Development and Psychopathology (2025), 1–11
doi:10.1017/S0954579425000070

CAMBRIDGE UNIVERSITY PRESS

Regular Article

Girls with higher levels of suicidal ideation experienced less parental reciprocity of eye-contact and positive facial affect during conflictual interactions: A pilot study

Kiera M. James[1], Aleksandra Kaurin[2], Amelia Lint[1], Samantha Wert[1], Kirsten M. McKone[1], Emily A. Hutchinson[1], Rebecca B. Price[1,3], Cecile D. Ladouceur[1,3] and Jennifer S. Silk[1]

[1]Department of Psychology, University of Pittsburgh, Pittsburgh, USA, [2]University of Wuppertal, Nordrhein-Westfalen, Wuppertal, Germany and [3]Department of Psychiatry, University of Pittsburgh, Pittsburgh, USA

Abstract

Although ample research links social factors and suicidality, there remains a gap in understanding how distinct processes within social communication relate to suicidality. We demonstrate how reciprocity of eye-gaze and facial expressions of happiness differ during parent-adolescent conflict based on adolescents' future suicidal ideation (SI). Facial affect analyses were based on 103 girls (ages 11–13; M = 12.28; 75% White) and their parents. Eye-gaze analyses were conducted in subset of these dyads ($N = 70$). Participants completed a conflict discussion during which gaze to their partners' eyes was assessed using mobile eye-tracking glasses and facial affect was coded using FaceReader Observer XT. Adolescents' SI was assessed 12-months later. Actor-partner interdependence models tested whether participants' gaze and affect predicted their own and their partners' gaze and affect one second later and if these intra and interpersonal dynamics differed based on adolescents' future levels of SI. Girls from dyads with less parental reciprocity of eye-gaze and happiness reported higher levels of SI 12-months later. During early adolescence, girls whose parents reciprocate their eye-contact or positive affect less during conflict may be at heightened risk for SI. If replicated, social communication could provide a promising intervention target to reduce suicidality prospectively.

Keywords: actor–partner interdependence modeling; eye-gaze; facial affect; parent-adolescent interaction; suicide

(Received 14 May 2024; revised 29 January 2025; accepted 31 January 2025)

Increasing rates of suicide among youth in the last two decades underscore the critical need to understand processes underlying risk (Centers for Disease Control and Prevention, & National Center for Injury Prevention and Control, 2021). Alarmingly, suicide is the second leading cause of death among those 13–17 in the US, and rates of suicidal ideation and attempts, which are higher among girls than boys, are even more widespread (Centers for Disease Control and Prevention, & National Center for Injury Prevention and Control, 2021, Centers for Disease Control and Prevention, 2024). Yet, despite extensive effort, etiological processes underlying risk for suicidal thoughts and behaviors (STB) are not well understood, suggesting the need to reexamine conceptual and methodological approaches to overcome limitations of previous research. One significant limitation is a heavy focus on self-report indices of risk, which are susceptible to bias and fail to capture processes outside of participant awareness, including fine-grained second-to-second processes that occur during social interaction. As such, the Research Domain Criteria (RDoC) project of the National Institute of Mental Health (NIMH; Cuthbert, 2014) provides a particularly useful framework for continued suicide research (Glenn et al., 2017, 2018).

The RDoC project (Cuthbert, 2014) identifies social processes as a key domain for psychopathology and disordered behavior, including STB. Within RDoC, the Social Processes domain includes three systems involved in one's response to social contexts (i.e., affiliation/attachment, perception and understanding of self/others, social communication). Although factors related to *affiliation/attachment* form the foundation of theoretical models of suicide (e.g., thwarted belongingness; perceived burdensomeness; Van Orden et al., 2010), less is known about the relation between *social communication* (i.e., the reception and production of facial and non-facial information during social exchange) and STB. Specifically, theoretical models of suicide propose that the desire to die is often driven by intense distress following social disconnection or rejection (e.g., Klonsky & May, 2015; Van Orden et al., 2010). Supporting this conceptualization, studies examining the link between social factors and STB establish the putative role of social connectedness in reducing STB risk (Kuramoto-Crawford et al., 2017), as well as the role of interpersonal stressors (e.g., peer victimization, bullying, parental criticism, lack of parental support) in increasing risk (Ackard et al., 2006; Chiu et al., 2017; Conner et al., 2016; John et al., 2018; Katsaras et al., 2018; Randell et al., 2006; Sheftall et al., 2013; Soole et al., 2015). From an RDoC perspective, research on social processes across the lifespan has

Corresponding author: Kiera James, James; Email: kij9@pitt.edu

Cite this article: James, K. M., Kaurin, A., Lint, A., Wert, S., McKone, K. M., Hutchinson, E. A., Price, R. B., Ladouceur, C. D., & Silk, J. S. (2025). Girls with higher levels of suicidal ideation experienced less parental reciprocity of eye-contact and positive facial affect during conflictual interactions: A pilot study. *Development and Psychopathology*, 1–11, https://doi.org/10.1017/S0954579425000070

© The Author(s), 2025. Published by Cambridge University Press. This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted re-use, distribution and reproduction, provided the original article is properly cited.

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

largely focused on subcomponents of affiliation/attachment (e.g., perceived burdensomeness; Van Orden et al., 2006), attachment style (Grunebaum et al., 2010; Sheftall et al., 2014), loneliness/lack of belonging (Burke et al., 2016; Fisher et al., 2015), and social connectedness (Sampasa-Kanyinga & Hamilton, 2016). Despite many strengths, these studies rely heavily upon self-report indices of these social processes, and few have captured real-time or objective measures of systems within the Social Processes domain across multiple units of analysis. Research aimed at understanding precise and potentially modifiable processes involved in social communication is essential given that the way in which one receives, processes, and produces information during social exchange contributes to components of affiliation/attachment (e.g., connectedness), which are linked to STB. Moreover, this type of research may be particularly important during the transition from childhood to adolescence as increasing rates of STB coincide with an increased incidence of, and reactivity to, interpersonal stress among girls (Ge et al., 1994; Rose & Rudolph, 2006; Rudolph & Hammen, 1999; Rudolph, 2014). Specifically, girls report more negative interpersonal interactions (Kowalski et al., 2014; Nesi et al., 2019; Rideout & Robb, 2018) and exhibit greater sensitivity to interpersonal stressors than boys (Guyer et al., 2009, 2012; Leadbeater et al., 1995; Rose & Rudolph, 2006; Weinstein et al., 2006). Moreover, given that nonfatal STB are more prevalent among adolescent girls than boys (Centers for Disease Control and Prevention, 2024; but see also, Miranda-Mendizabal et al., 2019), this line of inquiry may be more theoretically and developmentally relevant for girls than boys during adolescence.

To this end, RDoC identifies a variety of specific biobehavioral processes involved in social communication (e.g., eye gaze, facial affect, pupillary response). These processes have been examined via individual responses to images, videos, and simulated interaction, as well as in the context of actual dyadic interactions. Eye-gaze, a significant regulator of social interaction, shapes attentional orienting and conveys context-dependent information about interest and engagement to a social companion (Böckler et al., 2014; Frischen et al., 2007; Hietanen, 2018; Kleinke, 1986; Lyyra et al., 2018; Shirama, 2012). Sustained eye contact may convey aggression in certain contexts, but love or comfort in others. Additionally, momentary eye gaze reciprocity during interaction fosters intimacy, trust, and affiliation (Argyle & Dean, 1965). Importantly, eye gaze also influences concurrent behavioral and physiological processes involved in social communication, such as increasing positive facial affect from the recipient (Hietanen et al., 2018) and physiological arousal (Jarick & Bencic, 2019; Mazur et al., 1980). Although one study showed that youth with a history of suicidal ideation (SI) demonstrate prolonged gaze toward fearful faces (Tsypes et al., 2017), no research has examined the relation between eye-gaze during actual social interactions and STB.

Facial affect is another distinct and accessible behavioral process involved in social communication which includes positive expressions, like smiling, that signal friendliness, trust, and altruism to the recipient and increase approach within the interaction (Centorrino et al., 2015; Krumhuber et al., 2007; Mehu et al., 2007; Reed et al., 2012). Reciprocal exchange of positive affect during both positively- and negatively-valenced dyadic interactions (Heerey & Crossley, 2013; Heerey & Kring, 2007; Hess & Bourgeois, 2010) are associated with enhanced affiliation between dyadic partners (Golland et al., 2019). There is also preliminary evidence for higher levels of negative affect, lower levels of positive affect, and reduced synchrony of positive facial affect in parent-child dyads in which the child has a STB history (Crowell et al., 2008; James et al., 2020). This research suggests that disruptions in behavioral processes involved in social communication, specifically, positive facial affect, may be one mechanism of risk in youth with STB. However, this preliminary work is cross-sectional, and no studies have examined the extent to which disruptions in positive facial affect during social interaction are related to future STB.

