynamic systems theory, self-regulation skills develop through the compilation of emotion control processes a child experiences in concert with biological and psychological characteristics (Thelen & Smith, 2006). Children exhibit self-regulation through temperament-based effortful control by regulating arousal and affect (Eisenberg, Smith, Sadovsky, & Spinrad, 2004). Self-regulation also uses inhibitory control in the regulation of emotion and behavior. Inhibitory control often relies on suppressing automatic responses that may not be socially appropriate at the time (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). Understanding the development of self-regulation behaviors informs parents and researchers of the typical, healthy trajectory of self-regulation. Likewise, studying the developmental processes at play can identify research and intervention areas to encourage stronger self-regulation abilities for more children.

The Development of Self-Regulation

Parents work alongside their children to help them build a socioemotional skillset to regulate emotions and behaviors better. Some researchers have found that children are challenged to control or moderate their behavioral or emotional responses in school settings, which contributes to the learning and growth of self-regulation skills (Miller & Goldsmith, 2017). These challenges facilitate learning, healthy behavior development, and regulatory abilities, which have been qualified as strong moderators of adverse life outcomes. Similar interactions happen at home between parents and their children. Children are constantly learning from their interactions and observations, making their home environment a strong contributor to self-regulation development.

Self-regulation is an ability that normally develops between the ages of 2 and 5 (Murray et al., 2019). Modeling, co-regulating, and teaching are three methods that encourage the development of self-regulatory abilities during this critical growth period (Lobo et al., 2020). Parents and teachers are often the first models for children, making their social interactions (i.e., co-regulation) a significant contributor to the critical developmental period for self-regulation (Gillespie, 2015). Infants and toddlers learn the behaviors associated with self-regulation through social interactions and social observation. During infancy, a child's emotion and behavior regulation is entirely reliant on their parents and caregivers to provide external soothing. Infants also learn self-soothing tactics like sucking on their fingers or a pacifier to calm down (Rosanbalm & Murray, 2017). As an infant's self-regulation abilities are minimal, this begins a critical period of building and growing. With time and experience, toddlers begin to self-regulate their emotions and behaviors more independently, leading to the formation of a self-regulation attractor state comprised of behaviors like deep breathing, seeking a hug from a caregiver, or holding on to a well-loved blanket to stop crying. Starting at the age of 3, children have entered the preschool years and are more equipped to behave and express emotions that fit their environment. Preschoolers have the capacity to problem-solve and self-regulate for increased lengths of time (Murray et al., 2019; Rosanbalm & Murray, 2017). So, emerging self-regulation skills provide opportunities for parents to use more verbal co-regulation behaviors. Both children and their caregivers play an active role in co-regulation (Lougheed et al., 2020).

However, the parent's role requires high levels of attentiveness, intentionality, and responsiveness for strong co-regulation. Parental responsiveness is a vital factor contributing to healthy co-regulation because the child's state is central to the process (Lunkenheimer et al., 2020). Parents' approaches should work in concert with the child's affect and behavioral input. Over time, each dyad's parent-child co-regulation patterns become more routine (Hadwin & Oshige, 2008). The repetition of strong co-regulation interactions paves the way for the development of attractor states that have the potential to experience a phase shift to more adaptive self-regulation abilities (Lunkenheimer et al., 2020). Using the Emotion Regulation Checklist as an example, at time point one, a parent may rate their child at a 4 (always) for item 8: "S/he is prone to angry outbursts/tantrums easily" (Shields & Cichetti, 1997). The transition over time from always to sometimes or never being prone to angry outbursts/tantrums easily may indicate a phase shift in that child's self-regulation skills from less to more adaptive. Understanding the parent's behaviors in-between time point one and the development of more control over their emotion can help determine what is contributing to the child's healthy progression. According to dynamic systems theory, the repeated interactions and the patterns that form from their experiences, interactions, and observations allow for the development of an attractor state of healthy self-regulation behaviors. It also allows for the potential emergence of more effective coping strategies and stronger self-regulation skills (Lobo et al., 2020).

Methods of Studying Emotion Control Processes

Researchers' work on parent emotion socialization processes has led to a theoretical model to study early regulation development (Eisenberg, Cumberland, & Spinrad, 1998). To study the process of emotion socialization leading to socioemotional competencies, researchers need to understand the contextual, cultural, and personal characteristics that are considered the major contributing factors to the emotion-related parenting practices exhibited with a child. The variable of emotion-related parenting practices, also referred to as emotion-related socialization behaviors (ERSBs), is a critical component of this model. These ERSBs are the emotion-focused co-regulation behaviors that a parent uses while interacting with their child. ERSBs are usually positive, constructive behaviors that address a child's state and promote a desirable outcome and a deeper understanding of emotion expression and emotion control. Examples of ERSBs include parental reactions to a child's emotions and discussions about emotions. For example, when a child gets frustrated with a toy, a parent responding by affirming the validity of their feelings, "I think it is fair to get frustrated when something is not working correctly" and allowing the child to take a step back from the toy to calm down, "do you want to put the toy down for now and work on this puzzle instead?". A lack of positive ERSBs, or inappropriate usage of ERSBs, contributes to the development of challenging behaviors and lack of self-regulation abilities (Eisenberg, Cumberland, & Spinrad, 1998).

Co-Regulation as an Effective Emotion Control Process

Co-regulation and emotion socialization are cooperating emotion control processes (Kurki et al., 2016). Emotion socialization refers to the social processes related to emotions, what they mean, and how they are addressed (Eisenberg et al., 1998). Co-regulation is a bidirectional process in which a person assesses a challenging situation and helps another navigate their thoughts, behaviors, and emotions (Lougheed & Hollenstein, 2011). There are a variety of behaviors that are markers of co-regulation. At home, parents and caregivers may exercise co-regulation at the dinner table by being responsive and constructive when a young child gets frustrated when their food is too hot. A child's frustration can be hard to manage when they do not have the words or skills to self-regulate themselves. That is why an adult stepping in to help a child work through those feelings and find a way to calm down is so important to discuss (Gillespie, 2015). In this example of adult-led co-regulation, the caregiver had the potential to provide a tool to help develop a child's ability to self-regulate and socialize their child to understand what frustration is and how that should be dealt with (Guo et al., 2015; Kurki et al., 2016). In essence, co-regulation processes and emotion socialization processes work parallel to each other with a common purpose.

Emotion Socialization

Emotion socialization is one of the most effective processes that teach children about emotional expression and meaning (Lougheed et al., 2020). Every day, caregivers and children interact with each other. This engagement provides the opportunity to communicate and teach children about life (Cole et al., 2009). Socioemotional engagement can be easily integrated into regular interactions and activities. During play, parents and caregivers can work with their children to understand what it means to be patient and resilient. Sometimes games or play activities can be challenging for children. It can be a challenging task to keep a child engaged during play activities. Parents may find it difficult to work with their young children who are frustrated or angry. It is in these moments that emotion socialization can be impactful. For example, during a play task that is part of a research study, a child may be allocated a certain amount of time to work on a puzzle. The pressure of time to complete a challenging puzzle may lead the child to become upset. A parent can choose to intrude to finish the child's puzzle. Alternatively, a parent has the opportunity to help the child relax and refocus by encouraging and assisting them by coming up with a systematic plan: "you are working hard on this puzzle. Let's take a deep breath, and we can see if we can find some pieces with both blue and red to match this edge". Responsive and constructive parenting in these situations provides children with the tools they need to self-regulate when they feel stressed (Baker, Fenning, & Crnic, 2011). It takes time and outside assistance for children to understand how to manage their emotions (Eisenberg, Cumberland, & Spinrad, 1998). Healthy and productive emotion socialization processes in a child's life encourage the development of strong emotional self-regulatory abilities (Lougheed et al., 2020). In a sense, emotion socialization processes help children learn the social component to dealing with their emotional expression and meaning.

Parent-Child Co-Regulation

The emergence of efficient and healthy self-regulation development is a significant benefit of incorporating intentional co-regulation into daily interactions (Cole et al., 2017). Parents tend to innately co-regulate with their children early in their lives (Valentovich et al., 2018). Soothing through touch and sound is a basic example of co-regulation. As babies grow, they need more help and guidance to adjust to developmental and environmental changes. Infants and toddlers begin interacting with their environment with new cognitive and physical abilities. While these changes are exciting, they also come with the potential of social challenges and obstacles. During this developmental period, parents are strong influences because of their co-regulation behaviors, including directing, modeling, and the scaffolding of more complex, controlled behaviors (Hadwin & Oshige, 2011). Coaching children through difficult situations can feel natural for caregivers, so the introduction of intentionality to make those interactions stronger is one solution (Swingler et al., 2018). Intentional co-regulation also has the power to help parents and caregivers focus on the meaning of their behaviors and what kind of impact they want to have (Gillespie, 2015).

