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Understanding the Development of Chronic Loneliness in Youth

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Abstract

Loneliness becomes more prevalent as youth transition from childhood into adolescence. A key underlying process may be the puberty-related increase in biological stress reactivity, which can alter social behavior and elicit conflict or social withdrawal ("fight-or-flight" behaviors) in some youth, but increased prosocial ("tend-and-befriend") responses in others. We propose an integrative theoretical model that identifies the social, personality, and biological characteristics underlying individual differences in social-behavioral responses to stress. This model posits a vicious cycle whereby youth who respond to stress with "fight-or-flight" tendencies develop increasing and chronic levels of loneliness across adolescence, whereas youth who display "tend-and-befriend" behaviors may be buffered from these consequences. Based on research supporting this model, we propose multiple intervention avenues for curtailing the prevalence of loneliness in adolescence by targeting key factors involved in its development: social relationships, personality, and stress-induced behavioral and biological changes.

Loneliness surges in adolescence. Over 50% of adolescents experience recurring feelings of loneliness (Heinrich & Gullone, 2006), compared to less than 20% of children 7–12 years old (Bartels et al., 2008; Qualter et al., 2015). Loneliness has been conceptualized as "feelings of distress and dysphoria resulting from a discrepancy between a person's desired and achieved levels of social relations" (Cacioppo, Cacioppo, Cole et al., 2015, p. 1), and can be experienced even in the presence of others. For example, a study of Dutch 13- to 16-year-olds showed that, although adolescents reported greater loneliness when they were alone than when they were with others, some also reported feeling lonely when they were at school and with classmates (van Roekel et al., 2015). Because social belonging is increasingly important in adolescence (Tomova et al., 2021), loneliness may arise from an increased but unmet need for social connection in adolescence. Feelings of loneliness are not inconsequential, as they are associated with increased risk of current and future depression, anxiety, and suicidal ideation (Loades et al., 2020; Tomova et al., 2021), which also become more prevalent during adolescence (Merikangas et al., 2010). Given bidirectional longitudinal associations between loneliness and depression during

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adolescence (Vanhalst et al., 2013), loneliness likely contributes to poor mental health. Adolescent loneliness also increased during the COVID-19 pandemic (Farrell et al., 2023) and was associated with higher levels of depression (Ellis et al., 2020). This is particularly concerning because adolescent socio-emotional development has long-term implications for adult mental health (Berg et al., 2017). Adolescent loneliness can continue into adulthood, with 52% of American adults reporting feeling lonely sometimes or always (Cigna, 2020). Thus, it is critical to understand the processes underlying the escalating levels of loneliness during adolescence to prevent lasting dysfunction in adulthood.

Why are so many adolescents experiencing loneliness? Puberty-related increases in biological stress reactivity (Dahl & Gunnar, 2009) may contribute to this phenomenon. Starting with puberty, adolescents exhibit stronger cortisol and cardiovascular reactivity to laboratory psychosocial stressors (Stroud et al., 2009), face a greater number of stressors (Colten & Gore, 1991), and show increased sensitivity to environmental stimuli and social information (Dahl et al., 2018). It has long been recognized that the stress response can alter social behavior leading to increased tendencies towards conflict or social withdrawal ("fight-or-flight") during stressors (Cannon, 1932), which may be adaptive in some circumstances, assisting with self-defense ("fight") or averting conflict ("flight"), but which also can escalate social tensions.

More recently, Taylor (2006) theorized the stress response can also activate "tend-and-befriend" behaviors, including increased prosocial and affiliative behaviors. Together, these theories raise the possibility that the biological stress response activates behavioral repertoires that either impede or facilitate social connection after stressor exposure. However, Taylor's model has been tested primarily in adults, leaving unexplained when and why the "fight or flight" versus "tend-and-befriend" profiles emerge in development. Understanding the development of these behavioral response tendencies may help explain why loneliness rates rise during adolescence.

This paper proposes a theoretical model that identifies the biological, social, and personality characteristics that predispose youth to increased loneliness during adolescence. We hypothesize a vicious cycle whereby some youth who experience loneliness as puberty onsets will experience behavioral and biological changes that foster increasing loneliness across adolescence, whereas other youth will respond to puberty-related increases in stress reactivity by showing behavioral and biological changes that promote social connection (e.g., social support seeking), thus being protected against loneliness. These processes are hypothesized to be more pronounced and accelerated in adolescents who experience chronic stress or trauma compared to those experiencing mild, acute stressors. Biologically, we propose this cycle is perpetuated by oxytocinergic, adrenocortical, autonomic, and inflammatory activity. We describe this model and elaborate on the novel hypotheses and intervention strategies it suggests.

