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Mothering, fathering, and the regulation of negative and positive emotions in high-functioning preschoolers with Autism Spectrum Disorder

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Background: Children with ASD exhibit difficulties in regulating emotions and authors have called to study the specific processes underpinning emotion regulation (ER) in ASD. Yet, little observational research examined the strategies preschoolers with ASD use to regulate negative and positive emotions in the presence of their mothers and fathers. **Methods:** Forty preschoolers with ASD and 40 matched typically developing children and their mothers and fathers participated. Families were visited twice for identical battery of paradigms with mother or father. Parent–child interactions were coded for parent and child behaviors and children engaged in ER paradigms eliciting negative (fear) and positive (joy) emotions with each parent. ER paradigms were microcoded for negative and positive emotionality, ER strategies, and parent regulation facilitation. **Results:** During free play, mothers' and fathers' sensitivity and warm discipline were comparable across groups; however, children with ASD displayed lower positive engagement and higher withdrawal. During ER paradigms, children with ASD expressed less positive emotionality overall and more negative emotionality during fear with father. Children with ASD used more simple self-regulatory strategies, particularly during fear, but expressed comparable levels of assistance seeking behavior toward mother and father in negative and positive contexts. Parents of children with ASD used less complex regulation facilitation strategies, including cognitive reappraisal and emotional reframing, and employed simple tactics, such as physical comforting to manage fear and social gaze to maintain joy. **Conclusion:** Findings describe general and parent- and emotion-specific processes of child ER and parent regulation facilitation in preschoolers with ASD. Results underscore the ability of such children to seek parental assistance during moments of high arousal and the parents' sensitive adaptation to their children's needs. Reduced positive emotionality, rather than increased negative reactivity and self-regulatory efforts, emerges as the consistent element associated with ER processes in this group.
Keywords: Autism Spectrum Disorder, emotion regulation, emotional reactivity, mothering, fathering.

Introduction

Emotion regulation (ER) – among the cornerstone constructs in developmental research – defines processes implicated in the evaluation, management, and modification of emotional reactions toward the accomplishment of one's goals (Thompson, 1994). Emotion regulation is a multifactorial construct, including biological, behavioral, attentional, and cognitive components that hierarchically organize in response to external or internal events (Cole, Martin, & Dennis, 2004; Fox & Calkins, 2003). Most developmental research on ER has been conducted from the conceptual framework of temperament, particularly models that highlight emotional reactivity and regulation as central dimensions of temperament (Posner & Rothbart, 2000). As the parent–child relationship is critical in shaping children's ER (Feldman, 2007a; Kagan, Snidman, Kahn, & Towsley, 2007), the parent's overall style and specific regulation facilitation strategies during moments of high arousal are important contributors to the development of ER skills. Yet, despite the wealth of research on ER in infancy, very few observational studies tested ER during the preschool years, with none assessing preschoolers' ER in the presence of their mother and father. Comparing children's ER with both parents is important to tease apart regulatory components that are stable over time from those expressed in specific parent–child contexts.

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by social communication deficits and restricted, repetitive behaviors (APA, 2013). Difficulties in all aspects of emotionality, including emotion processing, understanding, expression, and management, have been repeatedly observed in children with ASD (Garon et al., 2009). Specifically, authors have pointed to marked deficits in ER and called for in-depth research on the topic that includes careful observations of the strategies children use to regulate emotions (Bachevalier & Loveland, 2006; Mazefsky et al., 2013). These authors further emphasized that such research must be conducted from the perspective of the specific regulatory difficulties in ASD. ER behaviors may have different goals or meaning for children with ASD compared with typically developing (TD) children, be more or less effective in regulating negative versus positive emotions, function differently in maternal versus paternal presence, or elicit different

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regulation facilitation behavior from parents. As such, a comparative study that includes the regulation of both negative and positive emotions, mother and father, and focus on regulatory behavior of both parent and child may help further specify ER processes in children with ASD. Furthermore, careful analysis of both emotional reactivity and regulatory behavior may indicate whether specific ER strategies are indeed successful in downregulating negative emotions or maintaining positive affect.

There are several reasons why preschoolers with ASD may have difficulty regulating emotions. High negative reactivity, irritability, and anxiety are frequent in children with ASD, necessitating greater regulatory effort (Gadow, DeVincent, Pomeroy, & Azizian, 2004). These could be associated with sensory-processing difficulties, characteristic of ASD, which may manifest in low reactivity thresholds (Levine, Conradt, Goodwin, Sheinkopf, & Lester, 2014; Rogers & Ozonoff, 2005). Individuals with ASD show abnormal response in brain regions that support ER, such as prefrontal cortex or amygdala (Herrington & Schultz, 2010), which may lead to augmented reactivity or deficient top-down regulatory processes. Difficulties in collecting and interpreting emotional cues (Golan, Baron-Cohen, & Golan, 2008), understanding others' mental states (Baron-Cohen, Lombardo, Tager-Flusberg, & Cohen, 2013), and using those to reevaluate social situations (Bauminger, 2004) may result in low flexibility and greater stress in social contexts in children with ASD. Deficits have also been found in joint attention, which predicts ER skills (Osterling & Dawson, 1994), sharing negative emotions (Sigman, Kasari, Kwon, & Yirmiya, 1992), and understanding complex emotions (Capps, Yirmiya, & Sigman, 1992). These may delay the acquisition of mature cognitive-based ER strategies or the ability to utilize parents for assistance.

