UNIVERSITY OF CALIFORNIA, IRVINE

Dyadic Micro-Analysis of Emotion Coregulation in Mothers and their Children with and without Autism Spectrum Disorder: Relations to Children's Developmental Outcomes

DISSERTATION

submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in Psychological Science

by

Valentina Valentovich

Dissertation Committee:
Professor Wendy A. Goldberg, Co-Chair
Assistant Professor Yuqing Guo, Co-Chair
Associate Professor Jessica Borelli

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CURRICULUM VITAE

VALENTINA VALENTOVICH

4201 Social and Behavioral Sciences Gateway
Department of Psychological Science
School of Social Ecology
University of California, Irvine
Irvine, CA 92697-7085

Email: vvalento@uci.edu

EDUCATION

2019 **Doctor of Philosophy, Psychological Science**
University of California, Irvine
Specialization: Developmental Psychology
Minor: Quantitative Methods
Dissertation*: Dyadic Micro-Analysis of Emotion Coregulation in Mothers and their Children with and without Autism Spectrum Disorder: Relations to Children's Developmental Outcomes*

2015 **Master of Arts, Social Ecology**
University of California, Irvine

2011 **Bachelor of Science, Psychology**
University of California, Davis
Minor: Education

RESEARCH EXPERIENCE

2014-2019 **Graduate Researcher**
Family Lab
Department of Psychological Science
University of California, Irvine
Principal Investigators: Wendy Goldberg, Ph.D., Yuqing Guo, Ph.D.

2012-2016 **Graduate Researcher**
Memory and Development Lab
Department of Psychological Science
University of California, Irvine
Principal Investigator: Angela F. Lukowski, Ph.D.

2011-2012 **Research Assistant**
Memory and Development Lab
Center for Mind and Brain
University of California, Davis
Principal Investigator: Simona Ghetti, Ph.D.

2010 **Research Assistant**
Early Start Lab
Medical Investigation of Neurodevelopmental Disorders Institute
University of California, Davis
Principal Investigator: Sally Rogers, Ph.D.

TEACHING EXPERIENCE

Instructor of Record, University of California, Irvine

Winter 2019 *Human Development and Cross-Cultural Perspectives*

Graduate Teaching Assistant, University of California, Irvine

Spring 2018 *Child Therapies*
Winter 2018 *Social Animal*
Fall 2017 *Naturalistic Field Research*
Winter 2016 *Psychology Fundamentals C*
Fall 2015 *Human Development and Cross-Cultural Perspectives*
Summer 2015 *Human Sexuality*
Spring 2015 *Infant Development*
Winter 2015 *Psychology Fundamentals B*
Fall 2014 *Human Development and Cross-Cultural Perspectives*
Spring 2014 *Lifespan Development*
Winter 2014 *Abnormal Psychology*
Fall 2013 *Cognitive Behavior Therapy*
Summer 2013 *Social Animal*
Spring 2013 *Lifespan Development*
Winter 2013 *Child Therapies*
Fall 2012 *Psychology Fundamentals C*

Invited Lectures, University of California, Irvine

Summer 2014 *Autism Spectrum Disorder: Applied Behavior Analysis*
Course: Psychology Fundamentals C
Winter 2014 *Applied Behavior Analysis Therapy*
Course: Psychology Fundamentals C
Fall 2012 *Autism Spectrum Disorder Treatments*
Course: Psychology Fundamentals C

PEER-REVIEWED PUBLICATIONS

Guo, Y., Valentovich, V., Garfin, D. R., & Goldberg, W. A. (revise and resubmit). Father-Child Emotion Coregulation and Adaptive and Maladaptive Behaviors in Children with and without Autism Spectrum Disorder.

Valentovich, V., Guo, Y., Garfin, D. R., & Goldberg, W. A. (2018). Emotion Coregulation Processes between Mothers and their Children with and without Autism Spectrum

Disorder: Associations with Children's Maladaptive Behaviors. *Journal of Autism and Developmental Disorders, 48,* 1235-1248.

Lukowski, A. F., Valentovich, V., Bohanek, J. G., & Slonecker, E. M. (2017). Sleep Quality and the Subjective Experience of Autobiographical Memory: Differential Associations by Memory Valence and Temporality. *Applied Cognitive Psychology, 31,* 604-614

CONFERENCE PRESENTATIONS

*mentored undergraduate or post-baccalaureate student

Valentovich, V., Guo, Y., Garfin, D. R., & Goldberg, W. A. (2018, February). *Emotion Coregulation Processes between Mothers and their Children with and without Autism Spectrum Disorder: Associations with Children's Maladaptive Behaviors*. Poster presented at the 3rd annual Social Ecology Poster Session for Masters and Doctoral Students, Irvine, CA.

Guo, Y., Garfin, D. R., Ly, A., Valentovich, V., & Goldberg, W. A. (2017, May). *Comparing Mother-Child and Father-Child Emotion Co-Regulation Processes in Relation to Adaptive Functioning.* Poster presented at the 14th annual International Meeting for Autism Research, San Francisco, CA.

*Nunez, C., *Myers, D., *Torres, T., *Mercer, R., Valentovich, V., Milojevich, H., Lukowski, A. F. (2016, April). *Adapting to Life with an Infant with Down Syndrome: A Study of Infant Birth Stories Written on Parent Weblogs.* Poster presented at the 11th annual Symposium on Cognition and Language Development, Los Angeles, CA.

*Torres, T., Valentovich, V., Milojevich, H., & Lukowski, A. F. (2016, April). *Sibling Relationships in Typically Developing Children and Children with Down Syndrome.* Poster presented at the 96th annual Western Psychological Association Convention, Long Beach, CA.

*Fallon K., *Acedo, G., *Liang S. A., *Hernandez, D., *De Pace, D., Valentovich, V., & Garfin, D. R., Goldberg, W. A., & Guo, Y. (2016, April). *Associations Between Parent-Child Positive Engagement and Maladaptive Behaviors in Children with Autism Spectrum Disorder.* Poster presented at the 96th annual Western Psychological Association Convention, Long Beach, CA.

Valentovich, V., (2016, March). *Examining Relations between Child Sleep Habits and Executive Functioning*. Poster presented at the 1st annual Social Ecology Poster Session for Masters and Doctoral Students, Irvine, CA.

Guo, Y., *Garcia, M., *Gutierrez, S., *Kim, S., *Merrell, S., *Garibay, C., *Martinez, P., *Davia, S., Valentovich, V., & Goldberg, W. A. (2015, May). *A Dynamic Systems Approach to Mother-Child Emotion Co-Regulation in Relation to Adaptive Functioning in Children with ASD.* Poster presented at the International Meeting for Autism Research 15th Annual Meeting, Salt Lake City, UT.

*Sarkian, A., Valentovich, V., & Lukowski, A. F. (2015, May). *Generational Status and Earliest Autobiographical Memories: Examining the Intergenerational Transmission of Narrative Style*. Poster presented at the 10th annual Symposium on Cognition and Language Development, Irvine, CA.

*Sarkian, A., Valentovich, V., & Lukowski, A. F. (2015, April). *Generational Status and Earliest Autobiographical Memories: Examining the Intergenerational Transmission of Narrative Style*. Poster presented at the Western Psychological Association 95th Annual Convention, Las Vegas, NV.

Valentovich, V., Bohanek, J., & Lukowski, A. F. (2015, March). *Sleep Quality and the Content of Autobiographical Memory: Differential Associations by Memory Valence and Temporality.* Poster presented at the Society for Research in Child Development 75th Biennial Meeting, Philadelphia, PA.

Valentovich, V., Bohanek, J., & Lukowski, A. F. (2014, May). *Sleep Quality and Autobiographical Memory during the Transition to Adulthood.* Poster presented at Association for Psychological Science 26th Annual Convention, San Francisco, CA.

Valentovich, V., Bohanek, J., & Lukowski, A. F. (2013, October). *Examining Associations between Sleep Quality and Autobiographical Memories in Young Adults.* Poster presented at the Cognitive Development Society 7th Biennial Meeting, Memphis, TN.

INVITED ADDRESSES

*Acedo, G., *Chin, A., *De Pace, D., *Fallon, K., *Hernandez, D., *Liang, A., *Provenzano, E., & Valentovich, V., (2015, May) *An Innovative Dynamic Systems Approach to Exploring Emotion Co-regulation in Children with and without Autism in the Context of the Strange Situation.* Oral presentation given that the University of California, Irvine Multi-Disciplinary Program Symposium. Irvine, CA.

Valentovich, V., & Lukowski, A. F. (2014, May). *Sleep Quality and Autobiographical Memory during the Transition to Adulthood.* Paper presentation given at the University of California, Irvine Department of Psychology and Psychology and Behavior Colloquium, Irvine, CA.

Valentovich, V., & Lukowski, A. F. (2014, May). *Examining Relations between Sleep Quality and Autobiographical Memories in University Students*. Paper presentation given at the 9th annual Symposium on Cognition and Language Development, Los Angeles, CA.

MENTORING EXPERIENCE

2018 **Summer Post-Baccalaureate Mentor**
Post-Baccalaureate Program in Psychological Science
Department of Psychological Science

University of California, Irvine

2017-2018 **Graduate Peer Mentor**
Graduate Student Peer Mentoring Program
Department of Psychological Science
University of California, Irvine

2014-2015 **Undergraduate Honor's Thesis Mentor**
School of Social Ecology
University of California, Irvine
Mentee: Adena Sarkian
Thesis: *Generational Status and Earliest Autobiographical Memories: Examining the Intergenerational Transmission of Narrative Style*.

2014 **Graduate Peer Mentor**
Graduate InterConnect Peer Mentor Program
Graduate Division
University of California, Irvine

2013-2014 **Undergraduate Honor's Thesis Mentor**
School of Social Ecology
University of California, Irvine
Mentee: Chelsea Burch
Thesis: *Examining Associations amongst Generational Status and Autobiographical Memory during the Transition to Adulthood*.

2012-2017 **Undergraduate Research Opportunities Program (UROP) Mentor**
University of California, Irvine

*Bayon, C., *Qu A., *Acedo G., *De Pace D., Valentovich, V., Goldberg, W. A., & Guo, Y. (2017, May). *Emotion Coregulation Among Mother and Child Dyads During the Strange Situation: State Space Grid Analysis.* Poster and oral presentations at the 24th Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Liang, S. A., *Fallon, K., *Hernandez, D., *De Pace, D., *Provenzano, E., *Chin, A., *Ball, E., Valentovich, V., & Goldberg, W. A., & Guo, Y. (2016, May). *A Dynamic Systems Analysis of Emotion Coregulation and Externalizing Behaviors in Children with Autism Spectrum Disorder.* Poster presented at the 23rd Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Torres, T., Valentovich, V., Milojevich, H., & Lukowski, A. F. (2016, May) *Sibling Relationships and Recall Memory in Typically Developing Children and Children with Down Syndrome.* Oral presentation at the 23rd Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Nunez, C., *Myers, D., *Torres, T., *Mercer, R., Valentovich, V., Milojevich, H., & Lukowski, A. F. (2016, May) *Adapting to Life with an Infant with Down Syndrome: A Study of Infant Birth Stories Written on Parent Weblogs.* Poster presented at the 23rd Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Avalos, B., *Wang, X. T., *Cruz, J. L., Valentovich, V., & Lukowski, A. F. (2016, May) *Sleep Habits and Working Memory in Young Children.* Poster presented at the 23rd Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Hillendahl, J., Valentovich, V., & Lukowski, A. F. (2015, May) *Understanding the relation between napping and memory in infants*. Poster presented at the 22nd Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Tran, K., *Li, T., Valentovich, V., & Lukowski, A. F. (2015, May) *Examining relations between sleep habits and executive functioning in childhood.* Poster presented at the 22nd Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Sarkian, A., Valentovich, V., Lukowski, A.F. (2015, May). *Generational Status and Earliest Autobiographical Memories: Examining the Intergenerational Transmission of Narrative Style*. Honors Thesis paper presentation given at the 22nd Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Rios, K., *Baek, S., Valentovich, V., & Lukowski, A. F. (2014, May). *Examining Associations between Sleep Quality and Autobiographical Memory during the Transition to Adulthood*. Poster presented at the 21st Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

*Burch, C., Valentovich, V., & Lukowski, A. F. (2014, May). *Examining Associations amongst Generational Status and Autobiographical Memory during the Transition to Adulthood.* Honors Thesis paper presentation given at the 21st Annual University of California, Irvine Undergraduate Research Symposium, Irvine, CA.

PROFESSIONAL DEVELOPMENT & SERVICE

2019 **Course Design Program**
Division of Teaching Excellence and Innovation
University of California, Irvine

2016 **Volunteer Judge**
Saint Joachim Catholic School Science Fair
Costa Mesa, CA

2015 **Multidisciplinary Design Program**
The California Institute for Telecommunications Information Technology
University of California, Irvine

2015 **Student Reviewer**
Society for Research on Adolescence 16th Biennial Meeting
Baltimore, MD

2014 **Mentoring Excellence Program**
Graduate Division
University of California, Irvine

2013 **Student Volunteer**
Cognitive Development Society 8th Biennial Meeting
Memphis, TN

PROFESSIONAL EXPERIENCE

2009-2012 **Applied Behavior Analysis Therapist**
Capital Autism Services
Sacramento, CA

2010 **Classroom Intern**
Patwin Elementary School
Davis, CA

2009 **Clinic Volunteer**
Medical Investigation of Neurodevelopmental Disorders Institute
Sacramento, CA

FELLOWSHIPS & AWARDS

2018 Social Ecology Dean's Dissertation Writing Fellowship
School of Social Ecology
University of California, Irvine

2018 Social Ecology Dean's Dissertation Data Collection Stipend
School of Social Ecology
University of California, Irvine

2016 Social Ecology Dean's Advancement Fellowship for Diversity Students
School of Social Ecology
University of California, Irvine

2018, 2016, 2015 Post-Baccalaureate Student Mentoring Award
Department of Psychological Science
University of California, Irvine

2015 Associated Graduate Students Travel Grant
University of California, Irvine

ABSTRACT OF THE DISSERTATION

Dyadic Micro-Analysis of Emotion Coregulation in Mothers and their Children with and without Autism Spectrum Disorder: Relations to Children's Developmental Outcomes

Valentina Valentovich
Doctor of Philosophy in Psychological Science
University of California, Irvine, 2019

Successful emotion regulation is essential for developmental outcomes for children with and without Autism Spectrum Disorder (ASD). Parent-child coregulation lays the foundation for the development of children's self-regulation. This dissertation used a dyadic, micro-analysis approach to explore emotion coregulation between mothers and their children with and without Autism Spectrum Disorder in low-stress and moderately-stressful contexts. The first study examined the structure and the content of emotion coregulation in relation to children's internalizing and externalizing behaviors in a low-stress context (Chapter 2). Findings demonstrated that dyadic positive engagement moderated the relationship between dyadic flexibility and maladaptive behaviors for children with ASD. The second study assessed dyadic repair processes in mothers and their children with ASD in a low-stress context (Chapter 3). Results showed that over half of dyads engaged in repair processes and such repair was associated with dyadic and child functioning. The third study investigated relations between early emotion coregulation processes in mother-child dyads in the moderately-stressful context of the Strange Situation and neurotypical children's later socioemotional outcomes using data from the NICHD Study of Early Child Care and Youth Development (Chapter 4). The structure and the content of mother-preschool-aged child emotion coregulation predicted aspects of

children's social competence and peer relationships in middle childhood. Findings from this dissertation have significant conceptual and methodological implications. The results contribute to the existing literature on early emotion coregulation by examining these dyadic processes in relation to children's behavioral and socioemotional functioning. Moreover, the findings provide important information on mother-child emotion coregulation processes at the dyadic, micro-level across contexts (low-stress and moderately-stressful contexts) for both dyads of children with and without ASD.

CHAPTER 1:

Introduction

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that affects 1 in 59 or 1.7% of children in the United States (Centers for Disease Control and Prevention, 2018). Characteristics of ASD include challenges in social communication and restricted, repetitive behaviors (American Psychiatric Association, 2018). Children with ASD also commonly experience co-occurring symptoms, such as internalizing and externalizing behaviors, with prevalence rates of psychopathology ranging from 33-86% (Hartley, Sikora, & McCoy, 2008; Ooi, Tan, Lim, Goh, & Sung, 2011; Simonoff et al., 2008). Early interventions target behaviors and skills to help improve deficits across these domains (Dawson et al., 2012; Mahoney & Perales, 2003); therefore, it is imperative to gain a better understanding of pathways to and factors associated with maladaptive behaviors in children to inform and evaluate therapeutic efforts to reduce psychopathology.

One factor that may contribute to maladaptive behaviors in children with ASD is deficits in emotional processes. In addition to experiencing increased maladaptive behaviors, children with ASD also demonstrate impairments across emotional functioning, including expressing, understanding, and managing emotions (Loveland, 2005; Yirmiya, Kasari, Sigman, & Mundy, 1989). Importantly, children with ASD have deficits in regulating their reactions to emotionally arousing situations (Loveland, 2005). Emotion regulation refers to "extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions…, to accomplish one's goals" (Thompson, 1994, p. 27-28). Emotion regulation encompasses a range of processes and effective regulation requires the ability to adjust strategies to be situationally appropriate (Thompson, 1994). Behavioral observations, child-reports, and parent-reports indicate that young children as well as adolescents and young adults with ASD use more

ineffective strategies than neurotypical (NT) peers during positive and negative situations (Garon et al., 2009; Jahromi, Bryce, & Swanson, 2013; Jahromi, Meek, & Ober-Reynolds, 2012; Konstantareas & Stewart, 2006; Mazefsky, Borue, Day, & Minshew, 2014; Samson, Hardan, Podell, Phillips, & Gross, 2014; Samson, Huber, & Gross, 2012), and compromised emotion regulation capabilities may represent an important factor in the development of psychopathology (Mazefsky et al., 2013).

