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EMPIRICAL ARTICLE

Feeling socially connected to others is linked to better emotion regulation in adolescent girls' daily lives: An ecological momentary assessment study

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Abstract

Developing effective emotion regulation ability to manage negative emotion (NE) is critical during adolescence. Social baseline theory posits social connectedness may impact adolescents' everyday emotion regulation. This study examined the relation between social connectedness and NE after a negative social interaction (emotion regulation) and whether contextual factors moderate the association. Adolescent girls ($N = 114$; $M_{age} = 12.26$, $SD = 0.8$) from a midsized Midwestern U.S. city (67.5% White, 19.3% Black/African American, 9.6% biracial, 1.8% Asian, 1.8% Native American/other race; 8.8% Latinx) completed a 16-day ecological momentary assessment (EMA) protocol, reporting current NE, current social context and social connectedness, peak NE, and receipt of co-regulatory support. Multilevel models were used to examine direct associations of social connectedness on emotion regulation, defined as current NE regressed on peak NE, and moderation of the social connectedness-emotion regulation association by social context, co-regulatory support, and adolescent shyness. Greater within- and between-person social connectedness was associated with better emotion regulation (greater reductions in NE). However, the within-person association depended on girls' social context: Compared to being with solely peers and/or non-family, being with family was associated with a weaker association between social connectedness and emotion regulation. Similarly, receiving in-the-moment co-regulatory support was associated with a weakened link between within-person social connectedness and emotion regulation, which appeared to be driven by reports of co-rumination. Results indicate that social connectedness is associated with better emotion regulation among girls, particularly in interactions with peers and non-family compared to family, highlighting the value of social connection with peers and non-family members. However, co-rumination disrupts the benefits of social connectedness, suggesting social connectedness is not beneficial during maladaptive co-regulatory processes.

KEYWORDS
adolescent emotion regulation, ecological momentary assessment, social connectedness

INTRODUCTION

Adolescence is a time of vast developmental shifts. Early adolescence, in particular, is a time of rapid change, especially for adolescent girls (Pfeifer & Allen, 2021). Although puberty onset is occurring at younger ages in youth in industrialized societies (including most of those where cited research has been conducted), most girls

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typically enter puberty around late childhood (ages 8–10) and have largely completed pubertal development by their early teenage years (ages 12–14; e.g., Aris et al., 2022); although there is variation in timing of pubertal onset and how quickly girls move through pubertal development (Biro et al., 2014; Dorn et al., 2013), in addition to (and resulting from) the physical and hormonal changes associated with puberty, the early adolescent brain undergoes a significant amount of development and restructuring (e.g., Crone & Dahl, 2012). Social interactions become much more salient (Blakemore & Mills, 2014) and adolescents become broadly more emotionally reactive, particularly to social information like social reward and rejection (Somerville et al., 2010). Further, adolescents are becoming increasingly independent and are branching out from their families of origin to engage with novel settings, relationships, and experiences. Additionally, adolescents become more reliant on peers and other age-mates as emotional support, as they shift away from primary reliance on parents/caregivers (Allen et al., 2022; Cui et al., 2020; Miller-Slough & Dunsmore, 2020; Steinberg & Morris, 2001). Taken together, the array of physical, emotional, and social changes of early adolescence results in a period during which the ability to effectively regulate emotions is particularly important for well-being. It is important to note that adolescent development is not a monolith, despite the preponderance of research on the topic from Western, educated, industrialized, rich, democratic countries (WEIRD countries; Henrich et al., 2010; Rad et al., 2018), including many of the studies cited here. Although our sample is also from a WEIRD country, the United States, we would like to contribute to raising awareness of the non-representativeness of (at least some) research on adolescent development. Where possible, we provide descriptive information about the geographic origin and demographic breakdown of samples included in the studies cited, to better contextualize the literature in its cultural and demographic origins. However, as some cited findings extend across demographic or cultural groups, for readability we have opted to provide this information in a supplemental table to provide additional positioning of these results in the sociocultural context in which they were observed. Information on demographic characteristics of the samples in cited literature on adolescent development is included in Appendix S1 of the Supplement.

As reported in several meta-analyses, research has consistently linked adolescents' difficulties in regulating negative emotions with greater internalizing symptoms (Aldao et al., 2010; Compas et al., 2017; Schäfer et al., 2017), at least for English-speaking adolescents (largely from the United States, Canada, and Global North), which comprise the participants from most of the studies aggregated in these meta-analyses. The implications of effective emotion regulation are especially important for adolescent girls, who—at least in the United States—tend to experience more intense negative emotion (Abitante et al., 2022; Griffith et al., 2021) and are at greater risk for developing internalizing symptoms, relative to adolescent boys (Merikangas et al., 2010; Salk et al., 2017; Twenge, 2020). Girls' heightened sensitivity to the social context (Rudolph, 2002) and, for some girls, dispositional shyness (Karevold et al., 2012) might result in more frequent elevated negative emotion throughout the course of adolescent girls' day-to-day lives that may be challenging to regulate. Further, the changing everyday contexts and increased social salience of adolescence (Blakemore & Mills, 2014), during which young people reorient from the family of origin toward peer relationships as a primary source of emotional support (again, as observed in the United States; Allen et al., 2022; Cui et al., 2020; Miller-Slough & Dunsmore, 2020; Steinberg & Morris, 2001), prompt a need to better understand the inter- and intrapersonal factors associated with adolescent girls' real-world regulatory efforts.

One underexplored factor that may influence the success or failure of adolescents' real-world regulatory efforts is social connectedness, or the extent to which adolescents feel close to individuals in their immediate social context. Social baseline theories of cognition and emotion suggest that social connectedness may play an important role in adolescents' regulatory efforts (Beckes & Coan, 2011). Contrary to (typically Western) assumptions that the regulatory baseline or set-point of organisms is the individual operating independently, social baseline theory posits that individuals' physiological set-points assume interaction with others. From this perspective, cognitive and emotional processes—such as emotion regulation—are less physiologically taxing when undertaken in proximity to others. A review of the adult literature supporting social baseline theory by Gross and Medina-DeVilliers (2020) cites a growing body of empirical findings supporting the role that social relationships play in facilitating regulation. (Note, most of the studies cited in the review were conducted in the United States and Europe.) Most pertinent to this study, the authors cite findings indicating that having physical contact with a partner during emotionally threatening situations aids in regulation (Johnson et al., 2013), and relationship quality plays an important role, with greater regulatory benefit coming in the context of higher relationship quality (Coan et al., 2006).

In the developmental literature, a number of studies have examined *physiological* regulation, or the regulation of physiological systems, between parents (typically mothers) and children in the United States/Global North countries, from infancy through childhood and into adolescence and adulthood (Davis et al., 2018; Feldman, 2012; Lougheed, 2020; Timmons et al., 2015; Woody et al., 2016). However, although there is some preliminary literature on interpersonal regulation (i.e., regulation that occurs with the assistance of another person) in adolescents in the United States and Canada (Lougheed et al., 2016; Stone et al., 2022), there is little research detailing how adolescents reorient from predominantly receiving regulatory support from family members to receiving support from peers and romantic partners. Further,

adolescents frequently interact with multiple social partners in a range of relationship forms (e.g., friends, siblings, parents, grandparents) throughout their daily lives, limiting the ecological validity of laboratory-based studies focused on a single dyadic relationship or interaction. Hence, more research is needed to examine the extent to which being in close proximity to peers, non-family, and family members helps adolescents regulate their emotions in real-world contexts.