Differences were also noted in negative and positive expression, underscoring the need to test children's regulatory behavior in relation to emotional reactivity. Children with ASD were found to express more negative emotions during interaction with caregivers (Begeer, Koot, Rieffe, Meerum Terwogt, & Stegge, 2008; Capps, Kasari, Yirmiya, & Sigman, 1993). Similarly, infants who were later diagnosed with ASD expressed less positive emotions during social interactions and authors have suggested that alterations in positive emotionality may be among the early markers of ASD in the context of genetic risk (Garon et al., 2009; Zwaigenbaum et al., 2005). It has been suggested that difficulties in positive and negative reactivity and ER processes are among the earliest markers of ASD diagnosis (Zwaigenbaum, Bryson, & Garon, 2013). However, despite their centrality, very little research has utilized direct observations to assess emotional reactivity and regulation in young children with ASD.

The few observational studies of ER in preschoolers with ASD tested children in situations that elicit frustration and none, to our knowledge, in tasks aimed to elicit positive emotions. By 3–4 years of age, children with ASD express a range of regulatory behaviors when frustrated, typically of immediate, physical nature (Stansbury & Sigman, 2000). Compared with TD children, preschoolers with ASD use more simple strategies, such as self-soothing, venting, self-talking, or avoiding, which are often ineffective in reducing negative affect (Jahromi, Meek, & Ober-Reynolds, 2012; Konstantareas & Stewart, 2006). Such observations complement parental reports indicating that preschoolers with ASD have limited capacities to redirect attention from negative stimuli or exercise self-control (Kasari & Sigman, 1997). Yet, these studies tested ER in situations that offered no parental support and did not assess whether children with ASD seek parental assistance and how successful is parental support in regulating emotions. One study examined ER in ASD during interaction with mother and found associations between maternal regulation facilitation tactics and toddlers' self-comforting behavior (Gulsrud, Jahromi, & Kasari, 2010), but this study did not include TD comparison.

During the preschool years, children's ER skills undergo significant maturation (Eisenberg, Spinrad, & Eggum, 2010; Feldman, 2009), and parents play an important role in supporting children's ER at this stage by serving as models, regulation facilitators, or as targets of the child's regulatory effort (Morris et al., 2011). The parent's role in facilitating ER in preschoolers with ASD, whose regulatory capacities are already compromised, is therefore of empirical and clinical importance. Parents assist preschoolers' emerging ER skills by combining soothing and diverting strategies, typically employed with infants and toddlers, with strategies that help children move from physical tactics to those involving reflection and symbolization (Feldman, Dollberg, & Nadam, 2011; Morris et al., 2011). To maintain positive emotionality, parents use social attunement, synchrony, and social play (Feldman, 2007a,b). Possibly, parents of preschoolers with ASD may be less inclined to use complex cognitive-based strategies and use physical, nonverbal tactics, which are more readily perceived by the child.

In addition to the immediate emotion-eliciting context, the parent's general style, including sensitivity, warm discipline, and social reciprocity, supports the consolidation of ER skills (Davidov & Grusec, 2006). Parents of children with ASD were found to be as sensitive and responsive as those of TD children and parental sensitivity predicted socioemotional development in this group (van Ijzendoorn et al., 2007). Although most studies tested maternal effects, the few studies with fathers showed that TD toddlers engaged in more self-soothing behavior with fathers (Bridges, Grolnick, & Connell, 1997) and

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infants reached higher levels of positive emotionality with father (Feldman, 2003). Only one study examined father–child interaction in ASD and reported higher child negativity and lower social engagement with fathers compared with developmentally delayed children (Pisula, 2008).

