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Children's history of suicidal ideation and synchrony of facial displays of affect during mother–child interactions

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Background: Suicidal thoughts and behavior can begin early in childhood and are a leading cause of death in youth. Although specific mechanisms of risk remain largely unknown, theorists and researchers highlight the importance of the parent–child relationship. The current study focused on one aspect of this relationship: the dynamic exchange of facial affect during interactions. Specifically, we examined the relation between children's history of suicidal ideation (SI) and synchrony of facial expressions during positive and negative mother–child interactions. **Methods:** Participants were 353 mother–child dyads. Of these, 44 dyads included a child with an SI history. Dyads engaged in positive and negative discussions during which their facial electromyography was recorded from mothers and children to index second-to-second changes in positive (zygomaticus) and negative (corrugator) facial affect. **Results:** Child SI dyads were characterized specifically by reduced synchrony of positive facial affect during the positive discussion compared to dyads without child SI. **Conclusions:** These findings suggest child SI dyads exhibit reduced synchrony of normative positive expressions during mother–child interactions. If replicated and extended in longitudinal research, these results may help to explain one mechanism of risk among children with SI. **Keywords:** Facial expression; suicide; parent-child interaction; parent-child relationships.

Introduction

Each year, approximately 800,000 deaths by suicide occur worldwide (WHO, 2017). Of particular concern, rates of suicide have increased dramatically over the past two decades in children aged 10–14 (National Center for Health Statistics, 2016). Suicide is now the second leading cause of death among children aged 10–14 in the United States (CDC, 2017). Suicidal ideation (SI) can occur in children as young as three years of age (Whalen, Dixon-Gordon, Belden, Barch, & Luby, 2015) and up to 26.84% of children age 6–12 report current SI (Kovess-Masfety et al., 2015). These statistics highlight the critical need for research on factors that contribute to the development and maintenance of suicidal thoughts and behavior (STB) in children. To date, however, most STB research has focused on adolescent and adult samples.

One factor that may be particularly important to the development and maintenance of STB during childhood is the way in which parents and children interact with each other. Various aspects of the parent–child relationship including cohesion, warmth, conflict, perceived support, and communication are associated with risk for psychopathology and suicide-related outcomes in youth (e.g., Ackard, Neumark-Sztainer, Story, & Perry, 2006; Conner et al., 2016; Soole, Kõlves, & De Leo, 2015). The relation between parent–child interactions and child STB appears to be bi-directional, with a separate body of research highlighting the impact of a child's past STB on both parent and child communication within parent–child interactions (O'Donnell et al., 2003; Wagner et al., 2000).

Despite the strengths of these studies, a potential limitation is that they focused on broad measures of parent and child behavior. A more recent study that employed a detailed, moment-to-moment visual coding of behavior during parent–child interactions (e.g., conflict resolution discussions) found that dyads with child STB demonstrated greater conflict escalation during the interaction than dyads without child STB (Crowell et al., 2013). Another study focusing on changes in physiological reactivity (heart rate variability; HRV) during parent–child interactions found that although most children exhibited the typical pattern of HRV suppression from a baseline resting period to interactions (e.g., Vacation Planning and conflict resolution discussions) with their parents, children with an SI history who also had a critical parent displayed no change in HRV across tasks (James, Woody, Feurer, Kudinova, & Gibb, 2017). Finally, a study examining levels of positive and negative affect during a stressful mother–adolescent interaction task found that dyads with adolescent STB demonstrated higher levels of negative affect and lower levels of positive affect than dyads without adolescent STB (Crowell et al., 2008). Together, these studies suggest normative, heathy

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processes involved in parent–child interaction are disrupted in families of children with STB. A fine-grained understanding of how these potentially modifiable processes occurring in parent–child interactions are disrupted is critical for discerning whether they can be targeted through clinical intervention to reduce risk for future STB.

