UNIVERSITY OF CALIFORNIA

Los Angeles

Caregiver Strategies: Impact on Dysregulation & Joint Engagement in Toddlers with Autism Spectrum Disorder

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Education

by

Sydney Taylor Seese

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ABSTRACT OF THE DISSERTATION

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Doctor of Philosophy in Education

University of California, Los Angeles, 2024

Professor Connie L Kasari, Chair

Background: Young children with autism spectrum disorder (ASD) are at risk for challenges with their emotion regulation abilities, and often have dysregulating behaviors. For young children who exhibit dysregulation, this might also impact their ability to jointly engage with others. This study aims to examine the relationship between dysregulation (challenges with ER) and joint engagement within the context of a free play interaction between toddlers with ASD and their caregivers.

Methods: Participants include 149 children with ASD (*M* age 21 months) and their caregivers prior to intervention (baseline). Bivariate correlations and regression analyses were conducted to explore the relations between dysregulation, joint engagement, and caregiver strategies.

Results: Of the 149 children included in this study, 122 (82%) demonstrated at least one episode of dysregulation (lasting over three seconds) within the caregiver interaction, and 50% of those behaviors were deemed intense. Child dysregulation is significantly, and negatively, related to time spent jointly engaged with their caregiver ($r(148)=-.260$, $p=.001$). Caregivers increased use of active strategies (e.g., redirection) and avoidant strategies are related to increased child

dysregulation (active strategies: $r(147)=.260$, $p=.001$; avoidant strategies: $r(147)=.196$, $p=.017$). In contrast, caregivers' use of developmentally appropriate engagement and regulation strategies (JASPER Caregiver Strategies) is predictive of less time dysregulated ($F(4,143)=7.618$, $p<.001$, $R^2=.146$). Higher JASPER caregiver strategies are associated with less time unengaged ($r(148)=-.246$, $p=.003$). A significant moderation effect of JASPER caregiver strategies on the relation between dysregulation and time unengaged was found, $F(5,114)=9.712$, $p=<.001$, $R^2=.299$. The moderation results suggest that caregiver strategies impact the relationship between dysregulation and time unengaged.

Conclusion: Toddlers with ASD often exhibit dysregulation behaviors, which are associated with time spent engaged with their caregivers. Caregivers' use of active and avoidant co-regulation strategies was associated with the time children spent exhibiting dysregulation, suggesting that as the duration of dysregulation behaviors increased, caregiver's use of these strategies also increased (or vice versa). In contrast, the use of developmentally appropriate strategies related to engagement and regulation (JASPER strategies) predicted less time spent in dysregulation. Additionally, the JASPER caregiver strategy overall score is linked to reduced time unengaged. Finally, results suggest that JASPER caregiver strategies (but not co-regulation strategies) impact (i.e., significantly moderate) the relationship between dysregulation and time unengaged. Future research should continue to explore the mechanisms through which caregiver strategies impact child outcomes and investigate the moderating role of caregiver strategies in the relationship between dysregulation and joint engagement over time.

The dissertation of Sydney Taylor Seese is approved.

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University of California, Los Angeles

2024

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LIST OF APPENDICES

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2011-2015	Bachelor of Arts in Psychology
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RESEARCH EXPERIENCE

Research Assistant and Cognitive and Behavioral Therapist

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University of California, Los Angeles

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Graduate research assistant and cognitive and behavioral therapist trained in JASPER (Joint Attention, Symbolic Play, Engagement and Regulation) a treatment approach designed for children with autism. Received training in Applied Behavioral Analysis techniques, in particular, Discrete Trial Training (DTT). Supervisors: Connie Kasari, Ph.D.

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Research coordinator responsible for assisting faculty and Principal Investigators in all aspects of research including ensuring integrity of protocols, preparing, and editing research manuals, consents, amendments, and reviews to IRB. Responsible for coordination of participants for studies, administration of neuropsychological measures, scoring and collecting data, data analysis. Supervisors: Lauren Kenworthy, Ph.D., Laura Anthony, Ph.D., and John Strang, Psy.D.

Publications & Presentations

Seese, ST., Cohenour, T., Seese, SK., Gulsrud, A., Kasari, C. (2024). *In Preparation.* Dyadic Interactions Between Infants/Toddlers with Autism Symptoms and Their Caregivers: Effects of Family Incidence of Autism on Caregiver Strategy Use.

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Ratto, A.B., Kenworthy, L., Yerys, B.E., Bascom, J., Wieckowski, A.T., White, S.W., Wallace, G.L., Pugliese, C., Schultz, R.T., Ollendick, T.H., Scarpa, A., **Seese, S**., Register-Brown, K., Martin, A., & Anthony, L.G. (2018). What about the Girls? Sex-Based Differences in Autistic Traits and Adaptive Skills. *Journal of Autism and Developmental Disorders, 48,* 1698-1711.DOI 10.1007/s10803-017-3413-9

Cohenour, T., **Seese, S**., Seese, S., Gulsrud, A., Kasari, C. (2024, May).

Dyadic Interactions Between Infants/Toddlers with Autism Symptoms and Their Caregivers: Effects of Family Incidence of Autism on Caregiver Strategy Use and Joint

Engagement. Poster presented at the 23rd Annual Meeting of the International Society for Autism Research.

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Caregiver Interaction Strategies Differ Between Boys and Girls with Down Syndrome. Poster presented at 56th Annual Gatlinburg Conference.

In early childhood, emotion regulation is foundational to overall health and functioning across a variety of developmental domains (Blair et al., 2015). Emotion regulation (ER) is an underlying core ability that allows a child to successfully interact with and navigate their surrounding environments and is considered to be an instrumental developmental task (Cole et al., 1994; Berkovits et al., 2017). Children with intellectual or developmental disabilities, including children with autism spectrum disorder (ASD), are at increased risk for poor or impaired ER, often known as dysregulation (Raver et al., 2017). Dysregulation refers broadly to maladaptive patterns of emotion regulation that disrupt functioning (Cole et al., 1994). Dysregulation occurs at high rates in children with autism spectrum disorder (Hartley et al., 2008) and these challenging behaviors generally persist over time (Herring et al., 2006; Matson et al., 2010). Children develop ER within the context of their social and emotional environment (Guo et al., 2017); and thus, caregivers are instrumental in supporting and facilitating the healthy development of ER during early childhood (Baker et al., 2018; Gulsrud et al., 2010; Kopp, 1982; Lincoln et al., 2017; Morris et al., 2007; Paley & Hajal., 2022; Sameroff et al., 2009). For children with developmental disabilities, including toddlers with ASD, little research has examined specific dysregulation behaviors, and the strategies caregivers employ to support their young child's ER within the context of challenging behaviors. This includes the characteristics of the dysregulation (i.e., duration and intensity) children may exhibit during naturalistic interactions with their caregivers. Few studies have explicitly examined the relationship between dysregulation and joint engagement (shared attention between two individuals on an object/event), which may further clarify contexts in which regulation skills may improve. This study seeks to understand how children's regulation may be related to joint engagement with a caregiver (parent), and further, what effects caregiver strategies may have on this relationship.

Understanding how caregivers respond to their child's dysregulation has important implications for interventions that support both the caregivers and the child during these challenging moments. Supporting children with ASD in their development of healthy and appropriate regulation skills is of utmost importance during this critical developmental stage.

Study Purpose

The purpose of this study will be one of the first to characterize dysregulation behaviors *and* caregiver strategies within toddlers with ASD and their caregivers (see Table 1). Next, the study will examine factors that may be associated with dysregulation behaviors, caregiver strategies, and joint engagement, during a free play interaction prior to intervention. Finally, the study will examine the relationship between dysregulation, joint engagement, and caregiver strategies. Specifically, the study will examine if caregiver strategies moderate the relationship between dysregulation and joint engagement in toddlers and preschoolers with ASD.

Joint Engagement: Context for Learning

All children learn a variety of skills through play and within transactional interactions with others. During dyadic interactions between children and their caregivers, if both individuals are jointly engaged (e.g., playing together), there are increased opportunities for social communication and learning (Tomasello & Farrar, 1986; Shih et al, 2021). Children with ASD have social communication deficits, which often includes delayed development of joint attention skills and shorter periods of joint engagement compared to typically developing peers (Adamson et al., 2012; APA, 2013; Shih et al., 2021). Joint engagement (JE) refers to the state (duration of time) in which social partners (an adult and a child) are mutually focused on an event or object and involves the coordination of shared attention and shared communication behaviors with a

social partner (Adamson et al., 2004). Recent research on children with ASD has shown that joint engagement is a potential mechanism for increases in joint attention, such that longer periods of parent and child engaging on an object/event/activity result in increased opportunities for social communication (Kasari et al., 2006; Shih et al., 2021). However, it would be apparent that for young children who exhibit dysregulation, this might also impact the ability to jointly engage with a partner. This study aims to further understand the relationship between dysregulation (challenges with ER) and joint engagement within the context of a free play interaction between toddlers with ASD and their caregivers.

Emotion Regulation and Dysregulation: Definitions & Distinctions

In the general developmental literature, defining both emotion regulation and dysregulation has been historically broad and not entirely universal. However, emotion regulation and dysregulation are considered to be aspects of the broader construct of self-regulation. Emotion regulation is regarded as a complex, interactive, and dynamic process between an individual and their environment. Generally, ER refers to a multitude of physiological, cognitive, emotional, and behavioral abilities that supports an individual's ability to monitor and control one's actions and responses to stimuli in order to effectively pursue a goal (Berkovits et al., 2017; Cole et al., 1994; Jahromi & Stifter, 2008; Mazefsky et al., 2013; Morris et al., 2007; Thompson, 1994). Emotion regulation includes the ability to follow through on appropriate goal-directed behavior, which may be conscious or unconscious (Eisenberg et al., 2005) and often encompasses reactivity (the speed and/or intensity of emotions) and the specific strategies that are utilized to manage and monitor emotions. ER occurs within the context of both positive and negative emotions; healthy ER would be considered as the successful up regulation of positive emotions and down regulation of negative emotions (Gross et al., 2015). All children

regulate their behaviors and emotions within the context of their social and emotional environments (Guo et al., 2017). Dysregulation refers to an impairment in ER, not an absence of ER (Cole et al., 1994). Emotion dysregulation can serve various purposes for an individual, albeit it may manifest or contribute to maladaptive functioning depending on context. Children with disabilities, including autism, are at increased risk for poor ER skills and increased dysregulation (Cai et al., 2018).

Dysregulation is commonly reported in individuals with ASD, with rates ranging between 27% to 86% (Hartley et al., 2008; Ooi et al., 2011; Totsika et al., 2011) and are reported as early as 12 months of age (Gomez & Baird, 2005). Challenges with ER for individuals with ASD is related to a variety of negative outcomes and impacts across the lifespan, including mental, social, and physical health problems (Cai et al., 2018; Gotham et al., 2015). Research on children with ASD reports high rates of externalizing behaviors (Hartley et al., 2008), internalizing problems (Mazefsky et al., 2013), emotional difficulties (Mayes et al., 2011; Ting & Weiss, 2017), and poor ER strategy use (Konstantareas & Stewart, 2006). Studies suggest that compared to non-ASD controls, children and youth with ASD have poorer ER (Delucia et al., 2021; Mayes et al., 2011; Jahromi et al., 2013; Samson et al., 2014), may exhibit more negative affect (Day et al., 2022; Garon et al., 2009; Mazefsky et al., 2013), have more intense emotional reactions (Northup et al., 2021), and may utilize less effective ER strategies (Jahromi et al., 2012; Konstantareas & Stewart, 2006). Some researchers speculate these differences in regulation may be due to individuals with ASD being predisposed to impairment due to biological underpinnings of ASD and aspects of functioning (i.e., cognition, language) (Beck et al., 2021). This study aims to further understand the factors that may influence dysregulation

which has important implications for supporting the heathy development of ER of children with ASD.

Development of ER in Typically Developing Children

In order to fully grasp the developmental differences for children with ASD, understanding typical development allows us to contextualize differences in trajectories and behaviors of those with autism.