Studies have demonstrated co-regulation strength through analyses done on the parent-child behavior and emotion expression during interactions. Cole et al. (2003) analyzed parental responsiveness and the reciprocity of positive emotions in parent-child interactions in a study comprised of 85 preschoolers and their mothers. Cole et al. (2003) used mother reports and researcher observations of controlled tasks to assess concordance between conduct problems, emotion expression, and behavior expression. Mother reports from the Child Behavior Checklist were used to assess behavior regulation abilities. The researchers observed the participants, parent-child dyads, during a waiting task and a timed play task to assess mutual emotion regulation. The researchers coded the dyad's behaviors and emotions on a second-by-second basis. This study determined that the expression of positive affect in one member of the dyad initiated a positive emotion response from the other. This mutual positive behavior expression pattern was most typical in securely attached dyads with no history of conduct problems for the child. Mutual negative affect occurred less often and only in dyads with a history of reported conduct problems in early childhood. Regardless, co-regulation was deemed helpful when coded as positive and constructive but maladaptive when dyads were coded as negative or angry. However, this study could not determine the impact of the content or structure of co-regulation on self-regulation outcomes. The proposed study accounts for the content of co-regulation interactions and their relationship to self-regulation through the coding scheme that will be utilized.

Guo et al. (2015) examined the content of co-regulatory interactions in contrast with attachment styles in a parent-infant dyad during a strange situation task. The researchers observed the parent and child together, temporarily apart, and then back together to examine emotion and affect changes. The content and structure of co-regulation within parent-child interactions can determine the strength and the adaptiveness of self-regulatory outcomes (Valentovich et al., 2018). Content-dependent emotion co-regulation was present for all dyads in the study. Content-dependent emotion co-regulation is demonstrated by parents relying on contextual information to help guide their child towards a behavioral or emotional goal. An example of content-dependent emotion co-regulation is when a parent spends time encouraging a frustrated child to take a step back and take a breath to keep them focused on the task at hand. The findings showed that secure dyads maintained relatively high levels of positive affect throughout the tasks compared to insecure dyads. The insecure dyads had lower levels of affect throughout the tasks and focused on content-free emotion co-regulation. Content-free emotion co-regulation is not specific or reliant on contextual information (e.g., "Let me see a smile, be happy!"). Because this study demonstrated how a strong, secure relationship between a caregiver and their child helps provide a foundation for effective co-regulation, the proposed study will further examine affect matching and the content of interactions to understand further what makes co-regulation effective for preschool-age children. The proposed study will take this idea a step further by analyzing the relationship between effective co-regulation and self-regulation abilities, as Guo's study did not include a self-regulation measure.

Lobo and Lunkenheimer (2020) investigated the impact of dyadic contingency and dyadic flexibility between parents and their three-year-old on self-regulation abilities at the age of four. Dyadic contingency is the extent to which a dyad sticks to a certain co-regulation pattern. Dyadic contingency was measured through the coding of behaviors and the affect of each person during a timed interaction. Dyadic flexibility was assessed using state space grids and measured a dyad's ability to transition and adapt to changes. The researchers used data from a larger study. Their sample included 100 dyads with data collection points at age three and then at age four. Data included parent reports and observations of the dyad during three parent-child interaction tasks. The tasks included a play task, a clean-up task, and a Parent-Child Challenge Task (PCCT; Lunkenheimer et al., 2017). The Parent-Child Challenge task was an observed dyadic interaction in which the mothers verbally guided their 3-year-old child to complete increasingly difficult puzzles to win a reward. A follow-up study with this sample at age 5 showed when co-regulation was categorized as positive and based on the interaction's context, children displayed stronger self-regulation abilities (Lobo & Lunkenheimer, 2020). In other words, responsive and positive co-regulation interactions significantly impacted later assessments of self-regulation abilities. After running lag sequential analyses, they found that dyadic contingency led to synchronized positive affect during those interactions. Dyads with high levels of flexibility had a higher rate of affect and behavior transitions. The idea of flexibility exemplifies the strength and width of a parent's self-regulation abilities. With the flexibility to work with a child responsively and contextually, the child has more room to incorporate many different regulation skills into their repertoire. Dyadic contingency and flexibility of affect and behavior combined with high positive/neutral interaction content supported healthy self-regulatory development. Affective contingency also supported the child's inhibitory control. This suggests that a wide range of co-regulation strategies and responsiveness amidst a changing environment helps construct a diverse self-regulation skillset. However, this study did not probe which behavior patterns were constructive, which was a goal in the current study.

Current Study

Dynamic systems theory has guided self-regulation researchers towards the developmental period in which self-regulatory abilities begin to emerge. Studies like that of Guo et al. (2015), who examined co-regulation in infancy, cannot look at the impact of those interactions unless the sample is followed longitudinally. Co-regulation patterns need to have been stabilized to some extent to understand better the attractor states that are formed during those interactions. An ideal time to study the co-regulation patterns that have been developed and their impact on children's self-regulation is between the ages of three and six.

Studies that have investigated co-regulation patterns in self-regulation development in this age group have found relationships among those processes, but some limitations exist in this work. DST requires a researcher to examine the collection of variables, processes, and contexts in combination with change over time to make conclusions about behavior emergence. Additionally, the identification of control parameters and phase shifts is necessary to understand how development unfolds. Given that this approach is difficult and expensive to implement, researchers often focus on smaller aspects of co-regulation in self-regulation development. Shortterm in-depth studies can make significant contributions to the field. For the current study, I contribute to the literature by producing a deeper understanding of the strength and impact of everyday co-regulation and how this might relate to a preschool child's current self-regulatory skills. An analysis of co-regulation processes between a four- to five-year-old child and their parent during a timed, developmentally appropriate play task provided helpful information about the content, structure, pattern, and intensity of co-regulation interactions that may regularly occur in the home. Regular co-regulation patterns, or a lack thereof, should then relate to the child's self-regulatory abilities.

Self-regulation was assessed using one parent report with two subscales and one behavioral observation measure. The Emotion Regulation Checklist provided two scores that represented the mother's perception of her child's emotion regulation abilities. The behavioral observation measure was based on codes and scores assigned to the child during a behavioral observation of a videotaped Lock Box Task. The behavioral observation Lock Box Task was used to formulate a global regulation score that was used to describe the child's self-regulatory abilities during that task. Having both parent reports and an observation-based measure of self-regulation further contributes to the literature on co-regulation.

Few studies look at co-regulation between parents and their preschool-age children in conjunction with their children's self-regulation development. It is helpful to investigate what co-regulation patterns correlate with healthy and constructive responses from children and whether those interactions significantly associated with a child's general emotion and behavior regulation abilities. The content, structure, and pattern of co-regulation interactions can determine the effectiveness of those emotion-related socialization behaviors. It is also helpful to study reciprocity between parent and child affect. Positive affect in both members of a dyad should create a long-lasting positive expression pattern for the dyad as a foundation for growth and healthy self-regulatory development. A lack of reciprocity is displayed when the dyad's affect is not in synch, leading to a less impactful interaction. This study aimed to test the relationship between emotional affect, co-regulation, and child self-regulation capabilities.

My research questions included one exploratory/descriptive question (#1) and three questions based on current literature (#2-4):

1. How do the mother-child dyads behave and express emotion during the Three-Bags-Task? How do the two self-regulation measures (Parent report from the Emotion Regulation Checklist and observed behavior from Lock Box Task) relate to one another?
2. How does flexibility, as determined by displaying a wide range of positive parent co-regulation behaviors (Teaching/Proactive structure, Positive reinforcement, Commands), relate to children's self-regulation abilities?
    a. Hypothesis: Greater flexibility of displays of positive parent co-regulation behaviors will be significantly and positively correlated with children's self-regulation.
3. How does time spent in positive, constructive parenting behaviors relate to child engagement? Does parent engagement correlate with child engagement? Does parent engagement encourage positive co-regulation behaviors?
    a. Hypothesis: The frequency of positive parent behaviors and engagement will be significantly positively correlated with the number of adaptive child behaviors displayed. Negative parent behaviors and disengagement will be significantly positively correlated with dysregulated child behaviors.

4. What affect attractor states do the mother-child dyads spend most of their time in? What is the relationship between the dyadic affect attractor states, determined by the affective groups the parent-child dyad is most frequently observed in, and self-regulation scores?

    a. Hypothesis: A positive dyadic affective attractor state will predict higher self-regulation scores.