The relation between social connectedness and emotion regulation is particularly relevant during the adolescent period, as normative developmental increases (in the United States/Global North) in adolescent emotional reactivity (Somerville et al., 2010) and sensitivity to peer feedback (Blakemore & Mills, 2014) as observed in the United States may result in an increased frequency of emotionally charged experiences, especially in response to negative interpersonal interactions. Adolescents experience heightened positive emotional reactivity in response to positive peer feedback (Guyer et al., 2012), and greater negative emotional reactivity and variability in response to negative peer feedback (Somerville et al., 2010). These circumstances may be exacerbated in dispositionally shy youth: One recent study using the current sample (girls oversampled for shyness/fearfulness) found that girls who exhibited greater neural sensitivity to social threat also exhibited more negative emotion reactivity to a negative peer interaction (as assessed via EMA; Sequeira, Rosen, et al., 2021). Indeed, the mere *presence* of a peer induces greater emotional reactivity among adolescents who believe that they are being socially evaluated (Somerville et al., 2013). Moreover, as peer relationships become increasingly salient throughout the adolescent period, compared to relationships with parents (Blakemore & Mills, 2014), the stakes are higher in peer contexts for adolescents to effectively regulate emotions that may arise in real-world contexts with peers.

Social connectedness and emotion regulation: Stronger with peers?

The degree to which social connectedness influences adolescents' regulatory abilities in real-world settings may be dependent on precisely *whom* girls feel close to in the moment (i.e., family members versus peers). Adolescent girls may exhibit systematic differences in how social connectedness impacts their ability to regulate emotions in their everyday lives based on their precise social context in the moment. The increased salience of peer interactions in adolescence suggests, in theory, that higher levels of social connectedness to peers could have particularly beneficial impacts on adolescent emotion regulation, compared to parents/caregivers or other family members. Further, there is empirical evidence to suggest that early adolescent girls may benefit more in their emotion regulation when they feel socially connected to peers. Results from one experience sampling study showed that a peer's presence helped buffer the negative effect of a stressful event (Adams et al., 2011). Additionally, at the same time as adolescents are increasingly invested in building social bonds with their peers, their emotions are more variable in response to peer feedback, creating circumstances in which the social costs of not effectively regulating negative emotions may be especially high. Hence, adolescent girls may be especially motivated to regulate negative emotions when in peer contexts (compared to being with family) to avoid social rejection (e.g., associated with socially deviant displays of emotion [Zeman & Garber, 1996]) and build social affiliation with peers. Examining whether early adolescent girls' social context in everyday life—specifically whether they are with peers or family members—alters the association between social connectedness and adolescent emotion regulation is an important next step in understanding adolescent emotion regulation development.

Co-regulation: Benefits for both social connectedness and emotion regulation?

Another factor that may alter the association between social connectedness and negative emotion regulation for adolescent girls is co-regulation, or early adolescent girls involving other individuals in their regulatory efforts. Theoretically, engaging in co-regulation may strengthen the association between social connectedness and negative emotion regulation via two distinct mechanisms. First, the process of engaging with a close other in an intimate process, like dealing with a difficult interpersonal situation, may directly increase feelings of social connectedness (von Salisch et al., 2014). Alternately, co-regulation may provide direct benefits to the adolescent through facilitating more successful down-regulation of negative emotion (Do et al., 2025), by introducing the adolescent to more effective strategies or scaffolding the use of more cognitively challenging strategies such as reappraisal. However, the research on co-regulation in adolescents' daily lives is sparse, and there is some indication that *co-rumination*, as one typically maladaptive co-regulation strategy in which adolescents repetitively focus on and discuss the upsetting situation with another individual, may function differently. Engaging in co-rumination with peers has been shown to increase social connectedness *and* perpetuate negative emotion/depressive symptoms (see Rose, 2021 for a review) in adolescent girls from the United States. Hence, although there is theoretical rationale for co-regulation broadly strengthening the association between social connectedness and emotion regulation, empirical findings on co-rumination suggest that it might function differently than other co-regulatory efforts.

Shy adolescents: Particularly sensitive to social connectedness?

Early adolescent girls' dispositional shyness may also influence the link between social connectedness and emotion

regulation. Some limited empirical work indicates that dispositional shyness may strengthen the association between social connectedness and emotion regulation, through findings suggesting that interactions with peers and parents buffer dispositionally shy adolescents against the development of anxiety disorders. A twenty-year prospective longitudinal study showed that social involvement with peers during adolescence moderated the link between individual behavioral inhibition tendencies and future risk for developing anxiety during adulthood (Frenkel et al., 2015). High social involvement—or connectedness—during adolescence weakened the risk for developing future anxiety, whereas lower social connectedness heightened this risk. Further, one meta-analysis indicated that parental warmth was modestly linked to fewer anxiety symptoms among youth, and these results were consistent across study demographics and locations (McLeod et al., 2007). Taken together, these findings suggest that during adolescence, dispositionally shy individuals may be particularly sensitive to how social connection with both parents and peers may subsequently impact their emotion regulation capacities and development of psychopathology.

The current study

Being near and feeling close to others likely impacts adolescents' ability to regulate negative emotion as they move throughout their daily lives, warranting further investigation into this question within adolescents' real-world contexts via EMA. Through multiple prompts administered within a single day, EMA allows researchers to examine momentary socioemotional experiences that reflect adolescents' everyday lives, enhancing ecological validity and limiting retrospective bias (Silk et al., 2011). As such, the use of EMA would not only capture adolescents' changing social contexts with different social partners throughout a single day, but also elucidate how such in-the-moment connectedness within these social contexts impacts adolescents' momentary emotion. To our knowledge, only one daily diary study has examined the relation between social connectedness and negative emotion regulation in a sample of mostly female, mostly White adolescents from the United States, showing that parents coaching their children on regulating emotions was more effective at reducing negative emotion in the context of higher social connectedness (Mak et al., 2023). Although Mak et al.'s (2023) findings underscore the important moderating effects of social connectedness, it remains unclear how social connectedness and emotion regulation are directly associated during adolescents' daily lives at a momentary level.

The current study aims to fill this gap in the literature by examining the association between social connectedness and emotion regulation (as reductions in NE from a negative interpersonal interaction) via EMA in a sample of early adolescent girls at elevated risk for internalizing disorders due to dispositional shyness or fearfulness. Further, the current study examines emotion regulation in response to a particularly salient context for adolescent girls: negative emotion regulation in response to negative peer events (Blakemore & Mills, 2014). We hypothesized that greater social connectedness—both on average and relative to one's personal average—would be associated with more effective emotion regulation. In addition to examining the direct effect of social connectedness on adolescent girls' negative emotion regulation, we assessed three factors that likely moderate the association: the current social context, engagement in co-regulatory support, and girls' dispositional shyness. First, we tested whether interacting with peers versus family members moderated the association. We hypothesized that the effect of social connectedness on emotion regulation would be stronger among adolescents currently in a social context with peers (versus with family or other non-peers). Second, we examined whether adolescent girls engaging in co-regulation with others moderated the association between social connectedness and emotion regulation. We hypothesized that the effect of social connectedness on negative emotion regulation would be stronger when adolescents engaged in co-regulation. Finally, we examined whether elevated dispositional shyness moderated the association between social connectedness and negative emotion regulation. We hypothesized that the effect of social connectedness on emotion regulation would be stronger among adolescent girls with higher levels of dispositional shyness.

Emotion regulation: A note on terminology

There is growing interest in elucidating factors related to adolescents' emotional regulation—and often also reactivity—in their everyday lives using methods based in EMA. Broadly, studies indicate that daily stressors and negative interpersonal interactions lead to negative emotion reactivity and require adolescents to regulate to return to baseline (Bai & Repetti, 2018; Ha et al., 2019), although it is often challenging to determine the degree of voluntary versus implicit regulation that occurs. It is important to note that in this nascent literature, there is not yet consensus on the best ways to describe the most common operationalizations of change in emotion as assessed via EMA. There is more consensus around the concept of "emotional reactivity" as assessed via EMA, and researchers have typically operationalized reactivity as a participant's emotion report at the same timepoint or in response to a peak stressor, sometimes regressed on their emotion at the previous timepoint (Bai & Repetti, 2018; Ha et al., 2019; Herres et al., 2018; Morgan et al., 2017), although there is still relatively wide variation in the precise statistical operationalization.