Successful emotion regulation is a significant developmental goal and is a crucial factor in adaptive functioning for children with and without ASD (Eisenberg et al., 1993; Mazefsky et al., 2014; Pouw, Rieffe, Stockmann, & Gadow, 2013). Children's self-regulation abilities develop within the context of early social relationships with their parents (Bridges & Grolnick, 1995; Kopp, 1982; Thompson & Meyer, 2007). Parents contribute to children's emotion regulation development though several mechanisms, such as responding sensitively to children's cues, validating emotions, teaching specific strategies (e.g., redirecting attention), and modeling behaviors (Morris, Silk, Steinberg, Myers, & Robinson, 2007; Thompson & Meyer, 2007). Relative to parents of NT children, parents of children with ASD tend to use more active strategies, such as redirecting, prompting, and providing physical comfort (Doussard-Roosevelt, Joe, Bazhenova, & Porges, 2003; Gulsrud, Jahromi, & Kasari, 2010; Hirschler-Guttenberg, Feldman, Ostfeld-Etzion, Laor, & Golan, 2015). Despite the centrality of parent-child relationships in children's emotional development, additional work is needed to elucidate how early dyadic emotion processes are related to developmental outcomes in NT children and children with ASD.

The overarching goal of this dissertation was to gain insights into mother-child emotion coregulation by examining emotion processes at the dyadic level in low-stress and moderately-

stressful contexts and to investigate relations between emotion coregulation and child behavioral and socioemotional functioning in children with and without ASD. To that end, three studies were conducted to explore three different, but related questions. First, how are emotion coregulation processes in mother-child dyads with children with and without ASD related to children's maladaptive behaviors (Chapter 2)? Second, how are patterns of dyadic repair processes in mother-child dyads with children with ASD related to dyadic and child functioning (Chapter 3)? Third, how do emotion coregulation processes in NT mother-child dyads predict children's later socioemotional functioning (Chapter 4)?

To address the three main questions of the thesis, dyadic micro-analysis of previously collected videotapes of mother-child interactions from two independent projects were conducted. Chapters 2 and 3 used the same cross-sectional dataset of families raising children with and without ASD to explore emotion coregulation in a low-stress context. Chapter 4 used data from one site of the NICHD Study of Early Child Care and Youth Development (SECCYD), a longitudinal dataset of families with NT children, to explore emotion coregulation in a moderately-stressful context.

Chapter 2 of the dissertation assessed the interaction between two aspects of emotion coregulation (i.e., structure and content) in mother-child dyads in relation to preschool-aged children's maladaptive behaviors in a low-stress context. These relations were examined using cross-sectional data in two groups: mother-child dyads of children with ASD and mother-child dyads of NT children.

Chapter 3 investigated patterns of mother-child dyadic repair in a low-stress context and explored relations between repair processes and dyadic and child functioning. These patterns were examined using cross-sectional data in mother-child dyads of children with ASD.

Chapter 4 used longitudinal data from the NICHD SECCYD to investigate how aspects of early mother-child emotion coregulation (i.e., structure and content) in a moderately-stressful context predicted children's social competence and peer relationships in middle childhood. These relations were examined in mother-child dyads of NT children.

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CHAPTER 2:

Emotion Coregulation Processes between Mothers and their Children with and without Autism Spectrum Disorder: Associations with Children's Maladaptive Behaviors

Abstract

A dyadic microanalysis approach was used to examine emotion coregulation processes in mother–child interactions in relation to children's maladaptive behaviors. Seventy-two mother–child dyads (46 children with Autism Spectrum Disorder (ASD); 26 neurotypical children) were previously videotaped in a semi-structured play procedure at home and mothers reported on children's internalizing and externalizing behaviors. Mother-child interactions were reliably coded in 5-second intervals and analyzed using Space State Grid software. Regression analyses supported moderation, whereby greater dyadic flexibility and more mutual-positive engagements were significantly associated with lower levels of maladaptive outcomes for children with ASD. Results have implications for initiating positive interactions and promoting effective parenting that help improve behavior in young children with ASD.

Emotion Coregulation Processes between Mothers and their Children with and without Autism Spectrum Disorder: Associations with Children's Maladaptive Behaviors

Emotion regulation involves engaging in behaviors and strategies to manage (inhibit, enhance, or maintain) emotional experiences (Calkins and Hill 2007; Thompson 1994). The ability to regulate emotions using effective strategies develops throughout childhood within the context of social interactions. Children and parents engage in a process of emotion coregulation during social exchanges in which parents and children mutually regulate their emotional experiences (Cole, Martin, & Dennis, 2004; Feldman 2003; Field 1994). Initially, parents play pivotal roles in demonstrating emotion regulation strategies during parent–child interactions (Denham et al. 2011; Kopp 1989). Young children rely on their parents to modify their emotional experiences (e.g., child is physically soothed by being held); as children become older, they increasingly use their own internal regulation strategies (e.g., shifting attention to a different play object when the desired object is not available) (Calkins and Hill 2007; Cicchetti, Ganiban, & Barnett, 1991; Kopp 1982, 1989).

Emotion coregulation processes are reciprocal in nature and involve transactions between dyads (Cohn and Tronick 1988; Cole et al. 2004; Field 1994). Parents may engage in various behaviors during interactions to facilitate children's emotion regulation development (e.g., scaffolding, monitoring, responding to child's cues). The engagement states of both parents and children vary in valence; dyads may engage in mutual positive, mutual negative, or mismatched (e.g., child in negative state and mother in positive state) states. The content of emotion coregulation processes differs for children with behavior problems compared to those without such problems. For example, preschool-aged children with conduct problems engaged in more mutual negative (e.g., angry) and mismatched interactions with their mothers relative to children

without conduct problems (Cole, Teti, & Zahn-Waxler, 2003). Additionally, for preschoolers whose conduct problems improved as they transitioned to school, mother–child interactions were higher in mutual-positive engagement and lower in mutual-negative engagement compared to children who did not improve (Cole et al. 2003), indicating that the emotional content of parent–child interactions may be important for managing child conduct problems over time.

Children with Autism Spectrum Disorder (ASD) commonly experience impairments in emotion regulation abilities and social interactions (American Psychiatric Association 2015; Loveland 2005; Mazefsky et al. 2013), which may underlie behavioral problems (Mazefsky and White 2014). Emotion dysregulation, or failure to use efficient emotion regulation strategies, occurs more frequently in individuals with ASD compared to neurotypical (NT) individuals (Samson, Huber, & Gross, 2012). Parent reports of emotional experiences indicate that in addition to experiencing more anger and anxiety, children and adolescents with ASD engage in increased maladaptive strategies (e.g., repetitive behaviors) and decreased adaptive emotion regulation strategies (e.g., problem solving) relative to NT children (Samson, Wells, Phillips, Hardan, & Gross, 2015). Behavioral observations of children with ASD during frustrating tasks also indicate that they use fewer efficient strategies (e.g., distraction) and more maladaptive strategies (e.g., avoidance and venting) compared to NT peers (Jahromi, Meek, & Ober-Reynolds, 2012; Konstantareas & Stewart, 2006). Of importance, maladaptive strategies tend to be associated with higher levels of internalizing (e.g., anxiety and depression) and externalizing behaviors (e.g., aggression and defiance) for both ASD and NT groups of children (Mazefsky, Borue, Day, & Minshew, 2014; Rieffe et al. 2011).

Only a handful of studies has examined how various aspects of emotion coregulation between parents and children with ASD are associated with behavioral outcomes, and whether

dyads with children with ASD engage in different patterns of regulation relative to dyads with NT children. Ting and Weiss (2017) examined parent co-regulation, child emotion regulation, and child psychopathology in school-aged children with ASD during discussions of negative past events. Greater parental scaffolding (e.g., sensitive responses to child) and the child's knowledge of appropriate emotion regulation strategies were associated with fewer parent-reported externalizing behaviors. Other work has demonstrated that higher levels of parental emotion coaching behaviors (e.g., intervening in situations that cause emotion) were associated with fewer externalizing behaviors in young and school-aged children with ASD (Wilson, Berg, Zurawski, & King, 2013).

Prior work suggests that parents of children with ASD engage in a similar range of emotion coregulation behaviors as parents of NT children (Gulsrud, Jahromi, & Kasari, 2010; Hirschler-Guttenberg, Feldman, Ostfeld-Etzion, Laor, & Golan, 2015) and are equally as responsive and sensitive to children's cues as parents of NT children (Hirschler-Guttenberg et al. 2015; Siller and Sigman 2002). However, parents of children with ASD vary in the frequency of the specific strategies they employ, which may indicate an awareness of and sensitivity to the child's developmental needs. For example, in one study, mothers of children with ASD used active strategies, such as redirecting, prompting, and providing physical comfort, more frequently relative to mothers of NT children during episodes of distress (Gulsrud et al. 2010). Similarly, Hirschler-Guttenberg and colleagues (2015) found that both mothers and fathers of preschool-aged children with ASD engaged in more direct and physical behaviors, such as physical soothing, verbal comfort, and redirection whereas parents of NT children used more cognitive strategies such as emotional reflection and cognitive reappraisal.

State Space Grid

The State Space Grid (SSG) method offers an approach that allows for moment-to-moment analysis of dyadic behaviors (Lewis, Lamey, & Douglas, 1999) and has been used to analyze the behaviors of mothers and children simultaneously (Hollenstein 2007; Hollenstein and Lewis 2006; Sameroff 2009). Rooted in dynamic systems theory (Ford and Lerner 1992), the SSG provides a graphical representation of the dyadic behaviors in real time against all possible combinations of behaviors (Hollenstein 2007). Using the SSG, parent–child behaviors can be examined on two dimensions, structure (i.e., dyadic flexibility) of interactions and content (i.e., dyadic-affect engagement). Dyadic-affect engagement refers to the mutual positive, mutual negative, or mismatched behaviors of parents and children in real time, and dyadic flexibility refers to the degree of movement across various engagements; greater movement indicates flexibility or emotional variability in dyadic interactions (Hollenstein 2007; Hollenstein, Granic, Stoolmiller, & Snyder, 2004; Van der Giessen et al. 2015).

The SSG has recently been used to examine emotion coregulation in mothers and children with ASD (Guo, Garfin, Ly, & Goldberg, 2017); more commonly, it has been used to examine dyadic emotion processes and maladaptive behaviors in high-risk children and children with behavior problems. For example, Hollenstein and colleagues (2004) observed parents and high-risk kindergarteners during various structured activities and examined the flexibility of interactions. Decreased flexibility of dyadic interactions was associated with higher levels of internalizing and externalizing behaviors. Similarly, aggressive children exhibited fewer externalizing behaviors following a family intervention when parent–child interactions increased in flexibility and mutual positive engagements (Granic, O'Hara, Pepler, & Lewis, 2007).

Past research suggests that the structure as well as the content of parent–child interactions are important aspects of emotion coregulation that are associated with maladaptive behaviors in

children. Lunkenheimer and colleagues (2011) examined the interaction between mother- and father-child affect engagement and the flexibility of behaviors in predicting maladaptive behaviors for children at risk for conduct problems. Parent–child interactions were observed when children were 3 years old and teacher-ratings of externalizing behaviors were obtained after the transition to kindergarten. The results revealed that greater dyadic positive engagement and flexibility interacted in predicting lower levels of externalizing behaviors. It is presently unknown whether interactions between dyadic-affect engagement and dyadic flexibility are indicative of maladaptive behaviors in children with ASD and it is unknown if similar behavior patterns will emerge for children with ASD and NT children.

The Current Study

Previous research has indicated that emotion coregulation during social interactions between mothers and children is important in children's behavioral functioning; however, there is a paucity of research examining these associations in children with ASD. Moreover, past research has not examined how particular aspects of emotion coregulation interact to predict maladaptive behaviors for children with ASD and whether these interactions vary for dyads with and without a child with ASD. The present study implemented a dynamic systems approach, using the SSG, to analyze moment-to-moment emotion coregulation processes during mother–child dyadic interactions. We examined whether two aspects of the emotion coregulation process, dyadic flexibility and dyadic-affect engagement, significantly interact in indicating maladaptive behaviors in children diagnosed with ASD and NT children.

Hypothesis 1: Given that past research documents differences in psychopathology between NT children and children with ASD (Bauminger, Solomon, & Rogers, 2010; Bölte, Dickhut, & Poustka, 1999; Kim, Szatmari, Bryson, Streiner, & Wilson, 2000), we predicted that

children with ASD and NT children would vary on levels of maladaptive behaviors. Specifically, we expected children with ASD would have higher levels of maternal-reported maladaptive (i.e., internalizing and externalizing) behaviors relative to NT children.

Hypothesis 2: Mutual-positive and mutual-negative engagements were expected to moderate the associations between dyadic flexibility and maladaptive behaviors. Based on previous research indicating differences in parent–child interactions between dyads with children with ASD and dyads with NT children (Kasari, Sigman, Mundy, & Yirmiya, 1990; Sigman, Mundy, Sherman, & Ungerer, 1986), we hypothesized that the associations would vary for dyads with children with ASD and for dyads with NT children; the direction of the associations was exploratory.

Method

Participants

The participants in the present study were 72 mother–child dyads; 46 children were diagnosed with ASD (34 boys and 12 girls; mean age = 5.27 years, *SD* = 1.42 years) and 26 children were NT (17 boys and 9 girls; mean age = 4.34 years, *SD* = 1.12 years). Forty-four percent (*n* = 32) of the participants were Caucasian, 18% (*n* = 13) were Asian, 18% (*n* = 13) were Hispanic, and 19% (*n* = 14) were of mixed ethnicity. Seventy-one percent (*n* = 51) of mothers obtained at least a four-year college degree and 65% (*n* = 44) of families who provided an annual household income (*n* = 68) reported $75,000/year and above.

To be eligible to participate, children with ASD must have received a clinical diagnosis and further confirmation either through the Autism Diagnostic Observation Schedule-2 assessment (ADOS-2; Lord et al., 2012) or the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003). Seventeen (37%) of the children with ASD came to the University

for the ADOS-2 assessment. The ADOS-2 is a standardized assessment of children's social behaviors and communication. An extensively-trained, certified researcher observed and coded children's behaviors during structured and semi-structured play interactions that constitute the ADOS-2. Standardized cut-off scores were used to determine a classification of Autism, Autism Spectrum, or non-spectrum (Lord et al., 2012).

Children with ASD who were not able to come to the University for the ADOS-2 had their clinical diagnosis confirmed by the SCQ, an assessment of ASD symptom severity in children that has well-established reliability and validity (Rutter et al., 2003). Mothers completed the 40-item questionnaire inquiring about their child's behaviors relating to communication, social functioning, and stereotyped and repetitive behaviors throughout his or her lifetime. A cutoff score of 11 has demonstrated adequate sensitivity for pre-school aged children (Allen, Silove, Williams, & Hutchins, 2007). Children in the ASD group met or exceed this score.

Procedure

The study was approved by the University's Institutional Review Board. Families of children with and without ASD were recruited through advertisements distributed at local organizations (e.g., medical offices) and at community events (e.g., Walk Now for Autism Speaks) in a large western state as well as through a database of families who previously expressed interest in participating in research studies. Children with ASD were also recruited through an online database of families, the Interactive Autism Network (IAN), and through the IAN Community Research Opportunities Bulletin Board.

Families participated in an in-home study session. Prior to the home visit, mothers received a packet of questionnaires and a written informed consent form in the mail. Mother engaged in semi-structured play activities with their children during the home visit and

completed the questionnaires. The mother–child interactions were videotaped for later coding. The current study is based on micro-coding of the recorded videotapes. Mothers received a $25 gift card and children received a small toy after completing the session.

Measures

Demographic information. Mothers completed questionnaires that inquired about demographic and background information including their age, education level, ethnicity, income level, and occupation. Mothers also provided information on their children's age, gender, and diagnostic and intervention history.

Broader autism phenotype. Mothers completed the Broader Autism Phenotype Questionnaire (BAPQ; Hurley, Losh, Parlier, Reznick, & Piven, 2007), a 36-question assessment of personality and language characteristics that are similar to symptoms of ASD. Items were rated on a 6-point response scale ranging from 1 (very rarely) to 6 (very often) and covered areas such as social personality, rigid personality, and pragmatic language deficits. Higher scores indicated higher levels of ASD characteristics.

Child maladaptive behaviors. The Vineland Adaptive Behavior Scales (VABS-II; Sparrow, Cicchetti, & Balla, 2005), a standardized measure of children's adaptive and maladaptive behaviors, was used to assess internalizing and externalizing behaviors. The current study used only the maladaptive scale since the focus is on problem behaviors. Mothers completed the VABS-II parent rating form and rated the frequency with which their children engaged in maladaptive behaviors on a 3-point scale ranging from 0 (never) to 2 (often). Internalizing and externalizing behavior index v-scale scores were obtained from the raw scores on the maladaptive behaviors component. The VABS-II has demonstrated reliability and validity (Sparrow et al., 2005).

Mother–child emotion coregulation. Mothers and children were videotaped during the Three Boxes procedure (Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004; Vandell, 1979), a 10-min semi-structured play activity. Mother–child dyads were presented with three boxes that contained toys (e.g., cash register, money, and food) and mothers were instructed to interact with their children as they normally do at home. This procedure was selected because it captures activities that mothers and children normally engage in and uses a standardized set of toys. It also has a long history of validly and reliably eliciting maternal behaviors (e.g., sensitivity) and child behaviors (e.g., child mood, sustained attention, activity level) and it was a key component of the NICHD early childcare research network toolkit (NICHD Early Child Care Research Network; 1997; 1999).

The videotaped interactions were later coded for engagement states of mothers and children as a measure of emotion coregulation based on the combination of mutually exclusive behaviors, body postures, attention, facial expressions, and vocalizations. Mother and child behavior cues were coded in five-second intervals using Mangold International's INTERACT 9.47 (Mangold 2007) software program. Children and mothers were coded separately for positive engagement, negative engagement, and disengagement states; each of the engagement states were coded across three levels: low, medium, and high, as defined by the quality and quantity of behaviors and emotions. The behavioral coding schemes were created using an iterative process by researchers until consensus was reached. Pairs of extensively trained research assistants independently coded the mother and child engagement states; inter-coder reliability for the mother engagement states was 91.76% (k = 0.81) and the inter-coder reliability for the child engagement states was 91.07% (k = 0.82). Disagreements about codes were resolved through discussion.