Therefore, the current study focused on disruptions in parent–child synchrony, which reflects the dynamic exchange of behavioral and physiological processes during interactions (e.g., Davis, Bilms, & Suveg, 2017; Gray, Lipschutz, & Scheeringa, 2017; Im-Bolter, Anam, & Cohen, 2015; Woody, Feurer, Sosoo, Hastings, & Gibb, 2016). Colloquially, synchrony refers to being ‘in sync’ with someone during interaction and involves reciprocal responsivity of verbal and nonverbal cues from both partners (Leclère et al., 2014). Dyadic synchrony can be assessed across multiple methods of analysis including physiology, neural processes, physical movement, eye gaze, and affect (Feldman, 2012). Although synchrony research has not been conducted in populations of youth with STB, in other populations, greater parent–child behavioral, affective, and physiological synchrony are associated with many positive outcomes (e.g., Gray et al., 2017; Healey, Gopin, Grossman, Campbell, & Halperin, 2010; Woody et al., 2016). Conversely, reduced affective synchrony is related to problem behaviors (Im-Bolter et al., 2015) and psychopathology (Criss, Shaw, & Ingoldsby, 2003; Deater-Deckard, Atzaba-Poria, & Pike, 2004). Importantly, recent studies highlight the role of synchrony in child development, suggesting parent–child synchrony plays a role in the co-regulation of emotion (Reindl, Gerloff, Scharke, & Konrad, 2018) and enhances a child’s ability to self-regulate emotion (Suveg, Shaffer, & Davis, 2016), thereby reducing future risk.

Facial electromyography (EMG) is an efficient method of objectively assessing second-to-second changes in facial affect during interactions (Tassinary, Cacioppo, & Vanman, 2007). Given its sensitivity in detecting minute changes in expressions including valence and intensity, indexing affective response via facial EMG may provide a more nuanced understanding of second-to-second changes in facial affect than visual behavioral coding systems (Cacioppo, Petty, Losch, & Kim, 1986). Electrodes placed over the corrugator supercilii muscle (activated as eyebrows narrow during frowning) and the zygomaticus major muscle (activated as the corners of the mouth contract during smiling) provide indices of negative and positive facial affect, respectively (Cacioppo et al., 1986; Dimberg, 1990). Additionally, facial EMG offers the opportunity to record and analyze changes in facial affect and affective responses during an interaction without disrupting that interaction to assess self-reported affect.

The goal of the current study was to examine synchrony of facial affect during positively and negatively valenced mother–child interactions, using facial EMG to index moment-to-moment changes in mother and child facial expressions, and to examine the contribution of child’s SI to this co-regulation of positive and negative affect. We chose to focus specifically on the role of active SI rather than death ideation given evidence that SI and death ideation represent distinct forms of distress (Yoder, Whitbeck, & Hoyt, 2008). We focused on mother–child dyads because mothers play a key role in the regulation and expression of affect during interactions with their children. Indeed, shared affect in the context of family interactions has long been recognized as an important part of the family’s overall emotional climate and parents’ indirect socialization of children’s emotional development (Saarni, 1985, 1999), including parents’ expression of emotions and responses to their children’s emotions (Eisenberg, Cumberland, & Spinrad, 1998). Therefore, mothers could help to reinforce or enhance specific forms of facial affect during certain types of interactions (e.g., positive facial affect during positive interactions) or help to reduce or prevent the escalation of others forms of facial affect (e.g., negative facial expressions during conflictual discussions). Given that dyadic synchrony involves input from both members, we specifically tested whether the impact of children’s SI history was at least partially independent of mothers’ own suicidality.

Accordingly, we first examined children’s and mothers’ overall intensity and valence of facial expressions in both interactions, and whether these overall levels differed depending upon children’s SI history. We hypothesized that, across dyads, mothers and children would exhibit more positive facial affect in the positive interaction and more negative facial affect in the negative interaction. We also hypothesized that children with an SI history would exhibit more negative facial affect and less positive facial affect across both interactions than children without SI. However, given the paucity of research in this area, we did not make specific hypotheses regarding whether mothers’ overall levels of facial affect may differ across interactions depending on their children’s SI history.