There is less consensus about the term for return to baseline post-reactivity. Terms of art have included "emotion regulation," "recovery", or "return to baseline"; however, studies have typically operationalized such constructs in the same way: as the autoregressive effect or residualized change in emotion from peak negative or positive emotion to the emotion level at the next timepoint (Bai & Repetti, 2018; Ha et al., 2019; Morgan et al., 2017). Some of the difficulty in

establishing clear terminology and operational definition is likely grounded in ongoing debate about the nature of emotion regulation broadly defined (Gross, 2015). Although some theoretical models of emotion regulation imply that regulatory process is conscious and effortful, sometimes purely through semantics (e.g., attentional "deployment"; Gross, 2002, p. 283), there is broad recognition that emotion regulation processes often occur quickly, are highly dynamic (Silk, 2019), and are context-dependent (Aldao et al., 2015). In the present study, we operationalize effective "emotion regulation" as steeper reductions in one's self-reported negative emotion from a peak emotion level in response to a negative peer interaction. Although terms such as "return to baseline" and "recovery" have been used in other EMA studies with similar operationalizations as noted above (Bai & Repetti, 2018; Ha et al., 2019; Morgan et al., 2017), we would argue that each of these terms suffers from similar methodological and conceptual challenges as labeling the process "emotion regulation." Further, since our grounding in social baseline theory encompasses aspects of physiological regulation, a highly dynamic, multiply determined, recursive process, conceptualizing the cognitive-emotional process observed here in similar terms seemed appropriate. Hence, the current study uses "emotion regulation" as the primary descriptor for reductions in NE after a negative peer interaction, joining the aforementioned studies in building our understanding of real-world emotion processes in adolescents' daily lives (Bai & Repetti, 2018; Ha et al., 2019). However, we strive to provide our more precise operational definition (e.g., "reductions in NE") where possible to keep our results grounded in the precise phenomenon observed.

METHOD

Participants

Participants were drawn from a longitudinal study examining emotional, social, and neural development in 129 adolescent girls ages 11–13 from a midsized Midwestern city in the United States, oversampled for risk for social anxiety and depression based on elevated shyness/fearfulness. This sample size was determined to be adequately powered to detect medium effects for the broader study's overarching aims, which were to examine neural sensitivity to social threat and reward. Participants and their primary caregivers were recruited through online and community announcements. For additional details on recruitment, please see Sequeira, Rosen, et al. (2021). Risk status was based on participants' scores on the Shyness/Fearfulness subscales of the Early Adolescent Temperament Scale–Revised (EATQ-R; Ellis & Rothbart, 2001), with scores of .75 *SD* above the mean on either subscale (parent or adolescent report) indicating high risk for developing social anxiety and/or depression. Exclusion criteria included current/past DSM-5 diagnosis of major depressive disorder or any anxiety disorder with the exception of specific phobia; IQ <70; current or past diagnosis of autism spectrum disorder or a psychotic disorder; serious medical or neurological conditions; presence of braces, metal in the body, or any other MRI contraindications; use of psychoactive or endocrine disruption medications, with the exception of stimulants; and acute suicidal risk. Information on the analysis sample is included below in the Analytic Approach, in conjunction with detail on missing data.

The final analysis sample comprised 114 adolescent girls ($M_{age} = 12.26$ [$SD = 0.8$]). As discussed below, two participants did not participate in EMA and ten participants were excluded due to issues with EMA data collection (not meeting response minimums, technological problems). Three participants were dropped due to having too few observations that met criteria for the current study (3 or fewer observations). Participants predominantly identified as White (67.5%), with participants also identifying as Black/African American (19.3%), biracial (9.6%), Asian (1.8%), Native American (0.9%), and of another racial identity (0.9%). Additionally, 8.8% of participants identified as Latinx. Parents reported on family income using a scale ranging from 0 ($10,000) to 10 ($100,000), in $10,000 increments. Median total family income was between $80,001 and $90,000. The demographics of the sample were broadly representative of the midsized Midwestern city in the United States where the study was conducted, with the exception of median total family income, which was considerably higher than median income for the city at large (U.S. Census Bureau, 2022).

Procedure

All study procedures were approved by the University of Pittsburgh Institutional Review Board, and informed consent was obtained from all participants prior to conducting study procedures. The overarching study was conducted across three years, with three primary waves of data collection occurring at baseline and at two- and three-year follow-up visits. The current study examines data from the first wave only; accordingly, procedures from waves two and three will not be discussed here. At baseline, adolescent participants and their participating parents completed a series of questionnaires, in addition to completing a clinical interview (lab visit 1) and several observational tasks (lab visit 2). After the second laboratory visit, participants were provided with a study smartphone for the purposes of conducting a 16-day EMA protocol focused on adolescent social experiences and their social context, emotions, thoughts, and activities via the Web Data Express app. The EMA protocol began the Saturday following the lab visit (with a few exceptions) and continued for the following 16 days (six weekend days and ten weekdays).

Participants received three prompts during weekdays and four prompts on the weekend totaling 54 prompts over the course of the 16-day assessment window. During the lab visit, participants indicated their typical morning wakeup time, which was used as the timing of the first morning prompt of the day. The remaining two-weekday prompts

were delivered at random times in two blocks in the late afternoon and evening. No prompts were delivered during the school day to minimize disruption and to limit bias related to differing school policies regarding cellphone use in school/during the school day, but youth could still report on experiences during the school day at the afternoon prompt. On weekends, prompts were delivered in four blocks: morning, late morning/early afternoon, late afternoon, and evening. Surveys expired after 1 hour.

Pertinent to the current study, at the outset of each prompt, adolescents were asked to report their current emotional state ("Please rate how you were feeling just before the phone beeped:") on eight discrete emotions: happy, sad, joyful, worried, stressed, interested, mad, and excited (largely drawn from the Positive and Negative Affect Schedule [Watson et al., 1988]). Each emotion was rated on a 0–100 sliding scale where *0 = Not at all* and *100 = Extremely* with the slider initially anchored at 0. Participants subsequently reported their current social context ("Who are you with?") using a multiselect format with the response options: *nobody; a friend or friends; boyfriend, girlfriend, or kid I have a crush on; other kid or kids; teacher or coach; mother/step-mother; father/step-father; sibling(s)/step-sibling(s); grandparent(s); other relative(s); other adult(s)*. For each of the social context options endorsed, participants responded to the question, "How close or connected do you feel to [person] right now?" on a 0–100 slider where *0 = Not at all* and *100 = Extremely* with the slider initially anchored at 0. These items were all drawn from previously published EMA studies on adolescent samples (Silk et al., 2012, 2019; Waller et al., 2014).

At each prompt, participants were asked about the most negative social interaction with peers they had experienced since the previous prompt in response to the question, "Think about the interaction with other kids your age that made you feel the worst since the last beep on [last prompt time]. What happened?" (Silk et al., 2003, Silk et al., 2011). Participants were asked to briefly describe the interaction in an open text box. If participants had difficulty thinking of a situation, they were provided with a hint prompt asking them to reflect on what they had been doing at the last prompt, what they had been doing since, who they talked to/what the person said, and noting that even minor irritations were relevant. (See below and Analytic Approach for more detail on how emotion regulation was modeled.)

Relevant to the current study, after providing a description of their most recent negative social interaction, participants were asked when the interaction occurred ranging from *0 = Within the last 15 minutes* to *9 = Before yesterday* and to rate how they felt during the interaction on the four discrete negative emotions (sad, mad, worried, stressed), using the same 0–100 scale described above. Although not always conceptualized as an emotion, "stressed" was included based on preliminary work showing that "stressed" is a word that teens often use to describe their negative feelings in daily life (Hamilton et al., 2021; Sequeira, Silk, et al., 2021). They also reported whether they engaged in an emotion regulation strategy in response to the event ("Did you react in any of the following ways?"), including the use of rumination ("I kept thinking about how bad I was feeling or how bad the situation is") and whether they received co-regulatory support ("Did anybody help you, encourage you, or participate with you in this reaction?"). As a note, we examined co-rumination in a sensitivity analysis, but otherwise the specific strategy used was not germane to the current study, and hence the remaining strategies are not discussed in detail.

Measures

Current negative emotion (NE)

As noted above, at the outset of each EMA prompt, participants reported their current, in-the-moment NE on four discrete emotions (sad, mad, worried, stressed) on a 0–100 sliding scale. To create a composite measure of current NE, these four discrete negative emotions were aggregated using the mean and yielded adequate reliability ($\alpha_{within} = .70$; $\alpha_{between} = .94$).