As such, the current study used a microlevel behavioral approach to study emotional reactivity and ER strategies in preschoolers with ASD, compared with TD children, in response to negative (fear) and positive (joy) emotions in the presence of their mothers and fathers separately. Observational studies of ER in preschoolers suggested that ER behavior coheres into two main constructs, *self-regulation* – strategies children use to manage heightened arousal, and *assistance seeking* – behaviors that involve turning to parents to help regulate emotions (Feldman, Vengrober, Eidelman-Rothman, & Zagoory-Sharon, 2013; Roben, Cole, & Armstrong, 2013). We thus examined both constructs with each parent. In parallel, we microcoded mothers' and fathers' simple and complex regulation facilitation strategies during emotion-eliciting paradigms and the parent's general style during parent–child interactions. Such 2 (emotions) by 2 (parent) design was thought to expand current knowledge on ER processes in ASD by detailing the strategies children with ASD use in the presence of each parent; charting general, emotion-specific, and parent-specific ER strategies; and testing the effectiveness of maternal and paternal assistance in this group.

Four hypotheses were proposed. First, in terms of reactivity, we expected children with ASD to express less positive and more negative emotions overall. Second, consistent with prior research, children with ASD were expected to use more self-regulatory behavior to manage arousal; however, consistent with findings showing comparable parental sensitivity, we expected similar levels of assistance seeking behavior. Third, parents of children with ASD were expected to use simple regulation facilitation strategies, including diverting talk, physical comfort, or social play, and less complex strategies, such as cognitive reframing or emotional reflection. During interaction, parents were expected to show comparable levels of sensitivity and warm discipline, while preschoolers with ASD to exhibit lower social engagement. Finally, we expected the parent's overall reciprocal style to correlate with lower negative and higher positive reactivity and more assistance seeking behavior. We also tested whether children's IQ is related to parent's and child's behavior during moments of emotion regulation.

Methods

Participants

Eighty families of mothers, fathers, and their preschool-aged child participated in two groups. The *ASD Group* included 40 preschoolers (5 females) diagnosed with ASD by trained clinicians according to DSM-IV-TR criteria (APA, 2000) and their parents. Families were recruited from psychiatric clinics and special-needs kindergartens in central Israel. Diagnosis was confirmed using the 2nd edition of the Autism Diagnostic Observation Schedule (ADOS 2; Gotham, Risi, Pickles, & Lord, 2007), with 56% given module 2 of the ADOS and 44% module 3. One child failed to meet ASD criteria and was excluded. The *Typical Development group* included 40 preschoolers (6 females) and their parents with no neuropsychiatric disorders who matched the ASD group on mental age, gender, and family demographics. TD participants were screened for ASD using the Childhood Autism Spectrum Test (CAST;Scott, Baron-Cohen, Bolton, & Brayne, 2002). Because ER abilities are sensitive to developmental stage, children were matched on mental age consistent with prior research on ER in ASD (Jahromi et al., 2012). Groups were matched on raw scores of the *Stanford-Binet Intelligence Scale* (Thorndike, Hagen, & Sattler, 1986), a standardized test assessing IQ in children aged 2 years and above. The Stenford-Binet Intelligence Scale assesses four domains of cognitive abilities: Verbal reasoning, abstract/visual reasoning, quantitative reasoning, and short-term memory. Four subtests, one from each domain, were administered to all participants by two trained psychologists to control for mental age: Vocabulary, Pattern Analysis, Quantitative Reasoning, and Bead Memory. The sum raw scores in the ASD group averaged 49.05 (*SD* = 19.31) and in the TD group 51.15 (*SD* = 18.64), with no group differences on any subset. Five children in the ASD group scored one or fewer *SD* from the average (Table 1). The study was approved by the Institutional Review Board and all parents signed informed consent.

Procedure

Diagnostic and cognitive assessment. During a visit to kindergarten children were tested with the Stenford-Binet Intelligence Scale and those with ASD were administered the ADOS 2 by trained psychologists.

Home visits. Two identical home visits were conducted within the same month with mother or father (counterbalanced), each lasting approximately 2 hr and including parent–child interactions, ER procedures, and self-reports. ER procedures were carefully selected to elicit negative and positive emotions in this population and to involve minimal long-term emotional effects in accordance with ethical guidelines, as follows:

1. *Parent–child free play* – Parent and child engaged in a 7-min free play with preselected toys known to elicit symbolic play at this age (Feldman, 2007b). Instructions were 'Play with your child as you typically do'.
2. *ER: Mask* (Goldsmith & Rothbart, 1996) – child and parent sat in front of experimenter, who put on four masks of increasing fearfulness: rabbit, lion, alligator, and monster. Each mask was put on for 15 s.
3. *ER: Puppets* (Goldsmith & Rothbart, 1996) – child and parent sat face-to-face, were given five colorful hand puppets, and were asked to play with the puppets for 5 min.

Coding. *Parent–child interactions.* The Coding Interactive Behavior (CIB, Feldman, 1998) was used. The CIB includes 42 scales each rated from 1 (low) to 5 (high) that aggregate into several parent, child, and dyadic composites. The system has been used in many studies of typically developing and high-risk children and showed good psychometric properties for children at this age (Feldman, 2012). The following factors were used.