Next, we examined synchrony of facial affect during the discussions by assessing how in sync mothers’ and children’s facial affect was during any given moment. To our knowledge, no study has examined whether mother–child synchrony of facial affect differs in dyads with and without child STB. However, based on research suggesting synchrony in mother–child facial affect, behavior, and physiology are associated with adaptive and positive outcomes (e.g., Gray et al., 2017; Healey et al., 2010; Woody et al., 2016) and potential disruptions in processes involved in parent–child interactions among dyads with child STB (Crowell et al., 2013; James et al., 2017; O’Donnell et al., 2003; Wagner et al., 2000), we hypothesized that dyads with child SI would exhibit less synchrony of facial affect during the mother–child interactions than dyads without child SI. We also examined the impact of mother–child synchrony on changes in self-reported affect (sadness) during each task and whether this relation was moderated by child SI. In all of the analyses, we predicted any observed effects would be maintained even after statistically controlling for children's and mothers' current levels of depression and anxiety, which would support the hypothesis that disruptions in synchrony among dyads with child SI are not simply due to current symptoms of depression or anxiety. Finally, because there is clear evidence for the intergenerational transmission of STB (Brent & Melhem, 2008), we also examined whether the effects would be maintained after statistically controlling for mothers' history of a suicide attempt (SA), which would provide additional evidence to the specific role of children's SI.

Methods

Participants

Participants in this study were 353 children aged 7–11 and their biological mothers recruited from the community. The average age of children was 9.32 years (*SD* = 1.48), and 51.6% were boys. In terms of race/ethnicity, 72.2% of the children were Caucasian, 13.6% were African American, 13.0% were multiracial, and the remainder identified as some other race/ethnicity. The average age of mothers in our sample was 36.53 years (*SD* = 5.64, Range = 25–54). In terms of race/ethnicity, 80.2% were Caucasian, 16.1% were African American, 1.7% were multiracial, and the remainder identified as some other race/ethnicity. Information about psychiatric diagnoses of participants in our sample can be found in Appendix S1.

Measures

Children's suicidal ideation. Children's history of SI was assessed using questions from the K-SADS-PL (Kaufman et al., 1997). Specifically, as part of the K-SADS interview, mothers and children were asked, 'Sometimes children who get upset or feel bad think about dying or even killing themselves. Have you [Has your child] ever had these types of thoughts?' If a child endorsed SI, the interviewer asked follow-up questions to ensure the child was specifically endorsing thoughts of suicide and not thoughts of death more generally (i.e., considering doing something to kill themselves rather than only thinking they may be better off dead). Those rated as a 2 ('occasional thoughts of suicide') or as a 3 ('recurrent thoughts of suicide with or without thoughts of a specific method') on the K-SADS based on child or mother report were coded as having a history of SI. Children who only endorsed thoughts of death without active SI were not included in the SI group. In this sample, 44 (12.5%) children had a history of SI based on child and/or mother report, which is consistent with prevalence rates of SI in youth reported in previous studies (e.g., Kovess-Masfety et al., 2015; Nock et al., 2013).[1]

Discussion Paradigm. Prior to the Discussion Paradigm, mothers and children both completed an Issue Checklist, which presents a series of potential topics of disagreement (fighting with siblings, helping with housework, etc.) and asks them both to identify whether they have had recent (within the last month) interactions regarding any of these topics and how negative those interactions were from 1 (*calm*) to 5 (*angry*). The dyads then engaged in a four-minute Vacation Planning task, during which they planned a vacation for just the two of them together. Finally, the dyads engaged in a six-minute Conflict Discussion task, during which they were instructed to talk about the issue from the Issue Checklist rated as the most negative by the mother and child, describe the recent disagreement, and try to resolve it. If the dyads completed their discussion prior to the required length of time (i.e., four or six minutes), they were prompted to either elaborate or discuss another topic of disagreement. If dyads were still talking when they reached the 4- or 6-min mark, they were interrupted and encouraged to continue their conversation at a later time. The same protocol was followed for both groups.

EMG signal recording and processing. During each phase of the Discussion Paradigm, facial EMG was recorded simultaneously from the mother and child using Biopac M150 wireless recording systems (BIOPAC Systems Inc., Goleta, CA). The EMG signal was recorded using miniature (4 mm) surface bipolar Ag/AgCl electrodes following standard procedures and placement (Cacioppo et al., 1986). Electrodes filled with electrode gel were attached over the corrugator supercilii and zygomaticus major muscles via adhesive rings (Cacioppo et al., 1986). MindWare EMG 3.0.12 (Mindware Technologies Ltd., Gahanna, OH) was used to transform and analyze the EMG signals, which were sampled at 1,000 Hz and band-pass filtered within the frequency range of 20–500 Hz. A 60-Hz notch filter was applied to remove power line noise, after which the EMG signal was rectified and integrated. The data were binned into 1 s epochs.