Studies examining physiological processes (i.e., heart rate variability [HRV]/respiratory sinus arrhythmia [RSA], cortisol response) during in laboratory-based interpersonal stressors provide initial support for differences in processes involved in social communication in those with and without STB (Giletta et al., 2017; Rizk et al., 2018; Wilson et al., 2016). Specifically, adults who have attempted suicide (Wilson et al., 2016) and adolescent girls who subsequently experience SI (Giletta et al., 2017) exhibit more parasympathetic withdrawal (i.e., decreases in HRV/RSA) during an in vivo social stress paradigm, suggesting these individuals experience the interaction as more threatening and exhibit a lower capacity for emotion regulation during stressful social interactions. Other studies in which youth engaged in both positively- and negatively-valenced discussions with their parent identified differences in social communication in youth with and without a history of STB in the context of interpersonal stress (i.e., blunted HRV across positive and negative interactions when interacted with a highly critical parent; James et al., 2017), as well as during positively-valenced social interactions (i.e., less reciprocity of facial displays of positive affect indexed via facial electromyography; James et al., 2021). Similarly, a few studies have examined behavioral (i.e., eye gaze) or neural (i.e., fMRI) processes involved in social communication to examine responses to pictures of threat-relevant emotional faces (Jollant et al., 2008; Olié et al., 2015; Pan et al., 2013; Tsypes et al., 2017) or simulated social rejection in a laboratory setting (Olié et al., 2015), though not during actual social interactions. These studies highlight differences in social communication among participants with and without STB histories, including sustained eye-gaze and heightened responsivity in brain regions associated with sustained threat processing, responding to salient social feedback, and guiding socio-emotional behavior (Lau et al., 2012; Masten et al., 2009; Mayberg, 2003; Siegle et al., 2012; Silk et al., 2014), particularly in the context of interpersonal stress (i.e., social exclusion) or threat-relevant stimuli (angry/fearful faces). Collectively, this nascent research also suggests the importance of continued effort to clarify the specific nature of these group differences in social communication (e.g., attenuated physiological reactivity, facial affect, attentional biases) across multiple units of analysis, in the context of both positively- and negatively-valenced social exchanges, and during actual dyadic interaction. Though rigorous, prior research in this area largely focuses on differences in social communication in those with and without current or lifetime STB, and, to date, only one study has examined the relation between social communication and prospective risk for STB in adolescent girls (Giletta et al., 2017).

The current study, therefore, takes a multiple-units-of-analysis approach to examine adolescent girls' social communication production and reception during actual social interactions and to determine the extent to which alterations in social communication are linked to girls' subsequent STB. Specifically, we sought to test the extent to which the exchange of eye-gaze and facial displays of happiness during a parent-adolescent conflict discussion are associated with future SI severity in early adolescent girls at risk for depression. Given that reciprocity of eye-gaze and positive facial affect during social interaction fosters affiliation between social companions (Argyle & Dean, 1965; Golland et al., 2019), we

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

hypothesized that girls from parent-adolescent dyads that demonstrated less eye-gaze reciprocity during a conflict discussion would be more likely to report higher levels of SI at the 12-month follow-up. We predicted similar patterns would emerge when looking at the exchange of positive facial affect, such that girls from dyads that demonstrated less reciprocity of positive facial affect (i.e., happiness) would be more likely to report higher levels of SI at the 12-month follow-up. Although our primary aim was to understand how social communication patterns are linked to girls' SI prospectively, we also tested associations between patterns of gaze and affect and girls' recent history of SI (i.e., in the two weeks prior to the baseline assessment).

Method

Participants

At baseline, this sample included 129 early adolescent girls (aged 11–13; $M = 12.27$) and their parents ($M_{age} = 42.62$; $SD_{age} = 6.87$), recruited as a part of a larger, longitudinal study examining socio-affective and neurobiological risk factors in the development of affective disorders. Participants were recruited from the community with internet and flyer advertisements and the University of Pittsburgh CTSI research portal. The sample was enriched for risk for affective disorder such that two-thirds of girls presented with a fearful or shy temperament at baseline based on parent- and child-report on the Early Adolescent Temperament Questionnaire – Revised (Ellis & Rothbart, 2001) Fearfulness and Shyness scales. Acute suicidality (i.e., current suicidal intent, planning, or behavior) was an exclusion criterion of the parent study; however, no participants reported current suicidal intent, planning, or behavior during their baseline assessment (which was used to confirm eligibility). The team also intended to exclude participants who reported plans or intent to harm someone else; however, none of the participants endorsed any homicidal intent or planning.

Of the 129 dyads enrolled, 103 completed the interaction paradigm with usable *dyadic* facial affect data and 12-month follow-up data while 70 had usable dyadic eye-tracking data and 12-month follow-up data. As such, 103 dyads were included in facial affect analyses and 70 were included the eye-tracking analyses. The facial affect sample included 94 biological mothers, one adoptive mother, and eight biological fathers. The eye-gaze sample included 61 biological mothers, one adoptive mother, and eight biological fathers. The discrepancy in sample sizes for the facial affect and eye-gaze models was largely due to technical difficulties that prevented precise alignment of parents' and adolescents' eye-gaze data at the 1-second level and vision/eye problems that prevented the collection of adequately calibrated gaze data. Gaze was not a key variable in the larger longitudinal study. As such, vision/eye problems were not exclusion criteria. Criteria for facial affect and eye-tracking and data loss are described below in more detail below. Demographic and clinical characteristics for each sample are presented in Table 1.

Measures

Girls' suicidal ideation (SI)

Girls' SI was assessed at baseline and the 12-month assessment using four items from the Mood and Feelings Questionnaire – Suicidal Ideation Subscale (i.e., "Thought that life was not worth living," "Thought about death and dying," "Thought family would be better off without self," and "Thought about killing self'; MFQ-SI; Angold et al., 1987) that form a suicide-related composite. These four items assess passive and active SI over the past two weeks on a three-point Likert scale (0=*not true,* 1=*sometimes,* 2=*true*). This composite does not assess method, planning, intent, or behavior. Previous research has demonstrated strong reliability and validity of the MFQ-SI among adolescents (Hammerton et al., 2014), and this was consistent in the present sample ($\alpha = .77$). In the current study, 10 of the adolescents included in the facial affect analyses reported SI via the MFQ at the 12-month assessment. Seven of the adolescents included in the eye-gaze analyses reported SI via the MFQ at the 12-month assessment. SI was treated as a continuous variable in both the eye-gaze and facial affect models.

Parent-adolescent interaction task

Parent-daughter dyads completed a standardized conflict discussion of "Hot Topics" (Heatherington et al., 1999) as a part of a larger dyadic interaction protocol. Specifically, at the start of the study, both girls and parents completed a questionnaire about recent disagreements they have had with each other (adapted from Hetherington, 1992). Participants were asked to report how often they disagreed (never—everyday) and how bad the disagreement was (not at all bad—extremely bad) on a series of common problems (e.g. behavior towards each other, girls' lying behavior, keeping room tidy). While participants completed other tasks, a research assistant ranked the top two problems based on frequency and intensity. The problem, or conflict, chosen for the discussion was the issue that occurred most often and was rated the worst by both girls and mothers. The most common problem selected was "girl's behavior towards their mother," with 25% of pairs reporting this as the most frequent and intense issue. Participants were instructed to identify the main problem and discuss what would be the best solution to the problem. If participants ran out of things to discuss regarding the first problem, they were instructed to discuss the second problem.' Change scores reflecting differences in participants' self-reported happiness and sadness from baseline to after the Hot Topics task show that adolescents and parents both report decreases in happiness (ΔParent = −7.38; ΔAdolescent = −5.46) and increases in sadness (ΔParent = 4.09; ΔAdolescent = 2.26; (McKone et al., 2021).

Eye gaze

During the Hot Topics task, girls' and their parent's eye-gaze was continuously recorded using binocular Tobii Pro Glasses 2 (Tobii Technology, Falls Church, VA, USA). Resembling reading glasses, these mobile eye tracking glasses include a high-definition camera that captures the wearer's visual field, measuring approximately 80° horizontal and 52° vertical. The glasses are equipped with four eye tracking sensors, with a sampling rate of 50 Hz and infrared illuminators that support the eye tracking sensors by brightening the eye. Eye-gaze data was processed using Tobii Pro Glasses Analyzer (Tobii Technology, Inc.), and a customized specified filter allowed for the classification of eye movements (e.g., fixations, saccades). Fixations were identified as consecutive sequences of raw data points below the velocity threshold of 30°/s. The Tobii Real-World Mapping function allowed for automated fixation-mapping to areas of interest (AOI) using proprietary Tobii algorithms. An AOI was formed around the interaction partners' eyes and regions of interest analyses identified whether fixations to

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

the AOI occurred at each sampling point.[1] The automatic mapping procedure plotted the raw gaze data and any fixations from the glasses' video camera onto a still image, which was devised from a representative still image generated from a single frame and captured by each participant's glasses camera. Errors were manually corrected. In the current study, data were binned into 1 s epochs and analyses were based on the total duration of participants' gaze to their partners' eyes in a given second.