Peak negative emotion (NE)

Peak NE was operationalized by taking the mean of the same four negative emotions (i.e., sad, mad, worried, stressed) reported in response to the participant's most negative social interaction since the last prompt. The composite measure of peak NE yielded somewhat poor reliability at the within-person level ($\alpha_{within} = .48$) and adequate reliability at the between-person level ($\alpha_{between} = .85$). As a note, it is possible that the negative social interaction reported on was not the participant's overall peak NE since the previous prompt, as participants may have experienced higher levels of NE in response to non-social circumstances. However, for simplicity's sake, we will reference peak NE and note this limitation in the discussion.

Social connectedness

Social connectedness was calculated by taking the mean across all social connectedness ratings reported at each prompt. For example, if a participant reported being with their mother only, the social connectedness value for that observation would be equivalent to the rating of social connectedness with their mother. However, if a participant reported being with two parents and a sibling, the social connectedness value would be the average of the three ratings reported for that observation. Social connectedness was person-mean centered to allow for distinguishing within- and between-person effects.

Social context

To examine the hypothesized moderation of social context on the link between social connectedness and emotion

regulation, two dummy variables were calculated. First, a binary "family" variable was computed in which participants received a "1" if they reported being with any family members at that observation (mother, father, siblings, grandparent, or other relative) and a "0" if they reported being alone or with non-family members only (friend, boy/girlfriend, other kid, teacher, other adult). Second, a binary "peers" variable was computed in which participants were designated a "1" if they reported being with peers at that observation (friend, boy/girlfriend, other kid) and a "0" if they reported being alone or with family or non-peers only (mother, father, siblings, grandparent, other relative, teacher, other adult). As a note, observations in which participants were with *both* family and peers were designated a "1" for both variables. Social context was person-mean centered to allow for disentangling between- and within-person effects, with the person-mean centered on the grand mean to facilitate interpretation of between-person effects.

Co-regulatory support

To examine moderated effects of receiving co-regulatory support in response to the participant's worst negative social interaction, a binary variable was calculated in which "1" indicated the participant reported receiving co-regulatory support at that observation and a "0" indicated the participant did not report receiving co-regulatory support. Participants could receive co-regulatory support from a parent, sibling, friend, or an unspecified "other" individual.

Shyness

Shyness was reported using the parent report on the Shyness subscale of the Early Adolescent Temperament Questionnaire–Revised (EATQ-R; Ellis & Rothbart, 2001). The scale includes four items: "I feel shy with kids of the opposite sex"; "I feel shy about meeting new people"; "I am shy"; and "I am not shy" (reversed). Items were rated on a 1–5 Likert scale from *1* = "almost always untrue" to *5* = "almost always true" and composited by summing items after reverse-scoring the final item. The scale exhibited adequate reliability ($\alpha = .87$). Shyness was grand-mean centered.

Age

Participant age was calculated in years, grand-mean centered, and included in analyses as a covariate.

Transparency and openness

Study hypotheses and the analytic plan were pre-registered on Open Science Framework prior to conducting analyses (OSF link: https://osf.io/hmesf/?view_only=3a55ec74b74e45b19111ea7402a8e1ee.). Analysis code is also available on OSF. Data and study materials are available upon request.

Analytic approach

Prior to analyses, data were inspected for compliance and errors. Of the 129 participants in the parent study, 128 participated in EMA; one participant withdrew from the lab visit prior to the EMA protocol. Each participant was sent 54 prompts resulting in a total of 6912 possible observations. Four participants were excluded for not reaching minimum response requirements (25% completion) and four participants withdrew from the EMA portion of the study and were therefore excluded. Two participants' data were lost due to technology issues. Unanswered prompts were considered missing ($n = 1307$). Participants completed an average of 85% EMA prompts (range = 20–54). Observations in which participants responded only to a final negative social interaction prompt *without* a time bound of "since the previous prompt" were also excluded ($n = 2604$). Further, "nonsense" answers and several duplicated observations from one participant were excluded ($n = 435$). (Nonsense answers were largely free-text gibberish, e.g., "jkjhjvu" or participants stating "nothing" had happened.) Finally, previous analyses examining emotion regulation in EMA have established a cutoff of minimum levels of peak NE to support the inference that regulation is occurring (e.g., Stone et al., 2019; Tan et al., 2012; Waller et al., 2014). However, as these cutoffs can vary and introduce a source of "researcher degrees of freedom" (Wicherts et al., 2016), we pre-registered our approach and planned sensitivity analyses to ensure the robustness of the results. As our primary interest was in retaining valid study data, and recognizing that there may be individual differences in how emotional intensity is reported (e.g., one adolescent's "10" may be equivalent to another's "30"), we opted to set a cutoff of 10/100 as the minimum emotion rating across all four negative emotions used to calculate the peak NE variable as our primary analytic sample. In other words, at least one of the four negative emotions had to have a value of 10/100 or greater. This cutoff resulted in $n = 342$ observations being dropped. However, to ensure our results are robust, we planned sensitivity analyses using samples with cutoffs of 0/100 and 20/100 as well. Per the pre-registration, results that are not robust to these alternate cutoffs will be noted below.

Consistent with the stated analytic approach in our pre-registration, we first examined multilevel correlations between our variables of interest using Mplus version 8.5 (Muthén & Muthén, 2020). Prior to running our analyses, we first examined the distribution of our outcome variable and conducted exploratory analyses to identify the best-fitting model. Current NE was right-skewed and had a high proportion of zero values. We tested a series of multilevel models applying different error distributions, including normal, Poisson, semi-continuous, and gamma distributions with and without zero-inflation, visually inspected

the residuals, and tested for model fit using the DHARMa package in R (Hartig & R Core Team, 2022). Details of the model testing process are available on OSF. The Tweedie distribution with a log link provided the best model fit and did not require any unsupported theoretical assumptions about the data-generating process (such as those required by zero-inflated or hurdle models). Hence, all models were run using this error distribution.

Subsequently, we followed our pre-registered model-building process, first testing a means-only model with a random effect of person in order to partition variance in momentary NE at the within- and between-person levels. Next, peak NE was added to the model to create the baseline regulatory model, followed by covariates, which were retained regardless of significance. In this baseline regulatory model, the fixed intercept captures the average association between peak NE and momentary NE, whereas the random intercept reflects individual variation around the average effect, conditioned on significant covariates, effectively accounting for systematic individual differences in tendency to report high or low NE across the course of EMA. Hence, associations between predictors of interest (e.g., social connectedness) and NE reflect the contribution to reductions (or lack thereof) in current NE after it has been residualized on peak NE. We then tested the direct effects of between- and within-person social connectedness prior to testing our moderators (social context, co-regulatory support, shyness) in separate models, resulting in a total of four hypothesis tests. To further elucidate our model, a negative association between social connectedness and current NE would indicate further reductions in current NE beyond those accounted for by associations with peak NE. A sample model and parameters of interest are included below, using social context as the sample moderator and including all covariates.

Level-1 model:

$$\begin{aligned}\text{CurrentNE}_{ij} = {} & ß_{0j} + ß_1\text{PeakNE}_{ij} + ß_2\text{SocialConn}_{ij} + ß_3\text{SocialContext}_{ij} \\ & + ß_4\left(\text{SocialConn}ij^{*}\text{SocialContext}ij\right) + ß_5\text{TimeElapsed}ij \\ & + ß_6\text{StudyDay}ij + eij.\end{aligned}$$

Level-2 model:

$$\begin{aligned}ß_{0j} = {} & ɣ_{00} + ɣ_{01}\text{Age}_j + ɣ_{02}\text{PMSocialConn}_j + ɣ_{03}\text{PMSocialContext}_j \\ & + ɣ_{04}\text{PMSocialConn}^{*}\text{PMSocialContext}_j + u_{0j}.\end{aligned}$$

$$ß_{1j} = ɣ_{10} + u_{1j}.$$

$$ß_{2j} = ɣ_{20} + ɣ_{21}\text{PMSocialContext}_j + u_{2j}.$$

$$ß_{3j} = ɣ_{30} + ɣ_{31}\text{PMSocialConn}_j + u_{3j}.$$

The primary parameters of interest include $ß_3$, the within-person effect of social context, $ß_4$, the interaction effect of within-person social connectedness and within-person social context, $ɣ_{03}$, the effect of between-person social context, $ɣ_{04}$, the interaction of between-person social connectedness and between-person social context, $ɣ_{21}$, the cross-level interaction of within-person social connectedness and between-person social context, and $ɣ_{31}$, the cross-level interaction of between-person social connectedness and within-person social context. (As a note regarding our pre-registration: We erroneously left out the interactions between (1) between-person social connectedness and between-person social context and between (2) within-person social context and between-person social connectedness in our pre-registration and note it here to mark the deviation from the pre-registered project. Additionally, the pre-registration includes an erroneous description of ɣ21, which does not represent the between-person interaction effect of social connectedness and social context, but rather the cross-level interaction between between-person social context and within-person social connectedness.)