State affect. Participants rated their state sadness using a Visual Analog Scale (VAS). Mothers and children independently rated how they were feeling from 'very happy' to 'very sad' on a scale measuring 100 mm before the first discussion and after each of the tasks in the Discussion Paradigm, with higher numbers indicating greater sadness.

Symptoms. Children's depressive and anxiety symptoms were assessed using the Children's Depression Inventory (CDI; Kovacs, 1981) and Multidimensional Anxiety Scale for Children (MASC; March, Parker, Sullivan, Stallings, & Conners, 1997). In this study, the CDI and MASC demonstrated good internal consistency (αs = .82 and .88, respectively). Mother's depressive and anxiety symptoms were assessed using the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) and the Beck Anxiety Inventory (BAI; Beck & Steer, 1993). In this sample, both measures exhibited good internal consistency (αs = .87 and .90, respectively).

Mothers' history of suicide attempts. To assess for mothers' history of suicide attempts, mothers were asked, 'A suicide attempt is defined as intentionally hurting yourself with at least some wish to die *at that time*. How many times have you attempted suicide in your life?' In this sample, 56 (16%) mothers endorsed a history of at least one suicide attempt (SA). Of the mothers who endorsed a history of SA, 9 (16.1%) had a child with a history of SI. In contrast, of the mothers without a history of SA, 35 (11.9%) had a child with a history of SI.

Procedure

Upon arrival at the laboratory, mothers were asked to provide informed consent and children were asked to provide assent to be in the study. Next, mother and child were interviewed separately using K-SADS-PL and completed questionnaire assessments in adjacent interview rooms. Questionnaires were read aloud to children to ensure comprehension. As a part of a larger study, the battery of assessments included in study appointments was controlled such that every appointment lasted only four hours. The Discussion Paradigm, during which EMG activity was collected, was administered during the last 30 min of every appointment. This project was approved by the University's Institutional Review Board.

Results

Details of the analysis plan and our approach to handling missing data can be found in Appendices S2 and S3. Descriptive statistics for the study variables are presented in Table 1.

Overall levels of positive and negative facial affect during mother–child interactions

We first examined whether overall levels of EMG activity during the Discussion Paradigm differed depending upon children's history of SI. Using a linear mixed model, we found significant main effects of Person, $F(1, 918) = 62$, $p < .001$, Muscle, $F(1, 1062) = 265.54$, $p < .001$, and Task, $F(1, 2157) = 4.72$, $p = .03$, indicating that, overall, EMG activity was greater for children than mothers, for zygomaticus activity than corrugator activity, and during the Vacation Discussion than the Conflict Discussion. There was also a significant Muscle × Person interaction, $F(1, 1568) = 14.31$, $p < .001$, indicating children, compared to mothers, exhibited greater corrugator, $F(1, 1396) = 9.94$, $p < .01$, and zygomaticus, $F(1, 1404) = 62.33$, $p < .001$, activity across the discussions. Finally, there was a significant Muscle × Task interaction, $F(1, 2453) = 23.42$, $p < .001$, indicating zygomaticus activity was greater during the Vacation Planning Discussion than the Conflict Discussion, $F(1, 707) = 238.83$, $p < .001$, while corrugator activity was greater during the Conflict Discussion than during the Vacation Planning, $F(1, 701) = 58.74$, $p < .001$. Therefore, it appears our two discussions were effective in eliciting the expected facial displays of affect. However, none of the main or interactive effects of child SI were significant, suggesting levels of zygomaticus and corrugator activity did not differ based on children's SI history in either discussion. All of these effects were also maintained after statistically controlling for the influence of mother and child depressive (BDI-II and CDI) and anxiety (BAI and MASC) symptoms as well as mothers' history of SA (all *p*s < .01), suggesting our findings are at least partially independent of mothers' and children's current symptoms of depression and anxiety as well as mothers' history of SA.