Early childhood, including the infancy, toddlerhood, and preschool periods, are considered critical developmental periods of growth for a variety of skills, including self-regulation, emotion regulation, cognition, and communication abilities (Blair et al., 2004; Graziano et al, 2010). Maturation of self-regulation skills across early childhood is considered to be the time period of largest growth and also constitutes a pivotal transition between simple to more complex skills and behaviors (Blair et al., 2004; Calkins & Marcovitch, 2010; Garon et al., 2008; Jahromi et al., 2008; Kopp, 1989). Self-regulation begins in infancy, is followed by periods of sustained regulation in the toddler and preschool stages and continues to develop across later childhood involving maturation of independent skills of self-regulation (Cole et al., 1994). Evidence of regulation strategies in infancy includes behaviors such as looking away, self-comforting, protesting or smiling all of which aim to gain the attention of the caregiver (Calkins et al., 2010; Morales et al., 2005; Paley & Hajal., 2022; Rothbart et al., 1994). In a study including children as young as 12 months, researchers found that children exhibited the use of attention control strategies in order to self-regulate during a separation paradigm with their caregivers (Sethi et al., 2000). In general, as children grow older, their capacity for regulation tends to improve, enabling them to navigate situations more effectively by employing advanced self-regulation techniques. Caregivers coregulate with their children as they grow into

toddlerhood, which may look like physical comforting (Calkins et al., 2010; Morris et al., 2011). From toddlerhood into the preschool ages, children shift from the complete reliance on caregivers to shorter periods of self-regulation and adult and child co-regulation. By school age, children utilize a variety of advanced regulation strategies, that may include verbal and cognitive self-soothing, reappraisal, or attentional refocusing (Morris et al., 2011). Children who struggle with self-regulating and continue to have challenges with self-regulating that persist across the preschool period, are at risk for a multitude of later developmental problems including emotional challenges, poor social function, and problems in school (Campbell, 2002). ER predicts, and is related to, increases in social and behavioral difficulties across the lifetime (Matson et al., 2008; Wilson et al., 2007).

Development of ER in ASD

In the TD literature, there appears to be a stable and established trajectory for the development of self-regulation behaviors. For individuals with ASD, the development of ER is less clear, with few studies examining regulation, and trajectories of ER development from infancy to school age children (e.g., range of 12 months-52 months).

Research on ER in individuals with ASD frequently includes older children (e.g., 6 years and up), leaving many gaps in the current understanding of this topic (Cibralic et al., 2021). Given what we know from the few studies that include children from infancy to the preschool period, it appears that children with ASD may deviate from the typical trajectory. ER development may be delayed or considered deficient and less adaptive. Nuske and colleagues (2017) reported that young children with ASD (age range 24-59 months) relied on seeking comfort from caregivers more so than age and gender-matched TD peers, who more often utilized self-regulation strategies. Results from these findings suggest that children with ASD

may be delayed in their self-regulation development and may be relying on their caregivers for a longer period of time before the shift to independent regulation (Nuske et al., 2017). A recent study comparing regulation strategies in ASD toddlers to age-matched TD peers (*M* age= 25 months) found that toddlers with ASD engaged in more distraction strategies to regulate and demonstrated greater negative affect, suggesting toddlers with ASD may be ineffective in their regulation skills. However, this study had a small sample size (*N*=37), did not include any language measures, and did not evaluate or measure caregiver strategies despite caregivers being present (Day et al., 2022). The present study aims to address this gap in research by including toddlers with ASD and examining dysregulation within the context of a naturalistic caregiver child interaction, as well as examining the influence of the caregiver by evaluating the caregiver strategies.

Factors Related to ER & Dysregulation in Children with ASD

Research on children with ASD have suggested that there are several intrinsic factors that are associated with ER and dysregulation. These include age, gender, language ability, cognitive ability, executive function ability, and ASD symptomatology. Methodological considerations, including small sample sizes, exclusion of children with limited language abilities and younger children with ASD (less than 5 years old), and measurement issues, are all potential limitations to the findings of the current literature (Cibralic et al., 2021; Kasari et al., 2013).

Age and Gender

There are mixed findings for the effects of age on ER and dysregulation for children with ASD. Some studies suggest that younger children may display more frequent and intense emotion dysregulation compared to older children with ASD (Northup et al., 2021). However, as

mentioned, there is some evidence that children with ASD gain independent regulation abilities at a later stage of development compared to neurotypical children, suggesting a delay in skill acquisition (Baker et al., 2019). Other studies claim that challenging behaviors remain consistent over time and are chronic within children with ASD (Berkovits et al., 2017; Matson et al., 2010). In terms of gender, some studies suggest that females with ASD have higher emotion dysregulation and more severe emotional reactions compared to males with ASD (Northup et al., 2021; Wieckowski et al., 2020). Given the paucity of research on this topic, more information is needed to clarify the potential relationship (if any) between age, gender, and ER development or dysregulation.

Language Ability

Given the importance of language skills to social and emotional development in the TD literature (Bruner, 1983; Cole et al., 1986; Kopp, 1989), it is interesting to note that very few studies have investigated this relationship within children with ASD, and results are mixed (Cibralic et al., 2019). Some studies suggest that expressive language abilities are not related to emotion regulation (Berkovits et al. 2017; Jahromi et al., 2013), while a few recent studies have suggested otherwise. Northup and colleagues found that children (ages 6-17) with ASD who were minimally verbal had greater reactivity than ASD individuals with fluent speech (Northup et al., 2021). In another study, Nuske reported that minimally verbal children with ASD (ages 5-8 years) had more regulation challenges in comparison to age matched typically verbal peers with ASD (Nuske et al., 2020). Both of these studies did not include limited language children who were younger than 5 years old and neither included multiple methods for regulation measurement. Additionally, both studies did not include a measure of the child's receptive language, which leaves a critical gap in our understanding of the child's overall language ability

and suggests that more information is needed to clarify the association between language and ER amongst children with ASD.

Cognitive Ability

Research suggests that, similar to TD literature, ER may be unrelated to cognitive abilities for children with ASD (Fenning et al., 2018; Berkovits et al., 2017). Of note, both Fenning et al., 2018 and Berkovits et al., 2017 included a small percentage of children with an IQ below 70, as most participants were within the average range of intellectual functioning. Recently, a few studies have suggested that cognitive abilities and regulation are bidirectionally related (Nuske et al., 2020). This is aligned with epiphenomenal ways of thinking, wherein skills develop alongside one another but are not necessarily influential or causal (Ursache et al., 2012). Additionally, the general exclusion, in research, of children who are minimally verbal and/or intellectually disabled (ID) suggests that more research is needed that includes these individuals to further parse and understand the relationships between cognitive abilities and ER.

ER & Core Symptoms of ASD

Research suggests that individuals with ASD may be prone to dysregulation due to differences in many domains of functioning (biological, cognitive, social etc.). However, dysregulation is not considered to be a defining feature or core component of ASD (APA, 2013). Despite this, numerous studies have reported significant relationships between features of ASD and dysregulation or poor ER. Dysregulation has been associated with social communication deficits (Martínez-González et al., 2022), restricted and repetitive behaviors (Samson et al., 2014), and executive function deficits (Jahromi et al., 2013; Mills et al., 2022).

In one theoretical model, Mazefsky and colleagues suggest that core characteristics of ASD are inherently related to emotion regulation (Mazefsky et al., 2013). Conclusions since this initial model have been mixed, with studies supporting (Beck et al., 2021; Berkovits et al., 2017; Fenning et al., 2018; Samson et al., 2014; White et al., 2014), and others refuting this claim (Conner et al., 2020; Samson et al., 2016). In one study, Samson et al., 2014 found that within a group of children with ASD (*N*=56; ages 6-16), emotion dysregulation was significantly correlated with scores measuring the core features of autism (including social cognition, communication and RRBs) even after controlling for cognition (IQ). However, some critiques of this study include the relatively small sample size, large age range, and the discrepancy between the number of males (*N*=47) and females *(N*=9) represented in the study. Other more recent studies include research by Fenning and colleagues, who reported that ASD symptom severity, as measured by the ADOS, was the single strongest intrinsic predictor of dysregulation in comparison to other factors including age and intellectual functioning (Fenning et al., 2018). Berkovits et al., (2017) reported a significant relationship between emotion dysregulation and core autism symptoms (measured via the ADOS). Additionally, they examined the stability of ER skills over time in a group of young children with ASD (*N*=108; ages 4-7; *M* FSIQ=90.3) and concluded that parent-reported ER scores were highly stable across two years of time and were strongly related to the child's social and behavioral function (Berkovits et al., 2017). ER was solely measured via parent report measures for this study and did not include any observational direct measures of ER, therefore generalizability of these findings should be considered. Future work would benefit from using multiple methods of measurement to limit informant bias (Cibralic et al., 2021; Paulhus & Vazire, 2007) and include more children with a broader IQ range to better understand these relations across individuals.

Social Communication Differences and ER. A core aspect of the ASD profile includes delays and/or impairments in social communication (APA, 2013). Important aspects of social communication include joint attention and joint engagement, which are considered precursor skills to later language learning (Mundy et al., 1986; Kasari et al., 2008). A child's ability to both attend to objects/individuals and appropriately *disengage* attention may be critical to regulation development (Rothbart et al., 1994). In TD children, increasing the amount of joint engagement between a caregiver and a child facilitates gesture (e.g., joint attention skills) and language learning (Tomasello & Farrar, 1986). Joint attention (JA) refers to a set of skills that coordinate the attention between two social partners. It is often parsed into two sets of behaviors: requesting (protoimperative) and sharing (protodeclartive). JA behaviors can be initiated, such as when a child points to a toy that they want (e.g., initiated requesting) or when a child shows their parent a toy they just found (initiated sharing). Alternatively, JA may be a response to others, such as when an adult points to an object, and the child responds by coordinating their attention to said object. Joint attention involves specific prelinguistic skills, including eye contact, pointing, and showing (Kasari et al., 2006; Weichselbaum et al., 2022). In TD toddlers, both Raver et al. (1996) and Morales et al. (2005) reported links between joint attention and the abilities of the toddler to self-regulate within the context of a child-caregiver interaction. If children with ASD are experiencing challenges with ER, or dysregulation, this may impact the amount of time spent jointly engaged with another individual. Overall, research on the relationship between dysregulation and *joint engagement* in young children with ASD is severely lacking; this study aims to further examine these associations.

RRBs & ER. Another core component of ASD includes restricted and repetitive behaviors and interests (RRBs) (APA, 2013). RRBs may be considered multifaceted in that repetitive

behaviors can be in response to specific emotional triggers or serve as a preemptive self-regulatory function (Samson et al., 2015). In a recent study, Mills and colleagues found that in small sample of children with ASD (N=44; ages 8-13 years of age), RRBs and challenges with inhibitory control (one aspect of self-regulation/executive function), positively predicted parent-reported emotion dysregulation (Mills et al., 2022). Samson et al., (2014) found that parent reported scores of their child's RRBs had the strongest link to emotion dysregulation. Both these findings suggest that RRBs in particular (a core feature of ASD) may be an underlying mechanism for emotion dysregulation within the ASD population.

Altogether, it appears that children with greater support needs may have increased challenges with ER and more dysregulation behaviors. These relationships between core symptoms of ASD and emotion dysregulation suggest that dysregulation may play a significant role in the emotional and behavioral problems seen within young children with ASD. Impaired ER often is correlated with negative social outcomes, problem behaviors, and other psychiatric conditions. Given these associations, there is an inherent need for targeted and personalized interventions that may support the development of healthy ER for young children with ASD. This study intends to extend the current body of literature by examining toddlers with ASD and the relationships between dysregulation behaviors and joint engagement, a nearly unstudied topic.

The Role of Caregivers in Emotion Regulation

Caregivers are highly influential to a child's overall development and play a fundamental and crucial role throughout infancy to early childhood. On average, TD children who are 30 months old, spend an average of 76% of their time playing and engaging with their caregiver (Adamson et al., 2004). Research has shown that caregivers are especially important contributors to a child's emotion regulation abilities as they may model effective regulation skills (Bandura, 1997;

Kopp, 1982; Morris., 2007), provide supportive contexts in which to practice regulation skills, and guide their child towards effective, appropriate, and increasingly refined regulation strategies (Lincoln et al., 2017; Thompson et al., 2014). Regulation abilities are developed through both transactional interactions with caregivers (and others) and within situational dysregulation through co-regulation. Co-regulation refers to specific and active strategies by the caregiver to assist, scaffold, and motivate the child to modulate their emotions (Gulsrud et al., 2010; Hirschler-Guttenberg et al., 2015). Co-regulation is especially important during the shift between early regulation abilities in infancy through preschool. During this time, children use more advanced and adaptive regulation skills, such as cognitive reappraisal (Morris et al., 2011) due to their increased autonomy and cognitive development. Researchers have suggested that some strategies are more effective and result in better ER than others, such as modeling, cognitive reappraisal or refocusing of attention (Gulsrud et al., 2010; Lincoln et al., 2017; Morris et al., 2011). When caregivers employ strategies that are punitive or minimal in their response to a child's negative emotions, this is often linked to increased dysregulation (Morris et al., 2017).