Child-positive-engagement states were characterized by child's intermittent or full social interaction with their mother or joyful and affectionate interaction as indicated by hugging or kissing; facing, leaning towards, or close proximity to mother; eye contact with the mother or mutual task; and neutral or positive facial expressions. *Child-negative-engagement states* were characterized by child's active or aggressive protesting of the interaction with mother or frustration as indicated by hitting, kicking, or throwing objects; pushing or rejecting interaction with mother; and whining, fussing, complaining, or crying. *Child-disengagement states* were characterized by child's withdrawal from the interaction as indicated by a slumped posture, turning away, or walking away from the interaction; partial or complete shifts in attention away from the interaction; and flat, fearful, or sad affect. *Child-object engagement* was characterized by child's positive engagement with toys (play objects) as indicated by full attention on toys, self-talk, and no social interaction with mother.

Mother-positive-engagement states were characterized by mother's monitoring, scaffolding, or affectionate social interaction with her child as indicated by hugging or kissing child; active imaginative play; facing or leaning toward the child; prompting or guiding child; eye contact with child or mutual task; neutral or exaggerated positive facial expression; and sensitivity to child's cues. *Mother negative-engagement states* were characterized by mother's frustrated, annoyed, or hostile interactions as indicated by guiding child with abruptness or physical force; intrusive behaviors; and minimal, stern, or angry vocalizations. *Mother-disengagement states* were characterized by mother's brief or full withdrawal from the interaction with child or parallel play with toy without interaction with child as indicated by physically turning away or walking away; ignoring child's request; no attention on interaction or

shifts away from interaction; neutral or flat facial expression; and self-talk or talking to sibling or research assistant. Copies of the coding schemes are available from the authors.

State Space Grid. The mother and child engagement state codes were imported into the State Space Grid GridWare 1.1. (Lamey, Hollenstein, Lewis, & Granic, 2004), a software program that allows for moment-to-moment analysis of dyadic interactions. The nine mother engagement states are located on the *y*-axis and the ten child engagement states are located on the *x*-axis of the grid. A nine-by-ten matrix of 90 cells was created, which represents all possible dyadic engagement states and each cell represents an engagement state. Region-level variables of dyadic-engagement states and grid-level variables of dyadic flexibility were derived from calculations using the Gridware program.

***Dyadic-affect-engagement state*.** The content of emotion coregulation was indicated by dyadic-affect-engagement states. Two regions of dyadic-affect-engagement states were created in the SSG: mother–child mutual-positive engagement and mother–child mutual-negative engagement. *Mutual-positive-engagement states* included mother and child positive engagement states across three levels—low, medium and high. *Mutual-negative-engagement states* included mother–child negative engagement and disengagement states across three levels— low, medium and high. A "visit" in the SSG grid refers to a dyad initiating into a particular engagement state and then leaving that state. The frequency of visits reflects the number of times a dyad moves into and out from a dyadic-affect-engagement state. The frequencies of mutual-positive- and mutual-negative-engagement-state visits were examined; visits were divided by the total duration of time spent in the task to account for any variations in the length of the interactions.

Dyadic flexibility. The structure of emotion coregulation was indicated by dyadic flexibility. Two grid-level variables of flexibility were derived from the SSG: *dispersion* and

average mean duration (AMD) of engagement states per visit. *Dispersion* refers to the spread of engagement states across all cells or the distribution of dyadic-affect-engagement states. Dispersion is calculated by summing the squared proportional durations across the 90 cells in the grid and is adjusted for the total number of cells producing a value between zero and one. A value of zero signifies that all engagement states are in one cell and a value of one signifies that the engagement states are distributed equally across possible states in the grid. Thus, greater dispersion indicates more flexibility or emotional variability (Hollenstein et al., 2004; Hollenstein & Lewis, 2006; Van der Giessen et al., 2015). *AMD* refers to the average amount of time spent in each visit to an engagement state or perseveration in a dyadic-affect-engagement state. Longer time spent in a state indicates less flexibility or emotional variability (Hollenstein et al., 2004). Together, *dispersion* and *AMD* provide the pattern of dyadic engagement across the grid with greater flexibility indicated by more dispersion and shorter AMD.

Plan of Analysis

Major study variables were examined for the presence of outliers. Scores that were three standard deviations above or below the mean were adjusted; two scores were reduced to three standard deviations above the mean. Variables were screened for skewness and kurtosis. To check for possible covariates, independent samples t-tests and Chi square tests between ASD and NT groups were conducted on child's age and gender, and mother's age, level of education, ethnicity, household income, and BAPQ. Next, bivariate correlations between grid- and region-level variables, maladaptive behaviors, and BAPQ were conducted. Group comparisons of mother–child dyads with children with ASD and NT children were also conducted using t-tests to examine differences in study variables of interest including dyadic-engagement states and dyadic flexibility as well as measures of maladaptive behavioral outcomes. For clarity of

interpretation, the region-level variables (*mutual-positive-engagement-state* visits and *mutual-negative-engagement-state* visits) were not divided by total duration in the t-tests and correlations.

Regression analyses were then conducted separately for ASD and NT samples to examine indicators of two outcomes: internalizing behaviors and externalizing behaviors. Two grid-level measures of flexibility (*dispersion* and *AMD*), two region-level variables of dyadic-affect-engagement-state visits (*mutual-positive-engagement-state* visits and *mutual-negative-engagement-state* visits), and SCQ scores were used as indicator variables. For each dependent variable, the first regression model tested main effects and the second model included the interaction terms for dyadic flexibility and dyadic-affect-engagement-state visits. Three-way interactions were conducted; however, given the small sample size, final analyses were conducted separately for the two groups to conserve power.

Results

ASD-NT Differences

ASD and NT group comparisons on demographic variables indicated that children with ASD were older than NT children [$t(70) = -2.85$, $p < .01$], and mothers of children with ASD had a higher level of education relative to mothers of NT children [$X^2(5) = 12.37$, $p < .05$]. Groups did not differ by child gender, mother ethnicity, family income, or mother BAPQ ($p > 0.05$). Bivariate correlations, separated by group (ASD and NT), among maladaptive behaviors, dyadic flexibility, dyadic-engagement states, BAPQ, and SCQ are shown in Table 1.

Table 1. Correlation Matrix of Major Study Variables for ASD[a] Dyads (Top Row; *n* = 46) and NT[b] Dyads (Bottom Row; *n* = 26)

Study variables	1	2	3	4	5	6	7	8
Maladaptive behaviors								
1. Internalizing	--							
2. Externalizing	0.40** 0.30	--						
Dyadic flexibility								
3. Dispersion	0.25† -0.34†	-0.03 0.12	--					
4.AMD[c]	-0.12 0.25	0.18 -0.06	-0.79*** -0.78***	--				
Dyadic-affect-engagement states								
5. Mutual-positive-engagement visits	0.40** -0.50**	-0.04 0.01	0.62*** 0.61***	-0.63*** -0.54**	--			
6. Mutual-negative-engagement visits	0.13 0.02	-0.11 0.19	0.69*** 0.37†	-0.56*** -0.34†	-0.28† 0.16	--		
Mother characteristic								
7. BAPQ[d]	0.26† 0.21	0.13 -0.20	0.11 -0.24	-0.08 0.13	0.10 -0.25	0.26† -0.35†	--	
Child Characteristic								
8. SCQ[e]	0.56*** 0.08	0.21 0.11	0.49*** -0.03	-0.47** 0.17	0.38** -0.24	0.34* -0.23	0.13 0.22	--

[a]ASD = Autism Spectrum Disorder; [b]NT = Neurotypical; [c]AMD = Mean duration per visit; [d]BAPQ = Broader Autism Phenotype Questionnaire; [e]SCQ = Social Communication Questionnaire

†p <.10, *p<.05, **p<.01, ***p<.001

Independent samples t-tests compared children with ASD and NT children on key study variables (e.g., dyadic flexibility, dyadic-affect-engagement-state visits, maladaptive behavior scores) as shown in Table 2. Dyads with children with ASD had significantly higher dispersion (i.e., more flexibility) and lower AMD (i.e., more flexibility) compared to dyads with NT children. Analyses also revealed that dyads with children with ASD had significantly higher frequencies of mutual-negative-engagement-state and mutual-positive-engagement-state visits relative to dyads with NT children. Children with ASD had significantly higher maternal reported levels of internalizing and externalizing behaviors (i.e., maladaptive behaviors) compared to NT children.

Table 2. Means, Standard Deviations, and t-tests for Dyadic-engagement-state Visits, Dyadic Flexibility, and Maladaptive Behaviors (N = 72)

	ASD[a] Group (n = 46)		NT[b] Group (n = 26)		
Study variables	*M*	*SD*	*M*	*SD*	t-test
Dyadic-affect-engagement states					
Mutual-positive-engagement visits	14.96	5.07	11.19	5.26	$t(70)= -2.99^{**}$
Mutual-negative-engagement visits	3.35	4.12	1.04	2.60	$t(70)= -2.59^{*}$
Dyadic flexibility					
Dispersion	0.79	0.11	0.68	0.14	$t(70)= -3.41^{**}$
AMD[c]	9.07	2.27	11.49	3.00	$t(70)= 3.86^{***}$
VABS-II behaviors					
Child internalizing behaviors	20.30	2.35	15.92	3.20	$t(70)= -6.66^{***}$
Child externalizing behaviors	18.00	2.94	16.46	3.01	$t(70)= -2.11^{*}$

[a]ASD = Autism Spectrum Disorder; [b]NT = Neurotypical; [c]AMD = Mean duration per visit
$^{*}p < .05$, $^{**}p < .01$, $^{***}p<.001$

Dyadic Flexibility and Mutual-Positive-Engagement-State Visits

Main effects for measures of dyadic flexibility (i.e., dispersion and AMD) and mutual-positive-engagement-state visits in relation to internalizing and externalizing behaviors for children with ASD are displayed in Tables 3 and 4 (see Model 1 for each set of analyses). A higher frequency of both mutual-positive-engagement-state visits or longer AMD were associated with greater internalizing behaviors for children with ASD (see Table 4).

Analyses revealed several statistically significant interactions. For dyads with children with ASD, the relationship between dispersion and internalizing behaviors was moderated by mutual-positive-engagement-state visits (see Figure 1). In these dyads with a higher frequency of mutual-positive-engagement- state visits, there was a negative association between dispersion and children's internalizing behaviors.

For dyads with children with ASD, the relationships between AMD and internalizing and externalizing behaviors were moderated by mutual-positive-engagement-state visits (see Figures 2A and B). In these dyads with a higher frequency of mutual-positive-engagement-state visits, there were positive associations between AMD and children's internalizing and externalizing behaviors. Regression analyses examining the frequency of mutual-positive-engagement-state visits and flexibility (i.e., dispersion and AMD) were not significant for dyads with NT children (ps > 0.05, *ns*).

Table 3. Regression Analyses of Mutual-positive-engagement-state Visits [a] and Dyadic Flexibility (Dispersion[b]) for ASD[c] Dyads (*n*=46)

	Internalizing Behaviors							
	Model 1				Model 2			
	b(SE)	95% CI	β	*p*	b(SE)	95% CI	β	*p*
SCQ[d]	0.21(0.06)	0.10, 0.32	0.55	<.001	0.20(0.05)	0.09, 0.31	0.51	.001
Mutual-positive-engagement visits	73.17(42.14)	-11.87, 158.20	0.26	.090	645.89(249.23)	142.57, 1149.21	2.29	.013
Dispersion[b]	-3.35(3.35)	-10.11, 3.41	-0.16	.322	10.82(6.87)	-3.06, 24.69	0.52	.123
Visits x Dispersion[b]					-721.99(310.09)	-1348.23, -95.75	-2.48	.025
Constant	17.19(2.07)	13.01, 21.37		<.001	6.59(4.96)	-3.42, 16.61		.191
Model Statistics		$F(3, 42)=7.76$, $p=.000$, Adjusted $R^2=.31$				$F(4, 41)=7.79$, $p=.000$, Adjusted $R^2=.38$		
	Externalizing Behaviors							
	Model 1				Model 2			
	b(SE)	95% CI	β	*p*	b(SE)	95% CI	β	*p*
SCQ[d]	0.15(0.08)	-0.02, 0.31	0.31	.079	0.13(0.08)	-0.03, 0.29	0.27	.116
Mutual-positive-engagement visits	-52.71(63.12)	-180.10, 74.68	-0.15	.408	681.79(379.90)	-85.43, 1449.01	1.93	.080
Dispersion[b]	-2.62(5.02)	-12.75, 7.50	-0.10	.604	15.55(10.47)	-5.60, 36.70	0.60	.145
Visits x Dispersion[b]					-925.93(472.68)	-1880.53, 28.66	-2.54	.057
Constant	18.46(3.10)	12.20, 24.72		<.001	4.87(7.56)	-10.39, 20.14		.523
Model Statistics		$F(3,42)=1.26$, $p=.299$, Adjusted $R^2=.02$				$F(4, 41)=1.97$, $p=.117$, Adjusted $R^2=.08$		

[a]Mutual-positive-engagement-state visits were divided by the total duration of the interaction; [b]Dispersion = distribution of emotion states visited on the SSG; [c]ASD = Autism Spectrum Disorder; [d]SCQ = Social Communication Questionnaire

Table 4. Regression Analyses of Mutual-positive-engagement-state Visits [a] and Dyadic Flexibility (AMD[b]) for ASD[c] Dyads (*n*=46)

	Internalizing Behaviors							
	Model 1				Model 2			
	b(SE)	95% CI	β	*p*	b(SE)	95% CI	β	*p*
SCQ[d]	0.24(0.05)	0.14, 0.34	0.63	<.001	0.23(0.05)	0.13, 0.33	0.60	<.001
Mutual-positive-engagement visits	117.35(41.74)	33.12, 201.58	0.42	.007	-161.25(138.77)	-441.50, 119.00	-0.57	.252
AMD	0.45(0.16)	0.12, 0.78	0.43	.009	-0.17(0.33)	-0.84, 0.50	-0.16	.619
Visits x AMD[e]					34.21(16.31)	1.27, 67.14	0.81	.042
Constant	8.93(2.59)	3.70, 14.16		.001	14.37(3.60)	7.10, 21.63		<.001
Model Statistics		$F(3, 42)=11.03$, $p=.000$, Adjusted $R^2=.40$				$F(4, 41)=10.04$, $p=.000$, Adjusted $R^2=.45$		
	Externalizing Behaviors							
	Model 1				Model 2			
	b(SE)	95% CI	β	*p*	b(SE)	95% CI	β	*p*
SCQ[d]	0.18(0.08)	0.02, 0.34	0.38	.025	0.17(0.08)	0.01, 0.32	0.34	.035
Mutual-positive-engagement visits	-2.59(64.82)	-133.41, 128.23	-0.01	.968	-429.83(215.81)	-865.68, 6.01	-1.22	.053
AMD	0.46(.25)	-0.06, 0.97	0.35	.079	-0.48(0.52)	-1.53, 0.56	-0.37	.355
Visits x AMD[e]					52.46(25.36)	1.23, 103.68	0.99	.045
Constant	10.43(4.03)	2.31, 18.56		.013	18.78(5.60)	7.48, 30.07		.002
Model Statistics		$F(3, 42)=2.33$, $p=.088$, Adjusted $R^2=.08$				$F(4, 41)=2.96$, $p=.031$, Adjusted $R^2=.15$		

[a]Mutual-positive-engagement-state visits were divided by the total duration of the interaction; [c]ASD = Autism Spectrum Disorder; [d]SCQ = Social Communication Questionnaire; [e]AMD = Mean duration per visit

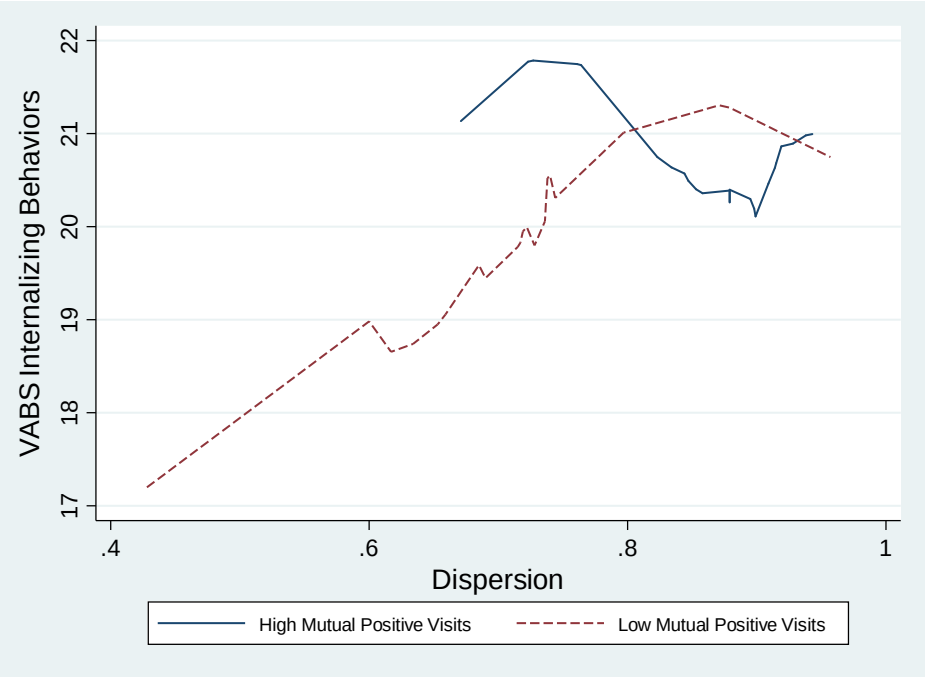
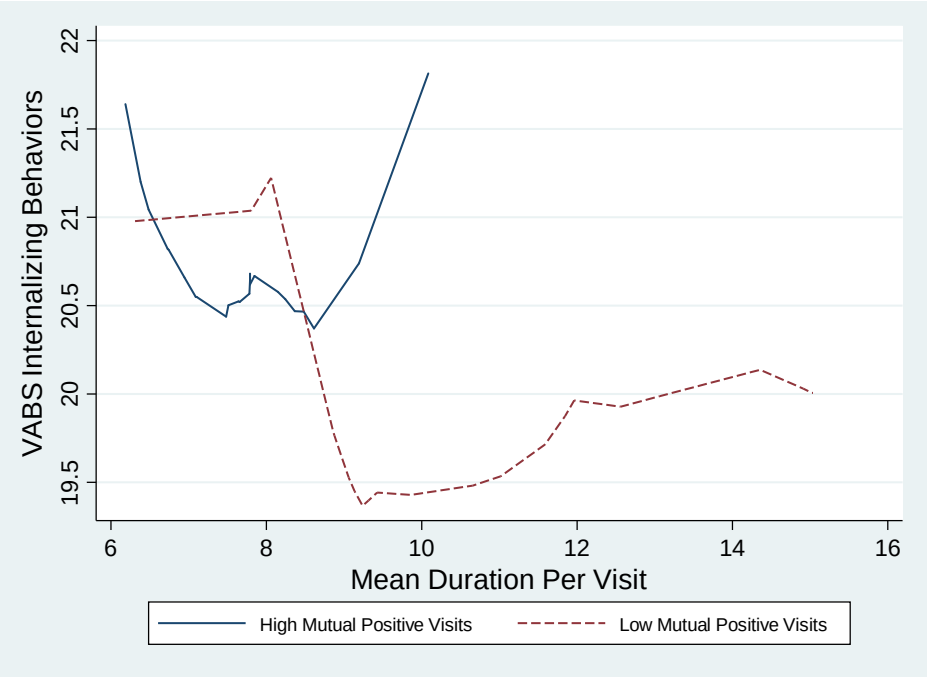