Synchrony of positive and negative facial affect

We then used a series of linear mixed models to examine EMG synchrony during the discussion tasks and to determine whether this relation was moderated by children's history of SI. As can be seen

Table 1 Descriptive statistics for mothers and children

	Dyads with an SI child ($n = 44$)	Dyads without an SI child ($n = 309$)	$r_{effect\ size}$
Child age	9.42 (1.42)	9.30 (1.49)	.03
Child sex (% girls)	36.4%	50.2%	−.09
Child race (% Caucasian)	81.8%	70.9%	.08
Mother age	36.53 (5.80)	36.53 (5.62)	.00
Mother race (% Caucasian)	84.1%	79.3%	.04
Annual family income	$25,001–30,000	$30,001–35,000	.01
CDI	9.67 (8.05)	5.22 (4.80)	.27**
MASC	46.70 (15.17)	43.49 (16.44)	.07
BDI-II	9.13 (10.18)	7.35 (7.93)	.07
BAI	4.51 (6.77)	4.50 (6.21)	.00
Child lifetime MDD	11.4%	1.9%	.18**
Mother lifetime MDD	38.6%	46.6%	−.05
Child lifetime anxiety disorder	15.9%	6.5%	.12*
Mother lifetime anxiety disorder	34.1%	29.4%	.03
Mother history of suicide attempt	20.5%	15.2%	.05
Vacation child corrugator	11823 (10918)	14580 (22033)	−.04
Vacation mother corrugator	10801 (7754)	10545 (8240)	.01
Vacation child zygomaticus	34117 (22620)	40973 (54793)	−.04
Vacation mother zygomaticus	270601 (44211)	25415 (23538)	.02
Conflict child corrugator	12712 (10806)	15292 (23431)	−.04
Conflict mother corrugator	13855 (10702)	12603 (10297)	.04
Conflict child zygomaticus	22107 (13184)	36895 (72517)	−.07
Conflict mother zygomaticus	20071 (36947)	19506 (22531)	.01

CDI, Children's Depression Inventory; BAI, Beck Anxiety Inventory; BDI-II, Beck Depression Inventory-II; MASC, Multidimensional Anxiety Scale for Children; MDD, Major Depressive Disorder.
*$p < .05$; **$p < .01$.

Table 2 Summary of synchrony analyses

	Zygomaticus						Corrugator					
	Vacation			Conflict			Vacation			Conflict		
	B	t/z	$r_{effect\ size}$	B	t/z	$r_{effect\ size}$	B	t/z	$r_{effect\ size}$	B	t/z	$r_{effect\ size}$
Fixed effects												
Intercept	0.00	−0.21	0.00	0.00	0.20	0.00	0.00	0.21	0.00	0.00	0.19	0.00
Mother EMG	0.12	15.83***	0.68	0.06	8.86***	0.46	0.30	3.83***	0.21	0.04	4.54***	0.25
Child SI	0.00	−0.12	0.00	0.00	0.06	0.00	0.00	−0.02	0.00	0.00	0.02	0.00
Child SI x Mother EMG	−0.05	−2.24*	0.13	−0.01	−0.53	0.04	0.02	1.09	0.08	−0.03	−1.45	0.11
Random slopes												
Mother EMG (within dyad)	0.01	2.46*	0.13	0.00	1.95*	0.10	0.00	0.58	0.03	0.00	1.67	0.09
Mother EMG (within dyad within family)	0.01	2.60**	0.14	0.01	5.31***	0.28	0.01	6.47***	0.34	0.01	5.09***	0.27

EMG, Electromyography Activity, SI, Suicidal Ideation.
*$p < .05$; ***$p < .001$.

in Table 2, there were significant main effects of mother zygomaticus activity on child zygomaticus activity during both the Vacation and Conflict Discussions, revealing synchrony of positive facial affect between mothers and children during both discussions. There were also significant main effects of mother corrugator activity on child corrugator activity during both the Vacation and Conflict Discussions, revealing synchrony of negative facial affect during both discussions. Finally, during the Vacation Discussion, there was a significant child SI × mother zygomaticus activity interaction predicting child zygomaticus activity. To determine the form of this interaction, we examined the relation between child and mother zygomaticus activity during the Vacation Discussion separately in dyads with and without child SI. Synchrony of zygomaticus activity during the Vacation Discussion was stronger among dyads with no child SI, $t(244) = 15.86$, $p < .001$, $r_{effect\ size} = .71$, than among dyads with child SI, $t(40) = 3.64$, $p = .001$, $r_{effect\ size} = .50$. All of our results were again maintained after we statistically controlled for the influence of mother and child depressive and anxiety symptoms as well as mothers' history of SA (all ps < .01).[2]