Other factors that may influence regulation development include caregiver familial characteristics such as parenting styles, parental responsiveness, temperament, parent stress, and the quality of the parent-child relationship (Dimachkie et al., 2021; Greenlee et al., 2021; Kim & Kochanska, 2012; Mills et al., 2022; Paley & Hajal, 2022; Patterson et al., 2014; Shire et al., 2016). Recent research suggests that familial composition, including the presence of siblings, may be associated with differences in caregiver behavior (Wan et al., 2012). These relations may have downstream effects on the younger siblings with ASD. Cohenour and colleagues (2023) found that children with autism who have an autistic sibling tend to have stronger cognitive and language abilities compared to those individuals who did not have autistic sibling (Cohenour et

al., 2023), and caregivers who already have a child with autism may be better equipped to co-regulate their second infant's behaviors. This study will also examine the potential relation between familial composition (e.g., presence of an older sibling with ASD) and caregiver strategies.

Theoretical Framework for Caregiver Influence

From a historical perspective, several theorists such as Vygotsky (1978) and Bruner (1983) highlight the importance of caregivers in their child's development, wherein caregivers facilitate the learning of new skills, abilities, and behaviors in their children through social interactions. Caregivers may scaffold (Bruner, 1986), such that the caregiver functions to provide support in extending the child's knowledge and adjusts their assistance throughout development.

In a more recent theoretical model, Sameroff et al., (2009) proposes a transactional model between caregivers and their children. Sameroff posits that through transactional interactions between caregivers and their children, caregivers contribute to the child's regulation through continuous, yet balanced, co-regulation (Sameroff et al., 2010). This model, as well as others (Morris et al., 2007; Nuske et al., 2020; Urasche et al., 2012) posit that ER and extrinsic influences, such as the family and caregivers, are bidirectional and mutually influential in nature over time.

This study further explores the transactional nature of co-regulation by explicitly examining strategies caregivers utilize with their child during episodes of dysregulation and within the context of a naturalistic, free play interaction.

Caregiver Inclusion in Research & Practice for Children with ASD

Current recommended practices highlight the crucial involvement of caregivers in their child's development and advocate that research and interventions for children with developmental disabilities should occur within authentic and natural learning environments, including the child's home and family contexts (Division for Early Childhood, 2014; Individuals with Disabilities Education Improvement Act of 2004; National Research Council, 2001). Thus, studies utilizing caregiver mediated interventions specifically for individuals with ASD has expanded. Caregiver mediated interventions are treatments in which caregivers implement therapeutic techniques and strategies directly with their child, with the support and guidance of a qualified therapist.

Research including caregivers of children with disabilities has historically been not well represented and seem to lack diversity (Robertson et al., 2017). Most studies of caregivers of children with ASD include participants that are white and educated and tend to exclude those whose primary language is not English (Trainor & Bal, 2014). This study includes a diverse participant pool, and aims to explore individual factors (e.g., age, gender, race/ethnicity, SES) and potential relations to the primary variables of interest (i.e., caregiver strategies).

More recently, an influx of interventions mediated by caregivers of children with ASD have proven to contribute successfully to 1) teaching caregivers' strategies that support their child's development and 2) significantly and positively impact child outcomes. Research has indicated that caregivers can be quite successful at implementing interventions at high fidelity (Shire et al., 2015; Shire et al., 2022) and caregivers implementing interventions has led to significant changes in their children's social communication skills, joint attention abilities, engagement with others, language acquisition, and reductions of challenging behaviors (Freeman & Kasari, 2013; Kasari et al., 2010; Nevill et al., 2018; Roberts & Kaiser, 2011).

Aims and Research Questions

The aims of the current study are threefold and as follows:

Aim 1) To characterize dysregulation behaviors in toddlers with ASD (ages 12-36 months) and characterize the strategies caregivers utilize within a caregiver child interaction.

RQ1: What dysregulation behaviors (type, duration, intensity) are toddlers with ASD demonstrating within a caregiver child interaction?

RQ2: What strategies (types) are caregivers of toddlers with ASD demonstrating within a caregiver child interaction?

Aim 2) To examine potential factors that may be associated with dysregulation behaviors, joint engagement, and caregiver strategies.

RQ3: What child factors (gender, race/ethnicity, cognitive ability, language ability, ADOS-severity) and caregiver factors (age, race/ethnicity, SES, education, familial composition (e.g., presence of an older sibling with ASD) are related to dysregulation behaviors, caregiver strategies, and joint engagement within a caregiver child interaction?

Aim 3) To examine the relationships between dysregulation behaviors, joint engagement, and caregiver strategies.

RQ4: Is the relationship between dysregulation (duration & intensity) and joint engagement moderated by caregiver strategies prior to intervention?

Hypothesis 1: Caregiver strategies will moderate the relationship between dysregulation (longer duration, high intensity) and joint engagement, such that: high dysregulation will relate to higher joint engagement when caregivers utilize higher (more co-regulated) parent strategies.

Methods

Participants

Participants from baseline assessments of two different randomized, controlled trial (RCT) projects comprise the sample of the analysis (*N*=149). Both projects examined the effects of caregiver mediated interventions on social communication outcomes and included young children with ASD and their caregivers. The samples will be referred to as Sample 1 and Sample 2, with all data from the entry (baseline) timepoint of the trials. Both samples recruited participants through existing early intervention programs and from community practitioners. Inclusion criteria for both projects consisted of children presenting with ASD concerns. Due to the young age of participants (12-36 months) children would be included on the basis of elevated scores on the ADOS-2, Toddler or ADOS-2, Module 1 and present some clinical concerns from professionals. Exclusion criteria for both studies consisted of major medical conditions, sensory or physical disorders. The two samples will be combined to address the research objectives.

The total sample for this study includes 149 children between the ages of 12-36 months (*N*=149, *M* age=21 months). Twenty percent of the sample (*N*=31) were female and 80% were male (*N*=118). The racial breakdown of the children in the sample is 46.3% White, 15.4% Asian, 2.7% Black/African American, 23.5% multiple races, 9.4% other, and 2.7% did not respond. Children had an average DQ (cognitive ability, assessed via the Mullen) of 72.92 (*SD*=21.67) and an average NVDQ of 80.52 (*SD*=21.62). Children's language abilities were equivalent to an average age of 14.18 months (for both expressive & receptive language abilities; assessed via the Mullen language domains; age equivalency scores). See **Table 1**.

One hundred and forty-nine caregivers (*M* age=36 years) were included in the sample. The racial breakdown of the caregiver's race is 48% White, 19% Asian, 7% Black/African American, 11% multiple races, 13% other, and 2% did not respond. Nineteen percent of caregivers identified as Hispanic/Latino. A majority of a caregivers were highly educated, with 47% completing a graduate degree, and 33% completing an undergraduate degree. Sixty four percent of caregivers reported an income greater than $100,000. **See Table 1**.

Procedures

At the initial baseline appointment, caregivers provided written consent for their participation and their children's participation in each study. Participants and their caregivers completed a variety of baseline assessments, including standardized parent reports, observational measures, and measures administered via clinicians and research staff (research assistants, graduate students). All assessors and coders were blind to experimental conditions.

Measures

Participant Characteristics

A demographic questionnaire was used to obtain descriptive information about child, caregiver, and family characteristics. Demographic information pertaining to child and caregiver age, gender and race/ethnicity, household income, caregiver education, and familial composition (e.g., presence of an older sibling with ASD) were used to characterize the samples.

Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2001)

The Autism Diagnostic Observation Schedule is a semi-structured, play-based, standardized assessment used to diagnose ASD. Participants aged 30 months younger were

administered via the Toddler Module, while participants 31 months or older were administered via Module 1. The ADOS Total Severity Score, Social Communication score and RRB score will be utilized for participants to provide a standardized score for each ADOS domain.

Cognitive and Language Assessment: Mullen Scales of Early Learning (MSEL; Mullen, 1995)

The MSEL is a widely used, standardized, developmental assessment and was used to assess cognitive ability at baseline. The MSEL is comprised of 5 subscales: gross motor, fine motor, visual reception, expressive language, and receptive language. An overall measure of cognitive ability uses four of the scales (fine motor, visual reception, receptive and expressive language scales) to yield the Early Learning Composite. This study will utilize two separate developmental quotients characterized by verbal (DQ; developmental quotient) and nonverbal components (NVDQ; nonverbal developmental quotient). The DQ includes scales of expressive language and receptive language, while the NVDQ includes visual receptive and fine motor scores. Additionally, the MSEL subscales of receptive language ability and expressive language ability will be utilized. The MSEL has been shown to have strong psychometric properties and is regarded as reliable and valid (Mullen, 1995). The MSEL was conducted by qualified assessors in accordance with assessment protocol. This measure provides standard summary scores as well as age equivalent scores. Age equivalency scores will be utilized for each variable of interest.

Caregiver-Child Interaction (CCX; Kasari et al., 2015)

The CCX is a video recorded caregiver-child free play interaction lasting 10 minutes. All participants are given a standard set of toys and instructed to play and interact as they typically would at home. The CCX videos were examined and utilized for (a) child's ER/dysregulation, (b) caregiver strategies, and (c) engagement states.

Observational Measures & Coding Procedures

All coding was completed by trained research staff and graduate students. Coders were blind to intervention conditions and established inter-rater reliability using intraclass correlation analyses (>.8).

Emotion Regulation & Dysregulation Coding Scheme (adapted from Gulsrud et al., 2010; Kasari 1993)

ER and dysregulation behaviors were coded using a protocol adapted from previous studies examining child regulation strategies. ER strategies and dysregulation were coded from the CCX, a 10-minute child-caregiver free play interaction. Dysregulation is coded by (a) type (b) duration (in seconds) and (c) intensity (Likert scale 0-5; then dichotomized to 0=low intensity (scores from 0-2) behaviors or 1= intense behaviors (scores from 3-5)). ER/Dysregulation behaviors include (a) Negativity (b) Physical Venting (c) Idiosyncratic behaviors (d) Avoidance (e) Distraction (f) Verbal repetitive behaviors (g) Self-soothing Behaviors (h) Cognitive/Verbal (i) Other-Directed Comfort seeking. ER/Dysregulation codes will be combined to yield three composite scores: (a) Physical ER/Dysregulation Behaviors (comprised of negativity, physical venting, idiosyncratic behaviors, self-soothing) (b) Verbal ER/Dysregulation Behaviors (comprised of verbal repetitive behaviors and cognitive/verbal strategies) and (c) Avoidance ER/Dysregulation Behaviors (comprised of avoidance and distraction). ER/Dysregulation codes will yield a total of three main variables for analyses: (a) Total Time of ER/Dysregulation Episode (b) Diversity of Dysregulation (c) Type (frequency & time of specific ER/Dysregulation episodes via Composite Scores).

Caregiver Co-Regulation Strategies (i.e., Emotion Regulation & Dysregulation Caregiver Strategy Scheme (adapted from Gulsrud et al., 2010; Kasari 1993)

Caregiver strategies during episodes of child dysregulation were coded using a protocol adapted from previous studies examining caregiver co-regulation strategies (Gulsrud et al., 2010). Caregiver strategies were coded from the CCX, a 10-minute child-caregiver free play interaction. Strategies include (a) Prompting/helping child, (b) Following the child's lead, (c) Redirection of attention, (d) Active Ignoring, (e) Emotional Following, (f) Physical comfort, (g) Vocal Comfort, (h) Reassurance and (i) Avoidance. Strategies were grouped into three composites, as previously done in Gulsrud et al., 2010. The composites included: (a) Active Strategies (consisting of codes involving active involvement from the caregiver, i.e., prompting/helping, redirection of attention, and physical comfort) (b) Vocal Strategies (consisting of codes involving verbal/vocal involvement from the caregiver, i.e., reassurance, vocal comfort (singing), and emotional following) and (c) Avoidance Strategies (consisting of codes that indicate minimal involvement from caregiver i.e., active ignoring, avoidance). Caregiver dysregulation variables used in analyses include type (frequency of strategy), diversity (number of different caregiver strategies utilized during CCX) and composite scores.