As reported above, the final sample for gaze analyses comprised 70 dyads. Of the 129 dyads enrolled in the study at baseline, 128 dyads completed the dyadic interaction paradigm. Of these, technical problems affecting at least one member of 24 dyads prevented us from collecting and/or precisely synchronizing data from both members of the dyad (see above). Data from three dyads were not collected in accordance with our protocol (e.g., differences in lighting, hair obstructing glasses). Adolescents from two dyads declined to complete the conflict discussion due to distress. Three adolescents with usable eye-tracking data did not complete the 12-month follow-up assessment of SI. Additionally, participants who (a) did not achieve adequate calibration ($n = 14$), (b) had less than 50% valid gaze data (i.e., where gaze coordinates can be estimated by Tobii) in at least one eye ($n = 1$), and/or (c) exhibited fixations toward any visual region less than 20% of the time were excluded from analyses ($n = 0$). This procedure is consistent with prior studies from our group (Allen et al., 2020; Hutchinson et al., 2019; Woody et al., 2019, 2020). Finally, members of 10 dyads (i.e., five parents and five adolescents from different dyads) were identified as far outliers based on very low levels of AOI data (e.g., data for only 5/300 possible seconds). These 10 dyads were excluded to ensure that included dyads had enough data points to test our hypotheses about the *exchange* of gaze between dyadic partners. All remaining participants had AOI data for at least 25% of the task. Participants with versus without usable dyadic eye-tracking data did not significantly differ in terms of demographic (i.e., age, income, race) or clinical (i.e., symptoms of anxiety, depression, SI) variables (lowest $p = .15$).

Facial affect

Facial affect was also assessed continuously during the interaction using FaceReader 7.1 (Noldus Information Technology, Inc.). Participants' faces were recorded using wall-mounted video cameras opposite their position with a sampling rate of 30 Hz. Videos were imported into FaceReader using the Observer XT program (Noldus Information Technology, Inc.). FaceReader employs a cascaded classifier algorithm to identify the face and its position before using two affect classification methods to achieve convergence (Loijens & Krips, 2019). First, the Active Appearance method synthesizes an artificial face model using over 500 key points on the face. Inferences about the shape of facial features and resulting expressions can then be made from the locations of these points (den Uyl & van Kuilenberg, 2005). Using an artificial neural network, the second method identifies patterns from image pixels to classify facial expressions independent of face modeling. This approach enables coding of emotional expressions even in the presence of participant characteristics (e.g., glasses, facial hair; Loijens & Krips, 2019). These two methods are combined to reach classification convergence – an output in which each possible affect classification (neutral and six emotion types) is assigned an intensity within each sample measurement (0%–100%). A detailed of description of FaceReader's classification algorithm and validation studies is provided in a recent publication from our group (Woody et al., 2022). Affect classifications and intensity percentages were used to identify the predominant affect displayed (i.e., the emotional or neutral expression with the highest intensity rating displayed with at least 50% intensity; Woody et al., 2020). A signal strength of>50% intensity for coding dominant affect was chosen based on extant research demonstrating youth become sensitive in detecting facial displays of emotion at medium intensities (Burkhouse et al., 2016; Pollak & Kistler, 2002). The present study focused on predominant codes of positive affect (i.e., happiness) given the low frequency of negative affect during the interaction task. Specifically, in the current study, parents and adolescents displayed relatively higher proportions of positive facial affect (11.6% and 28.6%, respectively) than negative facial affect (i.e., angry and sad; 1.14% and 0.34%, respectively). At least 50% of samples were successfully classified for all dyads included in analyses. Data were again binned into 1 s epochs and dichotomously coded to reflect whether a signal strength of >50% intensity happiness was displayed in a given second.

The final facial affect analysis sample comprised 103 dyads. Of the 128 parent-adolescent dyads who completed the interaction paradigm, at least one member of 25 dyads did not have usable data. Specifically, adolescents from two dyads declined to complete the conflict discussion due to distress. One parent slept through the conflict task due to a medical condition. Technical problems affecting at least one member of 18 dyads prevented us from collecting and/or precisely synchronizing data from both members of the dyad. Moreover, four adolescents with useable facial affect data did not complete the 12-month follow-up assessment of SI.

Symptoms

To better characterize the sample, girls' symptoms of depression and anxiety were assessed at baseline. Depressive symptoms were assessed using girls' report on the Mood and Feelings Questionnaire (MFQ; Angold et al., 1987), which contains 33 items assessing symptoms over the past *two* weeks on a three-point Likert scale (0=*not true*, 1=*sometimes*, 2=*true)*. MFQ items were summed to create a total score, where a higher score reflects more symptoms (range 0 to 66). Anxiety symptoms were assessed using girls' report on the Screen for Anxiety Related Disorders (SCARED; Birmaher et al., 1997), which contains 41 items assessing anxiety symptoms over the past week on a three-point Likert scale (0=*not true/hardly ever true*, 1=*somewhat true/ sometimes true*, 2=*very true/often true*). SCARED items were summed to create a total score where a higher score reflects greater symptoms (range 0 to 82). Both the MFQ and SCARED demonstrated excellent internal consistency in the current study ($\alpha s = 0.95$ and 0.94, respectively). Means and standard deviations are presented in Table 1.

Procedure and ethical considerations

Before enrollment, parents provided informed consent and girls provided assent to be in the larger, longitudinal study. At baseline, girls and their parents completed questionnaires assessing symptoms of anxiety and depression along with the dyadic Hot Topics task during which eye-gaze and facial affect were assessed.

[1]AOIs were also formed around the interaction partners' faces and bodies. Although the focus of the current project is eye-contact, we repeated our models using the face and body AOIs to determine the specificity of our findings to eye-contact (versus more general attention to the dyadic partner). Overall, our findings were specific to eye-contact. The nonsignificant results from these models are presented in supplementary Table 1.

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

Table 1. Descriptive statistics

	Eye-gaze ($n = 70$)	Facial affect ($n = 103$)
Adolescents		
Age	12.37 (.80)	12.25 (.83)
Pubertal Development (PDS)	3.47 (1.10)	3.41 (1.11)
Race (% White)	76.8%	74.0%
Depressive symptoms (MFQ)	8.74 (6.68)	9.31 (7.22)
Anxiety symptoms (SCARED)	16.33 (11.61)	15.55 (10.95)
% with SI score > 0 at 12-months	10.0%	9.7%
MFQ-SI score (for those who reported any SI)	1.43 (0.79)	1.90 (1.29)
Parents		
Age	42.47 (5.10)	42.18 (6.13)
Sex (% Mothers)	88.6%	90.0%
Race (% White)	84.8%	81.7%
Household income	\$70,000–\$80,000	\$70,000–\$80,000

Note. PDS = Pubertal Development Scale; MFQ = Mood and Feelings Questionnaire; SCARED = Screen for Childhood Anxiety Related Disorders.

At the 12-month follow-up assessment, girls again completed questionnaires assessing anxiety and depression, including suicidal ideation. All study procedures were approved by the University of Pittsburgh Institutional Review Board.

Analytic plan

Our analyses serve as an empirical demonstration of how intensive longitudinal data from real parent-child interactions can be quantified within a developmentally sensitive, interpersonal model of reciprocity. We present this demonstration in a pilot sample of early adolescent girls at risk for affective disorders based on shy and fearful temperaments. To achieve this goal, we used actor–partner interdependence modeling (APIM; Kenny & Ledermann, 2010) within a multilevel structural equation modeling (MSEM; Sadikaj et al., 2021) framework, both as a conceptual and methodological guide, to test our hypotheses.

The key components of APIM are *actor* and *partner effects*. *Actor effects* measure how much an individual's current behavior (e.g., eye-gaze, facial affect) is predicted by their own past behavior. *Partner effects* measure how much the individual's current behavior is influenced by their partner's past behavior, as well as the interdependence among partners in a dyad. Assessing continuous behavioral processes involved in social communication during a conflictual interaction generates a hierarchical data structure, wherein uninterrupted measures of gaze and facial affect data are nested within individuals. We used MSEM because it can accommodate a nested data structure (i.e., timepoints of continuously collected gaze and affect recordings nested in participants) and allows for the decomposition of the total variance into latent between-dyad variance and the within-dyad residual variance. Individual differences in reciprocity of eye-gaze and facial affect were separately modeled using random intercepts. At the within-dyad level we estimated actor and partner effects of social communication (i.e., eye-gaze, positive facial affect). These effects were also estimated to be random across individuals (i.e., random slopes). Significant within-dyad associations among parents' and adolescents' own social communication indicate that variables tend to fluctuate together away from a person's baseline level (e.g., seconds in which parents reciprocate their daughters gaze typically coincide with girls reciprocating their parents' gaze). At the between-dyad level, effects provide an estimate of an individual's average and their associations, akin to coefficients typically gathered from cross-sectional designs.

Our hypotheses were tested in a stepwise analytic approach, accounting for adolescents' and parents' baseline psychopathology and controlling for the possibility of suppression effects. Figure 1 provides a graphic overview of our data analytic approach. Specifically, to establish the validity of our social communication estimates, Model 1 included parents' and adolescents' eye-gaze (or,separately, facial affect) as predictors of their and their partner's eye-gaze (or facial affect), both at the within- and between-dyad level. Importantly, our outcome variables at time $T + 1$ (e.g., gaze or facial affect) were predicted by the same variables at time T. Next, Model 2 estimated whether negative random slopes of partner effects (i.e., blunted social communication) were amplified in girls exhibiting elevated levels of SI in the two weeks prior to the 12-month follow-up assessment. Accordingly, in Model 2, 12-month SI was introduced as a cross-level moderator of the strength of the random slope of each of the actor and partner effects. Facilitated by our stepwise approach, together, Model 1 and 2 allowed us to test what each of our predictors account for in a multivariate model examining differences in girls' SI prospectively. Simple slope analyses were used to determine the pattern of significant cross-level interactions.