As part of our pre-registration, we registered a sensitivity analysis to examine the effects of co-regulatory support excluding instances of co-rumination, as ruminating in conjunction with another person has been shown to be associated with both increased negative emotion and increased social connectedness with the rumination partner (Rose, 2021).

RESULTS

Descriptive analyses

Means, standard deviations, and/or percentages and multilevel correlations are included in Table 1. On average across persons and occasions, peak NE was higher than current NE. Figure 1 displays a subset of participants and their person-mean levels of current and peak NE, as well as momentary deviation around those person-means. Visual inspection indicated that current and peak NE track together over time for most participants, which is validated by a positive within-person correlation between current and peak NE (see below).

Bivariate associations

Between-person correlations

At the between-person level, peak NE was positively associated with current NE at a large effect size, indicating that girls who reported higher peak NE on average also reported higher current NE. Additionally, being with peers at a higher percentage of occasions was associated with higher levels of social connectedness on average, at a medium effect size. Older girls, compared to younger girls, reported being with friends more often and family less often on average, at medium effect sizes. Finally, girls who reported negative social interactions that had occurred longer ago on average reported receiving co-regulatory support on a greater percentage of occasions and reported being with friends less often on average, at medium effect sizes.

TABLE 1 Descriptive statistics and standardized correlations of study variables.

Within-level

Variable	*M*(*SD*)/%	1	2	3	4	5	6	7
1. Current NE	0 (11.76)	–						
2. Peak NE	0 (13.78)	**.28 [.24, .32]**	–					
3. Social connectedness	0 (19.2)	**−.16 [−.22, −.11]**	−.003 [−.06, .06]	–				
4. Co-regulatory support (1 = rec'd support)		.05 [−.01, .11]	**.13 [.07, .19]**	.08 [−.01, .16]	–			
5. Peers (1 = with peers)		−.05 [−.11, .02]	.02 [−.04, .08]	−.03 [−.11, .05]	**.10 [.01, .19]**	–		
6. Family (1 = with family)		**.07 [.01, .13]**	−.03 [−.09, .03]	−.01 [−.11, .09]	**.08 [.001, .17]**	**−.40 [−.48, −.32]**	–	
7. Time elapsed	0 (2.33)	**−.06 [−.10, −.02]**	.04 [−.003, .08]	.02 [−.05, .08]	**.12 [.06, .17]**	**−.19 [−.25, −.13]**	−.01 [−.07, .05]	–

Between-level

Variable		1	2	3	4	5	6	7	8	9
1. Current NE	11.09 (11.77)	–								
2. Peak NE	27.50 (16.41)	**.74 [.62, .82]**	–							
3. Social connectedness	61.83 (21.87)	−.22 [−.42, .001]	.03 [−.19, .23]	–						
4. Co-regulatory support	34%	.18 [−.04, .38]	.14 [−.08, .34]	.15 [−.08, .37]	–					
5. Peers	20%	−.11 [−.35, .14]	−.04 [−.27, .19]	**.33 [.09, .54]**	−.07 [−.33, .21]	–				
6. Family	58%	.21 [−.41, .01]	−.15 [−.35, .07]	.22 [−.01, .42]	.21 [−.03, .43]	−.16 [−.40, .11]	–			
7. Time elapsed	4.73 (1.63)	.05 [−.18, .27]	.07 [−.14, .28]	.00 [−.23, .23]	**.29 [.04, .50]**	**−.45 [−.65, −.19]**	−.06 [−.30, .18]	–		
8. Shyness	2.75 (0.96)	−.03 [−.23, .16]	.01 [−.18, .20]	−.11 [−.30, .10]	.03 [−.18, .25]	−.14 [−.36, .10]	.07 [−.14, .27]	−.03 [−.24, .18]	–	
9. Age	12.26 (0.80)	.14 [−.05, .32]	.03 [−.16, .21]	−.05 [−.25, .16]	−.01 [−.23, .20]	**.24 [.01, .44]**	**−.40 [−.56, −.21]**	−.06 [−.27, .15]	−.12 [−.29, .07]	–

Note: Current NE reflects negative emotion at the time of the EMA prompt. Peak NE reflects the peak negative emotion rating to the negative social interaction. Values in brackets are the 95% confidence intervals, and values in bold are those for which the confidence interval does not contain zero. At the within level continuous variables have $M = 0$ by design. Between-person percentages for binary variables represent the mean percentage of occasions in which participants endorsed that value (i.e., the grand mean). Within-person percentages for binary variables represent the proportion of total observations in which that variable was endorsed.

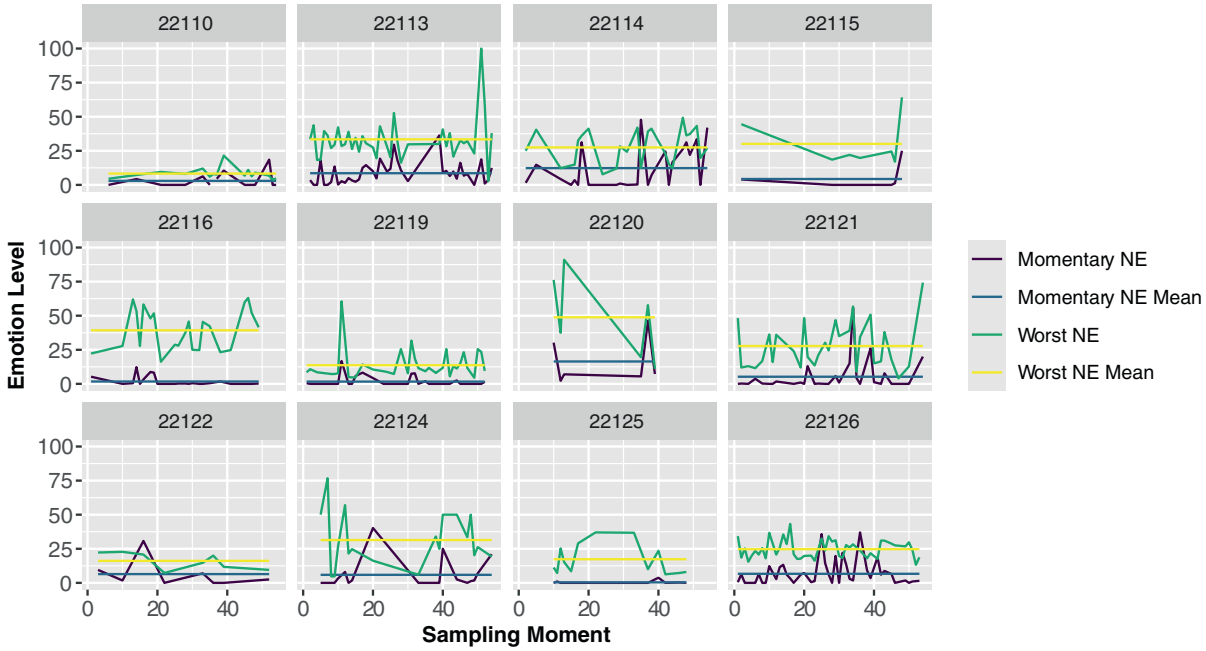

FIGURE 1 Momentary and worst negative emotion person-means and within-person variability for a subset of participants. NE, negative emotion.