Engagement States (adapted from Adamson et al., 2009)

Joint engagement was coded from the CCX. Engagement is coded via states, wherein each state is defined as 3 or more consecutive seconds in one of the mutually exclusive states. Engagement states include (a) unengaged (e.g., wanders, looks around), (b) onlooking (child watches play partner, but does not participate) (c) person engaged (e.g., attends to a person only-song or social game with no object), (d) object engaged (e.g., focuses exclusively on an object without noticing person), (e) supported joint engaged (child demonstrates awareness of both play

partner and activity) and (f) coordinated jointly engaged (e.g., child drives the interaction by coordinating the play partner and the shared activity). The interval is coded as either adult-directed (e.g., caregiver redirects the child's attention to their choice of activity or verbally/physically prompts participation) or child-initiated (e.g., child selects toys, initiates an action/comment, and the caregiver follows). Total time in child-initiated JE (sum of supported joint and coordinated JE) and adult-initiated JE will be used for analyses: both scores are calculated by summing the intervals coded as both jointly engaged and child-initiated (or adult-initiated).

JASPER Caregiver Strategies (adopted from JASPER Fidelity Rating Scale (Kasari et al., 2006; Shire et al., 2022)

JASPER caregiver strategy use was examined via a 30 item JASPER Fidelity Rating scale. The JASPER Fidelity Rating scale includes a variety of strategies that are common to many Naturalistic Developmental Behavioral Interventions. Each item is rated using a 0-5 scoring system, where "0" reflects no strategy implementation and "5" represents consistent, accurate, and developmentally appropriate strategy use for a percentage score. Strategies are grouped into seven domains: (a) Supports for Engagement and Regulation; (b) Environment; (c) Balancing Imitation and Modeling; (d) Play Routines; (e) Expanding Play Routines; (f) JA/BR Skills; (g) Language. For this study, JA/BR Skills and Language were combined to create the communication domain. Expanding Play Routines were not included in analyses due to majority of caregivers scored a zero on this domain. Therefore, analyses included five domains.

A percentage score is calculated for (a) total score with all domains and (b) each domain separately. The percentage scores are calculated by dividing the total number of points obtained across the items by the total possible score. Caregiver strategies were coded by expert graduate

students and research faculty; inter-rater reliability via intra-class correlations was established (<.80).

Data Analysis Plan

To gain an understanding of the nature of the data, first demographics and standardized measures are described using summary (i.e., means, medians, frequencies) and variability (i.e., standard deviations) for all primary variables of interest. Preliminary analyses were computed to test whether data meets the necessary assumptions for each model.

Bivariate correlations and multiple regression analyses were calculated to measure associations between child demographic characteristics (chronological age, gender, race/ethnicity, cognitive ability, language ability, ADOS severity) and child's dysregulation behaviors (frequency of types, duration, intensity), caregiver strategies, and joint engagement. Additionally, independent sample *t*-tests, 1-way ANOVAs, correlations and multiple regression analyses were conducted to measure the relationships between caregiver demographic characteristics (age, SES, education, family composition) and child's dysregulation behaviors (type, duration, intensity), caregiver strategies, and joint engagement.

Finally, multiple linear regressions were conducted to examine the moderating role of caregiver strategies, and the associations between child's dysregulation (type, duration, intensity), joint engagement, and caregiver strategies. The hypothesis for the moderation analysis is that caregiver strategies will have a moderating role, such that higher (more co-regulated strategies) may modify the strength (impact) or form of the relationship between dysregulation and joint engagement. These analyses will be conducted to investigate how caregiver strategies might moderate the associations between child's dysregulation behaviors and joint engagement.

Results

Preliminary Analyses

Sample 1 children had an average age of 26.6 months (*SD*=7.09). They had an average Developmental Quotient (DQ) of 73.07 (*SD*=25.03) and an average Non-Verbal Developmental Quotient (NVDQ) of 75.41 (*SD*=24.38). Children's average receptive language abilities were rated as an age equivalency of 17 months (*SD*=9.87) and their expressive language abilities averaged an age equivalency of 17.21 months (*SD*=9.6).

Sample 2 children had an average age of 17.87 (*SD*=2.93). They had an average DQ of 72.75 (*SD*=17.16) and an average NVDQ of 86.45 (*SD*=16.15). Children's receptive language abilities were an average age equivalency of 10.7 (*SD*=5.13) and their expressive language abilities were an average age equivalency of 10.39 (*SD*=4.31).

An independent samples *t*-test was conducted to test for differences between the two study samples on child demographic information. Results suggest that the children in Sample 1 were statistically significantly older compared to Sample 2 (t (147) =9.193, p= <.001). Sample 1 had higher DQ abilities compared to Sample 2 (t (147) =.092, p= <.001), although clinically these results may not be meaningful. Sample 1 had significantly higher receptive (t (147) =.4.735, p= <.001) and expressive language abilities (t (147) =5.440, p= <.001) in comparison to Sample 2 children. Sample 2 participants had significantly higher NVDQ's in comparison to Sample 1 (t (147) =-3.204, p= <.001). No differences were found in child ADOS scores or other demographic information. **See Table 1.**

Bivariate correlations were conducted between the co-regulation caregiver strategies and JASPER caregiver strategies. The overall JASPER caregiver strategy score was not significantly

related to any of the co-regulation composite scores (Active Strategies, Verbal Strategies, Avoid Strategies). Only one weak correlation was found between caregiver co-regulation avoid strategies and the JASPER caregiver strategy of engagement & regulation ($r(149)=-.195$, $p=.017$), suggesting that higher avoid strategies are related to less appropriate engagement & regulation strategies within the JASPER caregiver strategy scheme. No other strategies were related between the two schemes. **See Table 19 & 20.**

Summary Statistics of Core Variables: Dysregulation, Joint Engagement, Caregiver Co-Reg Strategies, JASPER Caregiver Strategies)

Dysregulation

Of the 149 children included in this study, 122 (82%) demonstrated at least one episode of dysregulation (lasting over three seconds) within the caregiver interaction. The average total time (in seconds) spent in dysregulation throughout the entire ten-minute interaction was 66 seconds (*SD*=73). Children, on average, exhibited 2.3 different types of dysregulation behaviors (e.g., diversity of dysregulation). The most common states of dysregulation include negativity (*M*=17.48, *SD*=38.14); physical venting (*M*=17.1, *SD*=35.3) and exhibiting idiosyncratic behaviors (*M* =16.64, *SD*=35.4). The least common types of dysregulation behaviors were cognitive/verbal (with no children exhibiting this state), self-soothing behaviors (*M*=.85, *SD*=7.75) and distraction (*M*=.83, *SD*=4.48). **See Table 2**.

The proportion of time spent in dysregulation was calculated for the entirety (full length) of the caregiver-child interaction. For the most common types of dysregulation behaviors, children on average spent 21% of the total interaction in exhibiting negativity, 22% of the total

interaction time physically venting, and 17% of the total interaction time exhibiting idiosyncratic behaviors. **See Table 2**.

Child & Family Factors Related to Dysregulation. The relationships between child characteristics, caregiver characteristics, familial characteristics, and proportion of total time dysregulated were explored. Results suggest that child age, sex, race F (6, 138) =4.88, p=.817), or ethnicity is not related to proportion of total time dysregulated. However, moderate relations were found between total time dysregulated and child's developmental abilities, including cognition: DQ, $r(147) = -.326$, $p=<.001$) and nonverbal DQ ($r(147) = -.338$, $p <.001$), such that higher overall DQ and nonverbal DQ were associated with less dysregulation. Child's language abilities and ADOS-2 scores were all slightly to moderately related to total time dysregulated: (receptive language, ($r(147)=-.262$, $p=.001$); expressive language ($r(147)=-.195$, $p=.017$); (ADOS-2, including Total Severity (r (147)=.295, $p<.001$), ADOS Social Communication domain scores ($r(147)=.281$, $p<.001$), ADOS RRB domain scores ($r(147)=.264$, $p=.001$). Caregiver characteristics (age, sex, race, ethnicity, education, and income levels (SES) were examined in relation to proportion of total time dysregulated. No relations were found between dysregulation or any caregiver characteristics. **See Table 3.**

Familial characteristics (birth order, number of siblings, presence of ASD sibling) were explored in relation to proportion of total dysregulation time. An independent samples t-test was conducted to compare the means of proportion of total time dysregulated between (a) children with an ASD sibling (N=26; M=.07, SD=.07) and (b) children without an ASD sibling (N=57; M=.12, SD=.13; either TD sibling, or no sibling). The results indicated a significant difference between the two groups $t(81)=1.817$, $p=.006$, such that children with an ASD sibling spend less

time dysregulated compared to children without an ASD sibling. The Cohen's *d* effect size was .430, suggesting a medium effect size. **See Table 4**.

Differences in Children with High versus Low Dysregulation. An independent samples *t*-test was conducted to examine whether child demographic information (cognitive skills, ADOS severity, language skills) differed between children with high dysregulation versus low dysregulation. A median split was applied to proportion of total time dysregulated, such that children with a proportion of time dysregulated above the median (.06) were deemed high dysregulation, while children at or below the median (.06) were deemed low dysregulation. Results of the *t*-test revealed significant differences in terms of children's ADOS RRB severity score and their language abilities (both expressive and receptive). Children with low dysregulation had lower ADOS RRB severity scores (M=3.08, SD= 1.592) compared to children with high dysregulation (M=3.49, SD= 1.988), $t(147)$=-1.379, p=.046). Additionally, children with low dysregulation had higher language abilities (receptive: M=16.32, SD=9.81; expressive: M=16.04, SD=12.29) compared to children with dysregulation (receptive: M=12.00, SD=6.69; expressive: M=12.29, SD=6.99). Results reveal a significant difference for receptive language $t(147)$=3.155, p<.001) and expressive language ($t(147)$=2.751, p=.009).

Predicters of Total Time Dysregulated. A multiple regression analysis was conducted to examine if proportion of total time ER/dysregulated could be predicted by specific child characteristics, including cognitive skills, language abilities, ADOS symptom level scores and ASD Sib status. After examining the correlational data, these variables were entered into the regression model. The overall model was significant R^2=.319, ($F(7, 75)$= 5.019, p<.001. As expected, there was a significant relationship between several variables, including ADOS severity scores and language abilities. ADOS RRB was the most significant (strongest) predictor,

b=.051, *t* (141) =4.645, *p*<.001. Other variables that were strong predictors included ADOS-SC scores and cognitive abilities via the DQ and NVDQ. See **Table 5**.

Dysregulation Intensity. Dysregulation behaviors (episodes) were coded for intensity of behaviors. The intensity (severity) of each state was coded on a 0-5 scale. Codes were then converted into a binary variable, where 1 indicates intense behaviors and 0 indicates no intensity/severity. 50.1% of the total time in dysregulation were coded as intense, while 49.9% of the time, behaviors were coded as not intense. Several child factors were found to be related to intensity. Child's NVDQ was slightly related to proportion total time of intense dysregulation (*r*(147)=.185, *p*=.044), such that higher NVDQ is related to more time dysregulated. Child's receptive language abilities were positively related to time intensely self-soothing (*r*(147)=.884, *p*=.020), and negatively related to intense idiosyncratic time (*r*(147)=-.298, *p*=.022). **See Table 3**.