Mother–child synchrony and changes in self-reported affect

Finally, we used a series of linear mixed models to examine the impact of mother–child synchrony on changes in self-reported sadness from before to after each task, and whether this relation was moderated by children's history of SI. Across all dyads, higher levels of synchrony in corrugator activity during the Vacation Discussion predicted larger increases in children's sadness from before to after the discussion, $t(335) = 2.21$, p=.03, $r_{effect\ size} = .12$. In addition, higher levels of synchrony in zygomaticus activity predicted larger decreases in self-reported sadness for children during both the Vacation, $t(335) = −3.45$, $p = .001$, $r_{effect\ size} = .19$, and Conflict, $t(335) = −2.08$, $p = .04$, $r_{effect\ size} = .11$, discussions. These effects were maintained after statistically controlling for the influence of mother and child depressive and anxiety symptoms as well as mothers' history of SA (all ps < .05) with one exception: Greater zygomaticus synchrony no longer significantly predicted larger decreases in children's self-reported sadness during the Conflict Discussion when statistically controlling for current symptoms of depression, $t(333) = −1.83$, $p = .07$, $r_{effect\ size} = .10$. In these analyses, none of the main or interactive effects predicting changes in mothers' self-reported affect were significant (lowest $p = .10$). Finally, child SI did not significantly moderate the impact of EMG synchrony on changes in self-reported affect for either muscle group in either discussion (lowest $p = .10$).[3]

Discussion

The primary goal of this study was to examine how levels and synchrony of facial affect during mother–child interactions may differ based on children's SI history. Although there were no differences in overall levels of positive or negative facial affect during the interactions, there were differences in the synchrony of facial affect. Specifically, child SI dyads exhibited less synchrony of positive facial affect during the positively valenced discussion than dyads without child SI. This reduction in synchrony was specific to positive facial affect (zygomaticus activity) during the positively valenced interaction and was not observed during the negatively valenced discussion or for negative facial affect (corrugator activity). Moreover, our findings were specific to the *synchrony* of facial affect rather than overall levels of positive or negative facial affect during the interactions, suggesting children with a history of SI (or their mothers) do not simply exhibit less positive facial affect or more negative facial affect overall during mother–child interactions. This specificity also suggests the findings are not the product of a global deficit in facial affective synchrony, but rather, a deficit in the transfer or dynamic exchange of positive facial affect that facilitates co-regulation during positively valenced conversations compared to dyads with no child SI. These findings were maintained when we statistically controlled for the influence of mothers' and children's depressive and anxiety symptoms, suggesting our results are at least partially independent of current symptoms and not driven by the group differences in children's depressive symptom levels. Moreover, our findings were maintained when we statistically controlled for the potential influence of mothers' SA history, suggesting the effects are at least partially independent of mothers' history of suicidal behavior, which is particularly noteworthy given the strong intergenerational transmission of these problems.

We also found, across dyads, differences in levels of synchrony during the discussion were associated with changes in children's self-reported sadness from before to after the discussion. Across dyads, higher levels of synchrony in positive facial affect (zygomaticus activity) were associated with decreases in children's sadness from before to after both discussions. Additionally, higher levels of synchrony in negative facial affect (corrugator activity) during the positively valenced discussion were associated with increases in children's sadness from before to after the discussion. Interestingly, the impact of synchrony on change in self-reported affect was specific to children. Thus, children may be more susceptible to both the risks and benefits of synchrony in facial affect than their mothers.

We did not predict our findings would be specific to positive facial affect during positively valenced discussions; nevertheless, our finding of reduced synchrony during the Vacation Discussion is consistent with previous research suggesting reduced parent–child affective synchrony is related to problem behaviors (Im-Bolter et al., 2015) and internalizing and externalizing disorders (Criss et al., 2003; Deater-Deckard et al., 2004). These findings also align with recent studies suggesting parent–child synchrony may be indicative of co-regulation of emotion (Reindl et al., 2018) and support the development of self-regulation (Suveg et al., 2016), in turn, reducing risk. Indeed, it is possible that children at risk of developing SI also exhibit difficulties with social reciprocity, including the dynamic exchange of facial affect, which builds co-regulation, and, perhaps, subsequent self-regulation capabilities mitigating risk.