CHAPTER IV: METHODS

This study used secondary data to examine mother-child co-regulation behaviors. The secondary data was collected from a larger, longitudinal R21 study referred to as "Learning, Emotions, and Play in School". The researchers used this study of a sample of 102 pre-K children to capture executive function and emotion regulation development over time in home and school contexts. The purpose of the R21 Pilot was to test the processes associated with learning, emotions and play in school. The PIs used various behavioral and self-report measures, observations, and physiological indicators to produce a full picture of the contributors and mechanisms that underlie a child's regulatory development. The original study had three data collection time points over one year. The current project used data from one time point. The procedures included coding existing videos of mother-child interactions during a semi-structured play task in a secluded room either at their home (n=13) or at their childcare center (n=28) and analyzing them for emotion socialization and co-regulatory patterns. This study also investigated the relationships between co-regulation and children's regulatory behaviors captured by existing social-emotional outcome measures.

Participants

The current sample included a subset of 41 mother-child dyads who participated in the Three Bags Task. At the time of the Three Bags Task, children's age ranged from 50 to 69 months (M=57.8) and included 20 boys and 21 girls. In this sample, 17.1% of mothers did not report their post-high school education, 2.4% of mothers attended some college, 4.9% attended vocational or associate programs, 19.5% earned a bachelor's degree, 19.5% earned a master's degree, and 36.6% earned a doctoral degree. For those families' who reported it, incomes ranged from $52,000 to $432,000 (M=$148,925; SD=$59,007; N=32). Mothers reported their child's race or ethnicity. The sample's ethnic category reports included Caucasian (n=29), African American (n=5), Hispanic/Latino (n=1), Asian/Pacific Islander (n=1), and Mixed (n=5). The children came from seven childcare centers in North Carolina, with one being a Head Start Program.

Procedures

Pre-K classroom teachers from seven full-time childcare centers, head-start programs, and church-based nursery school programs were invited to participate in the larger pilot study. Teacher who expressed an interest in the project invited children and parents from their classroom to participate in various regulation, cognition, and academic performance measures. Of the children who ended up participating in the pilot study, a subset of 50 dyads participated in the Three Bags Task. Of those dyads, 41 had no missing Three Bags Task data and were used as the current study's sample. Two children from the subsample attended a head start program, three were enrolled in a church-based nursery program, and the remaining children attended one of five full-time childcare centers. The observational measure of children's self-regulation abilities during a Lock Box Task, the mother-child Three Bags Task, and parent reports using the Emotion Regulation Checklist were collected between Spring of 2013 and Spring of 2014.

Measures

Emotion Regulation Checklist

Mother reports on the 24-item Emotion Regulation Checklist indicated the mother's perception of the child's emotion regulation abilities (Shields & Cicchetti, 1997). The items are rated on a 4-point Likert scale that indicates how frequently behaviors occur. Sample items include: "S/he can recover quickly from episodes of upset or distress (for example, does not pout or remain sullen, anxious, or sad after emotionally distressing events)" and "S/he exhibits wide mood swings (for example, the child's emotional state is difficult to anticipate because s/he moves quickly from very happy to very sad or mad)." An overall score is calculated to indicate weak to strong emotion regulation. The ERC contains two subscales. These subscales are used to assess Emotional Regulation and Emotional Lability/Negativity. The authors of the scale report that the Emotional Lability/Negativity subscale has a Cronbach's alpha of .96, and the Emotion Regulation subscale was .83 (Shields & Cicchetti, 1997). The emotion regulation subscale specifically assesses "situationally appropriate affective displays, empathy, and emotional self-awareness" (Shield & Cicchetti, 1997, p. 910). Children who receive higher scores demonstrate more adaptive emotion regulation processes. The Emotional Lability/Negativity "lack of flexibility, mood lability, and dysregulated negative affect" (Shield & Cicchetti, 1997, p. 910). Children who receive higher scores demonstrate more emotion dysregulation behaviors. Researchers have established validity using correlations with observers' ratings of the children's regulatory abilities and expressions of affect (Shields & Cicchetti, 1997).

Lock Box Task

A self-regulation behavior observation using a Lock Box Task provided a global self-regulation score to represent children's general self-regulatory abilities. During the Lock Box Task, a research assistant video-taped a child's attempt to open a locked box with a toy inside with a set of keys that do not fit the lock. The coding began when the child oriented towards the task. The mother sat nearby but was instructed not to interact with the child. In essence, this task tested the child's ability to regulate their behaviors (to follow the instructions) and their emotions (to calm down in moments of frustration). The coders used the Lock Box Coding Manual to identify and report the frequency of help-seeking behaviors, distractions, physical and verbal negative expressions, resignation, latency to frustration, duration of frustration, and maternal involvement. Based on these codes, a global regulation score was assigned for each child (0-4), with a 0 indicating that the child "demonstrated no control of distress responses to stimuli" and a 4 indicating that "the child seemed to completely regulate distress responses and distract from source of distress most of the time". An interrater reliability analysis using Cohen's Weighted Kappa statistic was performed to determine consistency among the two raters. The interrater reliability for the raters was found to be Kappa = 0.49 ($p < .0.001$), 95% CI (0.348, 0.625).

Three Bags Task

Researchers videotaped mother-child dyads in the structured play task. Dyads were sat at a table facing the camera with space in front of them to play. Mothers were asked to play with their children as they normally would for 15-minutes with a standardized set of three activities (a wordless picture book, two puzzles, and mailbox simulation toy). The wordless picture book was illustrated to tell the story of a child during a rainstorm. The two puzzles were labeled 1 and 2 with the intention the dyads play with them in order from easy to more difficult. The mailbox simulation toy came with a mailbox, postcards, stamps, and a key to simulate dropping off and picking up mail. Mothers were instructed to play with each bag, starting with the wordless picture book and ending with the mailbox, for about 5-6 minutes each. Dyads asked to sit and play together during each activity however they would like.

Each video observation of the Three Bags Task was approximately 15-minutes long ($M=15.05$, $SD=1.03$). The video observation begins when the dyad opens the first bag. Maternal and child behaviors were coded using Noldus Observer 14. The Dyadic Interaction Code manual was used as a reference to code mother-child behaviors and affect during the Three Bags Task to capture both behavior and emotion co-regulation processes (Lunkenheimer, 2009). We adapted aspects of this coding manual to fit this study's needs and simplify some of the codes. Codes are listed in Table 1. The coding scheme was specifically designed for tracking co-regulation behaviors and emotion expressions between a parent and their child during the Three Bags Task. The researchers first coded affect and engagement for the mother and child at 5-second intervals. The second viewing of the video was used to code mother and child co-regulation behaviors. All videos were saved and uploaded to a secure folder throughout the coding progress.

Parent behaviors were coded as point events. Parent behaviors included Intrusions, Teaching/Proactive Structure, Commands, and Positive Reinforcement. Each time a behavior from the coding scheme was observed, it received its corresponding code. If behaviors lasted longer than 3-seconds, they were coded again as a new event. Behavior flexibility in mothers was measured by the number of different co-regulation behaviors present during the play task from 0 (no positive parent co-regulation behaviors displayed in interaction) to 3 (3 positive parent co-regulation behaviors displayed across all interactions). Frequency of co-regulation behaviors was measured by computing the sum of positive, parent behaviors (commands, teaching/proactive structure, and positive reinforcement) divided by length of observation, creating a rate of time per minute spent in positive behaviors. Commands are clear directives or prompts to illicit a change in the child's behavior (e.g., "put that puzzle piece in the corner"). Teaching/proactive structure describes parent behaviors that prompt, guide or encourage the positive, desired behavior of the child or when the parent explains to the child how something works or offers clear instruction about a game or task in a helpful way (e.g., "this puzzle piece is a corner piece because it has two flat sides"). Positive reinforcement describes the mother's expressions of reward, praise, or support of a child's behaviors, emotions, and comments (e.g., "you are good at puzzles!"). Mother engagement and child engagement were measured by the proportion of time each spent engaged over the Three Bags Task across all the 5-second intervals. This was computed by summing the number of events of engagement divided by total engaged and disengaged events coded. Although not positive co-regulation behaviors, intrusions were coded and included in the descriptive analysis as it is a common parenting strategy during play. Intrusions represent the parent intruding upon or "taking over" the child's play or task-related behavior. Intrusions were parent behaviors coded as events.