Caregiver Co-Regulation Strategies

Caregiver co-regulation strategies during ER/dysregulation episodes were coded and analyzed for types and diversity (number of unique types of strategies utilized). The most common co-regulation strategies that caregivers utilized included redirection, avoidance, and help/prompting. The strategies that were utilized the least included vocal comfort (zero parents utilized this strategy at any point), reassurance, and physical comfort. Some caregivers (16%) demonstrated a wide diversity of different strategies (between four to six to different strategies) throughout the interaction. Conversely, 19% of caregivers solely demonstrated one strategy throughout the interaction. Most caregivers (44%) demonstrated between two to three strategies. Caregiver strategies were parsed into three composite scores (based on Gulsrud et al., 2010). Caregivers utilized active strategies an average of 46% of the time (*M*=.46, *SD*=.39). Caregivers

utilized avoidance strategies an average of 34% of the time (*M*=.34, *SD*=.36), and barely any caregivers (*M*=.009, *SD*=.04) utilized verbal strategies. **See Table 2.**

JASPER Caregiver Strategies

Caregivers were rated on a variety of strategies (via the JASPER Fidelity scheme) during the play interaction. Caregivers overall mean strategy score was relatively low (*M*=.31, *SD*=.10). Although most caregivers scored low (e.g., less than 50% score) throughout the majority of the domains, they were on average rated more highly on strategies supporting engagement and regulation (*M*= .42, *SD*=.12), environmental strategies (*M*=.36, *SD*=.14), and strategies related to imitation and modeling (*M*=.31, *SD*=.18). Most caregivers were rated low (e.g., less than 25%) on strategies related to play (*M*=.25, *SD*=.13) and caregiver communication strategies (*M*=.24, *SD*=.10). **See Table 2**.

Engagement Data

The time spent in each engagement state was coded and analyzed. Children, on average, spent the majority of the interaction in an object engaged state (50%; average time across the sample spent in an object engaged state). They spent 32% (on average) of the interaction in a supported joint engagement state, and 12% (on average) of the time in an unengaged state. **See Table 2**.

Dysregulation Behaviors (Time & Intensity) Relate to Joint Engagement States

Total time dysregulated is negatively (and significantly) related to proportion time joint engaged ($r(148)=-.260$, $p=.001$). Further, total time dysregulated also strongly and positively relates to time unengaged ($r(148)=-.361$, $p<.001$) and time onlooking ($r(148)=.237$, $p=.004$). **See Table 7.** A multiple regression analysis was conducted to examine if proportion of total time

unengaged could be predicted by proportion time dysregulated, while controlling for child ADOS scores (SC & RRB) and NVDQ. The overall model was significant R^2=.183, (F(4, 143)= 8.013, p<.001. Proportion time dysregulated was the strongest predictor, b= .454, t(143)=4.275, p<.001. **See Table 8**.

No relations were found between total time in intense dysregulation and joint engagement. However, results suggest that intense distraction behaviors are related to time unengaged (r(147)=.915, p=.004), but not time jointly engaged (r(147)=-.188, p=.687). **See Table 9.**

Caregiver Co-Regulation Strategies: Relations to Dysregulation & JE

Caregiver Co-regulation Strategy composite scores (Co-regulation Active strategies, Co-Regulation Verbal Strategies, & Co-Regulation Avoid Strategies) were analyzed in relation to dysregulation and joint engagement. No relations were found between verbal strategies and dysregulation or joint engagement.

Relations to Dysregulation

Caregiver's use of active strategies is related to total time dysregulated (r(147)=.260, p=.001), such that when caregivers use *more* active strategies, this is associated with *more* time dysregulated. In terms of specific dysregulation behaviors, relations were found between active strategies and: negativity (r(147)=.227, p=.005, idiosyncratic behaviors (r(147)=.191, p=.020), and avoidant behaviors (r(147)=.193, p=.018). Caregiver's use of avoid strategies were significantly and positively related to proportion time spent in dysregulation (r(147)=.196, p=.017). Avoid strategies were also related to specific dysregulation behaviors, including physical venting (r(147)=.235, p=.004) and vocalizations (r(147)=.237, p=.004).

Relations to Joint Engagement

Caregiver active strategies were negatively and significantly related to time joint engaged ($r(147)=-.218$, $p=.008$). $p=.004$), meaning that more active strategies is related to less time jointly engaged. No relations between avoid strategies and joint engagement were found. **See Table 11.**

JASPER Caregiver Strategies: Relations to Dysregulation and JE

JASPER caregiver strategy scores were examined for relations to dysregulation and joint engagement.

Relations to Dysregulation

The JASPER caregiver strategy overall score was significantly and negatively related to total time dysregulated ($r(147)=-.221$, $p=.007$), such that high (more appropriate) strategies are related to less time dysregulated. Examination of domain scores found certain caregiver strategies to be related to total time dysregulated. Engagement/regulation (ER) strategies were strongly and negatively related to total time dysregulated ($r(147)=-.345$, $p<.001$), physical venting ($r(147)=-.221$, $p=.007$), and idiosyncratic behaviors ($r(147)=-.165$, $p=.044$). Environmental (ENV) strategies were related to total time dysregulated ($r(147)=-.171$, $p=.037$). Communication strategies (Comm) were negatively related to idiosyncratic behaviors ($r(147)=-.202$, $p=.014$) and distraction ($r(147)=-.170$, $p=.038$). **See Table 12**. No significant relations between dysregulation and imitation/modeling or play strategies were found. A regression analysis of dysregulation confirmed that engagement and regulation strategies were most strongly related to time dysregulated, in comparison to other JASPER caregiver strategy scores.

The overall model was significant, ($F(4,143)=7.618$, $p<.001$, $R^2=.146$, and the *b* coefficient for engagement/regulation strategies was most predictive *b*=, *t* (141)= -3.322, *p*=.001. **See Table 13**.

JASPER Caregiver Strategy Overall Scores: Relations to Engagement

JASPER caregiver strategy overall scores were related to proportion time unengaged ($r(148)=-.246$, $p=.003$. No significant relations were found between JASPER caregiver strategy scores and time jointly engaged. **See Table 14**.

See Table 19 for relations between aforementioned core variables: Dysregulation, Engagement, Caregiver Co-Regulation Strategies, JASPER Caregiver Strategies.

Moderation Analyses Results

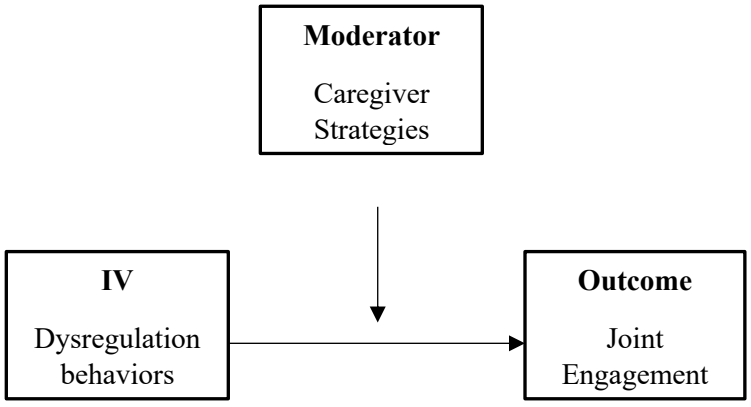

Figure 1: Moderation Design Figure.

*Moderation Analysis 1A: Time Jointly Engaged Moderated by ER/Dysregulation * JASPER Caregiver Strategies*

The first moderation analysis was conducted to examine if the relationship between dysregulation and joint engagement is moderated by JASPER caregiver strategies. The overall

JASPER caregiver strategy score was dichotomized into high and low strategy use (based on the median score, such that caregiver's who scored above the median were classified into "high" strategy use, and caregiver's who scored below the median were classified into "low"). Children who had no dysregulation were excluded from analyses (*N*=27). The overall model was significant, $F(4,115)=7.207$, $p=<.001$. Upon examination of the *b* coefficients, the interaction term was not significant. **See Table 15.**

Moderation Analysis 1B: Time Unengaged Moderated by ER/Dysregulation * JASPER Caregiver Strategies

The second moderation analysis was conducted to examine if the relationship between dysregulation and time unengaged is moderated by JASPER Caregiver Strategies. The overall JASPER caregiver strategy score was dichotomized into high and low strategy (based on the median score). Children who had no dysregulation were excluded from analyses (*N*=27). The overall model was significant, $F(5,114)=9.712$, $p=<.001$, $R^2=.299$. Upon examination of the *b* coefficients, the interaction term was significant and positive ($b =. 462$, $p=.017$). Results suggest that the relationship between dysregulation and proportion of time unengaged is influenced by the level of caregiver strategies. Specifically, when JASPER caregiver strategies are higher (more developmentally appropriate) the impact of dysregulation on time spent unengaged may be amplified (i.e., the slope of the high strategy use line is steeper). **See Table 16.**

Moderation Analyses 2A: Time Jointly Engaged Moderated by ER/Dysregulation * Caregiver Co-Regulation Active Strategies

A moderation analysis was conducted to assess if caregiver co-regulation active strategies moderate the relationship between ER/Dysregulation and joint engagement. Caregiver co-regulation active strategies were dichotomized into high and low strategy use, such that caregivers who had a higher proportion of time using active strategies were deemed high strategy users, and caregivers who had a higher proportion of time using avoid strategies (thus lower proportion of time using active strategies) were deemed low strategy users. Children with no dysregulation were excluded from analyses (N=27). Results of the overall model were significant $F(5,114)=6.088$, $p<.001$. However, upon further inspection of the interaction terms, caregiver co-regulation active strategies do not appear to be a significant moderator on the relationship between dysregulation and joint engagement. **See Table 17.**

*Moderation Analysis 2B: Time Unengaged Moderated by ER/Dysregulation * Caregiver Co-Regulation Active Strategies*

The second moderation analysis was conducted to examine if the relationship between dysregulation and time unengaged is moderated by caregiver co-regulation active strategies. Caregiver co-regulation active strategies were dichotomized into high and low strategy use, such that caregivers who had a higher proportion of time using active strategies were deemed high strategy users, and caregivers who had a higher proportion of time using avoid strategies (thus lower proportion of time using active strategies) were deemed low strategy users. Children who had no dysregulation were excluded from analyses (N=27). The overall model was significant, $F(5,114)=7.960$, $p=<.001$, $R^2=.259$. Upon examination of the b coefficients, the interaction term was not significant. **See Table 18.**

Discussion

This study explored the emotion regulation/dysregulation behaviors *and* a variety of caregiver strategies (e.g., co-regulation and JASPER caregiver strategies) for toddlers with ASD and their caregivers during a free play interaction. The primary goal of the study was to understand the relations between ER/Dysregulation, caregiver strategies, and their subsequent relation to joint engagement. The study produced three key findings.

Dysregulation in Infants/Toddlers with ASD

The first key finding is that young toddlers with ASD exhibit high rates of dysregulation, with 82% of children in this sample (*N*=123) displaying these behaviors. Toddlers also present a variety of emotion regulation (ER)/dysregulation behaviors, with an average of 2.3 unique behaviors per child. During a ten-minute interaction with their caregiver, children spent an average of 66 seconds (with a maximum time of 319 seconds) exhibiting dysregulating behavior. Further, approximately 50% of the time spent in dysregulation were coded as *intense (*e.g., severe anger/distress, intense physical activity, etc.). The prevalence of intensity scores was consistent across all dysregulation types, with the exception of self-soothing behaviors (88% not intense). A recent study by Northup and colleagues reinforces this finding of high rates of intense behaviors in young children with ASD (Northup et al., 2024). Northup's study found that young toddlers with ASD had a higher proportion of high-intensity negative affect compared to other toddlers without ASD. However, Northup's sample of toddlers with ASD was relatively small (*N*=11). Altogether, these findings suggest that toddlers with ASD might have challenges with their emotional expression that result in *intense* dysregulating behaviors.

Key Risk Factors of Dysregulation Behaviors in Young Toddlers with ASD

Child, caregiver, and familial characteristics and relations to dysregulation (type, duration, intensity) were explored to provide insight into who might be most at risk for dysregulating behaviors. Given the diagnostic and behavioral profile of young children with ASD, the results of the relational analyses examining child characteristics and proportion of total time dysregulated may not be entirely surprising. Results of this study suggest that key predictors of dysregulation include ADOS symptom levels, with the most significant predictor being the ADOS Restricted and Repetitive Behavior score (controlling for cognitive and language abilities). This relationship suggests that the severity of RRB's (higher scores= higher severity of behaviors) might lead to an increase in the amount of time spent dysregulated. A child engaging in an RRB may be pre-emptively signaling future dysregulation. Alternatively, a child who experiences some dysregulation might in fact cope with that dysregulation through an RRB. Future research would benefit from parsing these intricate behaviors. Additionally, the dysregulation coding scheme includes codes for specific repetitive behaviors (including idiosyncratic behaviors), thus also suggesting that the behavioral coding scheme may be an accurate way to measure some children's RRB's. Findings from this study align closely with several studies that also suggest that ADOS severity is predictive of emotion dysregulation (Fenning et al., 2018. Berkovits et al., 2017).