Although the present study is the first to our knowledge to examine disruptions in parent–child affective synchrony related to child STB, these results are consistent with the broader literature indicating disruptions in parent–child interactions when a child has a STB history (Crowell et al., 2013; James et al., 2017; O'Donnell et al., 2003; Wagner et al., 2000). Indeed, the capacity to regulate physiological responses to stress is indicated as one potentially important factor in the development of SI, and previous research illustrates a relation between difficulties in emotion regulation (which may be reflected by disrupted affective responses) and suicide-related outcomes in adults and adolescents (e.g., Kudinova et al., 2015; Rajappa, Gallagher, & Miranda, 2012).

The current study's strengths include the large sample size and use of EMG to index second-to-second changes in facial affect during actual mother–child interactions, and its limitations provide important directions for future research. First, due to the cross-sectional design, we cannot determine whether synchrony of facial affect is a cause or consequence of children's past SI, or whether the SI-related differences in synchrony of positive facial affect predict risk for future STB. Future research should examine whether disruptions in the normative verbal and nonverbal processes involved in parent–child interaction predict first onset or recurrence of STB in youth. Longitudinal research is also needed to examine whether a child's STB history predicts future change in parent–child interactions. Second, we focused on child SI rather than SA given the low base rate of SA among children and data showing SI increases risk for SA (Nock et al., 2013; Ribeiro et al., 2016). Research should determine whether similar effects are observed in families with child SA, as well as how characteristics of children's SI (e.g., frequency, duration, recurrence, severity, and recency) may affect these findings. Third, we are unable to examine whether this pattern generalizes to father–child interactions. Fourth, and finally, the SI group included children with an SI history reported by either themselves or their mothers, and there may be important differences between the children identified only through self-report, those identified only through mother report, and those for whom both the child and their mother identified the child SI history. Unfortunately, our sample was too small to examine differences in these subgroups; parental knowledge of a child's STB may have meaningful implications for how that parent and child interact, and for the nature of child's STB.

In summary, this study offers evidence for disruptions in synchrony of positive facial affect during positively valenced mother–child discussions among families with a history of child SI compared to those with no child SI. Although interpretation of these results is limited by the cross-sectional design of the present study, they lay the foundation for future prospective research. If replicated and extended using a longitudinal design that assesses STB more comprehensively, these results could provide insight into a mechanism by which past STB increases risk for future STB in youth, offering important targets for interventions. Interventions focused on improving potentially trainable processes involved in the parent–child relationship (e.g., synchrony and reciprocity of facial affect) may be enhanced through the incorporation of biofeedback in family therapy and may be particularly useful to higher risk families, including those in which the child has a STB history.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Psychiatric diagnoses.
Appendix S2. Analysis plan.
Appendix S3. Additional analyses.

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Key points

- Although interpersonal factors (e.g., the parent-child relationship) are highlighted as risk factors for suicide-related outcomes, little is known about moment-to-moment processes occurring during parent–child interactions, or how these may be disrupted in families with child suicidal ideation (SI).
- This study examined synchrony of facial expressions during positive and negative mother–child discussions indexed via facial electromyography among dyads with and without a history of child SI.
- During the positive discussion, child SI dyads exhibited less synchrony of positive facial affect than dyads in which the child did not have an SI history.
- This finding suggests a specific deficit in the sharing of positive affect in at-risk families, which may be one mechanism for future risk and a target of intervention.

Notes

1. In this sample, 35 children reported experiencing SI in their lifetime and 17 mothers reported that their child had experienced SI. Of these families, 10 had both the mother and the child indicate that the child had an SI history.
2. Although we were primarily interested in concurrent synchrony, we also conducted exploratory analyses to examine lagged synchrony. Specifically, we examined whether children's SI history moderated the impact of mothers' EMG activity at Time T-1 on changes in children's EMG activity from Time T-1 to Time T or the impact of children's EMG activity on changes in mothers' EMG activity. None of these analyses were significant. Additional details are available from the first author.
3. Although not a primary focus of the study, we examined whether children's sex might moderate any of our synchrony effects. None of the moderation analyses were significant, and all of our effects were maintained after statistically controlling for the impact of children's sex.

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