Child behaviors (bids for help, compliance, and noncompliance) were also coded as events. Each time a behavior from the coding scheme was observed, it received its corresponding code. If behaviors lasted longer than 3-seconds, they were coded again as a new event. Compliance and noncompliance were only coded in response to a parent command. Compliance is coded when the child follows their mother's command. Noncompliance is coded when the child does not respond to or follow their mother's command. Children's requests for more information, help, or clarification were coded as 'bids for help.' Bids for help (BH) were split into four categories based on frequency (0: no BH, 1: 1-3 BH, 2: 4-6 BH, 3: 7+ BH). Child compliance was calculated as the frequency of total compliant responses to commands during the play interaction. If a child was always compliant, they received a 0 for noncompliance, and they received a 1 if they showed one or more moments of noncompliance.

Emotional affect was coded into three categories: Neutral, Positive, and Negative. Affect codes were determined based on what the individual was presenting for the majority of each 5-second interval (i.e., if the mother displayed positive affect for 3 out of 5 seconds, the state code was positive affect). Neutral was coded when no emotion expression was present. Positive affect was characterized by smiles, laughs, and other physical and verbal expressions of happiness. Negative affect included expressions of annoyance, frustration, anger, and other physical and verbal expressions of discomfort and sadness. Affect attractor states were identified by putting the parent-child affect data into GridWare software (Hollenstein, 2013). Attractor states communicate what behaviors a person often exhibits (Thelen & Smith, 2006). An attractor state includes the handful of behaviors that an individual or group is drawn to out of all possible behaviors. GridWare software also produced statistics including frequencies and durations describing each dyad's affective state spaces, each dyad's total state space grid, and the state space grid, including all dyads' events (Hollenstein, 2013). See Table 1 for a list of code categories and names of each variable for parent and child behaviors.

One graduate researcher and I practiced using the Co-Regulation Coding Scheme with example videos. Once the coding definitions were agreed upon, we each coded two videos independently and then checked for reliability, which surpassed 85%. Ten videos were dual coded. Percent agreement scores were calculated for each variable: mother engagement (M=.98, SD=.04, range: .87-1), child engagement (M=.98, SD=.02, range: .94-1), mother affect (M=.94, SD=.04, range: .88-1), child affect (M=.91, SD=.04, range: .84-.97) and co-regulation behaviors (M=.86, SD=.05, range: .79-.96). All disagreements were resolved through discussion. At least 90% agreement was reached for 20% of the total videos ranging from 91% to 97% (M=.94, SD=.02).

Table 1. Behavior and Affect Codes for Parent-Child Dyads

	Parent Behaviors	**Child Behaviors**
Negative Behaviors	Intrusion +	Noncompliance *
Positive Behaviors	Positive Reinforcement x Teaching/Proactive Structure x Commands x	Compliance x Bids for Help +
Affect	Negative + Neutral + Positive +	Negative + Neutral + Positive +
Engagement	Engaged * Disengaged *	Engaged * Disengaged *

*Dichotomous

+Categorical

xContinuous

CHAPTER V: RESULTS

Preliminary Analyses

All behavior and emotion codes across the Three Bags Task were assessed for normality using skewness and kurtosis tests. Descriptive statistics were computed (see Table 2). Q-Q plots were created to ensure further the variables were normally distributed. Variable distributions for behavior flexibility, intrusive behaviors, and child noncompliance revealed high kurtosis and high skewness, so the variables were transformed before analysis. Mother engagement (M=.98, SD=.06) and child engagement (M=.98, SD=.03) were highly skewed, with almost all dyads maintaining high levels of engagement throughout the Three Bags Task. The engagement variables are included in Table 2 but omitted from further analyses. Three self-regulation scores were used as self-regulation child outcomes: the parent responses to the Emotion Regulation Checklist (ERC) and the global self-regulation score (an assessment of the child's self-regulatory abilities during the Lock Box Task) assigned to children by researchers during the Lock Box Task. The Emotion Regulation Checklist (ERC) contains two subscales representing emotion regulation skills and emotional lability/negativity. The observed behavior global self-regulation score from the Lock Box Task measured regulation behaviors globally on a scale of 1 (unregulated) to 4 (well-regulated). The observed behavior global self-regulation scores were normally distributed. Correlations and ANOVAs were used to examine relationships between child and family characteristics (age, race, gender, and SES) with each of the independent and dependent variables. Table 2 outlines means and standard deviations for the primary study variables, with Table 3 displaying levels of categorical variables and the number of dyads assigned to each level. Table 4 shows bivariate correlations for the primary study variables and potential covariates. Correlations did not show relationships with demographics, so there was no need for covariates

Table 2. Descriptive Statistics for Primary Variables

Variable Name	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis	N
Length of Observation (minutes)	10.1	17.55	15.05	1.03			41
Age in Months	50	69	57.83	4.76			41
Total Income	52000	432000	149406.3	62765.75			32
Sex	0	1	0.51	0.51			41
Proportion of Child Engagement	0.84	1	0.9871	0.03	-3.76	15.14	41
Proportion of Mother Engagement	0.64	1	0.9871	0.06	-6.16	38.83	41
Frequency of Intrusions	0	4	1.48	0.95	0.86	0.89	41
Rate of Co-regulation Behaviors	0.46	8.45	5.02	1.75	-0.09	0.22	41
Frequency of Commands	5	30	13.48	5.81	0.65	0.15	41
Frequency of Teaching/Proactive Structure	0	103	52.56	21.03	0.44	1.09	41
Frequency of Positive Reinforcement	0	23	9.51	5.69	0.32	-0.55	41
Frequency of Compliance	3	21	11.48	4.73	0.35	-0.71	41
Noncompliance Groups	0	1	0.73	0.45	-1.09	-0.86	41
Frequency of Bids for Help	0	3	1.12	0.78	0.77	0.82	41
Observed Self-Regulation Score	0	4	2.36	1.04	-0.35	-0.13	39
Lability/Negativity Score	17	43	26.06	5.88	1.05	1.52	35
Emotion Regulation Score	22	32	26.91	2.82	-0.42	-1.03	35

Table 3. Frequencies for Categorical Variables

Variable Name	Groups	Number of Dyads Assigned to Each Group
Intrusions	No Intrusions	4
	1-3 Intrusions	20
	4-6 Intrusions	12
	7-9 Intrusions	3
	9+ Intrusions	2
Noncompliance	No	11
	Yes	30
Bids for Help	No Bids for Help	7
	1-3 Bids for Help	25
	4-6 Bids for Help	6
	7+ Bids for Help	3
Attractor State	Child Neutral/Mother Positive	7
	Child Positive/Mother Neutral	20
	Child Positive/Mother Positive	13

Table 4. Bivariate Correlations for Primary Variables

	Length of Observation	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age in Months	-0.14													
2. Income	-0.08	-0.3												
3. Sex	0.21	.36*	0.18											
4. Intrusions	-0.04	0.04	-0.04	-0.17										
5. Commands	0.21	0.07	0.04	0.08	.37*									
6. Teaching/Proactive Structure	0.17	-0.12	0.02	-0.06	-0.11	.31*								
7. Positive Reinforcement	-0.06	-0.1	0.06	-0.16	-0.1	0.28+	.53**							
8. Co-regulation Behaviors	0	-0.06	0.05	-0.1	-0.02	.48**	.94**	.71**						
9. Compliance	0.23	0.06	0.08	0.19	0.29+	.89**	0.28+	0.23	.42**					
10. Noncompliance	0.24	0.05	-0.05	-0.04	0.02	.42**	0.17	0.22	0.23	0.25				
11. Bids for Help	.34*	-0.12	-0.18	-0.04	-0.08	-0.1	-0.14	-0.13	-0.22	-0.1	0.17			
12. Lability/ Negativity Score	0.22	-0.02	-0.17	0.11	-0.14	-0.12	0.28	-0.16	0.1	-0.19	0.13	-0.01		
13. Emotion Regulation Score	-0.16	0.18	0.06	-0.01	0.16	0.21	-0.04	0.11	0.07	.38*	-0.14	-0.28	-.71**	
14. Obsv. Self-Regulation Score	-0.15	0.14	0.32	0.09	0	-0.15	-0.19	-0.07	-0.17	-0.1	0.11	-0.12	0.15	0.02

+ Correlation is significant at the .1 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Research Questions