The Role of Receptive Language Abilities

In addition to the ADOS RRB score, this study identified that a child's receptive language abilities may also play a critical role in the *intensity* of some dysregulation behaviors (e.g., idiosyncratic behaviors). The negative relationship found suggests that children with lower receptive language abilities may be more likely to experience more intense/severe dysregulation episodes. These results may highlight how children who have difficulty with receptive language

abilities (such as their ability to understand and process verbal language) might be coping, or perhaps responding, to these challenges through means of dysregulating behaviors. Although this study supported a moderate correlational relationship, results from the regression model suggest that receptive language abilities may be playing a lesser role in comparison to cognitive abilities or ASD symptom levels. Nonetheless, future research would benefit from further unpacking how language abilities in preverbal/minimally verbal children influence dysregulation. Relatively few studies have examined the relationship between language abilities and dysregulation, and overall results have been mixed (Cibralic et al., 2021). This is one of the first studies to explicitly examine the *receptive language* abilities of children younger than 5 with a range of cognitive and language abilities (e.g., preverbal/ minimally verbal).These findings suggest that core challenges in ASD, particularly those related to repetitive behaviors and communication challenges, may be influencing, or exacerbating, the presence of dysregulation behaviors in young, preverbal (and some minimally verbal) children.

Factors to Consider: Impact of ASD Siblings

Analyses revealed significant differences in the duration of dysregulation for children with an ASD sibling compared to children without an ASD sibling. Results suggest that siblings may act as a protective factor, influencing outcomes related to dysregulation in other sibling with ASD. Interestingly, no significant results were found for outcomes in relation to the overall sibling count (total number of siblings, with and without ASD). This finding warrants further investigation, as there appears to be a specific distinction for the ASD sibling, rather than just sibling presence in general. Two recent studies found similar themes of specific influences of ASD sibling status on child outcomes (Cohenour et al., 2023) and caregiver strategy implementation (Seese et al., 2024, In Preparation). Seese et al., 2024 suggest that caregivers of

toddlers with ASD (who also have an ASD sibling), implement better play strategies compared to caregivers of ASD children without ASD siblings (either first born or older non-ASD sibling). Future research should further examine the impacts of ASD siblings on child dysregulation outcomes.

Impacts of Dysregulation: Joint Engagement

This study's second major finding is that the time (duration) of dysregulating episodes appears to impact (is related to) the *time* the child spends in a jointly engaged state with their caregiver. Additionally, time dysregulated is a significant predictor of time *unengaged*. Repercussions for less time spent jointly engaged has implications to other developmental outcomes, including social communication (Shih et al., 2021). Less time spent jointly engaged with their caregiver has been associated with less time for learning opportunities with their caregiver. One point that should be made is that clinically, children who are dysregulated can be jointly engaged with their caregiver at the same time. However, given that children with ASD are at risk for dysregulation behaviors AND have challenges with joint engagement, there may be a higher likelihood of dysregulation impacting joint engagement.

The *intensity* of the dysregulation behaviors also has an influence on the time spent jointly engaged. Intense episodes were characterized by the severity of the behaviors (e.g., screaming, crying, rapid overactive behaviors) which would impair the child's ability to sustain a back forth interval of communication in which the dyad is jointly engaged in a shared activity, conversation, or play toy. For example, if a child is upset about gaining access to a toy, the engagement between child and caregiver may begin as joint engagement (both child and caregiver engaging with each other and the object). As child increases the intensity of behaviors (moving from upset about access to toy to intense distress), joint engagement will often wane to

states of *unengagement*. From a clinical perspective, it appears obvious that increasing intensity of behaviors will impact the child's ability to engage with their caregiver.

How do Caregivers *Respond* to their Child's Dysregulation?

The third major finding to this study is that caregivers respond to their child's behaviors in a *variety* of ways throughout the interaction. Caregivers implement specific strategies that appear to target their child's dysregulation (i.e., Co-Regulation), and also implement strategies that support engagement, play and communication (i.e., JASPER Caregiver Strategies. This study highlights that certain co-regulating strategies are related to time dysregulated. Alternatively, other broader strategies (e.g., strategies to support engagement/environment/communication; JASPER Caregiver Strategies) may decrease the time a child spends dysregulated AND also may influence joint engagement outcomes.

Examining Caregiver Co-Regulation Strategies & Relation to Dysregulation & Joint Engagement

The first strategy scheme examined specific co-regulation behaviors/strategies (Gulsrud et al., 2010) that caregivers displayed. The most common strategies caregivers utilized were redirection (e.g., included in active strategy composite) and avoidance (e.g., avoidance composite strategy). Recently, Northup and colleagues also found that caregivers (regardless of child diagnosis) most frequently used redirection more so than any other strategy (Northup et al., 2024). The vast majority of caregivers did not use *any* verbal strategies (e.g., vocal comfort, reassurance). However, it is important to note that caregivers were still often talking while they exhibited specific strategies (e.g., redirection or physical comforting) they just did not use these specific verbal strategies (e.g., reassuring the child, saying, "Keep going!"). This finding aligns

with previous work that has emphasized that caregivers of young children with ASD might be cognizant of their child's developmental capabilities and overall receptive understanding of language (Northup et al., 2024). Therefore, caregivers are engaging in strategies that are indeed more *developmentally* appropriate for their minimally verbal children, which include strategies that do not involve a *sole* verbal component.

The results of this study suggest that caregivers' uses of active strategies are related to *increased* total time dysregulated. Specifically, caregivers are using active strategies when the children are displaying negative behaviors, idiosyncratic behaviors, and avoidant behaviors. These findings suggest that caregivers of toddlers with ASD are recognizing these specific dysregulation behaviors and are therefore, responding to this dysregulation with an increase in these strategies. Understanding how active strategies influence dysregulation, and hopefully diminish/lessen dysregulation, is an important target for future research. Given that this study was done only with baseline data, it is important to note that the results of this study do not imply causality between these variables. Recently, Dimachkie Nunnally et al. (2021) conducted a study that examined effect of caregiver co-regulation responses on subsequent child negative affect during a clean-up task. However, they did not find any effect on co-regulatory responses and their impact of reducing *future* negative affect in the child. Taken together, it is clear that the caregivers *intend* to influence the dysregulation they are recognizing. However, the strategies that caregivers display (regardless of context) have not been proven yet to be beneficial in reducing the dysregulating behavior.

Additionally, this study found that caregivers also avoided (did not act) during specific types of dysregulation behaviors. One surprising finding is that a notable proportion (34%) of caregivers in this study displayed avoidance strategies during their child's dysregulation

episodes. Caregivers were coded as "avoidant" when they (a) actively ignored the child's dysregulation or (b) avoided/ did not act during the episode. Coding caregiver's *unresponsiveness* is a relatively new construct that has only previously been captured in a few studies (e.g., Dimachkie Nunnally et al., 2021). This appears to be a relatively common strategy that has been unaccounted for in past research. This percentage of avoidant caregiver strategies (34%) imply that some caregivers might not respond at all to their child's dysregulation behaviors. Some clinical observations could suggest that caregivers could be in fact *unaware* of dysregulation, perhaps when those dysregulating behaviors are subtle/less intense. This is supported by the fact that caregiver's avoidant strategy use was positively related to child's vocalizing behaviors (variable: time, e.g., scripting, verbal repetitive behaviors) but not intensity of vocalization behaviors. Conversely, caregivers could be ignoring / avoiding specific types of dysregulating behaviors, as is suggested by results of the correlational analyses indicating that physical venting behaviors (both duration & intensity) and idiosyncratic behaviors (time) is significantly and positively related to the caregiver strategy of avoidance. Perhaps when children display some physical venting behaviors (jumping, running, active gross motor behaviors) caregivers do not intervene (utilize any strategy), even if those behaviors are considered *intense*. Dimachkie Nunnally et al. (2021), found that high energy behaviors may in fact be predictive of later negative affect. This is reinforced by the fact that these behaviors in this study were in in fact coded as dysregulation (and were in fact not appropriate for the context of the interaction). Perhaps, caregivers are not always aware of the *function* of certain behaviors. For vocalization dysregulation behaviors, caregivers may not feel the need to intervene, perhaps due to difficulty in discerning whether those behaviors are signs of dysregulation or just "typical" repetitive behaviors. Additionally, perhaps due to the child's young age and potential challenges with

language/communication, any verbalizations (even if repetitive) may not warrant (in the caregiver's mind) any action/strategy.

JASPER Caregiver Strategies & Relations to Dysregulation & Joint Engagement

Caregivers were also assessed on their overall strategy use (JASPER caregiver strategies supporting a variety of domains including engagement, regulation, play, communication) during the caregiver-child free play interaction. The caregiver's overall score on the use of these strategies relate to the time spent dysregulated. Caregivers who demonstrated sound strategies (more developmentally appropriate), was related to children who spent less time dysregulated. Additionally, higher strategy use was also related to time spent unengaged (meaning better strategy use was associated with less time *unengaged*). These results imply that caregivers employ strategies that may later influence their child's dysregulation, even if the strategy is not directly related to co-regulation (as is defined in the co-regulation strategy scheme). For example, upon further inspection of the specific domains within the JASPER caregiver strategies measure, several domains were significantly related to the amount of time dysregulated. Under the domain of Engagement/Regulation (ER), as one would hope, higher scores in this domain were significantly (and negatively) related to dysregulation (i.e., higher (better) strategies relate to less time dysregulated). Higher scores on the communication domain negatively relates to total time dysregulated, meaning that caregivers who had more developmentally appropriate communication strategies (e.g., used less directives/test questions, responded to child's communication, matched their language to child's developmental level) were linked to children with less time dysregulated. Implications of these findings suggest that future caregiver mediated interventions might be able to specifically target dysregulation behaviors through these explicit

strategies. A future target of this research will be to examine caregivers who learn JASPER strategies and how these strategies may influence dysregulation *over time*.

Further, JASPER Caregiver Strategies were significantly related to time spent *unengaged*. Specific strategies that relate to joint engagement outcomes (i.e., time unengaged) include environmental strategies (developmentally appropriate environmental strategies relates to less time unengaged) and communication strategies (developmentally appropriate communication strategy use) relates negatively to time spent unengaged (i.e., less time unengaged). No relations were found between caregiver scores and time spent jointly engaged. Although this finding may seem surprising, it may be that in fact, caregivers use of these strategies (implementation) is not *yet* at a point in which they impact the child's joint engagement. JASPER caregiver overall strategies were rated around 27% on average (similar to previous studies examining caregiver strategy use at baseline, i.e., Shire et al., 2022). Shire et al., (2022) highlighted that in order to make an impact on joint engagement outcomes, strategies must be implemented at a relatively high fidelity (~50% or higher) in order to impact child outcomes (e.g., greater strategy use relates to gains in joint engagement). In this study, caregivers were rated on these strategies at baseline (prior to intervention) and therefore had not been trained on these strategies. Prior research demonstrates that higher fidelity (better implementation) of these strategies *can* increase joint engagement outcomes for young toddlers with ASD (Shih et al., 2021; Shire et al., 2022).

Do Caregiver Strategies Moderate the Relationship between Dysregulation and Joint Engagement?

This study did not find a moderating effect of caregiver strategies (caregiver co-regulation strategies or JASPER caregiver strategies on the relationship between dysregulation

and joint engagement. However, a moderating effect of caregiver strategies on the relationship between *dysregulation and time unengaged* was significant. Results suggest that the relationship between dysregulation and proportion of time unengaged is influenced by the level of caregiver strategies. Specifically, when caregiver strategies are higher (more developmentally appropriate) the impact of dysregulation on time spent unengaged may be amplified.

Several reasons could explain the lack of significant findings for the moderating effects of caregiver strategies on *joint engagement*. One reason could be that caregivers may not be using enough appropriate strategies to support dysregulation AND help increase joint engagement. Given that the average strategy score was only 27% for JASPER Fidelity, it is possible that these strategies were not implemented as developmentally appropriately in order to support regulation and increase time jointly engaged. Additionally, there could be a lack of variability within the strategies that might be preventing the detection of moderation effects of caregiver strategies. Per the co-regulation strategies, as stated, caregivers mostly used redirection strategies and avoidant strategies and there was not a low of variation within those strategy composites.