Within-person correlations

At the within-person level, peak NE was positively associated with within-person current NE at a medium effect size, indicating that as girls reported higher levels of peak NE compared to their person-means, they also reported higher levels of current NE compared to their average levels. Within-person social connectedness was negatively associated with within-person NE at a small effect size, indicating that, as girls reported higher levels of social connectedness in relation to their person-means, they experienced lower levels of current NE compared to their average levels. In-the-moment co-regulatory support was positively associated with within-person peak NE at a small effect size, meaning that in moments when girls experienced higher levels of peak NE compared to their averages, they were more likely to receive co-regulatory support in that moment. Additionally, when girls reported being with peers in a given moment, they were more likely to receive co-regulatory support at that occasion. Further, in moments when girls reported being with family members, they reported higher levels of current NE compared to their average levels and they were more likely to receive co-regulatory support in that moment, both at small effect sizes. Additionally, they were less likely to report being with peers in moments they reported being with family at a medium effect size. Finally, when more time had elapsed since the negative social interaction, compared to a girl's average, they reported less current NE compared to mean levels, were more likely to report receiving co-regulatory support in relation to that interaction, and were less likely to be with peers in the moment, all at small effect sizes.

Model building

All models were run using the glmmTMB package (Brooks et al., 2017) in R version 4.2.1 (R Core Team, 2018) using the aforementioned Tweedie distribution with a log link (dispersion parameter $1 < p < 2$). First, an unconditional random intercept model was run to partition variance at the between- and within-person levels and indicated that 55.8% of the variance in current NE was attributable to between-person factors. We then added peak NE to the model to generate our emotion regulation model. After accounting for the contribution of the intercept, which reflects the average between-person effect of peak NE on current NE, peak NE was positively associated with current NE at a small effect size, such that, relative to their individual means, when adolescent girls experienced higher peak NE they also experienced higher current NE (Table 2). As a note, modeling emotion regulation in this way largely addresses systematic individual differences in reporting emotional experiences (i.e., findings that some individuals systematically report higher levels of experienced emotion than others).

Covariates

Within-person time elapsed was significantly negatively associated with current NE (see Table 2), such that, adjusting for levels of peak NE and relative to their person-means of time elapsed, adolescent girls who had more time elapsed after the negative social interaction reported lower levels of current NE, at a small effect size. Additionally, there was a significant positive effect of time in the study, indicating that

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TABLE 2 Baseline regulation, covariate, and social connectedness multilevel models.

	Regulation model			Covariate model			Social connectedness model		
Predictors	**Estimates**	**CI**	***p***	**Estimates**	**CI**	***p***	**Estimates**	**CI**	***p***
Intercept	3.26	2.65–4.00	<.001***	0.38	0.02–6.66	.505	0.28	0.02–5.22	.393
Peak NE	1.02	1.02–1.03	<.001***	1.02	1.02–1.03	<.001***	1.03	1.02–1.03	<.001***
Age				1.19	0.95–1.49	.136	1.22	0.97–1.54	.090
BP time elapsed				0.99	0.88–1.12	.877	0.96	0.85–1.09	.553
WP time elapsed				0.96	0.94–0.98	<.001***	0.98	0.95–1.01	.191
Study day				1.01	1.00–1.02	.043*	1.01	1.00–1.03	.120
BP social connectedness							0.77	0.65–0.91	.003**
WP social connectedness							0.84	0.79–0.90	<.001***
Random effects									
σ^2	0.97			0.97			1.00		
τ_{00}	0.81_{ID_Num}			0.79_{ID_Num}			0.64_{ID_Num}		
ICC	0.45			0.45			0.39		
N	114_{ID_Num}			114_{ID_Num}			111_{ID_Num}		
Observations	2220			2220			1139		
Marginal R^2/conditional R^2	0.112/0.515			0.131/0.523			0.198/0.510		

Note: Peak NE reflects the peak negative emotion rating to the negative social interaction. Time elapsed reflects the time that had elapsed between occurrence of the negative social interaction and the current EMA prompt.

Abbreviations: BP, between-person effects; WP, within-person effects.

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

as girls progressed through the study, they reported higher current NE, again at a small effect size. Age and between-person time elapsed were not significantly associated with current NE.

Social connectedness and emotion regulation

We first tested broad associations between social connectedness and emotion regulation (hypothesis 1). In support of hypothesis 1, at the between-person level, social connectedness was significantly negatively associated with current NE at a medium effect size (Table 2), indicating that adolescent girls who reported higher levels of in-the-moment social connectedness on average also reported lower levels of current NE, adjusting for peak NE (i.e., greater emotion regulation). At the within-person level, relative to their individual mean levels of social connectedness, in moments when girls experienced higher levels of social connectedness they also reported significantly lower levels of current NE (i.e., greater emotion regulation), at a small effect size. To summarize, higher levels of social connectedness were associated with greater reductions in negative emotion (i.e., greater emotion regulation) at both the between- and within-person levels.

Moderation by social context, co-regulatory support, and shyness

We then tested whether the association between social connectedness and emotion regulation varied based on our hypothesized moderators: social context (hypothesis 2), co-regulatory support (hypothesis 3), and shyness (hypothesis 4).

Social context

There was a significant, moderately sized interaction effect between within-person social connectedness and within-person family social context (hypothesis 2; see Table 3). Although feeling more social connectedness with other people in the moment (compared to one's personal average) was typically associated with greater reductions in negative emotions (i.e., greater emotion regulation), when an adolescent reported being with family members that negative association was significantly attenuated, contrary to hypotheses. A simple slopes analysis of the significant predictor at its varying levels (i.e., *0* = with peers/others; *1* = with family) indicated that when participants reported being with exclusively non-family members (i.e., peers and/or others) in the moment, the simple slope of within-person social

TABLE 3 Model testing moderation of social connectedness and emotion regulation by social context.

	Current NE		
Predictors	**Estimates**	**CI**	***p***
Intercept	0.63	0.02–16.17	.782
Peak NE	1.03	1.02–1.03	<.001***
Age	1.15	0.89–1.48	.282
BP time elapsed	0.96	0.84–1.09	.511
WP time elapsed	0.98	0.95–1.01	.227
Study day	1.01	1.00–1.03	.146
BP social connectedness	0.70	0.50–0.99	.045*
WP peers (1 = with peers)	0.94	0.75–1.18	.577
WP social connectedness	0.67	0.54–0.84	<.001***
BP peers	1.15	0.34–3.91	.820
WP family (1 = with family)	0.97	0.75–1.26	.840
BP family	0.70	0.30–1.61	.403
BP social connectedness × WP peers	0.96	0.74–1.25	.774
WP social connectedness × WP peers	1.12	0.91–1.37	.284
BP social connectedness × BP peers	1.12	0.38–3.25	.841
WP social connectedness × BP peers	1.39	0.82–2.34	.222
BP social connectedness × WP family	1.17	0.86–1.58	.313
WP social connectedness × WP family	1.26	1.02–1.56	.029*
BP social connectedness × BP family	0.76	0.37–1.56	.455
WP social connectedness × BP family	1.19	0.85–1.66	.315
Random effects			
σ^2	1.00		
$\tau_{00\,ID\_Num}$	0.63		
ICC	0.39		
N_{ID_Num}	111		
Observations	1139		
Marginal R^2/conditional R^2	0.206/0.515		

Note: Peak NE reflects the peak negative emotion rating to the negative social interaction. Time elapsed reflects the time that had elapsed between occurrence of the negative social interaction and the current EMA prompt.

Abbreviations: BP, between-person effects; WP, within-person effects.

*p < .05; ***p < .001.

connectedness and current NE was $b = -0.395$ (i.e., greater emotion regulation at higher levels of social connectedness with peers/others). By comparison, when participants reported being with family members or a mix of family members and non-peers, the simple slope of within-person social connectedness and current NE was $b = -0.162$ (i.e., comparatively less emotion regulation at higher levels of social connectedness). In summary, the association between social connectedness and emotion regulation was stronger when adolescent girls reported being with peers and others (i.e., resulting in a greater reduction in negative emotion) compared to when they reported being with family members (i.e., a lesser reduction in negative emotion).