Supplementing these primary models, we also examined the extent to which social communication dynamics were associated with girls' recent history of SI. To do this, our baseline measure of SI, which measured SI during the previous two weeks, was introduced as a cross-level moderator of strength of the random slope of each of the actor and partner effects – as in Model 2. Further, in sensitivity analyses, we restricted our dataset to biological mother-daughter dyads by excluding father-daughter dyads ($n = 8$ in each sample) and those involving adoptive mothers ($n = 1$). We also excluded the "thinking about death and dying" item from our SI composite score and focused instead on the three

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

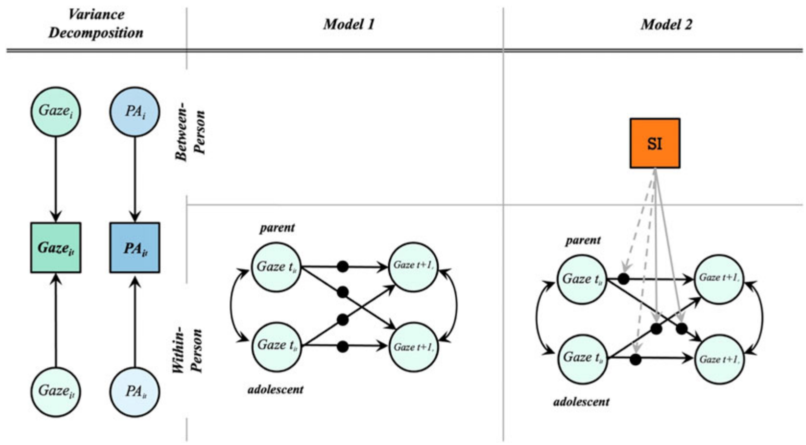

Figure 1. Multilevel structural equation models. Statistical models representing actor–partner interdependence models 1 and 2 and including the decomposition of observed variables into between- (subscript $_i$) and within-person (subscript $_t$) variance. Between-person variance reflects individual differences in the observed variables, and the within-person variance reflects epoch-to-epoch departures from each individual's mean on these variables. Single-headed arrows indicate regression paths; double-headed arrows indicate correlations. Filled dots represent random effects. Cross-level interaction: changes of the association strength of the actor- or partner-effects as a function of SI was assessed 12-months later. Horizontal lines denote actor-effects, diagonal lines denote partner-effects. Solid gray lines denote key hypotheses tested, dashed lines denote additionally tested moderation paths. Models 1 and 2 were repeated with facial affect data.

items more directly related to the participant (and not death in general). Finally, although our primary goal was to understand how social communication behaviors during parent-adolescent interactions relate to girls' subsequent SI (rather than changes in SI over time), we conducted sensitivity analyses in which we statistically controlled for baseline levels of SI. We present these results, which were consistent with the primary model findings, in the supplement.

For all models, MSEM was performed using Mplus Version 8.11 (Muthén & Muthén, 1998) with Bayesian estimation. Significance for all model parameters was determined based on 95% Credibility Intervals (CIs), with CIs excluding zero indicating parameters significantly differing from zero. Missing data were assumed to be missing at random given that participants with and without useable data did not significantly differ in terms of demographic (i.e., age, income) or clinical (i.e., symptoms of anxiety, depression, SI) variables (lowest $p = .06$). Participants with and without facial affect data did significantly differ by race ($p = .02$), which we attribute to documented challenges that automated facial recognition software has fitting algorithms to darker skin (Zou & Schiebinger, 2018), likely as a result of bias toward lighter skin in the training sets for these programs. Adopting a Bayesian approach to SEM allowed the use of all available data in estimation, yielding similar results to Full Information Maximum Likelihood with large samples for addressing missing data.

Results

Model 1: (Baseline actor and partner effects)

We found significant positive actor-effects for both eye-gaze ($B = .43$; CI: .37; .47) and positive facial affect ($B = .53$; CI: .51; .57). Significant partner-effects emerged only for positive facial affect ($B = .53$; CI: .51; .57; *see Model 1 in* Table 2 *for a detailed overview*). Overall, this pattern confirms our model's ability to capture gaze reciprocity (or lack thereof), and particularly so for models based on exchanges of positive affect. To illustrate, during a given second, when adolescents shared facial expressions of happiness with their parent, this expression was typically reciprocated by the parent (parent-to-adolescent partner-effect). In the case of significant actor-effects, positive-person effects suggest more sustained behaviors by each interaction partner during the interaction. At the between-dyad level, associations among actor- and partner-effects were either scarce or of generally negligible magnitude.

Model 2: (Interaction with 12-month SI)

In tests of cross-level interactions (*see right panel of* Figure 1), we observed that the positive within-dyad parent-to-adolescent effect for eye-gaze was weaker among adolescents who reported higher levels of SI 12 months later (i.e., less parental reciprocity of adolescents' gaze). This was evidenced by significant negative regression coefficients for SI at the 12-month follow-up ($B = -6.95$; CI: −14.18; −0.43; *see lower half of* Table 2). A parallel pattern emerged for happiness reciprocity. Here, the positive within-dyad parent-to-adolescent partner effect was once again less pronounced ($B = -6.1$; CI: −13.80; −1.29), but the parent-actor effect was stronger among adolescents reporting higher levels of SI 12 months later ($B = 1.58$; CI: .06; 4.39). Thus, beyond the observed decrease in reciprocity among dyads with adolescents who experienced more future SI, it was notable that, within this group, parents tended to display more sustained positive facial affect during conflictual interactions with their daughters (*see* Figure 1 and Table 2 *for details*).

Sensitivity analyses

First, we conducted a series of baseline models to determine whether similar patterns of social communication would emerge when examining adolescents' recent history of SI (i.e., SI in the two weeks preceding the baseline assessment). Adolescents' the severity of adolescents' history of SI did not significantly moderate any of the actor or partner effects in these models. Results of the gaze and facial affect models are presented in Supplemental Table 2. Next, we conducted sensitivity analyses for the gaze and positive facial affect models in which we restricted our dataset to biological mother-daughter dyads by excluding father-daughter dyads ($n = 8$) and one dyad with an adoptive mother. In the facial affect model, the parent-to-adolescent partner effect was

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

Table 2. Key unstandardized coefficients from multilevel structural equation actor–partner interdependence models

	Eye-gaze				Positive facial affect			
	Model 1		Model 2		Model 1		Model 2	
Within-person	B	CI	B	CI	B	CI	B	CI
Actor effect 1 (parent)	**.29**	**.24; .34**	**.29**	**.24; .34**	**.53**	**.50; .57**	**.54**	**.51; .57**
Actor effect 2 (daughter)	**.44**	**.38; .49**	**.44**	**.38; .49**	**.61**	**.58; .63**	**.62**	**.60; .64**
Partner effect 1 (parent→daughter)	.00	−.02; .02	.00	−.02; .02	**.05**	**.04; .06**	**.05**	**.04; .07**
Partner effect 2 (daughter→parent)	−.01	−.03; .02	.00	−.03; .02	**.08**	**.06; .10**	**.08**	**.06; .10**
Between-person								
12-month SI→ actor effect 1	–	–	.71	−.70; 2.00	–	–	**1.58**	**.06; 4.39**
12-month SI → actor effect 2	–	–	−.11	−1.24; 1.17	–	–	−1.64	−4.14; .77
12-month SI → partner effect 1	–	–	**−6.95**	**−14.18; −0.43**	–	–	**−6.1**	**−13.80; −1.29**
12-month SI → partner effect 2	–	–	1.67	−6.07; 9.07	–	–	.11	−5.97; 5.95

Note. Total: $N_{eye\text{-}gaze} = 70$ (*between*), $N_{eye\text{-}gaze} = 18{,}093$ (*within*); $N_{positive\ affect} = 103$ (*between*), $N_{positive\ affect} = 28{,}253$ (*within*); →indicates regression. Model parameter estimates are unstandardized. Bolded values indicate that 95% credibility interval of parameter estimates (CI) does not contain zero.

maintained ($B = -8.95$; CI: −19.43; −.72) while the parent actor effect was marginally significant ($B = 1.83$; CI: −.48; 4.42). In the gaze model, the parent-to-adolescent partner effect was marginally significant ($B = -7.45$; CI: −14.19; 1.45). In separate sensitivity analyses, we excluded the “thinking about death and dying” item from our SI composite score and focused instead on the three items more directly related to the participant (and not death in general). Similarly, in the facial affect model, the parent-to-adolescent partner effect was maintained ($B = -4.16$; CI: −9.05; −.79) while the parent actor effect was marginally significant ($B = 1.07$; CI: −.03; 2.89). The parent-to-adolescent partner effect was also marginally significant ($B = -4.53$; CI: −9.39; .25) in the gaze model. Finally, in a fourth set of follow-up analyses, we statistically adjusted for baseline levels of SI in our prospective models. In the baseline-adjusted facial affect model, the parent actor effect was maintained ($B = 1.59$; CI: .01; 3.64) while the parent-to-adolescent partner effect was marginally significant ($B = -6.82$; CI: −13.01; 1.10). In the baseline-adjusted gaze models, the parent-to-adolescent partner effect was maintained ($B = -6.30$; CI: −18.88; −.94). Given our relatively small sample size, we suspect the loss of significance in some of these follow-up analyses may be the result of the diminished power of these models. Nonetheless, the results remained generally consistent with the results of our primary analyses.