A strength of this study is the use of multiple methods (two different caregiver strategy schemes) to measure caregiver strategies, which allows for a more inclusive range and examination of strategies and their effects. However, it is still possible that some caregiver strategies were not captured. Further, it could be that caregiver strategies influence dysregulation and joint engagement independently rather than moderating the relationship between dysregulation and joint engagement.

Limitations and Implications

This study uniquely contributes to the current literature by examining dysregulation behaviors and caregiver strategies on young children with ASD, including a young toddler cohort of participants (12- 36 months). Moreover, this study further explored young toddler's dysregulation behaviors by describing both behaviors themselves and the intensity of those behaviors. Additionally, this study highlighted that there is a relationship between dysregulation and joint engagement. However, no effects were found for the potential moderating role of caregiver strategies on the relationship between dysregulation behaviors and joint engagement. Although this study has many strengths, some limitations should be addressed.

This study was conducted with cross-sectional data; therefore, we will not be able to conclude anything about the directionality of any potential associations. Future studies should examine how the child's dysregulation behaviors and joint engagement develop overtime. Given that these data were collected prior to an intervention aimed at increasing social communication outcomes for children with ASD, future studies could examine potential treatment effects on dysregulation outcomes and caregiver strategies. This study provides initial evidence (through relational analyses) that some caregiver strategies, and specifically engagement/regulation strategies, might be related to dysregulation outcomes. Future research would benefit from examining how specific engagement/regulation strategies might influence regulation. A recently published study by Shih et al., 2024 indicated that caregiver strategies moderated the treatment effect of children's joint attention skills from exit to follow up, highlighting the importance of understanding a caregiver's behaviors on child outcomes (Shih et al., 2024). An important next step for this study will be to examine how caregiver strategies might potentially moderate a treatment effect of dysregulation behaviors from entry to exit of an intervention study. Further, given the relatively little research based on interventions focused on dysregulating behaviors in

this young population, understanding potential mechanisms behind treatment effects would be an important research target for this population.

Young children with ASD often have challenging behaviors related to regulation, indicating an inherent need for interventions to support improving regulation behaviors, especially during this critical developmental period. When caregivers and children are jointly engaged and have enriching, positive interactions, this increases opportunities for learning and growth for the child. Caregivers may play a crucial role in helping support their child's ER development, and findings from this study may inform researchers and clinicians about the contexts in which these skills may be best improved.

Appendices

Table 1. Child and Caregiver Demographics.

Measure	Variable	Value	Total Sample	Study 1 Mean (SD) or N (%)	Study 2 Mean (SD) or N (%)
			N=149	N=80 (53%)	N=69 (46%)
Child Demographic	Child Age	(months)	22.38 (6.95)	26.26 (7.076)	17.87 (2.93)
	Gender	Male	117 (78.5%)	60 (75%)	57 (82.6%)
		Female	32 (21.5%)	20 (25%)	12 (17.4%)
	Child's Race	White	69 (46.3%)	39 (48.8%)	30 (43.5%)
		Multiple	35 (23.5%)	13 (16.3%)	22 (31.9%)
		Asian	23 (15.4%)	18 (22.5%)	5 (7.2%)
		Black/African American	4 (2.7%)	1 (1.3%)	3 (4.3%)
		Other	14 (9.4%)	8 (10%)	6 (8.7%)
		Did Not Respond/Missing	4 (2.7%)	1 (1.3%)	3 (4.3%)
	Child's Ethnicity	Hispanic/Latino	23 (15.4%)	15 (18%)	8 (11.6%)
		Not Hispanic/Latino	123 (82.6%)	62 (77%)	61 (88.4%)
		Did Not Respond/Missing	3 (2.0%)	3 (.03%)	0 (0%)
Child Baseline Scores	Mullen: Cognition	DQ	72.92(21.67)	73.07(25.02)	72.74(17.15)
		NVDQ	80.52(21.62)	75.40(24.37)	86.45(16.14)
	Mullen: Language	Receptive Lang.	14.18(8.65)	17.16(9.91)	10.73(5.13)
		Expressive Lang.	14.18(8.48)	17.45(9.76)	

Measure	Variable	Value	Total Sample	Study 1 Mean (SD) or N (%)	Study 2 Mean (SD) or N (%)
					10.39(4.31)
	ADOS Scores	ADOS-T	16.77(4.80)	16.01(4.71)	17.65(4.78)
		ADOS-SC	13.56(4.26)	12.51(4.28)	14.78(3.92)
		ADOS-RRB	3.28(1.80)	3.64(1.87)	2.87(1.63)
Family Demographics	Caregiver Age	Years	36.3	35.6 (5.7)	37 (5.1)
	Caregiver Gender	Male	18	5 (6.3%)	13 (18.8%)
		Female	131	75 (93.8%)	56 (81.2%)
	Caregiver Ethnicity	Hispanic/Latino	21 (14%)	14 (17.5%)	7 (10.1%)
		Not Hispanic/Latino	124 (83%)	64 (80%)	60 (87%)
		Did Not Respond/Missing	4 (.02%)	2 (2.5%)	2 (2.9%)
	Caregiver Race		71 (49%)	39 (48.8%)	32 (46.4%)
		White	16 (10%)	1 (1.3%)	15 (21.7%)
		Multiple	29 (19%)	22 (27.5%)	7 (10.1%)
		Asian	10 (.06%)	5 (6.3%)	5 (7.2%)
		Black/African American	20 (13%)	12 (15%)	8 (11.6%)
		Other	3 (.02%)	1 (1.3%)	2 (2.9%)
		Did Not Respond/Missing	0	0 (0%)	0 (0%)
	Caregiver Education		8 (.05%)	2 (2.5%)	6 (8.7%)
		Less than HS	18 (12%)	6 (7.5%)	
		HS Grad	54 (36%)	24 (30%)	
		Some College	96 (64%)	46 (57.5%)	
		College	1 (.006%)	0 (0%)	
		Grad Degree	6 (.04%)	2 (2.5%)	
		Special Training			
		Did Not Respond/Missing			

Measure	Variable	Value	Total Sample	Study 1 Mean (SD) or N (%)	Study 2 Mean (SD) or N (%)
					12 (17.4%) 30 (35%) 50 (58%) 1 (1.4%) 4 (5.7%)

Table 2. Primary Variables: Summary Statistics

Measure	Variable	Value	Mean (SD) or N (%)
			N=149
ER/Dysregulation	Total Time	(seconds) (proportion of time)	66.45 (72.97) .11 (.12)
	Negativity		17.47 (38.14) .21 (.32)
	Physical Venting		17.10 (35.29) .21 (.30)
	Idiosyncratic Bxs		16.66 (35.40) .18 (.29)
	Self-Soothe		.85 (7.75) .007 (.06)
	Avoidance		2.77 (9.2) .05 (.16)
	Distraction		.83 (4.47) .03 (.13)
	Comfort Seeking		1.70 (7.59) .02 (.11)
	Vocalizations		9.04 (26.63) .11 (.27)
	Cog/Verbal		0 (0)

Measure	Variable	Value	Mean (SD) or N (%)
Caregiver Co-Regulation			
	Help/Prompt	(Frequency) (proportion of time)	61(39.9%) .16 (.30)
	Follow		46(30.1%) .09 (.21)
	Redirect		75(49%) .25 (.32)
	Ignore		26(17%) .05 (.18)
	Emotion Following		6(3.9%) .006 (.04)
	Physical Comfort		18(11.8%) .03 (.13)
	Reassure		3 (2%) .002 (.02)
	Vocal Comfort		0 (0%) .00 (.0)
	Avoid		67(43.8%) .18 (.27)
	Active Strategies Composite	(Proportion of time)	.46 (.39)
	Verbal Strategies Composite		.009 (.04)
	Avoidance Strategies Composite		.34 (.36)
JASPER Caregiver Strategies			
	Engagement & Regulation	(%)	.42 (.23)
	Environment		.36 (.14)
	Imitation & Modeling		.31 (.18)
	Play		.25 (.13)
	Communication		.24 (.10)

Measure	Variable	Value	Mean (SD) or N (%)
	Overall Strategy Score		.31 (.10)
Engagement			
	Unengaged	(Time)	73.97 (83.34)
		(Prop of Time)	.13 (.15)
	Onlooking		15.78 (24.83)
			.02 (.04)
	Person Engaged		3.92 (14.12)
			.007 (.02)
	Object Engaged		305.74 (139.30)
			.50 (.23)
	Joint Engagement		197.18 (158.47)
			.33 (.26)

Table 3. Bivariate Correlations Among Demographic Information and Proportion of Total Time Dysregulated

	Time Dysregulation	Sig.
Age	.035	.675
DQ	-.326*	<.001
NVDQ	-.338*	<.001
ADOS Total Score	.295*	<.001
ADOS SC Score	.281*	<.001
ADOS RRB Score	.264*	.001
Receptive Lang	-.262*	.001
Expressive Lang	-.195*	.017
Caregiver Age	.062	.459
Income (SES)	-.112	.193

Note. *. Correlation is significant at the .05 level (2-tailed).

Table 4. Independent Samples *T*-Test: Means for Child Sex, ASD Sib Status, Child Ethnicity, Caregiver Sex, Caregiver Ethnicity on Total Time ER/Dysregulated

Variable	N	Mean	SD
Child Sex: Male	117	.11	.12
Child Sex: Female	31	.12	.10
Child Ethnicity (Yes, Hispanic/Latino)	22	.114	.10

Child: No Hispanic/Latino	117	.10	.01
ASD Sibling	26	.07	.07
No ASD Sibling	57	.12	.13
CG Sex: Male	18	.11	.12
CG Sex: Female	130	.11	.14
CG Yes, Hispanic/Latino	20	.13	.12
CG No Hispanic/Latino	124	.111	.12

Note. *CG = caregiver.

Table 5. Coefficients for Regression Model Predicting Total Time Dysregulated from Child's Cognitive Ability, Language Ability, ADOS Scores, and ASD Sib Status.

	Unstandardized B	Beta	t	Sig.
(Constant)	-.011		-.116	.908
DQ	.006	1.027	2.472	.016
NVDQ	-.005	-.863	-2.592	.012
ADOS SC	.006	.212	1.650	.103
ADOS RRB	.029	.400	4.645	<.001
Receptive Lang	-.001	-.098	-.795	.685
Expressive Lang	-.005	-.324	-.944	.201
ASD Sibling	-.021	-.079	-.824	.449

Note. Dependent Variable: Total Time Dysregulated (Proportion Scores). Receptive and expressive language are the age equivalency scores from the Mullen domains.

Table 6. Bivariate Correlations Among Demographic Info and Intensity Dysregulation Bxs

	Neg	PV	Idios	S-Soothe	Avoid	Dist	Comf	Vocs	Cog Verb
Age	.135	-.041	-.200	.359	-513*	.179	.388	-.007	X
Sig.	.281	.733	.129	.485	.017	.701	.239	.967	
DQ	-.220	-.198	-.151	.897*	-.074	-.186	-.670*	.015	X
Sig.	.076	.095	.253	.015	.751	.690	.024	.930	

NVDQ	-.238	-.206	-.094	.565	.000	-.534	-.609*	.077	X
Sig.	.054	.082	.480	.242	.999	.217	.047	.645	
ADOS Total	.174	.195	.274*	-.580	.362	-.263	.662*	.020	X
Sig.	.163	.101	.036	.228	.107	.569	.026	.905	
ADOS-SC	.134	.195	.248	-.709	.406	-.318	.519	.013	X
Sig.	.283	.101	.058	.115	.068	.487	.102	.940	
ADOS RRB	.246*	.138	.119	-.145	.019	.122	.727*	.165	X
Sig.	.046	.249	.367	.784	.936	.795	.011	.323	
Recept. Lang	-.056	-.113	-.298*	.884*	-.307	.226	-.745*	.042	X
Sig.	.656	.345	.022	.020	.175	.626	.009	.802	
Expr. Lang	-.012	-.092	-.234	.857*	-.439*	.088	-.482	-.042	X
Sig.	.921	.442	.075	.029	.047	.852	.133	.804	
CG Age	.072	-.068	.085	.169	-.016	-.234	.201	.094	X
Sig.	.577	.580	.532	.750	.951	.613	.552	.587	
Income (SES)	-.167	-.084	-.025		.307	-.020	-.307	-.135	X
Sig.	.211	.505	.854		.202	.966	.389	.440	
Total Sib	-.232	-.135	.012	-.250	.175	.091	-.571	.024	X
Sig.	.068	.261	.928	.685	.486	.846	.066	.890	
Birth Order	.015	.067	.098		-.234		.645	.629*	X
Sig.	.924	.675	.575		.401		.117	.002	

Note. *Correlation is significant at the .05 level (2-tailed).