Parental sensitivity (*Mother alpha* = .83, *Father alpha* = .90): acknowledgment of child's signals, elaboration of communication, positive affect, appropriate vocal quality,

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Table 1 Demographic characteristics

	Total sample ($N = 79$)	ASD group ($N = 39$)	TD group ($N = 40$)	t (78)
Child measures				
Age (months)	58.47 (13.93) 29–82	63.38 (12.35) 36–82	53.56 (13.83) 29–78	3.31*
Verbal reasoning	14.83 (5.13) 1–43	14.15 (4.08) 7–21	15.51 (5.98) 1–43	1.17
Abstract/Visual reasoning	13.36 (10.27) 1–80	12.67 (6.66) 3–27	14.05 (12.98) 1–54	0.59
Quantitative reasoning	11.35 (7.27) 1–54	11.15 (5.59) 1–20	11.54 (8.7) 1–80	0.23
Short-term memory	12.49 (6.26) 1–42	13.18 (4.86) 4–22	11.79 (7.58) 1–42	0.96
ADOS-2		11.89 (3.23) 7–22	N/S	
Parents' measures				
Mother age (years)	36.88 (4.45) 27–47	37.6 (4.45) 30–47	36.14 (4.39) 27–44	1.37
Father age (years)	39.49 (5.14) 28–53	40.34 (5.33) 31–53	38.6 (4.86) 28–52	1.12
Mother education (years)	16.26 (2.38) 12–25	15.94 (2.47) 12–22	16.59 (2.28) 12–25	1.42
Father education (years)	16.39 (3.34) 12–28	15.97 (3.71) 12–25	16.87 (2.85) 12–28	1.11

*$p < .05$.

resourcefulness in handling child's distress or expanding interaction, appropriate range of affect, supportive presence.
Parental intrusiveness (*Mother alpha* = .70, *Father alpha = .76*): parental overriding, physical manipulation, anger, hostility, criticism.
Parental limit setting (Mother alpha = .75, Father alpha = .67): on-task consistency, persisting effort to engage child, appropriate construction of interaction, warm limit setting.
Child involvement (Mother alpha = .72, Father alpha = .72). maintaining eye contact, joint attention, positive affect, affection to parent, alertness, social initiation, vocalizations, symbolic play.
Child withdrawal – child walks away or disconnects.
Child compliance – child obeys parent and follows rules.
Dyadic reciprocity (Mother alpha = .82, Father alpha = .82): mutual adaptation to partner's state, give-and-receive reciprocity, fluent and rhythmic interactions.

Two coders were trained to 90% reliability. Interrater reliability conducted for 20 interactions (25.3%), averaged *intraclass r* = .93 (range = .84–1.00).

Emotion regulation paradigms. Microcoding of child and parent behavior was conducted on computerized system. Codes were based on ER research in preschoolers with ADS following extensive piloting and are detailed in Supporting Material.

Child. *Affect* – negative, neutral, positive; *Gaze* – to parent, to object, joint, to experimenter, aversion, to environment; *Vocalizations* – cry/scream, laughter, to parent about object, to parent distraction, to experimenter, repetitive talk, none; *Child Regulatory Behaviors* – withdrawal, physical self-soothing, verbal self-comfort, idiosyncratic behavior, substitutive play; *Seeking Parent* – proximity seeking, using parent for help.

Parent. *Affect* and *Gaze* – similar to child; *Regulation Facilitation* – verbal comfort, physical comfort/touch, substitutive play, distraction. Additional codes for Masks: emotional reflection and cognitive reappraisal and for Puppets: interactive communication – engagement and symbolic play.

The following composites were computed:

1. Emotional reactivity: *Child Negative Emotionality* – Negative affect, negative vocalizations, protest. *Child Positive Emotionality* – positive affect, positive vocalizations.
2. Emotion regulation: *Child Self-regulatory behavior* – withdrawal, idiosyncratic behaviors, physical self-comfort, gaze aversion, solitary substitutive play. *Seeking parent* – proximity seeking, use parent for help.
3. Parent regulation facilitation: *Masks: Simple regulatory strategies*: physical comfort, verbal comfort; diverting talk, play; *Complex regulatory strategies* – emotional reflection, cognitive reappraisals. *Puppets: Simple regulatory strategies* – positive affect, social gaze to child. *Complex regulatory strategies*: interactive communication, symbolic play.

Two coders blind to group membership coded each episode and trained to 90% reliability. Interrater reliability computed for 15 observations in each episodes averaged *kappa* = .91, .83 for masks and puppets, respectively (range = .75–.94)

Results

In the first section, we present differences related to group (ASD, TD) and parent (mother, father) in parent–child social interactions; in the second, group- and parent-related differences in child emotional reactivity, ER, and parent regulation facilitation; finally, correlations between parent–child reciprocity, child IQ, and ER behavior are examined.