The first research question focused on how the mother-child dyads behaved and expressed emotion during the Three Bags Task as well as how the two self-regulation measures (Parent report from the Emotion Regulation Checklist and observed behavior from Lock Box Task) related to one another. The results showed that dyads were highly engaged, 98% of the time on average (M=.98, SD=.06; M=.98, SD=.03) during the Three Bags Task. Dyads most frequently expressed neutral or positive emotions. Three attractor states were formed across dyads with the mean indicating average number of dyadic affect expressions in each attractor state and "n" indicating the number of dyads that formed attractor states within that state space: Child Neutral/Mother Positive (n=7; M=10.02, SD=9.56), Child Positive/Mother Neutral (n=20; M=14.39, SD=11.39), and Child Positive/Mother Positive (n=13; M=14.27, SD=15.5). Rates of Commands (M=13.48, SD=5.8), Teaching/Proactive Structure (M=52.56, SD=21.03), and Positive Reinforcement (M=9.51, SD=5.69) were normally distributed and illustrated that almost all mothers displayed all three types of engagement. Self-regulation outcome scores were also normally distributed. Mothers tended to rate their child's Lability/Negativity moderately (M=26.06, SD=5.89) as well as their child's Emotion Regulation skills (M=26.91, SD=2.8). In other words, mothers perceived their children as having average emotion regulation abilities. A total of 7 children or 17% used no bids for help, 61% (n=25) used 1-3 bids for help, 14.6% (n=6) had 4-6 bids for help, and 7% (n=3) used more than 7 bids for help. A total of 73% of children (n=30) responded to commands with noncompliance. Noncompliance most often presented itself as ignoring their Mother's Command because they were focused on something else. Rates of compliance for children were normally distributed (M=11.49, SD=4.73). The observed behavior self-regulation score was not significantly correlated with either of the two ERC subscales:

Lability/negativity (r=-.15, p=.42) or Emotion regulation (r=.02, p=.9). The ERC Lability/Negativity subscale and the ERC Emotion Regulation subscale were strongly negatively associated (r=-.71, p=.000).

The second research question asked how flexibility, as determined by displaying a range of positive parent co-regulation behaviors (Teaching/Proactive structure, Positive reinforcement, Commands), related to children's self-regulation abilities. Behavior flexibility, however, was not included in any analyses as most mothers (n=40) displayed all three positive co-regulation behaviors during the Three Bags Task. Kurtosis and skewness tests further demonstrated that the data were not normally distributed. Instead, I first compared each co-regulation behavior to the self-regulation outcomes. Next, I computed a co-regulation variable to assess the association between the frequency of parent behaviors and children's self-regulation scores. The co-regulation variable included the sum of positive parent behavior frequencies divided by the length of the observation. Each co-regulation behavior was analyzed in relation to the others using correlations to check co-occurrence amongst co-regulation behaviors. Commands were positively correlated with both Teaching/Proactive Structure (r=.31, p=.05) and Positive Reinforcement (r=.28, p=.07). Teaching/Proactive structure was also positively correlated with Positive Reinforcement (r=.53, p<.01). So, the sum of the three co-regulation behavior frequencies divided by the length of the observation was used to determine relationships between the rate per minute of co-regulation behaviors and the children's self-regulation abilities. The rate of co-regulation was normally distributed (see Table 1.) This variable, co-regulation, did not correlate with the observed behavior score for self-regulation (r=-.17, p=.3) or with the two parent-reported subscales from the ERC measure: Lability/negativity (r=-.1, p=.56) and Emotion regulation (r=.07, p=.68).

Intrusive behaviors have been previously theorized to correlate with child self-regulation outcomes (Lobo & Lunkenheimer, 2020). So, as a post-hoc test, intrusion behaviors and child self-regulation outcomes were compared using a one-way ANOVA. Intrusive behavior frequencies were not significantly different in relation to ratings of lability/negativity ($F(4,30)=.604$, $p=.66$), emotion regulation ($F(4,30)=.807$, $p=.53$), or the observed behavior self-regulation score ($F(4,34)=.458$, $p=.77$).

The third research question asked (1) how time spent in positive, constructive parenting behaviors related to child engagement, (2) whether parent engagement correlated with child behaviors and (3) whether parent engagement correlated with positive parent co-regulation behaviors. Mother engagement ($M=.987$, $SD=.06$) and child engagement ($M=.987$, $SD=.03$) were tested for normality using skewness and kurtosis tests. These variables were highly skewed and not normally distributed, so they were not used in analyses. Therefore, these research questions could not be tested. However, to identify possible trends between engagement and self-regulation abilities, the engagement data was used to separate mothers and children into two groups (1: Moments of Disengagement; 2: Always Engaged). Still, no significant relationships were found between mother engagement groups and the observational self-regulation score ($r=.071$, $p=.67$), lability/negativity ($r=-.028$, $p=.87$) or emotion regulation ($r=.043$, $p=.81$). Likewise, no significant relationships were found between the child disengagement groups and the observational self-regulation score ($r=.1$, $p=.53$), lability/negativity ($r=.022$, $p=.9$), or emotion regulation ($r=-.04$, $p=.82$).

The final research question sought to determine (1) which affect attractor states the mother-child dyads spent most of their time in, and (2) the relationship between the dyadic affect attractor states and self-regulation scores. Descriptive statistics were analyzed for each affective attractor state group. The total number of events in each affective group was compared. The affect state space with the highest number of events was identified as the attractor state. Affect attractor state and self-regulation outcome scores were compared using ANOVA for the parent-reported self-regulation scores and chi-squares for the observed self-regulation scores. Affect attractor states were determined by the duration of time each mother-child dyad spent in affective states outside of baseline (mother neutral/child neutral). Figure 5 displays all dyadic moments of affect expression across all dyads. Every affect code for every dyad is depicted in Figure 5. The data mapped in this graph demonstrate that participants tended to stay in positive and neutral affective states. Figures 6-8 provide three examples of participants' affect state space grids during the Three Bags Task with dyads' attractor states outlined. Table 5 outlines the descriptive statistics for the duration of time dyads spent in the affect state spaces. Only three attractor states were found during this observation (see Table 6): Figure 6. Child Neutral/Mother Positive (n=7), Figure 6. Child Positive/Mother Neutral (n=20), and Figure 7. Child Positive/Mother Positive (n=13). According to Table 4, most dyads formed attractor states in Child Positive/Mother Neutral (M=14.39) and Child Positive/Mother Positive (M=14.27). To determine if there was a relationship between synchronized affect (i.e., Child Positive/Mother Positive), asynchronized affect (i.e., Child Neutral/Mother Positive), and self-regulation outcomes, correlations were used. Synchronized affect was not significantly associated with the observed self-regulation score (r=-.161, p=.33), Lability/Negativity (r=-.125, p=.47), or Emotion Regulation (r=-.003, p=.98). Likewise, asynchronized affect was not significantly associated with the observed self-regulation score (r=-.174, p=.29), Lability/Negativity (r=-.06, p=.71), or Emotion Regulation (r=.02, p=.92).

A one-way ANOVA was used to test the relationship between attractor states and self-regulation outcome scores. Parent reports of children's Lability/Negativity did not significantly differ by attractor state ($F(2,31)=1.33$, $p=.28$). Parent reports of child's Emotion Regulation did not significantly differ by attractor state ($F(2,31)=.639$, $p=.54$). The observed behavior measure of self-regulation abilities did not significantly differ by attractor state ($F(2,35)=.236$, $p=.79$).

To further test the relations between attractor states and behaviors, a one-way ANOVA was used to compare attractor states and rates of child compliance. Rates of compliance did not differ by attractor state ($F(2,37)=.213$, $p=.81$). A chi-square test was used to compare attractor states and rates of parent intrusions ($x^2(8)=16.23$, $p=.04$), indicating a significant association between intrusions and attractor states. Dyads with attractor states in Child Positive/Mother Neutral (50%) and Child Positive/Mother Positive (32%) were more likely to experience parent intrusions than the attractor state of Child Neutral/Mother Positive (17.5%).