Discussion

Under the framework of RDoC, this proof-of-concept study aimed to assess the extent to which two behavioral indices of social communication during conflictual parent-adolescent interactions (i.e., eye-gaze and positive facial affect) differ based on adolescents’ levels of SI. Confirming our hypothesis, girls who experienced less reciprocity of eye-gaze, and separately, less reciprocity of positive facial affect during parent-adolescent conflict reported higher levels of SI prospectively. Specifically, girls whose parents did not reciprocate their attempts at eye contact or their facial expressions of happiness during discussions were prone to report higher levels of SI at the 12-month assessment. Although we can make no causal determinations from the current study, the prospective nature of our findings highlight the potential importance of reciprocal eye-contact and positive facial affect during conflictual discussions between parents and their adolescent daughters, and suggests associations between these behavioral indices of social communication and future SI in early adolescent girls. Specifically, girls whose parents do not reciprocate their eye-contact or expressions of happiness during conflictual discussions may be at heightened risk for experiencing future SI. Importantly, this pattern of results is consistent with findings from the only published study examining associations between social communication – albeit physiology rather than behavior – and *future* SI. That study showed that adolescent girls who exhibit greater physiological withdrawal during a social stress paradigm report higher levels of SI prospectively (Giletta et al., 2017). The current study extends this prior work by examining the relation between *dyadic* patterns of social communication between interaction partners in the context of social stress and future SI in adolescent girls.

One possible explanation for this pattern of findings is that disruptions in social communication, like eye-gaze or positive facial affect, decrease how close or connected these adolescents feel to their parents, which may then increase risk for STB. Indeed, factors related to social connectedness (e.g., thwarted belongingness) form the foundation of theoretical models of STB (Klonsky & May, 2015; Van Orden et al., 2010) and there is empirical evidence that social connectedness protects against STB (Arango et al., 2019; Conner et al., 2016; Czyz et al., 2012; Kuramoto-Crawford et al., 2017; Whitlock et al., 2014). As described earlier, reciprocity of eye-gaze and positive facial affect during social interaction both facilitate affiliation between dyadic partners (Argyle & Dean, 1965, Golland et al., 2019). To this end, an adolescent whose parent does not reciprocate their attempts at adaptive social communication (e.g., eye-contact, the exchange of smiles during interaction) may be less likely to experience rewarding social interactions with their parent (e.g., connectedness), which may be especially important in the context of social stressors. Moreover, because environmental information and experiences, such as rewarding or punishing social interactions, shape subsequent decision-making and behaviors over the course of development (Nussenbaum & Hartley, 2019), the dynamics of these early parent-adolescent interactions may decrease the adolescent’s use of effective social communication processes in future interactions. Further, it may decrease their motivation to seek out future social interactions, resulting in a sense of disconnectedness and increased risk for STB.

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

Future research testing social connectedness as a mechanism through which disruptions in social communication increase risk for STB is needed.

It is also important to note that, in the current study, associations between dyadic social communication and adolescents' SI were specific to prospective risk: no significant relations emerged between dyadic social communication and adolescents' history of SI at baseline. Given the specificity of our findings to *future* SI, it is possible that disrupted reciprocity of gaze and affect may not be a clinical correlate of recent SI in early adolescent girls, but rather an early predictor of future risk. That said, the current study did not replicate prior studies demonstrating differences in processes involved in social communication (i.e., affect, physiology) in those with and without histories of STB (e.g., James et al., 2017, 2021; Rizk et al., 2018; Wilson et al., 2016), perhaps as a result of methodological differences between this previous research and the current study. For example, prior studies have focused on samples of children (James et al., 2017, 2021) and adults (Rizk et al., 2018; Wilson et al., 2016), but not adolescents, and it is possible – perhaps even likely – that there are developmental differences in social communication processes. Two of these previous studies also focused specifically on physiological responses during social stress paradigms in which participants did not know their interaction partners (Rizk et al., 2018; Wilson et al., 2016). It is possible that dynamics of social communication may be dependent on the context of the interaction, including the nature of the relationship between interactions partners (e.g., parent-child, peers, romantic partners, strangers). Finally, the current study focused on adolescents' recent history of SI (i.e., in the past two weeks) whereas prior studies have focused more broadly on lifetime history of STB.

The current study has several strengths including the use of high-quality and nuanced behavioral data during an ecologically valid parent-adolescent interaction paradigm. Nonetheless, several limitations warrant consideration. First, we consider this study to be a proof-of-concept due to the small number of adolescents endorsing (relatively low levels of) SI in this study. Ten (of 103) adolescents included in the facial affect analyses and seven (of 70) adolescents included in the gaze analyses reported SI at the 12-month follow-up assessment. The low rate of SI in our sample limits power for the presented analyses. Nonetheless, the same pattern of results emerges across both indices of social communication, which bolsters support for our findings. Second, the adolescents in our study who reported SI generally reported low severity, passive SI and the MFQ does not include items assessing suicidal planning, intent, or behavior. As such, we were unable to determine the specificity of these findings to passive vs. active suicidal thoughts, or suicidal thoughts vs. behaviors. Third, and relatedly, although assessing SI over a shorter period of time (i.e., two-weeks versus 12-months) improves the accuracy of report, we acknowledge the likelihood that some adolescents in our sample who did not report SI during the two-week period assessed by the MFQ may have experienced SI during the 12-month follow-up period. Future longitudinal studies that incorporate more frequent and comprehensive follow-up assessments of STBs are needed to better understand the trajectory of risk, particularly given that STBs are often episodic in nature and tend to fluctuate dramatically over time. Fourth, the current study focuses exclusively on dyadic social communication in the context of a conflict discussion. In the absence of similar data from a positively-valenced interaction, it is impossible to discern whether these patterns of social communication are specific to negatively-valenced interactions or to the nature of parent-adolescent interactions more generally.

It is also important to note that our sample for the facial affect analyses was much larger ($N = 103$) than the sample used for the eye-gaze analyses ($N = 70$). As a result, the facial affect models are more highly powered than the eye-gaze models. That said, we acknowledge the possibility that, in some instances, FaceReader may have inaccurately identified another emotional expression (e.g., derision) as happiness. Additionally, we observed systematic differences in which participants could be coded by FaceReader. Specifically, in our study, FaceReader was unable to code facial affect from significantly more participants who identified as Black than participants who identified as another race. As previously noted, there are documented challenges with automated facial recognition software fitting algorithms to darker skin (Zou & Schiebinger, 2018), which is likely the result of bias for lighter skin in the training sets for these programs. We note this as a significant limitation that impacted the racial diversity of participants included in some of our models. Finally, the current study is also limited by its focus on girls, hindering generalization to boys. This decision was made to reduce heterogeneity in the sample, enabling a more highly powered examination of the model, which is more theoretically relevant for girls than boys (e.g., Centers for Disease Control and Prevention, 2024; Guyer et al., 2009; Kowalski et al., 2014; Nesi et al., 2019; Rose & Rudolph, 2006; Weinstein et al., 2006). Future research that develops and tests mechanistic models of STB for adolescent boys is necessary. Relatedly, future studies that focus on the role of the parent-adolescent relationship in youth should not only enroll mother-daughter dyads, but also father-daughter, mother-son, and father-son dyads to determine the extent to which these dynamics of social communication differ as a result of the genders of relationship partners. These studies should also consider the role of other behavioral forms of social communication, like verbal behavior, in risk for STB.

Conclusion

In summary, findings from the current study indicate dynamics of social communication during conflictual (and potentially stressful) parent-adolescent interactions are associated with risk for STB in early adolescent girls. If replicated, the dynamics of eye-gaze and positive facial affect during parent-adolescent interactions could serve as accessible behavioral targets for prevention and intervention efforts to reduce future STB. Continued research in this area may elucidate specific and modifiable mechanisms of risk (e.g., social connectedness) that can be targeted to reduce future STB with cost-effective and accessible therapeutics like attention retraining and social skills trainings. If supported by future research, such interventions could aim to increase specific dynamics of social communication that sustain beneficial social connection processes to reduce STB during adolescence and into adulthood.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S0954579425000070.

Acknowledgements. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The authors thank Kayley Morrow, Marcie Walker, Elisa Borrero, Sarah Naselesky, Sarah Wang, Celine Lu, and Marcus Min for their help in conducting assessments and data management and the participants of the study for their time and willingness to provide data.