Social interactions with mother and father

Means and *SD*s of all interactive variables for the two groups with mother and father appear in Table 2.

1. Parent interactive behavior: Repeated-measure MANOVA examined group and parent differences in parental social behavior: sensitivity, intrusiveness, and limit setting. Results revealed main affect for parent; Wilks' $F[3,71] = 8.75$, $p < .01$, $\eta^2 = .27$, and no group effects. Univariate tests

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Table 2 Parent, child, and dyadic interactive behavior in children with ASD and TD children with mother and father

	ASD				TD						
	Child–mother		Child–father		Child–mother		Child–father				
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	F parent	F group	Effect size
Parental sensitivity	4.37	0.5	3.93	0.76	4.22	0.49	3.81	0.69	25.03**	n.s	.26
Parental intrusiveness	1.33	0.44	1.22	0.24	1.18	0.28	1.32	0.51	n.s	n.s	
Parental limit setting	4.35	0.77	3.94	1.01	4.28	0.77	4.05	0.8	6.14*	n.s	.08
Child involvement	3.45	0.58	3.4	0.59	3.95	0.44	3.8	0.48	n.s	21.51**	.23
Child withdrawal	1.84	0.91	1.88	0.93	1.24	0.43	1.26	0.51	n.s	19.95**	.22
Child compliance	3.96	0.96	4.05	1.04	4.39	0.59	4.24	0.78	n.s	4.36*	.06
Dyadic reciprocity	3.84	0.81	3.74	0.85	4.32	0.53	3.92	0.71	6.48*	5.63*	.08 (parent) .07 (group)

*$p < .05$; **$p < .01$.

indicated that mothers showed greater sensitivity and appropriate limit setting than fathers.

2. Child interactive behavior: Similar MANOVA for child behavior: involvement, withdrawal, and compliance, yielded significant group effect; $F[3,71] = 8.15$, $p < .01$, $\eta^2 = .26$. Children with ASD were less socially engaged, more withdrawn, and less compliant than TD children.
3. Dyadic reciprocity: ANOVA showed main effect for group; $F[1,72] = 5.63$, $p < .05$, $\eta^2 = .07$, and parent; $F[1,72] = 6.48$, $p < .01$, $\eta^2 = .08$. TD children and parents were more reciprocal and higher reciprocity was observed during mother–child interactions.

Reactivity, ER, and parent regulation facilitation

Emotional reactivity. Negative emotionality. Repeated-measures ANOVA computed with parent and paradigm as within-subject factors and group as between-subject factor showed main effect for paradigm; Wilks' $F[1,77] = 13.34$ $p < .01$, $\eta^2 = .15$: The fear paradigm elicited greater negative emotionality ($M = 7.25$, $SD = 2.66$) than the joy paradigm ($M = 1.74$, $SD = 1.02$). Paradigm-by-parent-by-group interaction emerged; $F[1,77] = 3.94$, $p < .05$, $\eta^2 = .08$. During masks, parent-by-group interaction, $F[2,76] = 6.46$, $p < .05$, $\eta^2 = .08$, indicated that while children with ASD displayed more negative emotions with father (TD: $M = 3.02$, $SD = 1.37$, ASD: $M = 11.07$, $SD = 3.17$), $t[77] = 2.35$ $p < .05$, no group difference emerged with mother (TD: $M = 8.62$, $SD = 2.84$, ASD: $M = 6.32$, $SD = 1.73$). *Positive Emotionality* – Similar ANOVA showed main effect for paradigm; $F[1,77] = 8.24$, $p < .01$, $\eta^2 = .10$. Children showed more positive emotionality during puppets ($M = 62.59$, $SD = 7.54$) than during fear ($M = 45.22$, $SD = 5.68$). Main effect was also found for group, $F[1,77] = 3.95$, $p < .05$, $\eta^2 = .05$. Children with ASD expressed less positive emotions across both paradigms ($M = 43.37$, $SD = 4.13$) than TD children ($M = 62.05$, $SD = 7.30$).

Child emotion regulation. Self-regulatory behavior. Repeated-measure ANOVA showed main effects for paradigm; Wilks' $F[1,77] = 32.16$, $p < .01$, $\eta^2 = .45$: children employed more regulatory behavior during Masks. Main effect for group, Wilks' $F[2,76] = 4.88$, $p < .01$, $\eta^2 = .12$, indicated that children with ASD exhibited more self-regulatory behavior during both paradigms. *Seeking Parent* – showed marginal effect for paradigm, Wilks' $F[1,77] = 2.84$, $p = .06$, $\eta^2 = .07$, with children seeking parents more during Puppets, and no group effects (Figure 1).