Figure 5. Affect State Space Grid (SSG) Including all Expressions of Affect Across all Dyads (n=41)

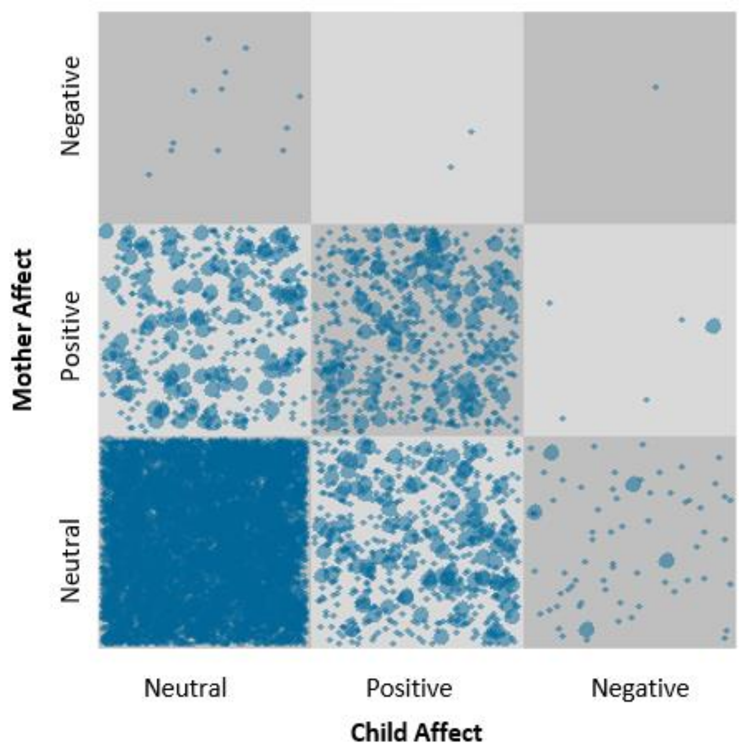


Figure 6. State Space Grid: Sample Child Neutral/Mother Positive Attractor State

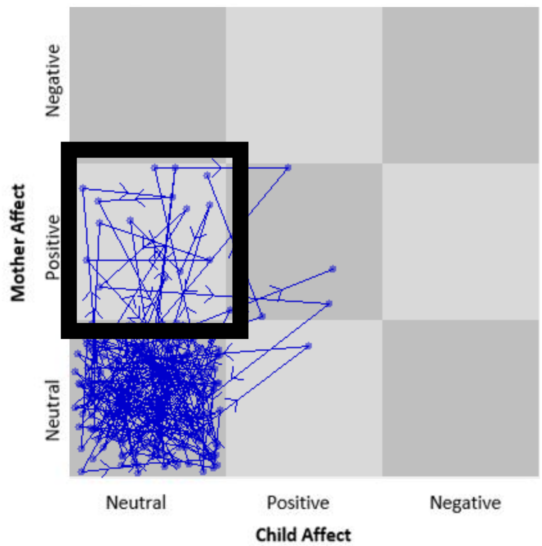


Figure 7. State Space Grid: Sample Child Positive/Mother Neutral Attractor State

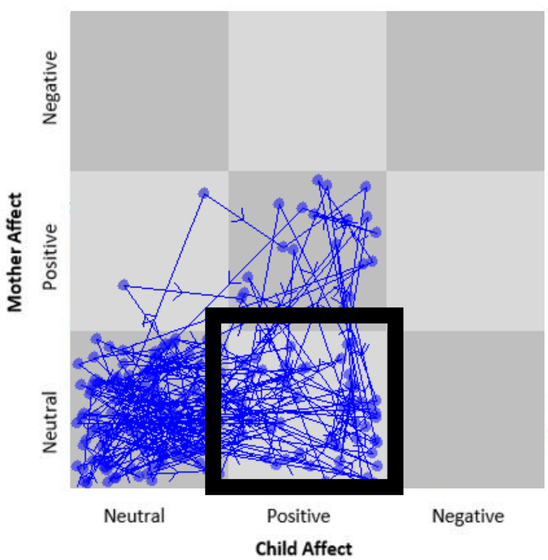


Figure 8. State Space Grid: Sample Child Positive/Mother Positive Attractor State

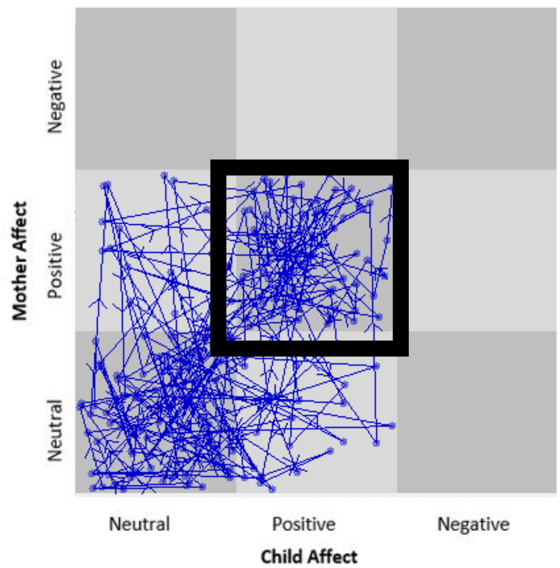


Table 5. Duration of All Dyadic Expressions of Affect in Each Affect State Space

	Minimum	Maximum	Mean	Std. Deviation	Variance
Child Neu./Mother Pos.	.00	40.00	10.02	9.56	91.42
Child Neu./Mother Neg.	.00	5.00	.29	.90	.81
Child Pos./ Mother Neu.	.00	52.00	14.39	11.39	129.94
Child Pos./ Mother Pos.	.00	68.00	14.27	15.50	240.40
Child Pos./ Mother Neg.	.00	1.00	.05	.22	.05
Child Neg./ Mother Neu.	.00	44.00	1.68	6.90	47.62
Child Neg./ Mother Pos.	.00	3.00	.12	.51	.26
Child Neg./ Mother Neg.	.00	1.00	.02	.16	.02
Synchrony	.00	21.91	4.81	5.18	26.82
Asynchrony	.28	4.26	1.48	.84	.71

Table 6. Number of Dyads Within Each Affect Expression Attractor State

Attractor State	N	%
Child Neutral/Mother Positive	7	17.1%
Child Positive/Mother Neutral	20	48.8%
Child Positive/Mother Positive	13	31.7%

CHAPTER VI: DISCUSSION

The purpose of this study was to contribute to the limited co-regulation literature by analyzing co-regulation in relation to self-regulation development in preschool children. Researchers had previously identified trends linking parent co-regulation behaviors and emotion expression to emotional and behavioral self-regulation skills (Lobo & Lunkenheimer, 2020; Guo et al., 2015; Cole et al., 2003). Most research on this topic has been supported by dynamic systems theory (Lewis, 2000; Cole et al., 2017). As such, dynamic systems theory was utilized as a framework for designing this study, analyzing the relationships amongst variables related to co- and self-regulation and interpreting the findings.

The Three Bags Task was used to produce a measure of co-regulation for this study. The first bag contained a wordless book. Dyads spent this activity describing the pictures, making up a story to match the illustrations, quietly looking through the pages, or asking questions. Once finished, they put the book away and moved on to bag two, which contained two puzzles. Parents began by instructing the child which puzzles to do first, asking which the child wanted to do first, or letting the child begin. Some mothers discussed strategies to complete the puzzle. Most spent some time inquiring about the pictures on the puzzle pieces. After bag two, some dyads were out of time and did not make it to bag three. Those who did were met with a mailbox toy. Dyads used the mailbox toy to pretend-play, read the postcards, and work on how best to fit the postcards into the mail slots.

Coding and analyzing the Three Bags Task video observation provided information about the mother and child's affective and behavioral tendencies during a structured play session. The tasks were relatively easy for child participation and for the parents to guide behavior. Each task prompted some level of problem-solving for the child and mother to work through together.

Parents demonstrated both adaptive and less adaptive behaviors meant to co-regulate the child through the play tasks. There was little variation in both mother and child behaviors, with most dyads actively participating and engaged throughout. This became an issue when attempting to address research questions that inferred a higher level of variability among dyads. The structure of the task seemed to encourage mothers to take a leading role by incorporating the main co-regulation behaviors being examined. While this led to little variation in mother co-regulation behaviors, the data reiterated the idea that these mothers were naturally inclined to guide, coach, and support their children during semi-structured activities. Likewise, emotion expression was limited in variability, with most dyads spending a large proportion of time with no or neutral emotion expression being displayed. When they did express emotion, dyads tended to express more positive emotions. Moments of negative affect were rare.

Co-regulation Behavior

Relatively high levels of co-regulation were present for most moms during the Three Bags Task. Commands, teaching/proactive structure, and positive reinforcement were co-regulation behaviors exercised across all mothers. Intrusions were used less often. These behaviors helped guide their children's behaviors, engagement, and focus (Kurki et al., 2016; Gillespie, 2015). Out of the co-regulation behaviors, teaching/proactive structure was exercised most often. Indicating that parents tended to be aware of the expectations of their role in this interaction: to entertain their child and keep them focused on the task at hand as per the researcher's instructions. Children also tended to be highly engaged and actively participating in the activity. Attractor states of emotion were characteristic of healthy emotion exchanges as dyads tended to reciprocate positive emotion or maintain a level of neutrality to focus on the task at hand.

In response to commands, children tended to comply within 10 seconds. Noncompliant responses to commands were not necessarily disruptive or maladaptive. Instead, noncompliance was often when children were problem-solving or too fixated on the task to change their behavior as instructed. Instances of confusion were often met with bids for help, communicating with their mother that they needed assistance with the task or more information. Bids for help often prompted mothers to engage in some form of co-regulation. Children's comfort with asking for help and parents' willingness to respond in a positive, constructive way may be a point of interest in future co-regulation research.