Figure 1. Interaction between mutual-positive-engagement-state visits and dispersion in predicting internalizing behaviors in children with ASD



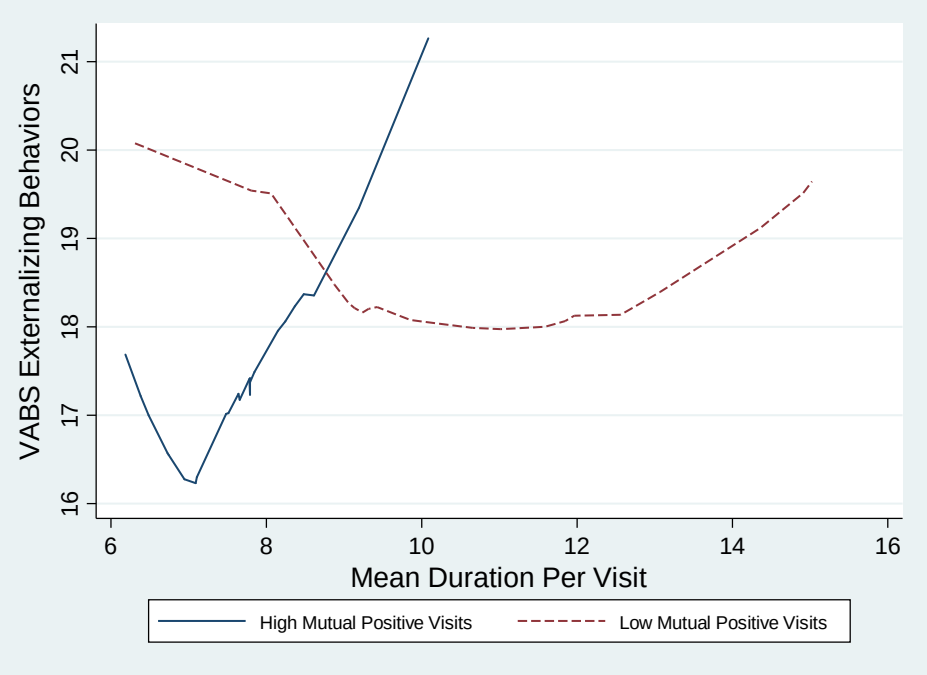


Figure 2A and B. Interaction between mutual-positive-engagement-state visits and AMD in predicting internalizing (panel A) and externalizing behaviors (panel B) in children with ASD

Dyadic Flexibility and Mutual-Negative-Engagement-State Visits

Main effects for measures of dyadic flexibility (i.e., dispersion and AMD) and mutual-negative-engagement-state visits in relation to internalizing and externalizing behaviors for NT children are displayed in Tables 5 and 6 (see Model 1 for each set of analyses). Analyses revealed several significant interactions. For dyads with NT children, the relationship between dispersion and externalizing behaviors was moderated by mutual-negative-engagement-state visits (see Figure 3). In these dyads with a higher frequency of mutual-negative-engagement-state visits, there was a negative association between dispersion and children's externalizing behaviors.

For dyads with NT children, the relationship between AMD and externalizing behaviors was moderated by mutual-negative-engagement-state visits (see Figure 4). In these dyads with a higher frequency of mutual-negative-engagement-state visits, there was a positive association between AMD and children's externalizing behaviors. Regression analyses examining the interactions between flexibility (i.e., dispersion and AMD) and the frequency of mutual-negative-engagement- state visits for children with ASD were not significant (ps > 0.05, *ns*). Because data screening revealed skewness and kurtosis on mutual-negative-engagement states in the NT sample, regression models were rerun using log-transformed variables. The pattern of results was consistent; for ease of interpretation the non-transformed variables are presented in the tables.

Table 5. Regression Analyses of Mutual-negative-engagement-state Visits [a] and Dyadic Flexibility (Dispersion[b]) for NT[c] Dyads (*n*=26)

	Internalizing Behaviors							
	Model 1				Model 2			
	b(SE)	95% CI	β	*p*	b(SE)	95% CI	β	*p*
SCQ[d]	0.12(0.23)	-0.35, 0.59	0.11	.593	0.09(0.21)	-0.33, 0.52	0.08	.652
Mutual-negative-engagement visits	138.80(154.74)	-182.11, 459.71	0.19	.379	3083.68(1265.71)	451.49, 5715.86	4.31	.024
Dispersion[b]	-9.18(4.75)	-19.02, 0.67	-0.41	.066	-3.34(4.99)	-13.73, 7.04	-0.15	.510
Visits x Dispersion[b]					-3544.76 (1514.05)	-6693.39, -396.12	-4.24	.029
Constant	21.47(3.31)	14.60, 28.34		<.001	17.47(3.47)	10.26, 24.68		.000
Model Statistics	$F(3, 22)=1.31$, $p=.295$, Adjusted $R^2=.04$				$F(4, 21)=2.56$, $p=.069$, Adjusted $R^2=.20$			
	Externalizing Behaviors							
	Model 1				Model 2			
	b(SE)	95% CI	β	*p*	b(SE)	95% CI	β	*p*
SCQ[d]	0.16(0.22)	-0.30, 0.63	0.15	.473	0.13(0.18)	-0.25, 0.50	0.12	.495
Mutual-negative-engagement visits	128.50(153.44)	-189.70, 446.71	0.19	.411	4081.08(1110.41)	1771.86, 6390.31	6.06	.001
Dispersion[b]	1.18(4.71)	-8.59, 10.94	0.06	.805	9.01(4.38)	-0.10, 18.12	0.43	.052
Visits x Dispersion[b]					-4757.73(1328.28)	-7520.04, -1995.42	-6.05	.002
Constant	14.78(3.28)	7.97, 21.59		<.001	9.41(3.04)	3.08, 15.73		.006
Model Statistics	$F(3, 22)=0.45$, $p=.720$, Adjusted $R^2=-.07$				$F(4, 21)=3.73$, $p=.019$, Adjusted $R^2=.30$			

[a]Mutual-negative-engagement-state visits were divided by the total duration of the interaction; [b]Dispersion = range of emotion states visited on the SSG; [c]NT = Neurotypical; [d]SCQ = Social Communication Questionnaire

Table 6. Regression Analyses of Mutual-negative-engagement-state Visits [a] and Dyadic Flexibility (AMD[b]) for NT[c] Dyads (*n*=26)

	Internalizing Behaviors							
	Model 1				Model 2			
	b(SE)	95% CI	β	*p*	b(SE)	95% CI	β	*p*
SCQ[d]	0.07(0.24)	-0.42, 0.56	0.06	.782	0.05(0.21)	-0.38, 0.48	0.04	.817
Mutual-negative-engagement visits	91.68(158.12)	-236.24, 419.61	0.13	.568	-1891.73(738.40)	-3427.31, -356.14	-2.64	.018
AMD	0.30(0.23)	-0.19, 0.78	0.28	.217	0.03(0.23)	-0.45, 0.50	0.02	.912
Visits x AMD[e]					230.14(84.15)	55.15, 405.13	2.74	.012
Constant	12.09(2.93)	6.00, 18.17		<.001	15.11(2.80)	9.28, 20.95		<.001
Model Statistics		$F(3, 22)=.60$, $p=.621$, Adjusted $R^2=-.05$				$F(4, 21)=2.45$, $p=.078$, Adjusted $R^2=.19$		
	Externalizing Behaviors							
	Model 1				Model 2			
	b(SE)	95% CI	β	*p*	b(SE)	95% CI	β	*p*
SCQ[d]	0.17(0.22)	-0.30, 0.63	0.16	.462	0.15(0.19)	-0.24, 0.54	0.14	.432
Mutual-negative-engagement visits	138.54(150.39)	-173.34, 450.43	0.21	.367	-2030.64(660.73)	-3404.72, -656.57	-3.02	.006
AMD	-0.02(0.22)	-0.48, 0.44	-0.02	.932	-0.32(0.20)	-0.74, 0.11	-0.31	.136
Visits x AMD[e]					251.69(75.30)	95.11, 408.28	3.18	.003
Constant	15.76(2.79)	9.98, 21.55		<.001	19.08(2.51)	13.86, 24.30		<.001
Model Statistics		$F(3, 22)=0.43$, $p=.733$, Adjusted $R^2=-.07$				$F(4, 21)=3.27$, $p=.031$, Adjusted $R^2=.27$		

[a]Mutual-negative-engagement-state visits were divided by the total duration of the interaction; [c]NT = Neurotypical; [d]SCQ = Social Communication Questionnaire; [e]AMD = Mean duration per visit

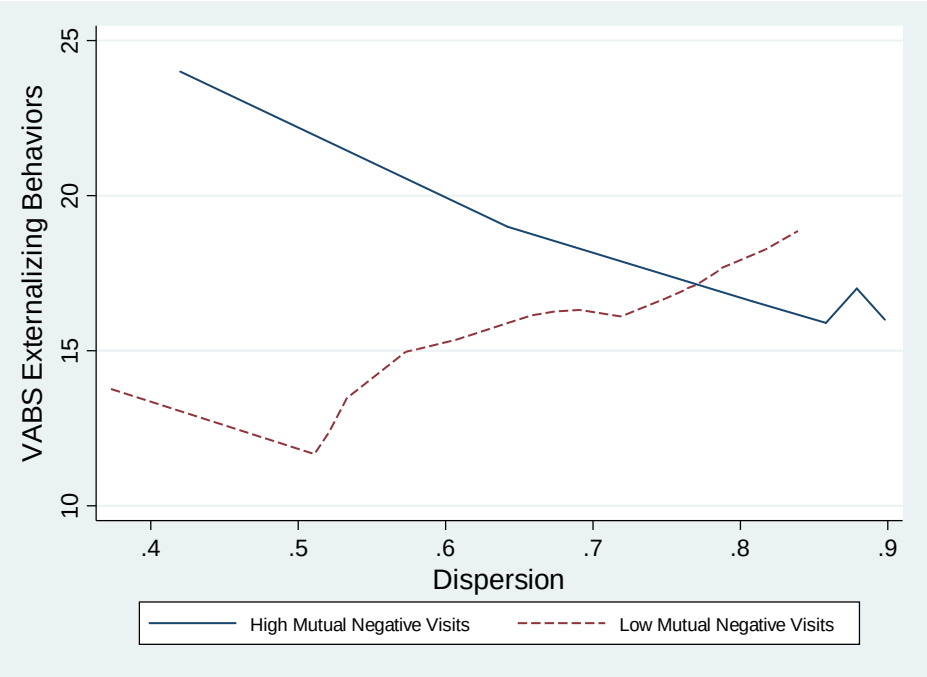


Figure 3. Interaction between mutual-negative-engagement-state visits and dispersion on externalizing behaviors in NT children.

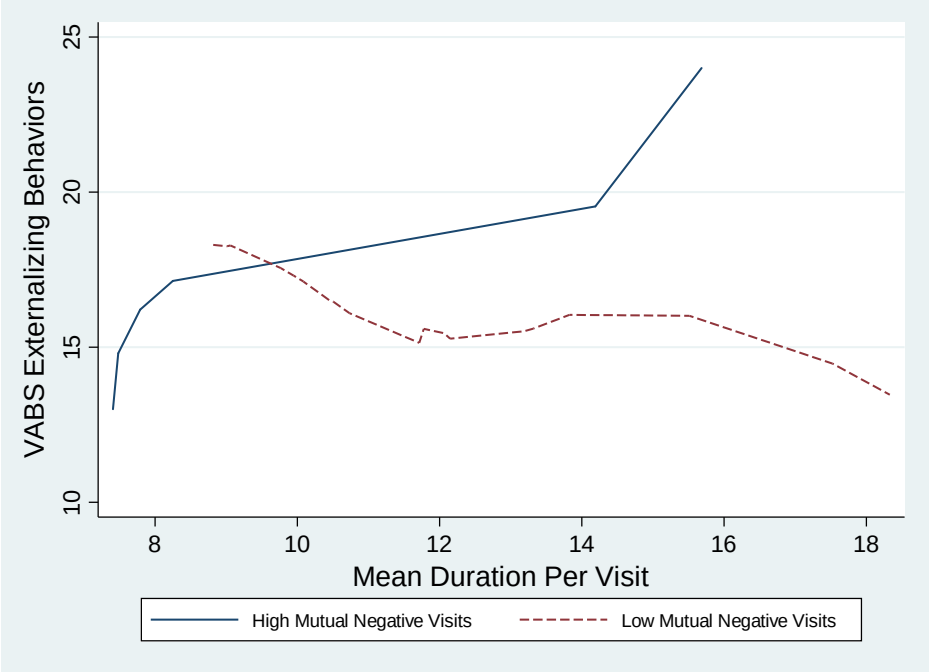


Figure 4. Interaction between mutual-negative-engagement-state visits and AMD on externalizing behaviors in NT children

Discussion

The present study contributes to our understanding of parenting of children with ASD through its examination of whether the structure and content of emotion coregulation processes in mother–child dyads were associated with child maladaptive behaviors. Specifically, interactions between dyadic flexibility (i.e., dispersion and AMD) and dyadic affect-engagement (mutual-positive and mutual-negative-engagement states) were examined in relation to children's internalizing and externalizing behaviors. For children with ASD, dyadic-positive engagement moderated the relationship between dyadic flexibility and internalizing and externalizing behaviors. For NT children, dyadic-negative engagement moderated the associations between dyadic flexibility and maladaptive behaviors.

Supporting Hypothesis 1, group comparisons revealed that children with ASD and NT children differed significantly on levels of maladaptive behaviors. Children with ASD had higher levels of both internalizing and externalizing behaviors relative to NT children, consistent with previous findings (Bauminger et al., 2010; Kim et al., 2000). Internalizing and externalizing symptomatology likely have bidirectional and reciprocal effects on emotion regulation (Gross & Jazaieri, 2014; Werner & Gross, 2010). In addition, symptoms of ASD along with symptoms of depression, anxiety, and behavior problems may have deleterious impacts on children's capacity for effective emotional regulation. It is important for future research to consider these and other comorbid conditions that might affect emotion regulatory processes.

Supporting Hypothesis 2, in dyadic interactions with their mothers, children with ASD who had greater dyadic flexibility (i.e., greater dispersion and shorter AMD) and greater frequency of mutual-positive engagement displayed lower levels of internalizing and externalizing behaviors. Children in NT dyads who engaged in greater dyadic flexibility (i.e.,

greater dispersion of emotion states and shorter AMD and had higher frequency of mutual-negative engagement during interactions displayed lower levels of externalizing behaviors.

The present study builds on existing literature examining the relationship between emotion coregulation and maladaptive behaviors (Cole, Teti, & Zahn-Waxler, 2003; Hollenstein et al., 2004; Ting & Weiss, 2017) by suggesting that for children with ASD, the interaction between the structure and content of emotion coregulation may be important in the manifestation of internalizing and externalizing behaviors. Similar to previous research on parents with children at risk for behavioral problems (Lunkenheimer et al., 2011), we found support for dyadic flexibility in conjunction with initiating mutual positive states acting as a protective factor against externalizing behaviors. We extend these findings to mother–child dyads with children with ASD and include internalizing behaviors as well as externalizing outcomes. For children with ASD, the ability of mother–child dyads to initiate mutual positive states while remaining flexible may protect against maladaptive behaviors. These dyads in our study engaged in a wider range of emotional states and for a shorter amount of time than NT dyads. It is likely that when dyads with children with ASD engage in flexible behaviors, they move between positive, negative, and disengagement states. Therefore, if these dyads engage in dyadic flexibility but do not frequently initiate positive states, children with ASD likely do not gain the full benefits of a wide range of emotional interactions. Together, these behavioral patterns indicated that shared dyadic positive engagements in addition to flexible interactions might play a critical role in the psychopathology of children with ASD.

A significant interaction emerged between dyadic flexibility and mutual-negative engagement for NT dyads for maladaptive behaviors. This interaction may be interpreted in the

context of adaptive regulation of negative emotions. In other words, this interaction could signify the ability to quickly recover from negative interactions. These results are consistent with prior SSG research demonstrating that improvements in aggressive children's externalizing behaviors were related to increased dyadic flexibility and acquisition of "repair" skills (i.e., ability to move out of negative states) rather than avoidance of negative states altogether (Granic et al., 2007). Engaging in a range of emotional experiences during dyadic interactions may be adaptive, even if some of those states are negative as long as they do not persist. Conversely, negative dyadic interactions may be detrimental if dyads lack the capacity to quickly recover and move back into a positive state. This may be a component of teaching children positive coping strategies: minor disturbances in dyadic interactions need not evolve into sustained negatively. Indeed, effective coping strategies involve the ability to regulate inherent negative emotions that arise in interpersonal interactions (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Southam-Gerow & Kendall, 2002; Zeman, Shipman, & Suveg, 2002).