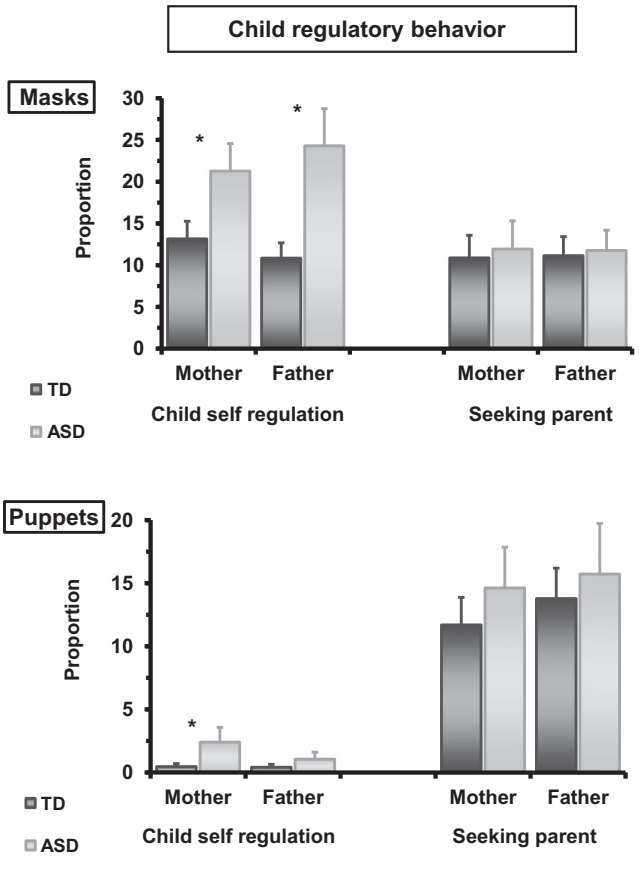

Figure 1 Child regulatory behavior of negative and positive emotions with mother and father *$p < .05$

Parent regulation facilitation. Simple strategies. Repeated-measure ANOVA showed group effects for Masks, $F[1,77] = 4.01$, $p < .05$, $\eta^2 = .053$, and

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Puppets, $F[1,77] = 4.63$, $p < .05$, $\eta^2 = .06$. Mothers and fathers of ASD preschoolers used more simple strategies. *Complex strategies.* During Masks, main effect for group, $F[1,77] = 5.80$, $p < .05$, $\eta^2 = .072$, indicated that parents of TD children used more complex strategies than parents of preschoolers with ASD. No group or parent effect was found during Puppets (Figure 2).

Correlations between parent–child reciprocity, child IQ, and parent and child's regulatory behavior

Pearson's correlations were computed for the entire sample of TD and ASD children. Mother–child and father–child reciprocity correlated with fewer self-regulatory behaviors during Masks: mother, $r_{78} = -.28$, $p < .05$; father, $r_{78} = -.23$, $p < .05$. Higher mother–child reciprocity correlated with lower negative emotionality during Masks, $r_{78} = -.25$, $p < .05$.

Finally, child IQ correlated with higher child social involvement during free play with both mother, $r_{78} = .23$, $p < .05$, and father, $r_{78} = .25$, $p < .05$, and greater child assistance seeking behavior during Masks with mother, $r_{78} = .24$, $p < .05$, and father, $r_{78} = .26$, $p < .05$, as well as during Puppets with father, $r_{78} = .25$, $p < .05$. Child IQ correlated with fewer self-regulatory behaviors during Masks, $r_{78} = .24$, $p < .05$, and Puppets, $r_{78} = .24$, $p < .05$, in interactions with father, not mother. Maternal behavior was unrelated to child IQ, but fathers' use of simple regulation facilitation strategies was negatively related to child IQ during both Masks $r_{78} = -.31$, $p < .01$, and Puppets, $r_{78} = .24$, $p < .05$.