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

Funding statement. This research was supported by the National Institute of Mental Health under grant R01 MH103241 awarded to J.S.S. and C.D.L. and grant F32 MH127880 awarded to K.M.J. Research reported in this publication was also supported by the National Center For Advancing Translational Sciences of the National Institutes of Health under Award Number KL2TR001856.

Competing interests. The authors declare none.

References

Ackard, D. M., Neumark-Sztainer, D., Story, M., & Perry, C. (2006). Parent-child connectedness and behavioral and emotional health among adolescents. *American Journal of Preventive Medicine*, *30*(1), 59–66. https://doi.org/10.1016/j.amepre.2005.09.013

Allen, K. B., Woody, M. L., Rosen, D., Price, R. B., Amole, M. C., & Silk, J. S. (2020). Validating a mobile eye tracking measure of integrated attention bias and interpretation bias in youth. *Cognitive Therapy and Research*, *44*(3), 668–677. https://doi.org/10.1007/s10608-019-10071-6

Angold, A., Weissman, M. M., John, K., Merikangas, K.R., Prusoff, B. A., Wickramaratne, P., Gammon, G. D. & Warner, V. (1987). Parent and child reports of depressive symp-toms in children at low and high risk of depression. *Journal of Child Psychology and Psychiatry*, *28*(6), 901–916. https://doi.org/10.1111/j.1469-7610.1987.tb00678.x

Arango, A., Cole-Lewis, Y., Lindsay, R., Yeguez, C. E., Clark, M., & King, C. (2019). The protective role of connectedness on depression and suicidal ideation among bully victimized youth. *Journal of Clinical Child & Adolescent Psychology*, *48*(5), 728–739. https://doi.org/10.1080/15374416.2018.1443456

Argyle, M., & Dean, J. (1965). Eye-contact, distance, and affilation. *Sociometry*, *28*(3), 289–384. https://doi.org/10.2307/2786027

Birmaher, B., Khetarpal, S., Brent, D., Cully, M., Balach, L., Kaufman, J., & Neer, S. M. (1997). The Screen for Child Anxiety Related Emotional Disorders (SCARED): Scale construction and psychometric characteristics. *Journal of the American Academy of Child & Adolescent Psychiatry*, *36*(4), 545–553. https://doi.org/10.1097/00004583-199704000-00018

Böckler, A., van der Wel, R. P. R. D., & Welsh, T. N. (2014). Catching eyes: Effects of social and nonsocial cues on attention capture. *Psychological Science*, *25*(3), 720–727. https://doi.org/10.1177/0956797613516147

Burke, T. A., Hamilton, J. L., Ammerman, B. A., Stange, J. P., & Alloy, L. B. (2016). Suicide risk characteristics among aborted, interrupted, and actual suicide attempters. *Psychiatry Research*, *242*, 357–364. https://doi.org/10.1016/j.psychres.2016.05.051

Burkhouse, K. L., Woody, M. L., Owens, M., McGeary, J. E., Knopik, V. S., & Gibb, B. E. (2016). Sensitivity in detecting facial displays of emotion: Impact of maternal depression and oxytocin receptor genotype. *Cognition and Emotion*, *30*(2), 275–287. https://doi.org/10.1080/02699931.2014.996531

Centers for Disease Control and Prevention. (2024). Youth Behavior Risk Survey: Data summary and trends report - 2011-2023.

Centers for Disease Control and Prevention, & National Center for Injury Prevention and Control. (2021). 10 leading causes of death 2001-2020. National Center for Health Statistics. https://wisqars.cdc.gov/data/lcd/home

Centorrino, S., Djemai, E., Hopfensitz, A., Milinski, M., & Seabright, P. (2015). Honest signaling in trust interactions: Smiles rated as genuine induce trust and signal higher earning opportunities. *Evolution and Human Behavior*, *36*(19), 8–16. https://doi.org/10.1016/j.evolhumbehav.2014.08.001

Chiu, Y. C., Tseng, C. Y., & Lin, F. G. (2017). Gender differences and stage-specific influence of parent-adolescent conflicts on adolescent suicidal ideation. *Psychiatry Research*, *255*, 424–431. https://doi.org/10.1016/j.psychres.2017.06.077

Conner, K. R., Wyman, P., Goldston, D. B., Bossarte, R. M., Lu, N., Kaukeinen, K., Tu, X. M., Houston, R. J., Lamis, D. A., Chan, G., Bucholz, K. K., & Hesselbrock, V. M. (2016). Two studies of connectedness to parents and suicidal thoughts and behavior in children and adolescents. *Journal of Clinical Child and Adolescent Psychology*, *45*(2), 129–140. https://doi.org/10.1080/15374416.2014.952009

Crowell, S. E., Beauchaine, T. P., McCauley, E., Smith, C. J., Vasilev, C. A., & Stevens, A. L. (2008). Parent-child interactions, peripheral serotonin, and self-inflicted injury in adolescents. *Journal of Consulting and Clinical Psychology*, *76*(1), 15–21. https://doi.org/10.1037/0022-006X.76.1.15

Cuthbert, B. N. (2014). The RDoC framework: Facilitating transition from ICD/DSM to dimensional approaches that integrate neuroscience and psychopathology. *World Psychiatry*, *3*, 28–35. https://doi.org/10.1002/wps.20087

Czyz, E. K., Liu, Z., & King, C. A. (2012). Social connectedness and one-year trajectories among suicidal adolescents following psychiatric hospitalization. *Journal of Clinical Child and Adolescent Psychology*, *41*(2), 214–226. https://doi.org/10.1080/15374416.2012.651998

den Uyl, M. J., & van Kuilenberg, H. (2005). The FaceReader: Online facial expression recognition. In L. P. J. J. Noldus, F. Grieco, L. W. S. Loijens and P. H. Zimmerman (Eds.), *Proceedings of Measuring Behavior 2005, 5th International Conference on Methods and Techniques in Behavioral Research* (pp. 589–590). Noldus Information Technology.

Ellis, L., & Rothbart, M. (2001). *Revision of the early adolescent temperament questionnaire*. Society for Research in Child Development.

Fisher, L. B., Overholser, J. C., Ridley, J., Braden, A., & Rosoff, C. (2015). From the outside looking in: Sense of belonging, depression, and suicide risk. *Psychiatry (New York)*, *78*(1), 29–41. https://doi.org/10.1080/00332747.2015.1015867

Frischen, A., Bayliss, A. P., & Tipper, S. P. (2007). Gaze cueing of attention: Visual attention, social cognition, and individual differences. *Psychological Bulletin*, *133*(4), 694–724. https://doi.org/10.1037/0033-2909.133.4.694

Ge, X., Lorenz, F. O., Conger, R. D., Elder, G. H., & Simons, R. L. (1994). Trajectories of stressful life events and depressive symptoms during adolescence. *Developmental Psychology*, *30*(4), 467–483. https://doi.org/10.1037/0012-1649.30.4.467

Giletta, M., Hastings, P. D., Rudolph, K. D., Bauer, D. J., Nock, M. K., & Prinstein, M. J. (2017). Suicide ideation among high-risk adolescent females: Examining the interplay between parasympathetic regulation and friendship support. *Development and Psychopathology*, *29*(4), 1161–1175. https://doi.org/10.1017/S0954579416001218

Glenn, C. R., Cha, C. B., Kleiman, E. M., & Nock, M. K. (2017). Understanding suicide risk within the Research Domain Criteria (RDoC) framework: Insights, challenges, and future research considerations. *Clinical Psychological Science*, *5*(3), 568–592. https://doi.org/10.1177/2167702616686854

Glenn, C. R., Kleiman, E. M., Cha, C. B., Deming, C. A., Franklin, J. C., & Nock, M. K. (2018). Understanding suicide risk within the Research Domain Criteria (RDoC) framework: A meta-analytic review. *Depression and Anxiety*, *35*(1), 65–88. https://doi.org/10.1002/da.22686

Golland, Y., Mevorach, D., & Levit-Binnun, N. (2019). Affiliative zygomatic synchrony in co-present strangers. *Scientific Reports*, *9*(1), 1–10. https://doi.org/10.1038/s41598-019-40060-4

Grunebaum, M. F., Galfalvy, H. C., Mortenson, L. Y., Burke, A. K., Oquendo, M. A., & Mann, J. J. (2010). Attachment and social adjustment: Relationships to suicide attempt and major depressive episode in a prospective study. *Journal of Affective Disorders*, *123*(1), 123–130. https://doi.org/10.1016/j.jad.2009.09.010

Guyer, A. E., Choate, V. R., Pine, D. S., & Nelson, E. E. (2012). Neural circuitry underlying affective response to peer feedback in adolescence. *Social Cognitive and Affective Neuroscience*, *7*(1), 81–92. https://doi.org/10.1093/scan/nsr043

Guyer, A. E., McClure-Tone, E. B., Shiffrin, N. D., Pine, D. S., & Nelson, E. E. (2009). Probing the neural correlates of anticipated peer evaluation in adolescence. *Child Development*, *80*(4), 1000–1015. https://doi.org/10.1111/j.1467-8624.2009.01313.x