The other part of Hypothesis 2, which stated that the structure and content of dyadic interactions would be differentially associated with behavioral outcomes in children with ASD and NT children, also was supported. Dyadic flexibility and the frequency of mutual-positive engagement were significantly associated with maladaptive outcomes for children with ASD, whereas dyadic flexibility and the frequency of mutual-negative engagement were significantly associated with maladaptive outcomes for NT children. We did not find that mutual-negative engagement moderated the association between flexibility and maladaptive behaviors for children with ASD, nor did we find that mutual-positive engagement moderated relations between flexibility and maladaptive behaviors for NT children. Our results are in line with past research documenting diagnostic group differences in emotion regulation behaviors for children

with ASD and NT children (Jahromi et al., 2012; Samson, Hardan, Podell, Phillips, & Gross, 2015) and differences in parent–child affective engagement states in children with and without behavioral problems (Dumas, Lemay, & Dauwalder, 2001). The findings build on past research by highlighting the different manner in which dyadic flexibility interacts with emotion states in predicting internalizing and externalizing behaviors for children with ASD and NT children.

The present research has clinical implications for family-systems-based interventions for children with ASD (Sivberg, 2002). In particular, interventions that focus on helping parents assist their children in engaging in positive dyadic interactions may improve children's behavior. The effective use of emotion coregulation strategies in the comparatively low stress environment of the home may help the child modulate displays of maladaptive behaviors. A variety of techniques could plausibly be used to improve initiation of positive interactions in dyads with children with ASD. Mindfulness-based interventions (Cachia, Anderson, & Moore, 2016), relational savoring interventions (Burkhart, Borelli, Rasmussen, & Sbarra, 2015), and mentalization-based interventions (Slade, 2005) may help promote positive dyadic engagement, improve parental perception of dyadic interactions, and increase parental sensitivity.

Limitations and Future Directions

One limitation in the present study is that the mother–child behaviors were observed during a low-stress play task. In everyday life, families encounter both low- and high-stress situations and the emotional demands of situations vary considerably. For example, it is likely that children and parents experienced more positive emotions in the present low-stress context than in a high-stress context, such as a frustrating event, which could modify the patterns of emotion coregulation behaviors (Stansbury & Sigman, 2000). Additional research should determine whether similar pattern of interactions between dyadic-affect-engagement states and

dyadic flexibility remain when parent–child behaviors are observed in other contexts such as during high-stress tasks or emotion eliciting events.

Another limitation of the study is the relatively small sample size. Future research should be conducted to replicate these findings in a larger sample of children, which would allow for statistical testing of three-way interactions. A larger sample size would also allow for additional covariates (maternal education and child age) to be included in the regression analyses to replicate and strengthen our findings. Future studies might include measures of children's cognitive abilities in addition to behavioral outcomes and a fuller complement of parental mental health measures (e.g., depressive symptoms).

All children with ASD in the present study had a parent-reported, physician-diagnosis of ASD, which was confirmed by either the ADOS-2 or SCQ scores; however, ideally, all children would have received an ADOS-2 assessment. Finally, the analyses examine how aspects of parent–child interactions may contribute to maladaptive behaviors in children in a cross-sectional design; however, we cannot draw causal inferences. It is likely that parent–child interactions and children's behaviors have reciprocal influences and children's maladaptive behaviors contribute to the emotion coregulation processes (Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000; Kiff, Lengua, & Zalewski, 2011). Future work utilizing a longitudinal study design may help elucidate these complex relationships. For greater insight into parent-child coregulation processes, future research also might be directed toward examining whether the child or parent takes the initiative in changing dyadic-affect states.

Conclusion

In conclusion, the observed relations between the content and structure of dyadic interactions in association with maladaptive behaviors provide support that emotion regulation in

the context of parent–child relationships are important factors in the expression of child psychopathology. The present study extends previous work on emotion coregulation to include the interaction between the structure and content of parent–child interactions and to examine these relations in dyads of children with ASD and dyads of NT children. Our study is one of the few to use dyadic moment-to-moment microanalysis of emotion coregulation in these dyads. Results demonstrate the unique manner in which emotion coregulation processes relate to maladaptive behaviors for children. When dyads frequently initiate mutually positive interactions, high dyadic flexibility is related to fewer maladaptive behaviors for children with ASD. For NT children, high dyadic flexibility involving mutually negative interactions is related to fewer maladaptive behaviors. Importantly, the results indicate unique implications for children with ASD. Dyadic flexibility combined with the initiation of mutual-positive interactions would be particularly beneficial for the behavior of children with ASD.

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CHAPTER 3:

Recovery from Negative Interactions: Emotion Repair Processes in Mother-Child Dyads of Children with Autism Spectrum Disorder

Abstract

The current study examined mother-child repair processes, defined as the ability of dyads to return to positivity following negative interactions, in dyads of children with Autism Spectrum Disorder (ASD) within a low-stress context. Forty-six mothers and their children with ASD (34 boys; mean age= 5.27 years, *SD*= 1.42) participated in a semi-structured play procedure at home and mothers completed a measure on children's adaptive and maladaptive behaviors. The previously videotaped interactions were micro-coded for positive, negative, child object, and mismatched interactions. In the context of a low-stress setting, over half of dyads engaged in cycles of repair. Results indicated that dyads engaged in two types of repair: indirect and direct. Dyads in the no-repair group had more adaptive dyadic and child functioning compared to the repair group. Within the repair group, higher total cycles of repair were related to less adaptive dyadic and child functioning. Findings from the current study contribute to our understanding of the repair processes in mother-child dyads of children with ASD as well as the associations between these repair processes and dyadic and child functioning.

Recovery from Negative Interactions: Emotion Repair Processes in Mother-Child Dyads of Children with Autism Spectrum Disorder

Children's socioemotional capabilities development within social contexts such as parent-child interactions, which provide young children the opportunity to learn and practice skills to successfully manage emotionally arousing situations. Parents and children contribute to dyadic interactions in a bidirectional and transactional manner (Cole, Martin, & Dennis, 2004; Field, 1994). The dynamic interactions between parents and children jointly influence and regulate each other (Feldman, 2007; Fonagy, Gergely, & Target, 2007). During emotion coregulation processes, in which parents and children mutually regulate emotions, dyads vary in the emotional content of the interactions to adjust to changes in the demands of the interaction and environment (Feldman, 2007; Tronick & Cohn, 1989). The dynamic interactions between parents and children can be assessed using the State Space Grid (SSG) method (Lewis, Lamey, & Douglas, 1999), which provides patterns of mother and child engagements (i.e., positive, negative, or mismatched behaviors) simultaneously (Hollenstein, 2007; Hollenstein, Granic, Stoolmiller, & Snyder, 2004). Interactions that are characterized by matched positive parent and child engagements are adaptive; yet, disruptions in positivity normally occur in parent-child dyadic relationships, even in well-functioning dyads (Beeghly & Tronick, 2011).

Disruptions that cause a rupture in positive parent-child engagement occur routinely but can be managed by a process of dyadic repair. The ability of dyads to repair ruptures, or to recover from mismatched or mutual negative states by returning to positive states, is crucial for children's successful emotional functioning (Beeghly & Tronick, 2011; DiCorcia & Tronick, 2011). Repair during interactions may provide an opportunity for children to learn and internalize strategies for managing challenges, which helps them move toward internal self-

regulation (Tronick & Beeghly, 2011). Children also learn that they do not need to remain in negative situations, rather they can shift away from such states and into positive engagement.

Dyadic repair has been examined using behavioral observations with typically-developing children. Much of the work investigating disruptions in the parent-child system has utilized the still-face procedure (Tronick, Als, Adamson, Wise, & Brazelton, 1978). In infants, the still-face paradigm causes stress when there is mismatch between mothers and infants (Adamson & Frick, 2003). The procedure begins with a 2-minute period of face-to-face play, after which mothers change their facial expression and become emotionally unavailable (i.e., the still-face period); the repair process begins when mothers become engaged again during a second play period (Tronick et al., 1978). Numerous studies using the still-face procedure have found that dyads were more often in mismatched states following the period of maternal disengagement relative to the play period (before the still-face manipulation) (Mastergeorge, Paschall, Loeb, & Dixon, 2014; Provenzi et al., 2015; Weinberg & Tronick, 1996; Weinberg, Tronick, Cohn, & Olson, 1999). Differences in dyadic responses during the recovery period have been related to specific maternal behaviors during the play period as well as more generally. For example, following the disruption, more sensitive maternal behaviors are related to greater increases in infant's positive affect and use of self-comfort behaviors (Braungart-Rieker et al., 2014). These findings indicate that parental behaviors during times of low-stress play are impactful in shaping how dyads respond to, and recover from stressful, negatively-arousing situations.

With older children, behavioral observations of disruptions in positive engagements and repair processes have been examined during discussions of difficult topics. In a study of adolescents with aggression problems and their mothers, for example, dyads were asked to discuss a positive topic, a negative topic, and a positive topic, where the negative topic caused

conflict (Granic, O'Hara, Pepler, & Lewis, 2007). Repair in this context was defined as the ability of dyads to engage in mutual positive or neutral interactions during discussions of a positive topic following the discussion of a negative topic (Granic et al., 2007). Results indicated that following a family-based intervention, dyads with children whose behavioral problems improved were able to repair their interactions by shifting to positive engagements following the conflict.

Recovery following a disruption in parent-child interactions in the still-face paradigm as well as in the negative topic discussion represent stressful contexts in which emotional distress is caused by an experimental manipulation. A low-stress context, such as free-play or semi-structured play, is representative of events likely encountered daily by young children and these contexts likely activate underlying skills that are necessary in a variety of situation (e.g., shifting from a preferred activity to a less preferred activity) across contexts, such as the home and preschool environment. Therefore, additional research on dyadic repair across contexts would provide a better understanding of different recovery processes in response to various situations.

In a recent study that also used the Space State Grid for analysis, repair processes in mothers and preschool-aged children were examined during both a challenging task and free-play (Kemp, Lunkenheimer, Albrecht, & Chen, 2016). Ninety-six mothers and their 3-year-old children were observed in a laboratory setting during a puzzle task in which mothers verbally helped children complete increasingly difficult puzzles (high-stress) as well as during free-play (low-stress). Repair in this study was defined as the ability of dyads to move to positive states following either negative engagements or mismatched engagements (Kemp et al., 2016). The results demonstrated that dyads engaged in repair processes across both conditions; dyadic repair also predicted child behavioral outcomes. Higher rates of repair during the challenging task was

associated with children's ability to use appropriate regulation strategies and fewer externalizing behaviors four months later (Kemp et al., 2016). These results suggest that repair processes may be important factors associated with behavioral outcomes in neurotypical preschool-aged children.

Additional work is needed to examine how dyads of preschool-aged children navigate and recover from negative emotions in more naturalistic settings (e.g., home setting) and how dyadic repair processes in those settings are related to emotional and behavioral functioning. Moreover, processes of dyadic repair have not been yet examined in dyads of children with developmental challenges. Identifying dyadic repair processes associated with emotional and behavioral outcomes may be particularly important for children with Autism Spectrum Disorder (ASD). Children with ASD commonly experience challenges in emotion regulation (Mazefsky et al., 2013) and have co-occurring maladaptive behaviors, such as internalizing and externalizing behaviors (Hartley, Sikora, & McCoy, 2008). Gaining a nuanced understanding of parent-child repair processes in dyads with children with ASD may help inform and evaluate family-based therapeutic efforts to reduce behavioral problems.

The Current Study

Parents and children engage in a dyadic process of mutually influencing and regulating their emotions, which involves episodes of rupture and repair of positive engagements. These dyadic repair processes have been examined in infants and children (Weinberg & Tronick, 1996; Granic et al., 2007) and have been linked to preschool children's externalizing behaviors and emotion regulation (Kemp et al., 2016). Additional work is needed in this area to describe dyadic repair processes in dyads of children with developmental challenges and to determine if they are associated with children's behaviors and dyadic functioning. The current study focused on young

children with ASD and applied a micro-analysis approach to investigate patterns of mother-child repair during a low-stress context (semi-structured play at home) and to explore the links to children's adaptive and maladaptive behaviors, ASD symptom severity, and dyadic emotional content of interactions.

Aim 1: The first aim of the current study was to explore repair processes in mother-child dyads with children with ASD during a low-stress task and to describe these repair processes.

Aim 2: The second aim of the study was to investigate whether there were any differences in repair processes in relation to dyadic and child functioning.

Method

Participants

Forty-six mothers and their children with ASD (34 boys; mean age= 5.27 years, *SD*= 1.42 years, range = 3.05-7.91 years) participated in the current study. Children received a physician diagnosis of ASD prior to participating and additional confirmation was obtained by administering the ADOS-2 or the SCQ using the standardized cut-off scores. Mothers reported on their ethnicity: 43 percent (*n*=20) indicated that they were Caucasian, 15% (*n*=7) were Asian, 24% (*n*=11) were Hispanic, and 17% (*n*=8) reported that they were mixed ethnicity. Sixty-nine percent (*n*=27) of mothers obtained at least a four-year college degree and 53% (n=23) had a family income greater than $75,000/year. Demographic information is presented in Table 1.

Table 1. Demographic Data (*N*=46)

	M(*SD*)
Child chronological age	5.27(1.42)
	n(%)
Child gender	
female	12(26%)
male	34(74%)
Mother ethnicity	
Caucasian	20 43%)
Asian	7(15%)
Hispanic	11(24%)
Mixed ethnicity	8(17%)
Maternal education (≥ 4-year college)	27(59%)
Family income (≥$75,000)	23(53%)

Procedure

The study was approved by the University's Institutional Review Board. Mothers and their children participated in semi-structured play activities in an in-home session. Mothers also completed questionnaires that were mailed prior to the home visit. The current study is based on the previously videotaped mother-child interactions during play and the questionnaire data.

Measures

Demographic Information. Mothers provided their age, education level, ethnicity, and income level, and occupation, as well as information on their children's age, gender, and diagnostic and intervention history.

Mother-child coregulation. Mothers and children completed the Three Boxes procedure (Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004; Vandell, 1979), a 10-minute semi-structured play activity. Dyads were given three boxes with age-appropriate toys and were instructed to play as they normally would while progressing through each of the boxes. The interactions were videotaped and later coded for emotion engagement states of mothers and children based on the combination of mutually exclusive behaviors, body postures, attention,

facial expressions, and vocalizations. Mothers and children were coded separately for low, medium, and high levels of positive engagement, negative engagement, disengagement; children were also coded for object engagement (for detailed information on the coding schemes see Guo, Garfin, Ly, & Goldberg, 2017). Mangold International's INTERACT 9.47 (Mangold 2007) software program was used to code behaviors in 5-second intervals. Trained research assistants independently coded the mother and child engagement states. Inter-coder reliability for the mother and child engagement states were 91.71% (k = 0.84) and 89.10% (k = 0.80), respectively.

Emotional content. The separate mother and child codes were combined to create five dyadic engagement states: *mutual-positive-engagement* (mother and child in any positive engagement state), *mutual-negative-engagement* (mother and child in any negative engagement or disengagement), *mother negative/child positive engagement* (mother in any negative engagement or disengagement and child in any positive engagement), *mother positive/child negative engagement* (mother in any positive engagement and child in any negative engagement or disengagement), and *child object* (child in object engagement and mother in any engagement).

The combined mother-child engagement codes were exported to the State Space Grid GridWare 1.1. (Lamey, Hollenstein, Lewis, & Granic, 2004) to obtain the frequency of *visits* and the *ratio* or duration of each of the dyadic engagement states (i.e., mutual-positive, mother positive/child negative, mother negative/child positive, and child-object). A v*isit* is defined as the ability of dyads to initiate a particular engagement state from a previous state and r*atio* is defined as the ability of dyads to maintain a particular engagement state. Visits and the ratio were divided by the duration of the play activity to account for differences in the length of the activity.

Dyadic repair. The combined mother and child engagement codes were also analyzed for dyadic repair processes. Based on prior work on repair in dyads of NT children and children

with behavioral problems (Granic et al., 2007; Kemp et al., 2016), the current study defined dyadic repair as engagement in mutual-positive-engagement states following a rupture in the interactions during which dyads engage in mutual-negative-engagement states. Other work has also included mismatched states (i.e., mother positive/child negative or mother negative/child positive) in the definition of a rupture (Kemp et al., 2016). A more conservative definition of the rupture was used in the current study since it is plausible that a mismatched state demonstrated one member of a dyad engaging in a process of attempting to shift the other member into a positive state.

The current study described two types of repair processes: *direct repair* in which dyads shifted from mutual-negative-engagement states directly to mutual-positive-engagement states and *indirect repair* in which dyads shifted to other engagement states (i.e., mother positive/child negative engagement, mother negative/child positive engagement, child object, or mutual-negative-engagement) prior to shifting to mutual-positive-engagement states. These two types of repair processes were included to explore whether dyads varied in their ability to immediately repair interactions. Children with ASD tend to have difficulties in social processes such as shared attention (Dawson et al., 2004; Mundy, Sigman, Ungerer, & Sherman,1986) and tend to focus their attention on objects (Bhat, Galloway, & Landa, 2010; Koterba, Leezenbaum, & Iverson, 2014), which may impact the process by which they recover from negative interactions with their mothers in this context. Based on previous work (Coppola, Aureli, Grazia, & Ponzetti, 2016; Reck et al., 2011), three variables were created to describe the steps of repair including the duration of the rupture (i.e., time spent in negative), the duration of repair (i.e., time spent in positive), and duration of time until repair or latency to repair (i.e., time from negative to positive).

The mother and child engagement codes were exported to Excel. Repair and no-repair groups were identified using the criteria of dyads engaging in at least one cycle of repair for the repair group. Within the repair group, the number of total cycles of repair that dyads engaged in and the number of direct and indirect cycles of repair were calculated. Finally, the duration of the rupture, the duration of repair, and duration of time until repair were calculated.