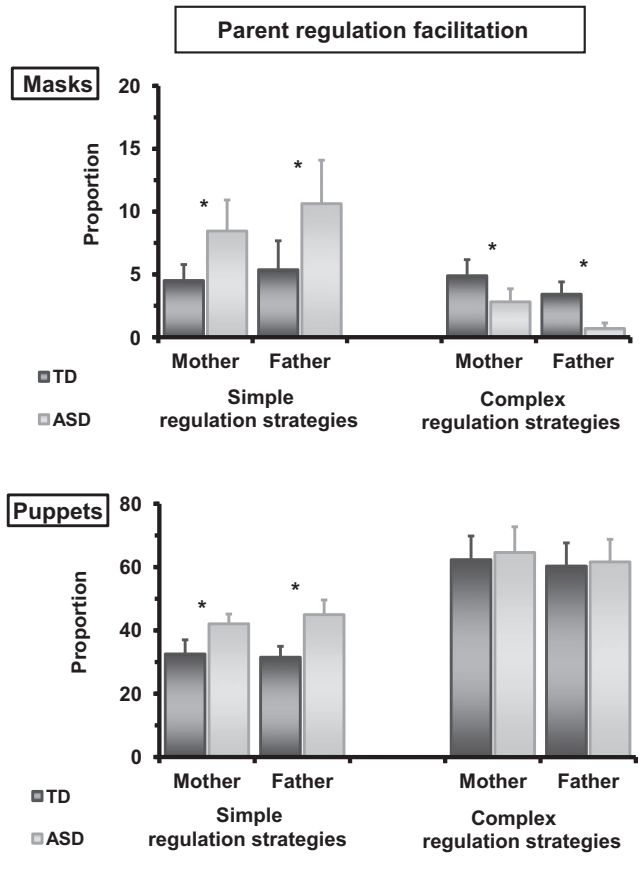

Figure 2 Mothers' and fathers' regulation facilitation behavior of negative and positive emotions *$p < .05$

Discussion

Despite the centrality of ER to developmental thought (Feldman, 2009), the measurable ER difficulties observed among children with ASD (Garon et al., 2009), and the call for further research on ER processes in ASD (Mazefsky et al., 2013), very little observational research on the topic exists. Our findings contribute to understanding the specific ER processes in this group in several aspects. First, with regard to reactivity, we found that positive emotionality was reduced in children with ASD across both paradigms and parents, attesting to the ubiquitous nature of this effect. In contrast, negative emotionality was higher only during fear and only with father, indicating that children's negative response is specific to stressful contexts and can be modulated by maternal presence. Second, with regard to regulation, results indicate that children with ASD use more simple self-regulatory tactics to manage emotions, particularly negative emotions, but assistance seeking behaviors are comparable to that of TD children, highlighting their capacity to turn to parents for help. Third, parents of children with ASD adapted their regulation facilitation tactics to the child's needs and utilized simple, direct, and physical strategies to manage moments of arousal. Finally, sensitive, responsive parenting was comparable to TD children and ours is the first study to show such findings for both mother and father. Consistent with much research on TD children (Feldman, 2007a), parent–child reciprocity correlated with better ER. Overall, our findings may help differentiate the more consistent ER-related processes from those which are more parent-specific and emotion-specific. Importantly, however, as our study compared children with ASD only with TD children and did not include high-risk comparison group, further research is required to test which elements are specific to ASD and which may be more broadly related to neurodevelopmental disorders.

Children with ASD expressed less positive emotionality overall. This was observed with both mother and father and in situations that elicit both negative and positive emotions. Such findings demonstrate that the reduced positive expression is not a by-product of the increased reactivity to stressful situations or the low reactivity threshold reported in children with ASD (Levine et al., 2014), but emerged when parents and children interacted in a joyful context in their home environment. Furthermore, low positivity was not only a carryover from the fear paradigm, as low child social engagement, including decreased positive affect, exuberance, and social initiation, was observed during free play, the first paradigm in the visit. Infant sibling studies showed

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that positive emotionality was reduced in children who later developed autism already in the first months of life and suggest that low positive affect may be among the first behavioral markers of ASD (Yirmiya et al., 2006; Zwaigenbaum et al., 2005). Our results support this conclusion by demonstrating the pervasiveness of reduced positive affective expression, observed across parent and paradigms during both free play and emotion-eliciting contexts.

In contrast, negative reactivity was context-specific. It was higher in children with ASD compared with TD children during the fear, not the joy paradigm, and with father, not mother. Consistent with much research in ASD (Corbett, Schupp, & Lanni, 2012; Jahromi et al., 2012), it appears that children with ASD are more reactive to the frustrating, fearful, or novel elements in their surroundings, possibly due to temperamental reactivity, sensory-processing difficulties, or greater amygdala response to stress. Our findings, however, provide compelling evidence for the success of mothers to downregulate their children's overreactivity and provide external-regulatory support through the use of simple, direct, and physical regulation facilitation strategies. These findings highlight the important role mothers of children with ASD play in the online regulation of negative emotions and underscore the fact that, similar to mammalian young (Hofer, 1995), the stress response of children with ASD may be malleable by the maternal presence. Interestingly, we found that this maternal effect was specific to situations that elicit stress and during free play, children with ASD showed more withdrawal than TD children, pinpointing the maternal effects to high-stress contexts.

Assessing children's ER behavior along the two dimensions – self-regulation and parent-seeking – revealed an interesting picture. As shown previously in child-alone setting (Jahromi et al., 2012; Stansbury & Sigman, 2000), children with ASD employed significantly more self-regulatory behavior when confronted with negative situations with both parents. However, the use of such physical, simple, and often idiosyncratic tactics during the fear paradigm showed a tenfold decrease during the joy paradigm, from 22% to 2%–3%, and during Puppets no group differences were found with father. These findings again highlight stressful contexts as those eliciting more self-regulatory effort in children with ASD.