Hammerton, G., Zammit, S., Potter, R., Thapar, A., & Collishaw, S. (2014). Validation of a composite of suicide items from the Mood and Feelings Questionnaire (MFQ) in offspring of recurrently depressed parents. *Psychiatry research*, *216*(1), 82–88. https://doi.org/10.1016/j.psychres.2014.01.040

Heatherington, E. M., Henderson, S. H., Reiss, D., Anderson, E. R., Bridges, M., Chan, R. W., Insabella, G. M., Jodl, K. M., Kim, J. E., Mitchell, A. S., O'Connor, T. G., Skaggs, M. S., & Taylor, L. C. (1999). Adolescent siblings in stepfamilies: Family functioning and adolescent adjustment. *Monographs of the Society for Research in Child Development*, *64*(4), 222.https://doi.org/10.1111/1540-5834.00046

Heerey, E. A., & Crossley, H. M. (2013). Predictive and reactive mechanisms in smile reciprocity. *Psychological Science*, *24*(8), 1446–1455. https://doi.org/10.1177/0956797612472203

Heerey, E. A., & Kring, A. M. (2007). Interpersonal consequences of social anxiety. *Journal of Abnormal Psychology*, *116*(1), 125–134. https://doi.org/10.1037/0021-843X.116.1.125

Hess, U., & Bourgeois, P. (2010). You smile-I smile: Emotion expression in social interaction. *Biological Psychology*, *84*(3), 514–520. https://doi.org/10.1016/j.biopsycho.2009.11.001

Hetherington, E. M. (1992). Coping with marital transitions: A family systems perspective. *Monographs of the Society for Research in Child Development*, *57*(2-3), 1–14. https://doi.org/10.1111/j.1540-5834.1992.tb00300.x

Hietanen, J. K. (2018). Affective eye contact: An integrative review. *Frontiers in Psychology*, *9*, 1587. https://doi.org/10.3389/fpsyg.2018.01587

Hietanen, J. K., Helminen, T. M., Kiilavuori, H., Kylliäinen, A., Lehtonen, H., & Peltola, M. J. (2018). Your attention makes me smile: Direct gaze elicits affiliative facial expressions. *Biological Psychology*, *132*, 1–8. https://doi.org/10.1016/j.biopsycho.2017.11.001

Hutchinson, E. A., Rosen, D., Allen, K., Price, R. B., Amole, M., & Silk, J. S. (2019). Adolescent gaze-directed attention during parent-child conflict: The effects of depressive symptoms and parent-child relationship quality. *Child Psychiatry and Human Development*, *50*(3), 483–493. https://doi.org/10.1007/s10578-018-0856-y

James, K. M., Kudinova, A. Y., Woody, M. L., Feurer, C., Foster, C. E., & Gibb, B. E. (2020). Children's history of suicidal ideation and synchrony of facial displays of affect during mother-child interactions. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *62*(1), 40–47. https://doi.org/10.1111/jcpp.13231

James, K. M., Kudinova, A. Y., Woody, M. L., Feurer, C., Foster, C. E., & Gibb, B. E. (2021). Children's history of suicidal ideation and synchrony of facial displays of affect during mother-child interactions. *Journal of Child Psychology and Psychiatry*, *62*(1), 40–47. https://doi.org/10.1111/jcpp.13231

James, K. M., Woody, M. L., Feurer, C., Kudinova, A. Y., & Gibb, B. E. (2017). Disrupted physiological reactivity among children with a history of suicidal ideation: Moderation by parental expressed emotion-criticism. *Biological Psychology*, *130*, 22–29. https://doi.org/10.1016/j.biopsycho.2017.10.003

Jarick, M., & Bencic, R. (2019). Eye contact is a two-way street: Arousal is elicited by the sending and receiving of eye gaze information. *Frontiers in Psychology*, *10*, 1262. https://doi.org/10.3389/fpsyg.2019.01262

John, A., Glendenning, A. C., Marchant, A., Montgomery, P., Stewart, A., Wood, S., Lloyd, K., & Hawton, K. (2018). Self-harm, suicidal behaviours, and cyberbullying in children and young people: Systematic review. *Journal of Medical Internet Research*, *20*(4), e129. https://doi.org/10.2196/jmir.9044

Jollant, F., Lawrence, N. S., Giampietro, V., Brammer, M. J., Fullana, M. A., Drapier, D., Courtet, P. & Phillips, M. L. (2008). Orbitofrontal cortex response to angry faces in men with histories of suicide attempts. *American Journal of Psychiatry*, *165*(6), 740–748.

Katsaras, G. N., Vouloumanou, E. K., Kourlaba, G., Kyritsi, E., Evagelou, E., & Bakoula, C. (2018). Bullying and suicidality in children and adolescents without predisposing factors: A systematic review and meta-analysis. *Adolescent Research Review*, *3*(2), 193–217. https://doi.org/10.1007/s40894-018-0081-8

Kenny, D. A., & Ledermann, T. (2010). Detecting, measuring, and testing dyadic patterns in the actor–partner interdependence model. *Journal of Family Psychology*, *24*(3), 359.

Kleinke, C. L. (1986). Gaze and eye contact: A research review.. *Psychological Bulletin*, *100*(1), 78–100. https://doi.org/10.1037/0033-2909.100.1.78

Klonsky, D. E., & May, A. M. (2015). The three-step theory (3ST): A new theory of suicide rooted in the, ideation-to-action, framework. *International Journal of Cognitive Therapy*, *8*(2), 114–129. https://doi.org/10.1521/ijct.2015.8.2.114

Kowalski, R. M., Giumetti, G. W., Schroeder, A. N., & Lattanner, M. R. (2014). Bullying in the digital age: A critical review and meta-analysis of cyberbullying research among youth. *Psychological Bulletin*, *140*(4), 1073–1137. https://doi.org/10.1037/a0035618

Krumhuber, E., Manstead, A. S. R., & Kappas, A. (2007). Temporal aspects of facial displays in person and expression perception: The effects of smile dynamics, head-tilt, and gender. *Journal of Nonverbal Behavior*, *31*(1), 39–56. https://doi.org/10.1007/s10919-006-0019-x

Kuramoto-Crawford, S. J., Ali, M. M., & Wilcox, H. C. (2017). Parent-child connectedness and long-term risk for suicidal ideation in a nationally representative sample of US adolescents. *Crisis-the Journal of Crisis Intervention and Suicide Prevention*, *38*(5), 309–318. https://doi.org/10.1027/0227-5910/a000439

Lau, J. Y. F., Guyer, A. E., Tone, E. B., Jenness, J., Parrish, J. M., Pine, D. S., & Nelson, E. E. (2012). Neural responses to peer rejection in anxious adolescents. *International Journal of Behavioral Development*, *36*(1), 36–44. https://doi.org/10.1177/0165025411406854

Leadbeater, B. J., Blatt, S. J., & Quinlan, D. M. (1995). Gender-linked vulnerabilities to depressive symptoms, stress, and problem behaviors in adolescents. *Journal of Research on Adolescence*, *5*(1), 1–29. https://doi.org/10.1207/s15327795jra0501_1

Loijens, L., & Krips, O. (2019). FaceReader Methodology Note. Noldus Information Technology.

Lyyra, P., Astikainen, P., & Hietanen, J. K. (2018). Look at them and they will notice you: Distractor-independent attentional capture by direct gaze in change blindness. *Visual Cognition*, *26*(1), 25–36. https://doi.org/10.1080/13506285.2017.1370052

Masten, C. L., Eisenberger, N. I., Borofsky, L. A., Pfeifer, J. H., McNealy, K., Mazziotta, J. C., & Dapretto, M. (2009). Neural correlates of social exclusion during adolescence: Understanding the distress of peer rejection. *Social Cognitive and Affective Neuroscience*, *4*(2), 143–157. https://doi.org/10.1093/scan/nsp007

Mayberg, H. S. (2003). Modulating dysfunctional limbic-cortical circuits in depression: Towards development of brain-based algorithms for diagnosis and optimised treatment. *British Medical Bulletin*, *65*(1), 193–207. https://doi.org/10.1093/bmb/65.1.193

Mazur, A., Rosa, E., Faupel, M., Heller, J., Leen, R., & Thurman, B. (1980). Physiological aspects of communication via mutual gaze. *American Journal of Sociology*, *86*(1), 50–74. https://doi.org/10.1086/227202

McKone, K. M. P., Woody, M. L., Ladouceur, C. D., & Silk, J. S. (2021). Mother-daughter mutual arousal escalation and emotion regulation in adolescence. *Research on Child and Adolescent Psychopathology*, *49*(5), 615–628. https://doi.org/10.1007/s10802-020-00763-z

Mehu, M., Grammer, K., & Dunbar, R. I. M. (2007). Smiles when sharing. *Evolution and Human Behavior*, *28*(6), 415–422. https://doi.org/10.1016/j.evolhumbehav.2007.05.010

Miranda-Mendizabal, A., Castellví, P., Parés-Badell, O., Alayo, I., Almenara, J., Alonso, I., Blasco, M. J., Cebrià, A., Gabilondo, A., Gili, M., Lagares, C., Piqueras, J. A., Rodríguez-Jiménez, T., Rodríguez-Marín, J., Roca, M., Soto-Sanz, V., Vilagut, G., & Alonso, J. (2019). Gender differences in suicidal behavior in adolescents and young adults: Systematic review and meta-analysis of longitudinal studies. *International Journal of Public Health*, *64*(2), 265–283. https://doi.org/10.1007/s00038-018-1196-1

Muthén LK, Muthén BO. (1998). Mplus User's Guide. Eighth. Muthén & Muthén.