Lobo and Lunkenheimer (2020) utilized three potentially difficult tasks to track co-regulation behaviors and affect. As the Three Bags Task is intended to be more play-oriented rather than challenging, I was interested in assessing the prevalence and impact of co-regulation during a lower-stress play interaction. During the video observation, most mothers exercised all three positive co-regulation behaviors (commands, teaching/proactive structure, and positive reinforcement). This indicates that the semi-structured play task was a good task to use to track co-regulation behaviors. However, co-regulation behaviors were not significantly associated with the three measures of child self-regulation, indicating that the Three Bags Task may not represent all typical co-regulation interactions between a mother and their child. Likewise, others in the child's life were also not assessed (e.g., fathers, teachers, siblings, etc.) but likely strongly influenced self-regulation development. According to dynamic systems theory, it's the culmination of all co-regulation patterns over time that contributes to a child's self-regulation development. So, suppose this mother-child session is not representative of all co-regulation patterns over time. In that case, it is not surprising that statistically significant links were not found between the frequency of co-regulation behaviors during this interaction and the child's self-regulation skills. The development of self-regulation skills in early childhood is complex and cumulative. Additionally, the scaffolding of co-regulation behaviors can only be studied over time. It would take a wide range of observations scattered over months or years to truly witness how parents adapt and grow their co-regulation behaviors in response to their child's burgeoning self-regulation abilities and vice versa. As both individuals are learning and changing through this process, it would be helpful to also examine parent's development of co-regulation behaviors as a function of their child's burgeoning self-regulation abilities, as their child's abilities should dictate how parents co-regulate.

Emotion Expression

Emotion socialization is suggested to be a primary mode for children to learn about emotion expression and meaning (Eisenberg, Cumberland, & Spinrad, 1998). A child's understanding of emotions contributes to their ability to regulate emotions (Baker, Fenning, & Crnic, 2011). Affect expression and affective exchanges between a mother, and their child are two measurable variables used to assess the impact of emotion-related socialization behaviors (ERSBs) (Eisenberg, Cumberland, & Spinrad, 1998). These ERSBs were identified during the dyadic interaction Three Bags Task and analyzed using state space grids. The purpose of identifying these ERSBs was to determine whether affect attractor states during the Three Bags Task are a good indicator of affective exchanges. Lobo and Lunkenheimer (2020) tracked affect every 30-seconds of mother-child video observations. We were able to track affect every 5-seconds of the Three Bags Task reliably. A shorter time interval increased the accuracy of moment-to-moment affective exchanges. Dyads tended to express moments of positive affect that would have likely been overlooked if summarizing all emotion expressions in a 30-second interval.

Three out of eight possible attractor states were found during this task due to limited variability in affect expression among dyads. Continued and scaffolded co-regulation and ERSBs are likely contributors to phase shifts into even more complex, strengthened self-regulation behaviors. Building off this perspective, the affect attractor states identified during the Three Bags Task were analyzed with the underlying assumption that these affect attractor states may be generalizable to dyadic affective exchanges in normal mother-child interactions. This data was meant to test the relationship that ERSBs and emotion expression has with self-regulation development. The findings from the current study did not show significant links between attractor state data, co-regulation behaviors, or self-regulation outcomes. Speculations about why this may be includes the lack of generalizability of the interactions observed during the Three Bags Task, not enough data on dyads' normal exchanges, and the cross-sectional design of this study. Likewise, since most dyads fit into one of three positive attractor states, slight nuances in emotion expression during this task made it unlikely to find a trend between emotion expression during this interaction and the child's understanding of emotions and affective expressions.

Self-Regulation Measures

One of the primary goals of this study was to find a link between the co-regulation behaviors, emotion exchanges, and self-regulation outcomes. Three measures were used (two subscales from the ERC and the behavior observation global self-regulation score from the Lock Box Task) to determine child self-regulation abilities. It is important to note that while scores from the two subscales of the parent report were strongly negatively associated with one another, the parent-reported scores were not associated with the researcher-reported observational global self-regulation score. The parent-reported ERC contained multiple questions about child behavior and emotion expression. These questions are directly related to emotion regulation. The observed behavior global regulation score was determined by researchers after observing a video of the child attempting to open a locked box with the wrong key. Researchers also rated the child on latency to frustration, global frustration, help-seeking behavior, distractions, emotion expression, and resignation. These ratings may be more indicative of children's immediate behavior response to a frustrating task and less indicative of their general self-regulation abilities. The global self-regulation score assigned during the Lock Box Task may not be a good proxy for the children's self-regulation abilities displayed in the settings they are used to or the types of activities they participate in more regularly.

In addition to using multiple self-regulation measures to gauge a child's abilities accurately, it would be ideal for collecting these data longitudinally. Children's phase shifts between emerging self-regulation behaviors and more complex behaviors could be studied if data were collected at multiple points. Likewise, multiple data collection points can help determine the control parameters of the child's behavior: what behaviors that child can exercise based on their personal characteristics and lived experiences. Ideally, data on parents' co-regulation behaviors in between these time points could contribute to our understanding of which behaviors and interactions are helping facilitate change and growth in their children's self-regulation skills.

Limitations

The small size and homogenous make-up of the sample used for this study is a significant limitation. Only a sub-sample of the original study participated in the Three Bags Task. This sub-sample is also highly educated, predominantly Caucasian, and high-income. Many of the benefits of having a diverse sample, including generalizability and variability were lost.

The utilization of only one observation to summarize mother-child co-regulation behaviors is likely insufficient. Dynamic systems theory and research suggests that co-regulation is most consequential when parents practice scaffolding and build upon their interactions with the child providing more information and support when needed (Cole, Bendezu, & Ram, 2017; Lunkenheimer et al., 2020; Murray et al., 2019; Guo et al., 2015). One observation only provides a snippet of the co-regulatory processes parents exercise across contexts. However, the Three Bags Task does include three qualitatively different activities. It may have been beneficial to separate the data by each of the three tasks to determine which tasks best showcase co-regulation. Different tasks may elicit different aspects of co-regulation, which could help determine how future researchers observe, code, and test co-regulation. For example, the simulated mailbox activity may have encouraged more pretend play in dyads than the other activities. Because pretend play has been identified as a learning opportunity for perspective-taking and the growth of empathy, this task may have given the most relevant information about mother-child co-regulatory processes (Vygotsky & Cole, 1978).

Implications and Future Directions

What we have learned about methods and measures from this study may be helpful in future research on co-regulation and self-regulation development. With solidified methods in studying co-regulation, the impact of co-regulation can be studied in different contexts to examine variations in streams of co-regulation behaviors. As previously stated, co-regulation studies may be more effective if longitudinally constructed and dyadic interactions are observed more than once in different contexts. Additionally, self-regulation data needs to be collected longitudinally with multiple time points to properly observe development over time. The ERC was a solid measure of emotion regulation. However, behavior regulation and global self-regulation skills were not captured with this one measure, so additional questionnaires or behavior observation measures should be included in future work.

Lunkenheimer's coding manual separated teaching behaviors and proactive structure behaviors. This was adapted into one behavior code for the current study: teaching/proactive structure behaviors. Our decision to combine these codes was based on using one observation of the Three Bags Task and our assessment of the constructs we were testing by mapping out these behaviors. Teaching and Proactive Structure codes were seen as interchangeable behaviors during the Three Bags Task. Lunkenheimer and Lobo (2020) used the original coding manual to analyze three observations of varying difficulty. The Three Bags Task did not capture as large of a range of difficulty as other studies. However, the high rate of Teaching/Proactive Structure codes compared to Commands and Positive Reinforcement may be a sign for future studies to break apart these codes and analyze more observations per dyad.

The findings from this study are preliminary and warrant further investigation into constructs, processes, and theories related to self-regulation development. The current study reassured the use of taking a dynamic approach to studying self-regulation development. Complex processes and input from various environmental sources may collaborate to facilitate the emergence of self-regulation behaviors (Lougheed et al., 2020; Lewis, 2000). However, the findings from this study also suggest that a larger, more diverse sample would help determine differences in development in terms of SES, access to resources, and family involvement (Buckner, Mezzacappa, & Beardslee, 2009). Limited variability among the sample demographics, with most children being white from middle to high-income households, is a significant limitation of this study. Most dyads had similar socioeconomic backgrounds, which may explain the homogeneity of the data. Trends in the data and reported results are not generalizable to the general population.