Co-regulatory support

Similarly, there was a moderately sized significant interaction between within-person social connectedness and within-person/in-the-moment co-regulatory support (hypothesis 3; Table 4). Again, although typically feeling more socially connected in the moment was associated with lower levels of current NE (i.e., greater emotion regulation), when the participant reported receiving co-regulatory support in the moment, the negative association was significantly attenuated, contrary to hypotheses. Simple slopes analysis calculating the social connectedness-emotion regulation slope at the values of the significant predictor variable (i.e., *0* = did not receive co-regulatory support; *1* = received co-regulatory support) indicated that when participants reported not receiving co-regulatory support in conjunction with their most recent negative interpersonal interaction, the simple slope of within-person social connectedness and current NE was $b = -0.239$ (i.e., greater emotion regulation at higher levels of social connectedness when not receiving co-regulatory support). By comparison, for instances in which participants reported receiving co-regulatory support, the simple slope of within-person social connectedness and current NE was reduced to $b = -0.048$ (i.e., less emotion regulation at higher levels of social connectedness when receiving co-regulatory support).

Planned sensitivity analysis: Co-rumination

When the $n = 54$ instances of co-rumination were excluded from analyses, the interaction effect of within-person social connectedness and within-person co-regulation was non-significant ($OR = 1.18$ [0.98–1.41], $p = .074$), suggesting that co-rumination accounted for a substantial portion of the effect. In summary, the association between social connectedness and emotion regulation was weaker when adolescent girls reported engaging in co-regulation, compared to moments when they did not co-regulate with others; however, this effect appears to be driven entirely by instances of one type of co-regulation: co-rumination.

Shyness

Parent-reported shyness was not significantly associated with current NE (i.e., emotion regulation), either directly or in interaction with social connectedness (hypothesis 4; Table 5).

Planned sensitivity analysis: Alternate samples

As noted above, we ran sensitivity analyses of all our models using alternate peak NE emotion cutoffs of 0/100 and 20/100.

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TABLE 4 Model testing moderation of social connectedness and emotion regulation by co-regulatory support.

	Current NE		
Predictors	**Estimates**	**CI**	***p***
Intercept	0.40	0.02–7.61	.540
Peak NE	1.02	1.02–1.03	<.001***
Age	1.20	0.95–1.51	.126
BP time elapsed	0.94	0.83–1.06	.295
WP time elapsed	0.98	0.95–1.01	.202
Study day	1.01	1.00–1.03	.126
BP social connectedness	0.77	0.63–0.94	.009**
WP co-regulatory support (1 = rec'd support)	1.09	0.91–1.31	.354
WP social connectedness	0.79	0.72–0.86	<.001***
BP co-regulatory support	1.79	0.84–3.84	.133
BP social connectedness × WP co-regulatory support	0.96	0.79–1.16	.679
WP social connectedness × WP co-regulatory support	1.21	1.02–1.43	.024*
BP social connectedness × BP co-regulatory support	0.92	0.48–1.75	.800
WP social connectedness × BP co-regulatory support	0.89	0.64–1.24	.494
Random effects			
σ^2	1.00		
$\tau_{00\ ID\_Num}$	0.64		
ICC	0.39		
N_{ID_Num}	111		
Observations	1137		
Marginal R^2/conditional R^2	0.203/0.514		

Note: Peak NE reflects the peak negative emotion rating to the negative social interaction. Time elapsed reflects the time that had elapsed between occurrence of the negative social interaction and the current EMA prompt.

Abbreviations: BP, between-person effects; WP, within-person effects.

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

TABLE 5 Model testing moderation of social connectedness and emotion regulation by shyness.

	Current NE		
Predictors	**Estimates**	**CI**	***p***
Intercept	0.23	0.01–4.51	.335
Peak NE	1.03	1.02–1.03	<.001***
Age	1.25	1.00–1.57	.055
BP time elapsed	0.96	0.85–1.08	.505
WP time elapsed	0.98	0.95–1.01	.207
Study day	1.01	1.00–1.03	.162
BP social connectedness	1.26	0.69–2.28	.451
Shyness	0.96	0.80–1.16	.700
WP social connectedness	0.85	0.70–1.03	.100
BP social connectedness × shyness	0.85	0.70–1.03	.096
WP social connectedness × shyness	0.99	0.92–1.06	.786
Random effects			
σ^2	1.02		
$\tau_{00\ ID\_Num}$	0.60		
ICC	0.37		
N_{ID_Num}	110		
Observations	1115		
Marginal R^2/conditional R^2	0.214/0.505		

Note: Peak NE reflects the peak negative emotion rating to the negative social interaction. Time elapsed reflects the time that had elapsed between occurrence of the negative social interaction and the current EMA prompt.

Abbreviations: BP, between-person effects; WP, within-person effects.

***$p < .001$.

All significant results reported in Tables 2–5 were robust to the alterations in sample size with one exception: The direct effect of between-person social connectedness was no longer significant in the social context moderation model.

DISCUSSION

This study used ecologically valid measures to examine the relations between early adolescent girls' social connectedness and emotion regulation as measured in reductions of NE after salient, negative social interactions occurring in everyday life. Consistent with social baseline theories, findings indicate that, adjusting for individual differences in reporting of emotion, when girls felt more socially connected with people (both family and non-family) in their immediate environment, they reported better emotion regulation (i.e., greater reduction in NE) in response to a negative interpersonal interaction. However, the strength of this relation between social connectedness and emotion regulation (greater reduction in NE) was dependent on two notable contextual factors: the composition of girls' immediate social environments and the receipt of co-regulatory support. Taken together, results suggest that key elements of early adolescent girls' social spheres—such as their social connectedness, whom they interact with, and whether they receive support—are important influences on their everyday effective regulation of negative emotions.

The first aim of the current study was to test an application of social baseline theory in early adolescent girls' everyday lives, examining whether experiencing greater social connectedness with others in their immediate environments was associated with more effective regulation of NE (i.e., greater reduction in NE) in response to a salient negative peer interaction. Consistent with social baseline theory and developmental shifts in the salience of interpersonal relationships for adolescents (Blakemore & Mills, 2014), girls' reports of greater social connection with other people were linked to more effective emotion

regulation (i.e., greater reduction in NE). The present study extends well-established laboratory and experimental work (Beckes & Coan, 2011; Davis et al., 2018; Gross & Medina-DeVilliers, 2020) by establishing that the regulatory effects of the presence of close others extend to the context of emotion regulation throughout the course of early adolescent girls' daily lives.

A second goal of the present study was to advance social baseline theories of emotion regulation in adolescence (Beckes & Coan, 2011; Davis et al., 2018; Gross & Medina-DeVilliers, 2020) by examining how everyday changes in contexts, including adolescents' immediate social surroundings and whether they receive regulatory support, influence the association between social connectedness and emotion regulation (i.e., greater reduction in NE). Hence, this study further elucidates how dynamic changes in adolescent girls' immediate social environments impact their success in regulating emotion in everyday life. Adolescent girls experienced greater regulatory success (i.e., greater reduction in NE) following a negative interpersonal interaction when they felt closer than usual to individuals outside the family context, such as peers. In other words, the benefits of in-the-moment social connectedness on reductions in NE after a negative interpersonal event were stronger when girls reported being with peers and other individuals outside the family. These findings align with broad re-orientation toward peer relationships in adolescence (e.g., Blakemore & Mills, 2014; Lim et al., 2023). In addition to spending more time with peers compared to parents (Larson & Richards, 1991), adolescents in the United States and Global North engage in more emotional disclosure with peers (Schwartz-Mette & Rose, 2012) and expect less emotional support from mothers (Zeman & Shipman, 1997). Recent work has also shown that most adolescents tend to seek friends as their first choice for help with emotionally salient problems (Sears, 2020). These findings suggest that early adolescent girls may seek out peers at least in part because they benefit most from feeling socially connected with peers and other non-family members in relation to alleviating negative emotion.