Table 7. Correlations Between Total Time Dysregulation and Joint Engagement Outcomes

		Joint Eng	Un Eng.	Obj Eng	Person Eng	Onlook
Total Time Dysreg	Pear Corr.	-.260**	.361**	.031	-.043	.237**
	Sig.	.001	<.001	.707	.606	.004

Note. *. Correlation is significant at the .05 level (2-tailed).

Table 8. Coefficients for Regression Model Predicting Total Time Unengaged from Time Dysregulated, Child's Cognitive Ability, and ADOS Symptom Levels

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	.336	.086		3.892	<.001
	Dysregulated	.454	.106	.355	4.275	<.001
	NVDQ	-.002	.001	-.231	-2.632	.009
	ADOS_SC	-.007	.003	-.192	-2.285	.024
	ADOS_RRB	-.006	.007	-.071	-.891	.374

a. Dependent Variable: Proportion Time Unengaged. Time Dysregulated = Proportion Time Dysregulated.

Table 9. Bivariate Correlations between Intensity Dysregulation Bxs and Joint Engagement States

		Un Eng.	Onlooking	Person Eng.	Obj Eng	Joint Eng.
Total Time Int	Pear Corr	-.046	-.031	.121	.040	.058
	Sig.	.621	.742	.189	.669	.531

Neg Int	Pear Corr	.241	.002	.118	.013	-.118
	Sig.	.053	.990	.348	.916	.348
PV Int	Pear Corr	.042	-.145	.259*	.046	-.102
	Sig.	.726	.229	.029	.701	.399
Idios Int	Pear Corr	.218	.057	-.067	.148	-.204
	Sig.	.097	.671	.612	.265	.122
Selfsoothe Int	Pear Corr	-.187	.954**	1.000**	-.317	-.030
	Sig.	.723	.003	<.001	.540	.956
Avoidance Int	Pear Corr	.292	-.083	-.225	.142	-.087
	Sig.	.199	.720	.328	.539	.708
Distraction Int	Pear Corr	.915**	-.298	-.354	.044	-.188
	Sig.	.004	.516	.437	.926	.687
Comfort Int	Pear Corr	.167	-.683*	.308	-.523	.340
	Sig.	.645	.029	.386	.121	.337
Voc Int	Pear Corr	-.094	-.143	.291	-.025	.063
	Sig.	.575	.393	.077	.883	.707

Note. *. Correlation is significant at the .05 level (2-tailed).

Table 10. Bivariate Correlations between Caregiver Co-Reg Strategies & Time Dysregulated Self

		Neg	PV	Idios	Soothe	Avoid	Distract	Voc	Comfort
Active	Pear Corr.	.227**	.023	.191*	.006	.193*	.112	-.057	.155
	Sig.	.005	.785	.020	.938	.018	.175	.492	.058
Verb	Pear Corr.	.091	-.068	-.064	.032	-.051	-.038	-.004	-.042
	Sig.	.269	.412	.435	.701	.535	.643	.961	.615
Avoid	Pear Corr.	-.018	.235**	.047	.046	-.044	-.019	.237**	-.045
	Sig.	.823	.004	.567	.577	.590	.822	.004	.586

Note. *. Correlation is significant at the .05 level (2-tailed). Active=Active Strategy Composite. Verbal=Verbal Strategies Composite. Avoid=Avoidance Strategies Composite.

Table 11. Bivariate Correlations between Caregiver Co-Reg Strategies and Joint Engagement States

		Joint Eng.	Uneng.	Onlooking	Person Eng.	Object Eng.
Active	Pear Corr.	-.218**	.156	.139	.076	-.015
	Sig.	.008	.059	.093	.360	.855
Verb	Pear Corr.	-.052	.005	.044	.033	-.021
	Sig.	.527	.952	.599	.694	.798
Avoid	Pear Corr.	.028	-.058	.053	.043	.025
	Sig.	.732	.481	.525	.607	.762

Note. *. Correlation is significant at the .05 level (2-tailed). Active=Active Strategy Composite. Verbal=Verbal Strategies Composite. Avoid=Avoidance Strategies Composite. Prop

Table 12. Bivariate Correlations between JASPER Caregiver Strategies and Dysregulation

		Neg Time	PV Time	Idios Time	Self Soothe	Avoid Time	Dist. Time	Voc Time	Comf. Time	Total DsyReg
ER	Pear Corr.	-.121	-.221**	-.165*	-.118	-.101	-.104	-.134	-.131	-.345**
	Sig.	.140	.007	.044	.151	.222	.207	.103	.110	<.001
Env	Pear Corr	-.063	.000	-.135	-.082	-.115	-.113	-.092	-.090	-.171*
	Sig.	.448	.996	.100	.322	.161	.169	.263	.273	.037
IM	Pear Corr.	.015	.108	-.120	-.087	-.096	-.122	-.151	-.076	-.090
	Sig.	.854	.191	.146	.290	.245	.138	.066	.357	.275
Play	Pear Corr.	.022	-.059	-.096	-.144	-.142	-.036	-.083	-.004	-.130

	Sig.	.789	.475	.243	.079	.084	.660	.313	.966	.114
Comm	Pear Corr.	-.100	-.157	-.202*	-.041	-.044	-.170*	-.037	-.083	-.269**
	Sig.	.224	.055	.014	.615	.591	.038	.658	.312	<.001

Note. *. Correlation is significant at the .05 level (2-tailed). ER=Engagement & Regulation. Env=Environment Strategies. IM=Imitation and Modeling. Comm.=Communication. Overall=Overall Caregiver Strategy Score.

Table 13. Regression Model Predicting Dysregulation from JASPER Caregiver Strategies

	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
(Constant)	.268	.035		7.618	<.001	.198	.338
Comm	-.281	.138	-.237	-2.028	.044	-.554	-.007
ER	-.372	.112	-.383	-3.322	.001	-.593	-.151
ENV	-.131	.109	-.151	-1.195	.234	-.347	.085
Overall	.433	.235	.341	1.848	.067	-.030	.897

a. Dependent Variable: Proportion Total Time Dysreg. ER=Engagement & Regulation. Env=Environment Strategies.

Table 14. Bivariate Correlations between JASPER Caregiver Strategies & Joint Engagement

		Joint Eng	Un Eng.	Onlooking	Person Eng	Obj Eng
ER	Pear Corr.	.132	-.122	-.068	-.060	.069
	Sig.	.109	.140	.408	.468	.403

Env	Pear Corr.	.047	-.226**	.094	.045	.029
	Sig.	.569	.006	.253	.586	.724
IM	Pear Corr.	.014	-.102	.152	-.037	-.084
	Sig.	.869	.216	.065	.654	.308
Play	Pear Corr.	.105	-.104	.131	-.007	-.151
	Sig.	.206	.210	.112	.933	.066
Comm.	Pear Corr.	.076	-.216**	-.011	-.170*	.066
	Sig.	.360	.009	.898	.039	.429
Overall	Pear Corr.	.050	-.246**	.092	-.065	.008
	Sig.	.549	.003	.268	.432	.924

Note. *. Correlation is significant at the .05 level (2-tailed).ER=Engagement & Regulation. Env=Environment Strategies. IM=Imitation and Modeling. Comm.=Communication. Overall=Overall Caregiver Strategy Score. Prop=Proportion time.

Table 15. Coefficients for Regression Model Predicting Joint Engagement from JASPER Caregiver Strategies, Dysregulation, Dysreg * JASPER Caregiver Strategies Interaction Term

	Unstandardized B	Beta	t	Sig.
(Constant)	-.2032		-1.438	.1525
Dysregulation	-.494	.2552	-1.938	.054
JASPER Strategies	-.259	.277	-.933	.352
Dys*JASPER Strategies	-2.079	2.244	-.926	.355
NVDQ	.006	.001	4.516	.000
ADOS RRB	.000	.016	.029	.976

Note. Dependent Variable: Total Time Dysregulated (Proportion Scores). Interaction Term: Dysregulation X JASPER Caregiver Strategies.

Table 16. Coefficients for Regression Model Predicting Time Unengaged from JASPER Caregiver Strategies, Dysregulation, Dysreg * JASPER Caregiver Strategies Interaction Term

	Unstandardized B	Beta	t	Sig.

(Constant)	.279		4.200	<.001
Dysregulation	-.218	-.184	-.747	.456
JASPER Strategies	-.030	-.102	-.853	.395
Dys*JASPER Strategies	.462	.602	2.425	.017
NVDQ	-.002	-.267	-3.105	.002
ADOS RRB	-.009	-.112	-1.328	.187

Note. Dependent Variable: Total Time Unengaged (Proportion Scores). Interaction Term: Dysregulation (Proportion Time Dysregulated) * JASPER Caregiver Strategies

Table 17. Coefficients for Regression Model Predicting Joint Engagement from ER/Dysregulation and Caregiver Co-Regulation Active Strategies: Interaction Effects

	Unstandardized B	Beta	t	Sig.
(Constant)	-.222		-1.295	.198
Dysregulation	-.513	-.182	-1.387	.168
Active Strategy	-.197	-.151	-1.215	.227
Dys*CAS	.342	.116	.708	.480
NVDQ	.007	.414	4.459	<.001
ADOS RRB	.014	.075	.849	.397

Note. Dependent Variable: Joint Engagement. Interaction Term: Dysregulation (Proportion Time Dysregulated) * Caregiver Co-Regulation Active Strategies Composite.

Table 18. Coefficients for Regression Model Predicting Unengagement from ER/Dysregulation and Caregiver Co-Regulation Active Strategies: Interaction Effects

	Unstandardized B	Beta	t	Sig.
(Constant)	.256		3.656	<.001
Dysregulation	.439	.371	2.915	.004
CoReg Active	.032	.106	.885	.378
Dys*CAS	-.031	-.025	.876	.876
NVDQ	-.002	-.276	-3.067	.003
ADOS RRB	-.010	-.120	-1.402	.164

Note. Dependent Variable: Unengagement. Interaction Term: Dysregulation (Proportion Time Dysregulated) * Caregiver Co-Regulation Active Strategies Composite.

Table 19. Bivariate Correlations Among Core Variables: Dysregulation, Caregiver Co-Reg Strategies & JASPER Caregiver Strategies, Joint Engagement

		Caregiver Strategy (Overall)	Co-Reg Active	Co-Reg Verb	Co-Reg Avoid	Time Dysreg	Joint Engagement
Caregiver Strat (overall)	Pear Corr.	1	.010	.029	-.108	-.221**	.050
	Sig.		.899	.724	.188	.007	.549
Co-Reg Active	Pear Corr.	.010	1	.075	-.472**	.260**	-.218**
	Sig.	.899		.362	<.001	.001	.008
Co-Reg Verb	Pear Corr.	.029	.075	1	-.104	-.028	-.052
	Sig.	.724	.362		.208	.734	.527
Co-Reg Avoid	Pear Corr.	-.108	-.472**	-.104	1	.196*	.028
	Sig.	.188	<.001	.208		.017	.732
Time Dysreg	Pear Corr.	-.221**	.260**	-.028	.196*	1	-.260**
	Sig.	.007	.001	.734	.017		.001
Joint Engagement	Pear Corr.	.050	-.218**	-.052	.028	-.260**	1
	Sig.	.549	.008	.527	.732	.001	

Note. **. Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed). Time Dysreg= Proportion Total Time Dysregulated.

Table 20. Bivariate Correlations Among Caregiver Co-Regulation Strategies & JASPER Caregiver Strategies

	Eng & Reg	Env.	Imit/Mod	Play	Comm.	Overall

Active Strategies	Pearson Correlation	-.085	-.038	.089	.078	-.094	.010
	Sig. (2-tailed)	.304	.649	.282	.342	.256	.899
Verbal Strategies	Pearson Correlation	.127	.001	-.012	-.010	.017	.029
	Sig. (2-tailed)	.123	.995	.884	.905	.840	.724
Avoid Strategies	Pearson Correlation	-.195*	.019	-.135	-.051	-.124	-.108
	Sig. (2-tailed)	.017	.819	.102	.538	.131	.188

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