Child adaptive and maladaptive behaviors. Children's behaviors were measured using the Vineland Adaptive Behavior Scales (VABS-II; Sparrow, Cicchetti, & Balla, 2005), a standardized parent-report questionnaire. Mothers rated the frequency of children's adaptive behaviors in four areas (communication, daily living skills, socialization, and motor skills) on a 3-point scale ranging from 0 (never) to 2 (usually). Mothers also rated the frequency of maladaptive behaviors (e.g., internalizing and externalizing behaviors) on a scale ranging from 0 (never) to 2 (often). Raw scores were converted to adaptive and maladaptive behavior composite standard scores. The VABS-II has demonstrated strong reliability and validity (Sparrow et al., 2005).

Child symptom severity. ASD symptom severity in children was assessed using the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003), a parent-report questionnaire. Mothers completed 40-items inquiring about their child's behaviors relating to communication, social functioning, and stereotyped and repetitive behaviors throughout his or her lifetime. The SCQ has well-established reliability and validity (Rutter et al., 2003).

Plan of Analysis

First, descriptive analyses were conducted to establish the number of dyads who engaged in at least one cycle of repair (repair group) and the number of dyads who did not engage in any cycles of repair (no-repair group). Descriptive analyses were also conducted to obtain the

number of total repair cycles, the number of direct (i.e., shifting directly from negative to positive engagement) and indirect cycles (i.e., shifting to other engagements after the rupture prior to shifting to positive engagement), the overall duration of ruptures (i.e., the amount of time spent in negative engagements prior to the repair), the overall latency of the repairs (i.e., the amount of time spent in other engagements prior to the repair), and the overall duration of positive engagement after the repair (i.e., the amount of time spent in positive engagement once the interaction is repaired) for the repair group. Additional descriptive analyses were conducted to obtain the duration of rupture, latency of repair, and duration of positive engagement per cycle; these variables were divided by the number of cycles.

Next, independent samples t-tests were conducted to determine if the repair group differed on demographic information compared to the no repair group. Then, a series of analysis of covariance (ANCOVAs) were conducted to examine group differences between the repair and no-repair groups on key dyadic and child measures: dyadic affect engagements, child adaptive and maladaptive behaviors, and child symptom severity. Mother's age was included as a covariate in the ANCOVAs. Finally, to determine if the number of total cycles was associated with dyadic affect engagements, child adaptive and maladaptive behaviors, and child symptom severity, bivariate correlations were conducted within the repair group.

Results

Descriptive Information

Sixty-three percent of dyads (*n*=29) engaged in at least one cycle of repair and 37% (*n*=17) of dyads did not engage in any repair. Within the repair group, 18 dyads engaged in at least one direct cycle and 26 dyads engaged in at least one indirect cycle (these classifications are not mutually exclusive). Group comparisons between dyads in the no-repair and repair groups on

demographic variables indicated that mothers in the no-repair group were older than mothers in the repair group [$t(44) = 2.11$, $p < 0.05$]. Groups did not differ by child age, child gender, mother education, or family income ($ps > 0.05$).

Table 2 provides the means and standard deviations for the number of total repair cycles, the number of direct and indirect cycles, the duration of the rupture, the latency of the repair, and the duration of positive engagement after the repair for the repair group. The number of repair cycles were 3.86 (*SD* = 2.60), with 2.44 (*SD* =1.50) direct cycles and 2.62 (*SD* = 1.96) indirect cycles. Table 3 displays the means and standard deviations for the duration of the rupture per cycle, the latency of the repair per cycle, and the duration of positive engagement after the repair per cycle for the repair group. Notably, the amount of time spent in negative engagements during the rupture per cycle was 14.37 seconds (*SD* = 12.94) in the indirect cycle and 7.61 seconds (*SD* = 3.07) in the direct cycle. The time to repair following the rupture per cycle was 33.62 seconds (*SD* = 23.13) in indirect cycles and 7.61 seconds (*SD* = 3.07) in direct cycles.

Table 2. Means and Standard Deviations for the Number of Repair Cycles and Duration of Repair Processes

Study variables	*M*	*SD*	*N*
Number of cycles			
Total	3.86	2.60	29
Direct	2.44	1.50	18
Indirect	2.62	1.96	26
Duration of rupture[a]			
Total	55.69	71.30	29
Direct	21.39	22.02	18
Indirect	47.31	70.56	26
Latency of repair[a]			
Total	98.10	105.90	29
Direct	21.39	20.15	18
Indirect	94.62	106.82	26
Duration of positive after repair[a]			
Total	63.79	50.67	29
Direct	51.11	43.94	18
Indirect	35.77	28.13	26

[a]The duration and latency variables provide the overall values for the entire interaction task in seconds

Table 3. Means and Standard Deviations for the Duration of Repair Processes per Cycle

Study variables	*M*	*SD*	*N*
Duration of rupture[a]			
Total	12.58	10.88	29
Direct	7.61	3.07	18
Indirect	14.37	12.94	26
Latency of repair[a]			
Total	25.56	20.69	29
Direct	7.61	3.07	18
Indirect	33.62	23.13	26
Duration of positive after repair[a]			
Total	18.29	12.79	29
Direct	19.86	15.46	18
Indirect	15.42	12.64	26

[a]The duration and latency variables were divided by the number of cycles to provide values per cycle in seconds

Repair-No-Repair Group Differences

ANCOVAs for differences between the repair and no-repair groups on dyadic affect engagement (positive, mismatch, and object), child adaptive and maladaptive behavior scores, and child symptom severity are shown in Table 4. Dyads in the repair group had more mutual positive visits, more mismatch (child negative/mom positive) visits, higher mismatch (child negative/mom positive) ratio (duration), and more symptom severity compared to the no-repair group. Dyads in the no-repair group had higher mutual positive ratio (duration) and more adaptive behaviors compared to the repair group.

Repair Group Correlations

Correlations among the number of total cycles, dyadic affect engagement, child adaptive and maladaptive behaviors, and child symptom severity are displayed in Table 5. Within the repair group, the number of total cycles were associated with parent-child affect engagements and children's adaptive behaviors. A higher number of total cycles were related to more frequent mutual negative visits, higher mutual negative ratio (duration), lower mutual positive ratio (duration), more frequent mismatched (child negative/mom positive) visits, higher mismatch (child negative/mom positive) ratio (duration), and fewer child adaptive behaviors.

Table 4. Comparisons of Repair and No-Repair Groups on Dyadic Affect Engagement, Vineland Adaptive and Maladaptive Behaviors, and SCQ[a] controlling for Mother's Age (*N*=46)

	No-Repair and Repair Groups (N=46)				Test of differences between groups
	No-Repair *n*=17		Repair *n*=29		
	M	*SD*	*M*	*SD*	
Dyadic affect engagement					
Visits					
Mutual positive	12.59	4.82	16.34	4.75	$F(1,2)=5.52$*
Child positive/mother negative	7.00	6.15	9.24	5.86	$F(1,2)=2.94$†
Child negative/mother positive	0.76	1.15	3.55	0.62	$F(1,2)=7.31$**
Child object	9.00	5.06	11.76	6.81	$F(1,2)=1.50$
Ratio (duration)					
Mutual positive	0.75	0.16	0.55	0.21	$F(1,2)=9.87$**
Child positive/mother negative	0.10	0.11	0.13	0.02	$F(1,2)=1.73$
Child negative/mother positive	0.01	0.01	0.04	0.04	$F(1,2)=7.17$*
Child object	0.14	0.11	0.19	0.14	$F(1,2)=0.97$
VABS-II behaviors					
Child adaptive behaviors	85.53	11.38	70.28	13.89	$F(1,2)=14.36$***
Child maladaptive behaviors	19.88	2.34	20.07	1.94	$F(1,2)=0.09$
SCQ					
Child symptom severity	15.82	6.12	20.97	5.27	$F(1,2)=9.89$**

[a]SCQ = Social Communication Questionnaire

†<.10; *p<.05; **p<.01; ***p<.001

Table 5. Correlation Matrix of Major Study Variables (*n*=29)

Study Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Total cycles	--													
2. Mutual positive visits	0.26	--												
3. Mutual negative visits	0.77***	0.06	--											
4. Child positive/mother negative visits	0.22	0.37*	0.21	--										
5. Child negative/mother positive visits	0.58***	0.11	0.65***	-0.27	--									
6. Child object visits	-0.00	0.52**	-0.07	0.27	-0.08	--								
7. Mutual positive visits	-0.61***	-0.46*	-0.66***	-0.48**	-0.40*	-0.39*	--							
8. Mutual negative visits	0.61***	-0.13	0.89***	0.06	0.65***	-0.12	-0.59***	--						
9. Child positive/mother negative ratio	0.11	0.30	0.06	0.90***	-0.33†	0.16	-0.38*	-0.08	--					
10. Child negative/mother positive visits ratio	0.62***	0.16	0.66***	-0.19	0.97***	-0.05	-0.44*	0.66***	-0.28	--				
11. Child object ratio	0.17	0.54**	0.05	0.08	0.04	0.80***	-0.63***	-0.04	-0.02	0.05	--			
12. Adaptive behaviors	-0.48**	0.12	-0.46*	-0.02	-0.19	0.22	-0.02	-0.34†	0.04	-0.27	0.36†	--		
13. Maladaptive behaviors	-0.04	0.02	-0.08	0.38*	-0.24	0.03	0.02	-0.12	0.32	-0.18	-0.11	-0.31†	--	
14. Symptom severity	0.30	0.12	0.17	0.31	-0.04	0.10	-0.17	0.06	0.21	0.10	0.04	-0.49**	0.48**	--

†<.10; *p<.05; **p<.01; ***p<.001

Discussion

Mothers and children engage in variety of affect engagements during interactions, including cycles of rupture and repair of positive engagements. The goal of the current study was to investigate patterns of dyadic repair following negative interactions in mother-child dyads of children with ASD. Specifically, links between repair processes in a low-stress context (semi-structured play activity) and children's adaptive and maladaptive behaviors, symptom severity, and emotional content were examined. In the context of a low-stress setting, over half of dyads engaged in cycles of repair. Dyads in the no repair group had more adaptive dyadic and child functioning compared to the repair group. However, within the repair group, higher total cycles of repair were related to less adaptive dyadic and child functioning. Results of the current study contribute to our understanding of the ability of dyads with children with ASD to recover from negative interactions as well as to our understanding of the associations between mother-child repair process and dyadic and child behaviors. This is one of the first studies, to our knowledge, to investigate the links between repair processes in a low-stress context and dyadic and child behaviors in dyads with children with ASD.

The results of the current study provide important descriptive information on the process of repair in dyads of children with ASD. Within this low-stress context, dyads engaged in two types of repair process: one in which dyads returned to positive states immediately following negative interactions and one in which they first engaged in at least one other type of engagement prior to returning to positive states. Additionally, the results provide information on three steps of the repair process: the time spent in negative engagement following the repair, the time needed to return to positive engagement, and the time spent in positive engagement once the interaction has been repaired.

Compared to the repair group, the no repair group had better dyadic and child functioning indicated by more child adaptive behaviors, less severe child ASD symptoms, fewer positive dyadic interactions, but more time spent in positive interactions, fewer child negative/mother positive interactions, and less time spent in child negative/mother positive interactions. The current study extends prior work on repair in the context of mother-child interactions (Granic, et al., 2007; Kemp et al., 2016), by exploring repair processes within a low-stress context (in the home) in which ruptures were spontaneous rather than experimental manipulated (e.g., Still-Face Procedure, discussion of negative topics) and by including dyads of children with ASD. Findings from the current study indicate that in this low-stress context, some dyads with children with ASD did not engage in negative interactions, rather they were able to sustain other engagements, including positivity, during a play activity which is generally positive, and this ability was related to overall higher adaptive functioning. Together, these findings highlight the importance of using a variety of contexts to expand our knowledge of dyadic repair processes and to inform the conditions under which repair processes may be advantageous for dyads and children.

Within the repair group, the total number of cycles was associated with dyadic and child functioning. A greater number of total cycles of repair was related with less time spent in positivity, greater initiation of and time spent in child negative/mother positive, and fewer child adaptive behaviors. Although the ability to repair interactions and successfully regulate negative emotions that dyads encounter may be important for adaptive functioning (Kemp et al., 2016; Skowron, Kozlowski, & Pincus, 2010; Weinberg, Olson, Beeghly, & Tronick, 2006), findings from the current study indicate that during a play activity, which creates a context for positive interactions, greater dyadic repair from mutual negativity to mutual positivity may not be

advantageous. These findings suggest that the context in which repair processes take place is an important factor in determining when repair processes may be beneficial for dyads.

No differences in child maladaptive behaviors were found between the repair and no-repair groups and repair cycles were not related to maladaptive behaviors. The lack of these findings could be due to the nature of the interaction task. In the low-stress task, dyads spent the majority of the time in positive engagements. This is consistent with previous work that found relations between repair processes and child maladaptive behaviors only in a challenging task but not during free-play (Kemp et al., 2016).

Limitations and Future Directions

One limitation of the current study is the relatively small sample size. The findings provide initial support for the importance of repair processes in dyadic outcomes and adaptive behaviors for children with ASD. However, future work should replicate these findings in a larger sample as well as include neurotypical dyads. A larger sample size with both groups would allow for a direct comparison of neurotypical dyads and dyads with children with ASD in the same context. Future work should also consider examining repair cycles within challenging task, which may provide an additional context for further exploring direct and indirect cycles of repair.

In the current study, dyads in the repair group initiated more positive interactions but spent less time in positive engagements compared to the dyads in the no-repair group. Previous work from our lab comparing neurotypical dyads and dyads with children with ASD found that the ASD group initiated more positive engagements relative to neurotypical dyads, but were unable to maintain positive interactions (Guo et al., 2017). The findings from the current study suggest that repair processes may be underlying factors that contribute to difficulties in

maintaining positive interactions in dyads of children with ASD. Future work should further examine the relations between repair processes and the ability of dyads to sustain positive interactions across different contexts in dyads of children with ASD as well as NT dyads to gain a better understanding of these relations.

The next step in this line of research will be to broaden the definition of rupture and examine repair processes following two types of mismatched engagements: mother positive/child negative and mother negative/child positive. Prior work has defined rupture as dyads engaging in either negative or mismatched states (Kemp et al., 2016). However, mismatched state could represent dyads attempts to move to positive engagements and patterns of repair following mismatch may be differentially associated with dyadic and child functioning.

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CHAPTER 4:

Early Dyadic Emotion Coregulation Processes in a Moderately-Stressful Context: Implications for Long-term Socioemotional Functioning

Abstract

Children's ability to regulate their emotions develops within the context of parent-child interactions and is essential for successful socioemotional functioning. Using data from the NICHD Study of Early Child Care and Youth Development, the current study implemented a dyadic, micro-analysis approach to explore longitudinal associations between early mother-child emotion coregulation in a moderately-stressful context and children's later socioemotional outcomes. Observational and parent- and child-completed questionnaire data were used. Mother-child (*N*=112) interactions during a moderately-stressful standardized laboratory procedure when children were 3 years old were coded for emotion coregulation. Early emotion coregulation was examined in relation to children's social competence and peer relationships at Grade 5. Results indicated that a wider range of dyadic emotions in the moderately-stressful context predicted fewer child self-control behaviors and greater shifting of emotions predicted child aggressive behaviors toward peers at Grade 5. Greater sustainment of dyadic positivity during early mother-child interactions predicted more child self-control behaviors and fewer intimate communication of problems with their best friend at Grade 5.

Early Dyadic Emotion Coregulation Processes in a Moderately-Stressful Context: Implications for Long-term Socioemotional Functioning

Children's ability to regulate their emotions is a key developmental goal and is essential for adaptive socioemotional functioning. Emotion regulation refers to the ability to change or modify emotional experiences (Thompson, 1994). Early emotional capabilities develop within social contexts during childhood. Parent-child interactions provide the setting for children to learn and practice strategies through the process of mutually coregulating emotions. Successful early regulation of emotions is important for children's social competence and peer relationships (Denham et al., 2003; Eisenberg et al., 1995; Hubbard & Coie, 2013; Ladd & Troop-Gordon, 2003), which are in turn linked to adaptive functioning in other areas, such as academic success, emotional functioning, and overall psychosocial adjustment in adulthood (Bagwell, Newcomb, & Bukowski, 1998; Hartup & Stevens, 1999; Malecki & Elliot, 2002). Although we know that parent-child interactions play a critical role in shaping children's emotion regulation abilities, less understood are the relations between early parent-child emotion coregulation processes in stressful contexts and children's socioemotional functioning in middle childhood. The current study investigates these associations by implementing a dyadic, microanalysis approach to examine early mother-child emotion coregulation and children's later social competence and peer relationships.

Parents play a primary role in facilitating the development of infants' and young children's emotion regulation skills by helping children externally modify their emotional experiences (Calkins & Hill, 2007; Cole, Michel, & Teti, 1994; Denham et al., 2011; Kopp, 1982, 1989). During preschool age, children expand their range of strategies and increasingly use their own internal regulation strategies. Although the early years are marked by significant

growth in emotion regulation and related abilities (Thompson, 1994; Zeman, Cassano, Perry-Parrish, & Stegall, 2006), parents continue to play pivotal roles in shaping emotion regulation skills during parent-child interactions (Calkins, 2011). Parents and children mutually regulate their emotional experiences in a process of emotion coregulation during social exchanges (Butler & Randall, 2012; Cole, Martin, & Dennis, 2004; Feldman, 2003; Tronick 1989). Repeated interactions between parent-child dyads across various contexts allow children to learn to use strategies to modulate negative emotions and internalize emotion regulation strategies.

Prior research on dyadic emotion processes has examined shared parent-child affect and dyadic synchrony, which refers to mutually regulated interactions, within low-stress contexts, such as free-play (Boyum & Parke, 1995; Feldman, Greenbaum, Yirmiya, 1999; Harrist, Pettite, Dodge, & Bates, 1994; Isley, O'Neil, Clatfelter, & Parke, 1999; Lindsey, Caldera, Rivera, 2013). This line of work has suggested that mutually positive synchronous interactions between mothers and children during early childhood are especially important for children's socioemotional functioning (Harrist & Waugh, 2002). For example, in the context of a semi-structed play activity, shared positive affect between mothers and toddlers predicted fewer aggressive behaviors with peers during observations of peer interactions, whereas shared negative affect predicted less prosocial behaviors and more aggressive behaviors with peers eight months later (Lindsey et al., 2013). Similarly, shared positivity and synchrony during free-play and structured activities between mothers and their preschool-aged children were associated with higher mother-reported child social competence (Pasiak & Menna, 2015). Together, these studies suggest that within low-stress contexts, the ability of mothers and their children to engage in mutually positive interactions is beneficial for children's social competence and peer

relationships. Less understood is the conceptualization of emotion coregulation within a moderately-stressful context and how it relates to children's socioemotional functioning.