Lag sequential analyses (LSA) would be a helpful statistical method to further tease out co-regulation patterns. Latencies and durations of behaviors and states could help answer research questions related to responsivity. Likewise, these analyses could be used to find links between emotion expression and co-regulation patterns. Identifying these patterns using LSA may lead to finding stronger relationships between co-regulation and self-regulation development.

Conclusion

Positive parent co-regulation models the various methods of regulating their emotions and behaviors for children. Co-regulation is how children learn how to behave at home, in social situations, and at school. Likewise, emotion-related socialization behaviors (ERSBs) specifically teach children emotion meaning and expression (Eisenberg, Cumberland, & Spinrad, 1998; Cole et al., 2009). The combination of co-regulation and ERSBs can direct children towards adaptive, healthy attractor states of self-regulation behavior (Cole, Bendezu, & Ram, 2017). Likewise, during an observed semi-structured play interaction, we learned that mother-child dyads were highly engaged, exhibited mostly neutral or positive affect, and worked together to understand and work through the prescribed tasks. Mothers exercised a range in frequency of co-regulation behaviors, with most mothers utilizing all three co-regulation behaviors during the observation. While the current study had limited findings to support the hypotheses, it did identify strengths and weaknesses with the methodology used to study co-regulation and self-regulation development.

REFERENCES

Baker, J. K., Fenning, R. M., & Crnic, K. A. (2011). Emotion socialization by mothers and fathers: Coherence among behaviors and associations with parent attitudes and children's social competence. *Social Development*, *20*(2), 412–430. https://doi.org/10.1111/j.1467-9507.2010.00585.x

Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist*, *57*(2), 111–127. https://doi.org/10.1037/0003-066X.57.2.111

Buckner, J. C., Mezzacappa, E., & Beardslee, W. R. (2009). Self-regulation and its relations to adaptive functioning in low income youths. *American Journal of Orthopsychiatry*, *79*(1), 19–30. https://doi.org/10.1037/a0014796

Christiansen, J., Christiansen, J. L., & Howard, M. (1997). Using protective factors to enhance resilience and school success for at-risk students. *Intervention in School and Clinic*, *33*(2), 86–89. https://doi.org/10.1177/105345129703300203

Cole, P. M., Bendezú, J. J., & Ram, N. (2017). Dynamical systems modeling of early childhood self-regulation. *Emotion*, *17*(4), 684–699. https://doi.org/10.1037/emo0000268.supp

Cole, P. M., Dennis, T. A., Smith-Simon, K. E., & Cohen, L. H. (2009). Preschoolers' emotion regulation strategy understanding: Relations with emotion socialization and child self-regulation. *Social Development*, *18*(2), 324–352. https://doi.org/10.1111/j.1467-9507.2008.00503.x

Cole, P. M., Teti, L. O., & Zahn-Waxler, C. (2003). Mutual emotion regulation and the stability of conduct problems between preschool and early school age. *Development and Psychopathology*, *15*(1), 1–18. https://doi.org/10.1017/S0954579403000014

Eisenberg, N., Cumberland, A., & Spinrad, T. L. (1998). Parental socialization of emotion. *Psychological Inquiry*, *9*(4), 241–273.

Gillespie, L. (2015). It takes two: The role of co-regulation in building self-regulation skills. *YC Young Children*, *70*(3), 94–96.

Goldhaber, D. (2000). *The developmental psychobiological perspective*. In *Theories of Human Development: Integrative Perspectives* (p. 159-183). CA: Mayfield Publishing.

Guo, Y., Leu, S.-Y., Barnard, K. E., Thompson, E. A., & Spieker, S. J. (2015). An examination of changes in emotion co-regulation among mother and child dyads during the strange situation. *Infant and Child Development*, *24*(3), 256–273. https://doi.org/10.1002/icd.1917

Hollenstein, T. (2013). *State space grids: depicting dynamics across development.* Springer. https://doi.org/10.1007/978-1-4614-5007-8

Kochanska, G, Murray, K, Jacques, T, Koenig A, Vandegeest, K. (1996). Inhibitory control in young children and its role in emerging internalization. *Child Development.* 67(2):490-507.

Kurki, K., Järvenoja, H., Järvelä, S., & Mykkänen, A. (2016). How teachers co-regulate children's emotions and behaviour in socio-emotionally challenging situations in day-care settings. *International Journal of Educational Research*, *76*, 76–88. https://doi.org/10.1016/j.ijer.2016.02.002

Leerkes, E. & Bailes, L. (2019). Handbook of emotional development. In *Emotional development within the family context* (pp. 627–661). https://doi.org/10.1007/978-3-030-17332-6_24

Lewis, M. D. (2000). The promise of dynamic systems approaches for an integrated account of human development. *Child Development, 71*(1), 36–43.

Lobo, F. M., & Lunkenheimer, E. (2020). Understanding the parent-child co-regulation patterns shaping child self-regulation. *Developmental Psychology, 56*(6), 1121–1134. https://doi.org/10.1037/dev0000926

Lougheed, J. P., & Hollenstein, T. (2011). The co-regulation coding manual. Unpublished manual.

Lougheed, J. P., Brinberg, M., Ram, N., & Hollenstein, T. (2020). Emotion socialization as a dynamic process across emotion contexts. *Developmental Psychology, 56*(3), 553–565. https://doi.org/10.1037/dev0000801

Lunkenheimer, E. (2009). Dyadic interaction coding manual. In *Unpublished manual. Fort Collins, CO: Colorado State University*.

Lunkenheimer, Erika & Kemp, Christine & Lucas-Thompson, Rachel & Cole, Pamela & Albrecht, Erin. (2016). Assessing Biobehavioral Self-Regulation and Coregulation in Early

Childhood: The Parent-Child Challenge Task. *Infant and Child Development*. 26. 10.1002/icd.1965.

Lunkenheimer, E., Hamby, C. M., Lobo, F. M., Cole, P. M., & Olson, S. L. (2020). The role of dynamic, dyadic parent-child processes in parental socialization of emotion. *Developmental Psychology*, *56*(3), 566–577. https://doi.org/10.1037/dev0000808

Miller, M. M., & Goldsmith, H. H. (2017). Profiles of social-emotional readiness for 4-year-old kindergarten. *Frontiers in Psychology*, *8*(JAN), 1–9. https://doi.org/10.3389/fpsyg.2017.00132

Murray, D. W., Rosanbalm, K., Christopoulos, C., & Meyer, A. L. (2019). An applied contextual model for promoting self-regulation enactment across development: implications for prevention, public health and future research. *Journal of Primary Prevention*, *40*(4), 367–403. https://doi.org/10.1007/s10935-019-00556-1

Newtson, D. (1993). The dynamics of action and interaction. In L. B. Smith & E. Thelen (Eds.), *MIT Press/Bradford Books series in cognitive psychology. A dynamic systems approach to development: Applications* (p. 241–264). The MIT Press.

Rosanbalm, K. D., & Murray, D. W. (2017). Promoting self-regulation in early childhood: a practice brief. OPRE Brief #2017-79. Washington, DC: Office of Planning, Research, and Evaluation, Administration for Children and Families, US. Department of Health and Human Services.

Shields, A., & Cicchetti, D. (1997). Emotion regulation among school-age children: The development and validation of a new criterion Q-sort scale. *Developmental Psychology*, *33*(6), 906–916. https://doi.org/10.1037/0012-1649.33.6.906

Swingler, M. M., Isbell, E., Zeytinoglu, S., Calkins, S. D., & Leerkes, E. M. (2018). Maternal behavior predicts neural underpinnings of inhibitory control in preschoolers. *Developmental Psychobiology*, *60*(6), 692–706. https://doi.org/10.1002/dev.21742

Thelen, E., & Smith, L. B. (2006). Dynamic Systems Theories. In W. Damon (Editor-in-Chief) & R. M. Lerner (Vol. Ed.), *Handbook of child psychology: Vol. 1 Theoretical models of human development* (6th ed., pp. 258-312). New York, NY: Wiley.

Valentovich, V., Goldberg, W. A., Garfin, D. R., & Guo, Y. (2018). Emotion co-regulation processes between mothers and their children with and without autism spectrum disorder: Associations with children's maladaptive behaviors. *Journal of Autism and Developmental Disorders*, *48*(4), 1235–1248. https://doi.org/10.1007/s10803-017-3375-y

Vygotsky, L. S. & Cole, M. (1978). *Mind in society: The development of higher psychological processes*. Cambridge: Harvard University Press.

Zeytinoglu, S., Calkins, S. D., & Leerkes, E. M. (2020). Autonomic nervous system functioning in early childhood: Responses to cognitive and negatively valenced emotional challenges. *Developmental Psychobiology*, 62(5), 657–673. https://doi.org/10.1002/dev.21926