Nesi, J., Wolff, J. C., & Hunt, J. (2019). Patterns of social media use among adolescents who are psychiatrically hospitalized. *Journal of the American Academy of Child and Adolescent Psychiatry*, *58*(6), 635–639.e1. https://doi.org/10.1016/j.jaac.2019.03.009

Nussenbaum, K., & Hartley, C. A. (2019). Reinforcement learning across development: What insights can we draw from a decade of research? *Developmental Cognitive Neuroscience*, *40*, 100733. https://doi.org/10.1016/j.dcn.2019.100733

Olié, E., Ding, Y., Le Bars, E., de Champfleur, N. M., Mura, T., Bonafé, A., Courtet, P. & Jollant, F. (2015). Processing of decision-making and social threat in patients with history of suicidal attempt: A neuroimaging replication study. *Psychiatry Research: Neuroimaging*, *234*(3), 369–377.

Pan, L. A., Hassel, S., Segreti, A. M., Nau, S. A., Brent, D. A., & Phillips, M. L. (2013). Differential patterns of activity and functional connectivity in emotion processing neural circuitry to angry and happy faces in adolescents with and without suicide attempt. *Psychological medicine*, *43*(10), 2129–2142. https://doi.org/10.1017/S0033291712002966

Pollak, S. D., & Kistler, D. J. (2002). Early experience is associated with the development of categorical representations for facial expressions of emotion. *Proceedings of the National Academy of Sciences of the United States of America*, *99*(13), 9072–9076. https://doi.org/10.1073/pnas.142165999

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press

Randell, B. P., Wang, W.-L., Herting, J. R., & Eggert, L. L. (2006). Family factors predicting categories of suicide risk. *Journal of Child and Family Studies*, *15*(3), 247–262. https://doi.org/10.1007/s10826-006-9020-6

Reed, L. I., Zeglen, K. N., & Schmidt, K. L. (2012). Facial expressions as honest signals of cooperative intent in a one-shot anonymous prisoner's dilemma game. *Evolution and Human Behavior*, *33*(3), 200–209. https://doi.org/10.1016/j.evolhumbehav.2011.09.003

Rideout, V., & Robb, M. B. (2018). Social media, social life: Teens reveal their experiences. Common Sense Media.

Rizk, M. M., Galfalvy, H., Singh, T., Keilp, J. G., Sublette, M. E., Oquendo, M. A., Mann, J. J., & Stanley, B. (2018). Toward subtyping of suicidality: Brief suicidal ideation is associated with greater stress response. *Journal of Affective Disorders*, *230*, 87–92. https://doi.org/10.1016/j.jad.2018.01.012

Rose, A. J., & Rudolph, K. D. (2006). A review of sex differences in peer relationship processes: Potential trade-offs for the emotional and behavioral development of girls and boys. *Psychological Bulletin*, *132*(1), 98–131. https://doi.org/10.1037/0033-2909.132.1.98

Rudolph, K. D. (2014). Puberty as a developmental context of risk for psychopathology. In *Handbook of developmental psychopathology: Third edition* (pp. 331–354). Springer. https://doi.org/10.1007/978-1-4614-9608-3_17

Rudolph, K. D., & Hammen, C. (1999). Age and gender as determinants of stress exposure, generation, and reactions in youngsters: A transactional perspective. *Child Development*, *70*(3), 660–677. https://doi.org/10.1111/1467-8624.00048

Sadikaj, G., Wright, A. G., Dunkley, D. M., Zuroff, D. C., & Moskowitz, D. S. (2021). Multilevel structural equation modeling for intensive longitudinal data: A practical guide for personality researchers. In J. F. Rauthmann (Ed.), *The handbook of personality dynamics and processes* (pp. 855–885). Academic Press.

Sampasa-Kanyinga, H., & Hamilton, H. A. (2016). Does socioeconomic status moderate the relationships between school connectedness with psychological distress, suicidal ideation and attempts in adolescents? *Preventive Medicine*, *87*, 11–17. https://doi.org/10.1016/j.ypmed.2016.02.010

Sheftall, A. H., Mathias, C. W., Furr, R. M., & Dougherty, D. M. (2013). Adolescent attachment security, family functioning, and suicide attempts. *Attachment and Human Development*, *15*(4), 368–383. https://doi.org/10.1080/14616734.2013.782649

Sheftall, A. H., Schoppe-Sullivan, S. J., & Bridge, J. A. (2014). Insecure attachment and suicidal behavior in adolescents. *Crisis-the Journal of Crisis Intervention and Suicide Prevention*, *35*(6), 426–430. https://doi.org/10.1027/0227-5910/a000273

Shirama, A. (2012). Stare in the crowd: Frontal face guides overt attention independently of its gaze direction. *Perception*, *41*(4), 447–459. https://doi.org/10.1068/p7114

Siegle, G. J., Thompson, W. K., Collier, A., Berman, S. R., Feldmiller, J., Thase, M. E., & Friedman, E. S. (2012). Toward clinically useful neuroimaging in depression treatment. *Archives of General Psychiatry*, *69*(9), 913. https://doi.org/10.1001/archgenpsychiatry.2012.65

Silk, J. S., Siegle, G. J., Lee, K. H., Nelson, E. E., Stroud, L. R., & Dahl, R. E. (2014). Increased neural response to peer rejection associated with adolescent depression and pubertal development. *Social Cognitive and Affective Neuroscience*, *9*(11), 1798–1807. https://doi.org/10.1093/scan/nst175

Soole, R., Kõlves, K., & De Leo, D. (2015). Suicide in children: A systematic review. *Archives of Suicide Research : Official Journal of the International Academy for Suicide Research*, *19*(3), 285–304. https://doi.org/10.1080/13811118.2014.996694

Tsypes, A., Owens, M., & Gibb, B. E. (2017). Suicidal ideation and attentional biases in children: An eye-tracking study. *Journal of Affective Disorders*, *222*, 133–137. https://doi.org/10.1016/j.jad.2017.07.012

Van Orden, K. A., Lynam, M. E., Hollar, D., & Joiner, T. E. (2006). Perceived burdensomeness as an indicator of suicidal symptoms. *Cognitive Therapy and Research*, *30*(4), 457–467. https://doi.org/10.1007/s10608-006-9057-2

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner, T. E. (2010). The interpersonal theory of suicide. *Psychological Review*, *117*(2), 575–600. https://doi.org/10.1037/a0018697

Weinstein, S. M., Mermelstein, R. J., Hedeker, D., Hankin, B. L., & Flay, B. R. (2006). The time-varying influences of peer and family support on adolescent daily positive and negative affect. *Journal of Clinical Child and Adolescent Psychology*, *35*(3), 420–430. https://doi.org/10.1207/s15374424jccp3503_7

Whitlock, J., Wyman, P. A., & Moore, S. R. (2014). Connectedness and suicide prevention in adolescents: Pathways and implications. *Suicide and Life-Threatening Behavior*, *44*(3), 246–272. https://doi.org/10.1111/sltb.12071

Wilson, S. T., Chesin, M., Fertuck, E., Keilp, J., Brodsky, B., Mann, J. J., Sönmez, C. C., Benjamin-Phillips, C., & Stanley, B. (2016). Heart rate variability and suicidal behavior. *Psychiatry Research*, *240*, 241–247. https://doi.org/10.1016/j.psychres.2016.04.033

Woody, M. L., Kaurin, A., McKone, K. M. P., Ladouceur, C. D., & Silk, J. S. (2022). Displays of negative facial affect during parent-adolescent conflict and the bidirectional transmission of social anxiety. *Journal of Child Psychology and Psychiatry*, *63*(8), 846–854. https://doi.org/10.1111/jcpp.13530

Woody, M. L., Price, R. B., Amole, M., Hutchinson, E., Benoit Allen, K., & Silk, J. S. (2020). Using mobile eye-tracking technology to examine adolescent daughters' attention to maternal affect during a conflict discussion. *Developmental Psychobiology*, *63*(6), e22024. https://doi.org/10.1002/dev.22024

Woody, M. L., Rosen, D., Allen, K. B., Price, R. B., Hutchinson, E., Amole, M. C., & Silk, J. S. (2019). Looking for the negative: Depressive symptoms in adolescent girls are associated with sustained attention to a potentially critical judge during in vivo social evaluation. *Journal of Experimental Child Psychology*, *179*, 90–102. https://doi.org/10.1016/j.jecp.2018.10.011

Zou, J., & Schiebinger, L. (2018). AI can be sexist and racist — it's time to make it fair. *Nature*, *559*(7714), 324–326. https://doi.org/10.1038/d41586-018-05707-8

https://doi.org/10.1017/S0954579425000070 Published online by Cambridge University Press