Research on children's emotion regulation capabilities may benefit from using a challenging or stressful context when dyadic social exchanges between children and parents are considered (Cole, Martin, & Dennis, 2004; Lunkenheimer, Kemp, Lucas-Thompson, Cole, & Albrecht, 2017). A context that elicits stress may provide an opportunity for parents to engage in efficient emotion regulation strategies with their children in the face of negative emotions (Lunkenheimer et al., 2017), which in turn allows children to learn ways to manage negativity. The Strange Situation (Ainsworth, Blehar, Water, & Wall, 1978) may be one context within which to examine mother-child emotion processes. The Strange Situation includes a play, two separation, and two reunion episodes, which have been traditionally used to classify young children in subsets of secure and insecure attachment categories. The separation episodes provide a moderately-stressful context (NICHD ECCRN, 2001) during which children tend to become stressed and the reunion episodes allow for observations of dyads' use of coregulation process to attempts to recover from the stressor.

Past research has examined emotion coregulation across episodes of the Strange Situation (Guo, Leu, Barnard, Thompson, & Spieker, 2015). The results showed that dyads of both insecurely and securely attached children had reduced positive interactions and increased negative interactions from the pre-separation to the second reunion, but dyads of securely attached children showed a smaller change. This study used the State Space Grid (SSG) method (Lewis, Lamey, & Douglas, 1999) to describe changing emotion coregulation processes across the low-stress and moderately-stressful contexts of the Strange Situation.

The SSG provides a graphical representation of micro-level parent and child behavior patterns simultaneously (Hollenstein, 2007, Hollenstein & Lewis, 2006; Sameroff, 2009). This method has been used to conceptualize aspects of emotion regulation in terms of the structure (i.e., the range of emotional interactions, the shifts of emotions, and perseveration in an emotional state) and the emotional content (i.e., the ability of dyads to initiate and remain in emotional engagements). Past research has examined the structure and emotional content of emotion coregulation in relation to children's maladaptive behaviors. For example, observed parent-child interactions during a series of activities, including discussions of problems that cause conflict, showed that decreased emotional variability (structure) during kindergarten predicted higher levels of externalizing behaviors in first grade for high-risk children (Hollenstein, Granic, Stoolmiller, & Snyder, 2004). Emotion coregulation examined in the context of the Strange Situation in preschool-aged children and their mothers has demonstrated that increased dyadic positivity (emotional content) in the second reunion predicted fewer internalizing behaviors in kindergarten (Guo, Spieker, & Borelli, under review).Yet, it is unknown how the two different aspects of emotion coregulation processes are related to typically developing children's adaptive functioning (e.g., social competence and peer relationships).

During middle childhood and pre-adolescence, forming and maintaining successful peer friendships becomes an important developmental task (Elicker, England, & Sroufe, 1992; Sullivan, 1953). Close friendships increase, and peer relationships become more complex across childhood (Parker, Rubin, Price, & DeRosier, 1995; Sullivan, 1953). Friendships in early childhood are mainly characterized by common activities and interests, whereas relationships in middle childhood focus on more complex qualities such as reciprocity, loyalty, and intimacy (Buhrmester & Furman, 1987; Hartup & Stevens, 1997). Developing successful friendships has

implications for other areas of development, such as academic achievements and overall adaptive adjustment (Bagwell et al.,1998; Malecki & Elliot, 2002). Gaining social skills such as cooperation, assertation, and self-control, not only contributes to children's social competence, but are valuable in successful peer relationships (Gresham & Elliott, 1984). These studies point to the importance of examining social interactions with peers as a marker of adjustment during middle childhood and beyond.

Current Study

Past research has demonstrated the importance of parent-child relationships for the development of children's emotion regulation capabilities and the impact of emotion regulation on children's socioemotional functioning. The current study expands prior work by examining how the structure and the emotional content of mother-child coregulation in the Strange Situation contributes to children's later socioemotional outcomes. Specifically, previously collected but newly coded longitudinal data were used to explore dyadic emotion coregulation processes using the SSG in mothers and their preschool-aged children and children's social skills and peer relationships in middle childhood.

Mother-child coregulation processes were examined in a standardized, moderately stressful procedure, a modified version of the Strange Situation adapted for preschool-aged children (Cassidy, Marvin, & MacArthur Working Group, 1992). Only the mother and child behaviors during the second reunion were the focus of the current study because this segment represented the most stressful episode given that the mothers had left for a second time, which adds to the stress of the first separation-reunion episodes and the second separation was extended by two minutes in the modified version due to older age of the children. Moreover, emotion

coregulation during the second reunion at 36 months has been found to be more predictive of children's behavioral outcomes compared to baseline (Guo, Spieker, & Borelli, under review).

Based on past research demonstrating links between early coregulation and children's behavioral outcomes (Feldman et al., 1999; Hollenstein et al., 2007; Isley et al., 1999; Lindsey et al., 2013; Van der Giessen et al., 2015), it was expected that both aspect of mother-child emotion coregulation (i.e., structure and emotional content) at 36 months would predict children's developmental outcomes in Grade 5.

Hypothesis 1: The first hypothesis pertains to the structure of emotion coregulation in mother and child interactions. It was expected that the structure (i.e., the range of emotional interactions, the shifts of emotions, and perseveration of emotional states) would predict children's social skills, behaviors towards peers, and friendship quality, but the directions were exploratory.

Hypothesis 2: Based on previous work demonstrating that shared positivity between parents and children were related to increased adaptive functioning in children in various domains, it was expected that more dyadic positivity and less dyadic negativity (emotional content of coregulation) would predict better social skills, fewer negative behaviors towards peers, and better friendship quality.

Method

Participants

Families who participated in one site of the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care and Youth Development (SECCYD) were included in the current study. The NICHD SECCYD was a longitudinal study of early child care and development. Data were collected in four phases (Phase I: 1 to 36 months, Phase II: 54

months to first grade, Phase III: second to sixth grade, and Phase IV: seventh grade to 15 years of age) across ten locations in the United States (see NICHD ECCRN, 2005 for detailed information of the original study). The present study focuses on videotaped behavioral observations and questionnaire data from Phase I (36 months) and Phase III (5^{th} grade) of the data collected at the University of Wisconsin, which was made available by the P.I., Professor Deborah Vandell.

A total of 120 videotapes from families who participated at the Wisconsin location were made available. Eight (7%) of those families were excluded in current study due to either a technical error with the videotaped interactions or no maternal participation in the interaction task. The final sample was 112 mother-child dyads with neurotypical children (boys: *n*=48, 43%; girls: *n*=64, 57%) who had usable videotapes and whose mothers completed the study questionnaires. Mothers reported their ethnicity as 92% (*n* = 103) Caucasian, 3% (*n* = 3) Asian, 4% (*n* = 5) African American, and 1% (*n* = 1) other. Three percent (*n* = 3) of mothers also identified as Hispanic. Seventy-four percent (*n* = 83) of mothers had some college education or more. Detailed demographic information is provided in Table 1.

Table 1. Demographic Characteristics of NICHD Wisconsin sample (*N*=112)

Child characteristics	*n*(%)
Gender	
female	64(57%)
male	48(43%)
Ethnicity	
Caucasian	99(88%)
Asian	3(3%)
African American	4(4%)
Other	6(5%)
Hispanic	6(5%)
Mother characteristics	
Ethnicity	
Caucasian	103(92%)
Asian	3(3%)
African American	5(4%)
Other	1(1%)
Hispanic	3(3%)
Age at study enrollment (in years)	27.82±5.26
Education	
Less than high school	6(5%)
High school	23(21%)
Some college	44(39%)
College degree	23(21%)
Graduate degree	16(14%)
Average family income-to-needs ratio	2.95±1.65

[a] averaged across 6,15, 24, & 36 month timepoints

Procedure

The study was approved by the appropriate institutional review boards for data collection in Wisconsin and for data coding at the University of California, Irvine. Written informed consent was obtained from the families. A multi-method approach was used to obtain the data. Demographic information was collected at birth and throughout Phase I. When children were 3 years old, mother-child dyads were observed and videotaped in the laboratory during the Strange Situation procedure. At Grade 5, mothers and children completed questionnaires inquiring about child socioemotional functioning. The videotaped mother-child interactions were later coded at

University of California, Irvine by a team of researchers, which was the focus of the present study along with the questionnaire data.

Measures

Covariates. Mothers reported demographic information including child gender (0= boy) and maternal education level when they enrolled in the study. Family income-to-needs ratio, which was based on the family income relative to the poverty threshold for a given household size, was assessed when children were 1, 6, 15, 24, and 36 months old. A measure of family socioeconomic status (SES) was calculated for the current study using maternal level of education and composite family income-to-needs ratio (averaged across the five points of data collection).

The Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977), a standardized self-report measure, was used to assess maternal depressive symptoms. Mothers rated the frequency of 20 items on a 4-point scale ranging from 0 [rarely or none of the time (less than 1 day)] to 3 [most or all of the time (5-7 days)]. Sample items include, "I was bothered by things that usually don't bother me," and "I felt that I could not shake off the blues even with help from my family or friends." Higher scores indicate the presence of more symptoms. The CES-D has good internal consistency and reliability (Radloff, 1977). A composite score was calculated from total scores reported when children were 6, 15, 24 and 36 months old.

Preschool Observations of Mother and Child

Mother-child interactions. Dyadic interactions were examined when children were 36-monthds old during the second reunion episode of the modified Strange Situation Procedure (Cassidy et al., 1992). A novel coding schemed was developed for use in this study to capture mother and child affect engagement. Codes for dyadic affect engagements were based on

behaviors, body postures, attention, facial expressions, and vocalizations. Mothers and children were coded for mutual positive engagement, negative affective engagement, and disengagement, which were coded across two levels of intensity: low and moderate/high.

Child engagement codes. *Positive engagement* was defined as children's positive social interaction with their mothers, characterized by happy, excited vocal expression, engaging in turn-taking or joint-task, eye contact, children responding to mother's requests, initiation, asking for help, affectionate or energetic interaction, eye contact, among others.

Negative engagement was defined as children protesting or expressing negative emotion, characterized by negative facial expressions, negative statements, soft whimper, whining, fussing, frowning, crying, refusing or rejecting interaction with obvious negative affect, aggression, pushing, kicking, hitting, and throwing objects, among others.

Disengagement was defined as children's withdrawal or shifting attention away from mother or task and was characterized by attention shifts from parent or task, self-talk or no vocalization, subtle or flat affect, gazing away, mostly no attention to parent or task, head or whole body turning away, ignoring questions or demands, walking away, and no interaction with parent or task, among others.

Mother engagement codes. *Positive engagement* was defined as mother's positive interaction with their children, characterized by focusing attention on child, initiating or sharing enjoyment, praising or encouraging child, providing appropriate assistance, being sensitive to child's needs or desires, expressing affection, offering comfort, labeling emotion, and genuine/wholehearted laughter, among others.

Negative engagement was defined as mother's negative directives or controlling interactions, characterized by verbal insensitivity to child's timing during play (i.e. interrupting

or talking over child), controlling without attending to child's readiness, refusing to engage in child's play activity, giving negative directives, engaging in unnecessary physically intrusive contact, dominating or directing play, provoking negative emotions in child, angry, irritated, or threatening expressions, among others.

Disengagement was defined as mother's withdrawal or removal from the interaction and was characterized by shifting attention away from the child or task, gazing away or turning head, physically shifting away from child or task, sighing or yawning, engaging in parallel play, and ignoring child's bids for attention, among others.

Affect engagement was coded separately for mothers and children in 4-second intervals using Mangold International's INTERACT 9.47 (Mangold, 2007) software program. Mother and child engagements were coded by separate teams of two extensively trained research assistants and the first author. The inter-coder reliability for the mother engagement was 93.93% (k = 89.86) and the inter-coder reliability for the child engagement was 90.17% (k = 81.63).

State Space Grid measures. The mother and child codes were merged for each dyad and exported to the SSG software. The SSG provides a grid of possible dyadic engagements with mother engagement states located on the *y*-axis and the child engagement states located on the *x*-axis. As in prior research from our lab using the SSG, three grid-level variables were derived from the SSG to capture the structure and five region-level variables to capture the emotional content.

Structure was indicated by *dispersion*, *transitions*, and *average mean duration (AMD)* of engagement states. *Dispersion* refers to the spread of engagement states across all cells or the range of dyadic engagement states. *Transitions* refer to the movement between cells or the shifting of dyadic engagement states. *AMD* refers to the average amount of time spent in each

visit to an engagement state or perseveration in a dyadic engagement state. Together, greater *dispersion*, more *transitions*, and shorter *AMD* indicate a more flexible structure.

Emotional content was indicated by *mutual-positive-engagement states* and *mutual-negative-engagement states*. *Mutual-positive-engagement states* included mother and child positive engagement (low and moderate-high). *Mutual-negative-engagement states* included mother and child negative engagement (low and moderate-high) and disengagement (low and moderate-high). For each of the dyadic engagement states, two main variables were derived from the SSG to examine the emotional content: *visits* and *ratio*. A *visit* refers to the ability of dyads to initiate a particular engagement state from a previous state; the number of visits were divided by the total duration of the task to account for variations in length of the task. *Ratio* refers to the ability of dyads to maintain a particular engagement state and is calculated as the time spent in each state divided by the total time spent in the procedure to account for variations in the length of the task. A third variable, *duration*, was also derived from the SSG to indicate the time spent in each state; duration was not divided by the total time spent in the procedure for easier interpretation.

Grade 5 Socioemotional Measures.

Child social competence. Child social competence at Grade 5 was measured using the Social Skills Rating System (SSRS; Gresham & Elliott, 1990), a standardized parent-report. Mothers rated the frequency of 38 behaviors from 0 (never) to 2 (very often). The SSRS captures four aspects of social skills: *cooperation* (e.g., volunteers to help family member with tasks), *assertion* (e.g., is self-confident in social situations), *self-control* (e.g., controls temper when arguing with other children), and *responsibility* (e.g., requests permission before leaving the house). Items on each of the subscales were summed separately and converted to standardized

scores; higher scores indicated more frequent displays of socially acceptable behaviors. A standardized total score was also computed. The SSRS has demonstrated reliability and validity for preschool- and school-aged children (3-18 years of age).

Child peer relationships. Children's relationships and behaviors with peers at Grade 5 was measured using the Child Behavior with Peers Questionnaire. Mothers rated 43 items on a 3-point scale ranging from 0 (not true) to 2 (often true). The questionnaire captures five aspects of peer interactions: *aggressive behaviors towards peers* (e.g., threatens other children), *asocial behaviors towards peers* (e.g., withdraws from peer activities), *excluded by peers* (e.g., not chosen as playmate by peer), *peer victimization* (e.g., is called names by peers), *prosocial toward peers* (e.g., seems concerned when other children are distressed), and *relational aggression toward peers* (e.g., spreads rumors or gossips about some peers). Scores on each scale were summed separately with higher scores indicating a higher tendency to engage in a particular type of behavior.

The Friendship Quality Questionnaire (FQQ; Parker & Asher, 1993) was used to assess children's report of their relationship with their best friend at Grade 5. Children rated 21 statements on a 5-point scale ranging from 1 (not at all true) to 5 (really true) to evaluate six aspects of their friendship: *companionship and recreation* (e.g., best friend and I always sit together at lunch), *validating and caring* (e.g., best friend and I make each other feel important and special), *help and guidance* (e.g., when I'm having trouble figuring out something, I usually ask best friend for help and advice), *intimate communication* (e.g., best friend and I are always telling each other about our problems), *conflict and betrayal* (e.g., best friend and I argue a lot), and *conflict resolution* (e.g., best friend and I make up easily when we have a fight). Items on each scale were summed separately; higher scores indicate more displays each behavior. A total

score was also computed with higher total scores indicating more positive behaviors with best friend.

Plan of Analysis

The SSG data were first checked for the presence of outliers. As in other studies using the SSG, data that were three standard deviations above or below the mean were adjusted (Guo et al., 2017; Hollenstein et al., 2004). Next, bivariate correlations among grid-level variables (*dispersion*, *transitions*, *AMD*) and region-level variables (*mutual-positive* and *mutual-negative-engagement state* visits), and child socioemotional measures (social competence and peer relationships) were conducted. Potential covariates (e.g., SES, maternal depression, and child gender) were also screened in bivariate analyses. In the correlations, the region-level variables were not divided by the duration of the task for easier interpretation.

OLS regression analyses were then conducted to examine relationships between indicator variables and scores on the Social Skills Rating System, Child Behavior with Peers, and Friendship Quality Questionnaire. Three grid-level variables (*dispersion*, *transitions*, and *AMD*), four region-level variables (*mutual-positive-engagement-state* visits and ratio, and *mutual-negative-engagement-state* visits and ratio), SES, maternal depression, and child gender were used as indicators. In each set of analyses, Model 1 tested the relationship between the covariates (SES, maternal depression, and child gender) and each child outcome and the Model 2 included the addition of each SSG variable.

Results

Descriptive statistics

Table 2 provides the means and standard deviations for the mother-child SSG grid- and region-level variables. The means and standard deviations for the Grade 5 child socioemotional

variables (Social Skills Rating System, Child Behavior with Peers, and Friendship Quality Questionnaire) are shown in Table 3.

Table 4 displays the correlations among the covariates, SSG grid- and region-level variables, and major child socioemotional outcomes. In terms of covariates, SES was positively correlated with children's self-control and negatively correlated with children's aggressive behaviors towards peers. Maternal depressive symptoms were negatively correlated with children's self-control and positively correlated with children's aggressive behaviors towards peers. Child gender was negatively correlated with aggression and positively correlated with intimate disclosure. In terms of SSG grid- and region-level variables, transitions were positively correlated with child aggressive behaviors towards peers. Dispersion was negatively correlated with self-control. Positive ratio was positively correlated with child self-control and negatively correlated with intimate disclosure. Negative visits were negatively correlated with child self-control and positively correlated with aggressive.