In contrast to self-regulation, children with ASD were as competent as their peers in seeking parental assistance and turning to parent was comparable to TD children across all four paradigms – negative and positive sessions with both mother and father. These findings indicate that children with ASD experience their parents as 'secure base' agents that provide assistance in modulating emotions and can turn to both mother and father during highly arousing moments. Our findings are the first to demonstrate this effect in fathers and underscore the close relationship fathers form with their children with ASD. Interestingly, children's tendency to use both maternal and paternal assistance correlated with child IQ, as did their social engagement during play with both parents, suggesting that more developmentally advanced children are not only better able to engage socially but turn more readily to facilitate regulation of high arousal. Overall, it appears that two findings held across parents and paradigms: children with ASD displayed less positive emotionality overall, and they were able to turn to both parents in ways similar to their TD peers across observations. Other findings were either context- or parent-specific.

Parents used different regulation facilitation tactics with TD and ASD children, and the use of such strategies did not differ between mothers and fathers. During fear regulation, parents of children with ASD used simple regulation facilitation strategies, including physical soothing, verbal comfort, divertive talk, and attention refocusing through play, strategies used by parents to regulate negative emotions in infancy and toddlerhood (Feldman et al., 2011). In contrast, parents of TD children used more cognitive-based tactics, such as emotional reflection and cognitive reappraisal, strategies similar to those used by adults to regulate emotions (Gross, 2013). However, during the joy paradigm parents of children with ASD used similar amounts of complex strategies, including verbal communication and symbolic play, while simultaneously employing greater amounts of simple strategies than parents of TD children, such as social gaze and positive facial expressions and vocalizations. Moreover, despite the child's low social involvement and greater withdrawal during parent–child interactions, mothers and fathers of children with ASD expressed similar levels of sensitivity, responsiveness, and appropriate limit setting, consistent with previous research on mothers (van Ijzendoorn et al., 2007). It thus appears that both mothers and fathers of children with ASD sense the child's needs in different social situations and adapt in context-sensitive manner. In fearful contexts, parents use strategies that enable soothing, distracting, and diversion to accommodate the child's difficulties in shifting attention (Zwaigenbaum et al., 2005). During positive moments, parents place more efforts on positive expression and social gaze to maintain focus on shared play. Such extra efforts were beneficial to the child's sense of security, as seen by the similar levels of proximity-seeking behaviors in both contexts and with both parents.

Our findings chart three important avenues for further research. First, as this is the first observational study to compare mothers and fathers, our data underscore the father's role in ASD by demonstrating that fathers were as skilled as mothers in using simple and complex regulation facilitation

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tactics and children turned to fathers as readily as to mothers for assistance. Thus, fathers and children with ASD form close, supportive relationships, which probably have unique effects on children's social–emotional growth. For instance, unlike mothers, fathers' behavior was sensitive to children's developmental level and fathers provided less simple regulation facilitation to children with higher IQ in both emotional contexts. In parallel, children with higher IQ showed less simple self-regulatory behavior with fathers in both contexts, but not with mother. These findings may suggest that fathers demand greater effort from children to act according to their developmental level and much further research is required to characterize the role of such parental style on children's emerging ER competencies. Second, our findings show that positive emotionality was the only ER-related process stably low in ASD and much research is required to further detail positive expressivity across contexts and ages. Finally, our results indicate that maternal presence functions to down-regulate negative reactivity in fearful contexts, possibly leading to longer dependence on the maternal external-regulatory support among children with ASD who are already more stress-prone. How to move away from such reliance on mother to autonomous self-regulation is a topic necessitating much further research.

Limitations of the study relate to the lack of longitudinal data to examine how individual variability in ER skills shapes social–emotional growth in children with ASD. Physiological data could have further elucidated biobehavioral mechanisms that underpin ER abilities in this population. Finally, assessment of a wider range of emotional contexts and social relationships, including friends and teachers, could have shed further light on person-specific and emotion-specific processes. Much further research is required to understand the mechanisms that underpin the development of ER in ASD across multiple social contexts and toward the accomplishment of various growth-promoting social goals.

Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Construction of coding scheme.

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Key points

- We measured emotion regulation (ER) strategies and parents' regulation facilitation in preschoolers with ASD during elicitation of negative and positive emotions in the presence of mother and father.
- Preschoolers with ASD showed lower positive emotionality overall and more negative emotionality during fear with father.
- Preschoolers with ASD exhibited more simple self-regulatory behaviors but comparable levels of seeking parental assistance.
- Parents of children with ASD employed simple regulation facilitation tactics to assist children's management of high arousal.
- Children with ASD turn to parents for help and parents adapt assistance to their children's needs. Reduced positive emotionality emerges as consistent across parents and emotional contexts in ASD.

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