By comparison, when in the presence of exclusively family members, adolescent girls' feelings of social connectedness were less strongly linked to decreases in their negative emotion. The current findings, in conjunction with the preference for friends as the first choice for emotional support (Sears, 2020), at least for girls from the United States, highlight that the benefits of social connectedness with peers outweigh those of other close relationships during adolescence. Correlational findings indicate that older adolescent girls were more likely to report being with peers further support of such a developmental re-orientation toward friends as first-line emotional support partners.

An alternative explanation for the relative regulatory benefit adolescent girls received in settings with peers is that adolescent girls may perceive it to be riskier to display NE with peers compared to with parents or family, which may increase adolescent motivation to down-regulate negative emotions when with peers in their everyday lives. With peers, the reward of social connection is higher (Blakemore & Mills, 2014; Somerville, 2013); consequentially, the stakes of disrupting this social connection by displaying strong negative emotions are higher as well. Adolescent friendships are relatively unstable compared to parent-adolescent relationships, at least as observed in the U.S. and other Global North countries (Chu et al., 2010; Faris & Felmlee, 2018), which raises the stakes of potential deviations from social norms for emotional expression and regulation. Further, research (largely conducted in the United States) has shown that adolescents are less accepting of peers' strong displays of negative emotion (Rubin et al., 2018), and youth anticipate greater negative feedback from close friends, compared to their parents, following an emotional disclosure (Zeman & Garber, 1996). In contrast, displaying negative emotions with family, particularly parents, is met with less punishment in terms of enduring feelings of connectedness or social support. Hence, adolescents may be more motivated to regulate negative emotions with peers versus family members. An alternative hypothesis, however, is that adolescents may feel better able to leverage certain emotion regulation strategies with peers, like distraction via smartphones or other media, whereas using those strategies with parents may lead to increased conflict (e.g., arguments about smartphone use/screentime limits). Further, conflict between parents and adolescents about smartphone use may be especially relevant given the sampling method used here; it is plausible that an adolescent responding to one of the EMA prompts delivered in this study may engender both increased parental conflict (i.e., lower connectedness) and NE for the adolescent, which may be contributing to the findings presented here. An important future direction is to examine these associations in differing cultural contexts, as differences in display rules and/or the developmental context related to reliance on peers versus parents may result in differing associations.

It is important to temper these interpretations with an acknowledgment that the current data do not allow for disentangling the ordering of effects: It is possible that adolescents' feelings of social connectedness influenced their emotion reports (current and peak NE), as all three were reported in the same time point. That said, current NE was reported prior to eliciting information about social connectedness and peak NE, decreasing the likelihood that adolescents were "primed" by their report of social connectedness in their reports of current NE. Research is needed that collects information on negative emotion-eliciting events, social connectedness, and regulatory success in a manner that allows for more sensitive testing of the order of effects. Such studies could also collect additional information on adolescent emotional goals related to seeking out social support from peers (or parents) to ascertain whether social connectedness in such contexts leads to more or less effective regulation.

Another goal of the study was to examine whether the benefits of social connectedness on emotion regulation (i.e., greater reduction in NE) differed dependent on whether adolescent girls received co-regulatory support from others. Surprisingly, contrary to hypotheses, when girls received help with employing emotion regulation strategies, the social connectedness-emotion regulation (i.e., reduction in NE) association was attenuated, suggesting that co-regulatory support disrupted the benefits of greater social connectedness on reducing negative emotion. However, this effect appeared to be entirely driven by instances in which girls engaged in co-rumination with others: Once observations with co-rumination were removed in a planned sensitivity analysis, co-regulatory support no longer significantly attenuated the association between social connectedness and emotion regulation (i.e., reduction in NE). The attenuated association between social connectedness and emotion regulation (i.e., greater reduction in NE) observed here is likely the result of increased feelings of social connection *and* poorer NE regulation emerging from adolescent girls co-ruminating with others, consistent with robust literature highlighting how co-rumination with peers is simultaneously linked to greater social connectedness *and* elevated NE among adolescent girls (Rose, 2021). While the co-rumination literature has predominantly focused on peer interactions, limited research suggests similar outcomes when adolescents co-ruminate with parents (Calmes & Roberts, 2008; Stone et al., 2019; Waller & Rose, 2010). Alternately, it is possible that adolescents who seek out co-regulatory support have more difficulty regulating emotions overall, which may degrade the effectiveness of social connectedness in the face of emotional overwhelm or similar.

Limitations and constraints on generality

Several limitations are important to note. The sample included all girls between the ages of 11 to 13 who were majority White and originated from a midsized Midwestern city in the United States, thus limiting the generalizability of our findings. Moreover, given that a large proportion of the sample was recruited for elevated risk for developing social anxiety and/or depression, findings may not be generalizable to girls experiencing internalizing symptoms at clinical levels or girls at low risk for internalizing symptoms. However, this sample at temperamental risk for developing internalizing symptoms may also be construed as a strength, as adolescent girls are especially attuned to social connection and sensitive to social rejection (Rose & Rudolph, 2006; Somerville, 2013), making it an important group to study. Our sample was also predominantly White, and we did not have adequate power to examine racial and/or ethnic differences. As emotion display norms are highly culture-dependent (Matsumoto, 1990), future work examining these associations in samples designed to assess such cultural differences would be highly informative. Another limitation is that our measure of "peak negative emotion" may not fully capture peak negative emotion prior to the EMA prompt, as it is possible that participants experienced peak negative emotion unrelated to negative social interactions. Our data collection procedures do not contain a mechanism for capturing negative emotion to non-social events, and future studies distinguishing social and non-social event negative reactivity are warranted. Further, reliability of our negative emotion construct was relatively low at the within-person level, which may suggest our findings would not be robust in other samples due to unreliability of measurement. Within-person negative emotion reliability appears to be systematically lower than between-person in adolescent samples (Bai & Repetti, 2018; Bai et al., 2017), with values around .70 frequently observed. Although the reliability observed here was considerably lower, the successful replication of results in our sensitivity samples suggests results are robust despite the low reliability within-person. Finally, participants could only submit one social connectedness rating per social context category (e.g., with "a friend or friends"), even if they were in the company of multiple friends—for whom participants might have perceived differing degrees of social connectedness. Future work examining social connectedness should consider collecting data that enables youth to elaborate upon the types of friends with whom they interact.

Conclusions

The current study extends social baseline theories (e.g., Beckes & Coan, 2011; Walsh et al., 2024) to adolescent girls' everyday lives, illustrating that greater feelings of social connection are a powerful contributor to reductions in NE for adolescent girls after emotionally salient, negative interpersonal interactions. However, the impact of social connectedness is dependent on contextual factors. More specifically, the association between social connectedness and emotion regulation (i.e., greater reduction in NE) was stronger in the presence of non-family members, such as peers, extending the literature on adolescent re-orientation toward peers (e.g., Allen et al., 2022; Cui et al., 2020; Miller-Slough & Dunsmore, 2020) to the regulatory context. In contrast, this social connection association was weaker when girls were aided in their regulatory efforts in response to the negative social interaction, which appeared to be due to the effect of co-ruminating with others. These findings further extend research on co-rumination in the context of adolescent girls' everyday lives (Battaglini et al., 2021; Rose, 2021), and further cement the paradox of co-rumination increasing perceived social closeness while also prolonging the experience of NE. These findings indicate that the benefits of feeling socially connected on regulating negative emotion in the real world largely depend on who girls are interacting with when they experience negative social interactions—and that how much girls feel socially connected to their peers matters for regulating their emotional response to such events. Study findings might inform clinicians working with adolescent therapy clients, such that clinicians may consider

incorporating involvement from peers in an adolescent client's treatment plan. More specifically, clinicians might encourage adolescent clients to practice emotion regulation skills in the company of peers to whom the adolescent feels socially connected, thus introducing the potential to maximize the regulatory benefits of social connection on adolescents' emotions in everyday life.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

PATIENT CONSENT STATEMENT

Participant consent was obtained by requesting signed parent/guardian consent and adolescent assent to study procedures.

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