Table 2. Means and Standard Deviations for Mother-Child Observation-based Grid- and Region-Level Variables (*N*=112)

Study variables	*M*	*SD*
Grid-level variables		
Transition	29.06	7.11
Dispersion	0.81	0.13
AMD[a]	6.85	1.97
Region-level variables		
Visits		
Mutual positive	6.60	2.56
Mutual negative	1.13	1.55
Ratio[b]		
Mutual positive	0.47	0.24
Mutual negative	0.03	0.05
Duration		
Mutual positive	92.01	47.69
Mutual negative	6.62	9.87

[a]AMD = Mean duration per visit; [b]Region ratio variables = proportion of time spent in a particular region divided by the total duration of the interaction

Table 3. Means and Standard Deviations for Grade 5 Child Socioemotional Measures

Study variables	*M*	*SD*	*N*
Mother-reported Child Social Skills Rating System			
Cooperation	11.84	3.12	94
Assertion	17.16	2.52	94
Responsibility	14.84	2.77	94
Self-control	13.36	3.72	94
Mother-reported Child Behavior with Peers			
Aggressive towards peers	0.27	0.30	92
Asocial towards peers	0.30	0.35	92
Excluded by peers	0.19	0.32	92
Peer victimization	0.22	0.36	92
Prosocial towards peers	1.70	0.36	92
Relational aggression towards peers	0.30	0.33	92
Child-reported Friendship Quality Questionnaire			
Companionship and recreation	4.32	0.80	93
Conflict and betrayal	1.49	0.66	93
Help and guidance	3.72	0.82	93
Intimate disclosure	3.78	0.96	93
Conflict resolution	4.44	0.78	92
Validation and caring	4.34	0.65	93

Table 4. Correlation Matrix of Major Study Variables

Study Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. SES	--												
2. Maternal depression	-0.35**	--											
3. Child gender	0.18	-0.06	--										
4. Transition	-0.14	0.06	0.12	--									
5. Dispersion	-0.11	0.07	0.14	0.66***	--								
6. AMD[a]	0.11	-0.06	-0.03	-0.86***	-0.69***	--							
7. Mutual positive ratio[b]	0.22*	-0.22*	-0.09	-0.33**	-0.56***	0.26*	--						
8. Mutual positive visits	0.03	-0.13	0.15	0.50***	0.26**	-0.48***	0.28**	--					
9. Mutual negative ratio[b]	0.19†	0.14	0.02	0.27**	0.31**	-0.14	-0.31**	-0.18	--				
10. Mutual negative visits	0.02	0.21*	-0.06	0.39***	0.38***	-0.23*	-0.34***	-0.10	0.90***	--			
11. Self-control	0.27*	-0.32**	0.18†	-0.14	-0.21*	0.15	0.26**	0.08	0.19†	-0.23*	--		
12. Aggressive behaviors	-0.38***	0.32**	-0.26*	0.25*	0.11	-0.12	-0.16	0.04	0.13	0.23*	-0.44***	--	
13. Intimate disclosure	0.10	-0.17	0.46***	0.06	0.15	-0.09	-0.26*	0.01	-0.01	-0.06	0.15	-0.08	--

[a]AMD = Mean duration per visit; [b]Region ratio variables = proportion of time spent in a particular region divided by the total duration of the interaction
†p <.10, *p<.05, **p<.01, ***p<.001

SSG Variables and Social Competence

Regression analyses examining the relationship between grid- and region-level SSG variables (i.e., dispersion, positive ratio, and negative visits) and mother-reported child social competence (i.e., self-control) are displayed in Tables 5, 6, and 7. Model 1 in each set of analyses presents the associations between SES, maternal depression, and child gender and child self-control scores. Model 2 in each set of analyses includes the addition of a grid- or region-level variable. Analyses revealed that less dispersion and greater duration in the positive region were associated with more frequent displays of self-control behaviors, when controlling for the covariates. Fewer negative visits was marginal associated with more frequent self-control behaviors, controlling for the covariates. SSG variables were not associated with other social competence subscales or the total score (*ps* > .05, *ns*); these nonsignificant results are not shown in a table.

Table 5. Dispersion and Mother-reported Child Self-Control Scale

	Model 1		**Model 2**	
	b(95% CI)	β	b(95% CI)	β
Covariates				
SES	0.19(-0.04, 0.43)	0.18	0.17(-0.06, 0.40)	0.16
Depression	-0.15(-0.28, -0.02)*	-0.25	-0.15(-0.28, -0.02)*	-0.24
Gender	0.83(-0.72, 2.39)	0.11	1.05(-0.49, 2.60)	0.14
SSG Structure				
Dispersion			-5.88(-11.64, -0.12)*	-0.20
Constant	10.19(5.00, 15.12)***		14.84(8.02, 21.67)***	
N	87		87	
Model Statistics	$F(3, 83)=4.88$, $p=0.003$, $R^2=0.15$		$F(4, 82)=4.83$, $p=0.002$, $R^2=0.19$ Change in R^2 from Model 1 =0.04, $p=0.045$	

†$p<.10$; *$p<.05$; **$p<.01$; ***$p<.001$

Table 6. Positive Ratio and Mother-reported Child Self-Control Scale

	Model 1		**Model 2**	
	b(95% CI)	β	b(95% CI)	β
Covariates				
SES	0.19(-0.04, 0.43)	0.18	0.15(-0.08, 0.38)	0.14
Depression	-0.15(-0.28, -0.02)*	-0.25	-0.13(-0.26, 0.00)*	-0.21
Gender	0.83(-0.72, 2.39)	0.11	1.04(-0.49, 2.58)	0.14
SSG Content				
Positive ratio			3.37(0.23, 6.50)*	0.22
Constant	10.06(5.00, 15.12)***		8.64(3.52, 13.77)**	
N	87		87	
Model Statistics	$F(3, 83)=4.88$, $p=0.004$, $R^2=0.15$		$F(4,82)=4.96$, $p=0.001$, $R^2=0.19$ Change in R^2 from Model 1 =0.04, $p=0.036$	

†$p<.10$; *$p<.05$; **$p<.01$; ***$p<.001$

Table 7. Negative Visits and Mother-reported Child Self-Control Scale

	Model 1		**Model 2**	
	b(95% CI)	β	b(95% CI)	β
Covariates				
SES	0.19(-0.04, 0.43)	0.18	0.22(-0.02, 0.45)†	0.20
Depression	-0.15(-0.28, -0.02)*	-0.25	-0.12(-0.26, 0.01)†	-0.20
Gender	0.83(-0.72, 2.39)	0.11	0.74(-0.80, 2.28)	0.10
SSG Content				
Negative visits			-94.24(-197.72, 9.24)†	-0.19
Constant	10.06(5.00, 15.12)***		10.02(5.03, 15.01)***	
N	87		87	
Model Statistics	$F(3, 82)=4.88$, $p=0.004$, $R^2=0.15$		$F(4, 82)=4.58$, $p=0.002$, $R^2=0.18$ Change in R^2 from Model 1=0.03, $p=0.074$	

†$p<.10$; *$p<.05$; **$p<.01$; ***$p<.001$

SSG Variables and Peer Relationships

The relationship between transitions and mother-reported child aggression towards peers is displayed in Table 8. Model 1 in the regression analysis presents the associations between SES, maternal depression, and child gender and child aggression toward peers scores. Model 2 in the analysis includes the addition of transitions. Results indicated that more transitions are

associated with more mother-reported child aggressive behaviors toward peers. SSG variables were not associated with other child behaviors with peers (*ps* > .05, *ns*); these nonsignificant results are not shown in a table.

Table 9 presents the relationship between positive ratio and child-reported intimate disclosure of problems. Model 1 presents the associations SES, maternal depression, and child gender and intimate disclosure of problems scores. Model 2 includes the addition of positive ratio. Higher positive ratio was found to be associated with fewer intimate disclosure of problems with the child's best friend. SSG variables were not associated with other friendship quality scores (*ps* > .05, *ns*); these nonsignificant results are not shown in a table.

Table 8. Transitions and Mother-reported Child Aggressive Behaviors Toward Peers

	Model 1		**Model 2**	
	b(95% CI)	β	b(95% CI)	β
Covariates				
SES	-0.03(-0.04, -0.01)**	-0.30	-0.02(-0.04, -0.00)*	-0.26
Depression	0.01(-0.00, 0.02)	0.17	0.01(-0.00, 0.02)	0.17
Gender	-0.13(-0.25, -0.01)*	-0.21	-0.15(-0.27, -0.04)*	-0.26
SSG Structure				
Transitions			0.01(0.00, 0.02)*	0.24
Constant	0.83(0.44, 1.22)***		0.52(0.07, 0.97)*	
N	85		85	
Model Statistics	$F(3, 81)=7.88$, $p<0.001$, $R^2=0.23$		$F(4, 80)=7.86$, $p<0.001$, $R^2=0.28$ Change in R^2 from Model 1=0.06, $p=0.015$	

†$p<.10$; *$p<.05$; **$p<.01$; ***$p<.001$

Table 9. Positive Ratio and Child-reported Intimate Disclosure of Problems

	Model 1		Model 2	
	b(95% CI)	β	b(95% CI)	β
Covariates				
SES	-0.00(-0.06, 0.06)	-0.00	0.01(-0.04, 0.07)	0.05
Depression	-0.03(-0.06, 0.00)†	-0.19	-0.03(-0.07, -0.00)*	-0.22
Gender	0.76(0.37, 1.14)***	0.39	0.68(0.31, 1.06)***	0.36
SSG Content				
Positive Ratio			-1.05(-1.81, 0.30)**	-0.27
Constant	2.89(1.60, 4.18)***		3.32(2.05, 4.60)***	
N	86		86	
Model Statistics	$F(3, 82)=6.99$, $p<0.001$, $R^2=0.20$		$F(4,81)=7.58$, $p<0.001$, $R^2=0.27$; Change in R^2 from Model 1 =0.07, $p=0.007$	

†$p<.10$; *$p<.05$; **$p<.01$; ***$p<.001$

Discussion

The aim of the present study was to determine whether preschool-aged dyadic emotion coregulation processes predicted children's social competence and peer relationships in middle childhood. The present work is one of the first studies to longitudinally examine patterns of both structure and emotional content in relation to children's socioemotional functioning. Early mother-child emotion coregulation was examined using a micro-analytic approach. Specifically, previously-recorded behavioral observations at 3 years were newly coded for two aspects of emotion coregulation, structure (i.e., range of emotional interactions and shifting of emotions) and emotional content (i.e., mutual positive and mutual negative interactions). These aspects of emotion coregulation were examined in relation to mother-reported child social skills and behaviors with peers, and child-reported friendship quality in Grade 5.

The findings demonstrated that coregulation during a brief, mother-child interaction in early childhood was salient for children's adaptive functioning approximately seven years later. Specifically, a wider range of dyadic emotional interactions within the moderately-stressful

context predicted children's lower self-control and greater shifting of dyadic emotional interaction predicted children's higher levels of aggressive behaviors towards peers. Dyadic positivity predicted children's greater self-control and fewer intimate communication of problems with their best friend. These results extend the evidence for the importance of gaining a better understanding of the role of the structure and the content of emotion coregulation in children's socioemotional functioning beyond maladaptive behaviors. The current study also demonstrates the utility of using a multi-method approach that includes observational data, mother-reported child social skills, and both mother and child reports of peer relationships.

Structure of Emotion Coregulation and Child Socioemotional Outcomes

Partially supporting Hypothesis 1, the structure of mother-child emotion coregulation predicted aspects of child's social skills and behaviors with peers. In this moderately-stressful context, a wider range of emotions predicted fewer child self-control behaviors and greater shifting of emotions predicted higher levels of child aggressive behaviors towards peers. These findings can be understood within the context of how dyads adapt to stressful changes. A prior study examining emotion coregulation in the context of the Strange Situation found that dyads of securely attached children adapted to the stressful change; however, dyads of insecurely attached children were more reactive to the stress of the separation (Guo, et al., 2015). In this study, both dyads of securely and insecurely attached children experienced changes indicated by increased negativity and decreased positivity, but the magnitude of change was smaller for secure dyads (Guo, et al., 2015). The current results are in line with prior findings. Emotion coregulation for dyads who had a wider range of emotions and greater shifting of emotions would be expected to be characterized by more emotional changes when responding to stress. Thus, children who had less regulated experiences provided by mothers in early childhood may develop lower levels of

self-regulation and higher levels of aggression in middle childhood. The capacity of dyads to adapt to stressful situation during a stressful situation in childhood may be an important factor associated with children's later socioemotional outcomes. The capacity of dyads to adapt to stressful situations may be related to their ability to repair; the opportunity to repair negative dyadic interactions can help children learn how to cope with negative emotions and internalize efficient regulation strategies for quickly returning to positivity when inevitable ruptures occur (Tronick & Beeghly, 2011).

The present study builds on existing research focused on micro-level, dyadic analysis of emotion coregulation (Granic, O'Hara, Pepler, & 2007; Hollenstein et al., 2004; Lunkenheimer, Olson, Hollenstein, Sameroff, & Winter, 2011; Van der Giessen et al., 2015), by exploring these processes in NT preschool-aged children in a moderately-stressful context and including children's later socioemotional outcomes. Child psychopathology (i.e., internalizing and externalizing behaviors) has been one of the main outcomes in studies examining coregulation processes, which has been examined in contexts such as discussion of positive, negative, positive topics (Granic, et al., 2007; Van der Giessen et al., 2015). Thus, within the context of the Strange Situation, the structure of emotion coregulation may be differently related to child socioemotional functioning relative to the structure in previous work examining children's internalizing and externalizing behaviors in various other contexts.

Emotional Content of Emotion Coregulation and Child Socioemotional Functioning

Emotional content predicted aspects of child socioemotional measures, partially supporting Hypothesis 2, stating that more dyadic positivity and less dyadic negativity would be associated with better child socioemotional functioning. In terms of social skills, dyads ability to sustain longer positive interactions in the context of moderately-stressful context predicted

higher levels of self-control behaviors. The ability to of dyads to initiation more negative interactions was marginally related to lower levels of self-control behaviors. These findings confirm prior research showing that mutual positive emotions in mother-child interactions are related with better child adaptive behaviors such as overall social competence (Pasiak & Menna, 2015) and self-regulation in younger children (Feldman, Greenbaum, & Yirmiya, 1999; Lindsey, Cremeens, Colwell, & Caldera, 2009).

In terms of peer relationship quality, greater mutual-positive engagement (i.e., the ability to sustain positive engagements) predicted fewer intimate communication of problems with friends. This finding initially may seem unexpected given that increased parent-child positivity has been linked to adaptive child outcomes. However, when considering social relationships from a developmental perspective, parents, particularly mothers, remain important during middle childhood; intimate disclosure occurs more commonly with parents than with peers (Buhrmester & Furman, 1987). Although children begin to develop significant relationships with peers during middle childhood and preadolescence, the nature of these peer relationships vary. The need for intimate disclosure among peers may develop later, with the shift to more frequent intimate disclosure with peers beginning in adolescence (Buhrmester & Furman, 1987; Hartup & Stevens, 1997). It is plausible that dyads in the current study who engage in more positivity during a moderately-stressful situation are more likely to have positive mother-child relationships. In such positive dyadic relationships, children may be more prone to have imitate conversation with their mothers rather than peers during middle childhood. More research is warranted to investigate these findings.

Limitations and Future Directions

Mothers participated in the Strange Situation for almost all of the cases, therefore, only mother-child emotion coregulation was assessed in the current study; too few fathers were available to be included in the analyses. However, fathers uniquely contribute to children's socioemotional development and emotional processes during father-child interactions may vary from mother-child interactions, which may in turn differentially influence child behavioral outcomes (Cassidy, Parke, Butkovsky, & Broungart, 1992; Feldman, 2003; Lindsey et al., 2012). Future work should examine whether similar patterns of emotion coregulation and child outcomes emerge for father-child dyads.

Another limitation of the present study is that children's socioemotional functioning was examined only at one developmental timepoint, middle childhood. To provide further insight into the lasting impact of early relationships and to determine whether these findings persist beyond this timepoint, future work should also address whether early dyadic processes are related to changes in children's socioemotional functioning over time using several data points (e.g., Grade 3, Grade 4, and Grade 5) or during other significant developmental periods (e.g., adolescence or transition to high school). These findings would contribute to our knowledge of the stability of developmental trajectories of social competence and peer relationships across time.

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CHAPTER 5:

Epilogue

Epilogue

This dissertation explored emotion coregulation between mothers and their children with and without Autism Spectrum Disorder within low-stress and moderately-stressful contexts in relation to children's behavioral and socioemotional functioning. Three studies examined three main aims by examining mother-child interactions and questionnaire data from two independent projects. Findings from these studies have significant conceptual and methodological implications.

Conceptually, these findings advance our understanding of emotion coregulation as a dyadic construct by examining the structure and content of emotion coregulation and repair processes in mothers and children as one unit during social interactions across contexts (low-stress and moderately-stressful). Moreover, these dyadic emotion coregulation processes were examined in mothers and their preschool-aged children in relation to children's immediate behavioral functioning as well as later socioemotional functioning. The structure and emotional content were associated with maladaptive behaviors and predicted aspects of social competence and peer relationships in middle childhood. Together, these findings underscore the value of utilizing early dyadic interactions in expanding current understandings of children's developmental outcomes.

Methodologically, these studies contribute to a growing area of research that utilizes a State Space Grid (micro-analytic approach) behavioral analysis. Micro-analysis of interactions allows for a more nuanced examination of the moment-to-moment behaviors that might not be captured using global ratings. Across the three studies, novel coding schemes were applied to mother and child interactions, which were micro-coded in 4- or 5-second intervals. Moreover, these studies focused on emotion coregulation across contexts (low-stress and moderately-

stressful contexts) from cross-sectional and longitudinal data. The low-stress semi-structured play activity and moderately-stressful Strange Situation provided unique contexts to explore emotion coregulation and children's developmental outcomes. Finally, this dissertation included mothers and their children with and without ASD. The results emphasize the importance of investigating moment-to-moment emotion coregulation in different contexts and compare such patterns between dyads of children with and without ASD.