Theoretical Model

Despite the benefits of social connection for mental and physical health (Hostinar, 2015), many adolescents and adults receive inadequate levels of social and emotional support

(American Psychological Association, 2018; Cigna, 2020). A deeper understanding of barriers that impede social connections could spark significant progress. We propose that loneliness during adolescence traps a subset of youth in a vicious cycle of increasing loneliness over time. The basis for this vicious cycle is the biphasic nature of the human stress response, which includes two major social-behavioral profiles (Taylor, 2006): "fight-or-flight" (an increase in conflict or social withdrawal in the aftermath of stress) and "tend-and-befriend" (an increase in prosocial and affiliative behavior). In this model (Figure 1), the quality of relationships with parents, siblings, and peers, in addition to specific personality traits (introversion, disagreeableness, neuroticism, and shyness) and individual differences in stress reactivity establish initial patterns of social connection or loneliness in early adolescence. Loneliness then biases stress responses toward a "fight-or-flight" social-behavioral profile, which can alienate others and lead to peer rejection or deprive youth of opportunities to engage socially, practice social skills, and receive and respond to social feedback (Rubin et al., 2009). This cycle accentuates their stress, loneliness, and social isolation throughout adolescence and over time. In contrast, initial patterns of successful social connections may bias the stress response towards a prosocial "tend-and-befriend" profile, which may lead youth to seek social support in the aftermath of stress, discover the stress-buffering qualities of social interaction, and develop increasingly rewarding social relationships over time.

In this model, adolescents who experience loneliness also experience increases in stress reactivity across multiple biological systems, including the oxytocinergic system, hypothalamic-pituitary-adrenocortical (HPA) axis, autonomic nervous system (ANS), and immune system. In turn, this increase in biological stress reactivity shifts behaviors after social stress to "fight-or-flight" rather than "tend-and-befriend" in some adolescents, a profile that can alienate them and accentuate future loneliness (Figure 1) during a developmental period when social interactions are of greater significance (Nelson et al., 2016). Over time, these states and behavioral tendencies consolidate into traits, leading to chronic loneliness and social isolation. Cultural norms likely also shape adolescents' social interactions and propensity to seek social connection. For instance, people from individualistic cultures report greater loneliness than those from more collectivist cultures, according to a worldwide survey of participants from 237 countries, islands, and territories (Barreto et al., 2021).

Below, we summarize evidence supporting the links among the constructs in our model.

Social Relationships in Adolescence

Adolescence has been described as a period of "social re-orientation" (Nelson et al., 2005), when puberty-related changes in the brain's social information processing network facilitate behavioral, motivational, and affective changes that result in greater sensitivity to social stimuli, particularly social evaluation (Somerville, 2013), as well as a reorientation from spending time with family towards spending time with peers and potential romantic partners (Nelson et al., 2005). Furthermore, adolescents exhibit heightened neural responses to social reward stimuli compared to children and adults (Somerville et al., 2011), and greater risk-taking and reward-related neural activation in the presence of peers compared

to alone (Chein et al., 2011). The increased salience of social rewards, coupled with the increased complexity and instability of adolescent social relationships, is theorized to increase depression risk (Davey et al., 2008). Together, these theoretical models and empirical findings suggest that the quality of social relationships is particularly influential for adolescent wellbeing.

Poorer quality relationships with parents, siblings, and peers have been linked to the development of loneliness during adolescence and into young adulthood (Laursen & Hartl, 2013; von Soest et al., 2020). These patterns occur across cultures, including non-Western countries such as China and Indonesia (Liu et al., 2015). Even prior to adolescence, a history of insecure attachments to caregivers can create internal working models that impede the development of close social relationships later in development, increasing risk of future loneliness (Cassidy & Berlin, 1999). Lower attachment security with parents is associated with social withdrawal and loneliness in adolescence (Goossens et al., 1998; Hastings et al., 2019). Having siblings and closeness to siblings relates to lower loneliness in adolescence and young adulthood in some studies from North America and Europe (Ponzetti & James, 1997; von Soest et al., 2020), but not all (Rönkä et al., 2014). Lower loneliness is reported by adolescents raised as only children compared to those raised with siblings in China (Lin et al., 2021), possibly due to spending more time with parents and developing a closer parent-adolescent bond (Lin et al., 2021).

Additionally, adolescents seek autonomy from parents, relying increasingly on peers for their social needs (Goossens, 2018). Furthermore, friendship participation predicts greater social-emotional well-being and lower loneliness in adolescence (Vitaro et al., 2009), but adolescents' risk of loneliness increases with unsatisfactory peer relationships and experiences of peer victimization or rejection (Brown & Larson, 2009; Laursen & Hartl, 2013; Woodhouse et al., 2012). Low friendship quality is associated with social withdrawal (Dryburgh et al., 2022) and is common in the friendships of socially withdrawn youth (Rubin et al., 2018). Lacking romantic relationships in late adolescence may also trigger feelings of loneliness (Woodhouse et al., 2012), and some single adolescents may experience loneliness due to decreased opportunities to spend time with friends whose time is occupied with dating (Laursen & Hartl, 2013). Overall, the quality of relationships with parents, siblings, and peers primes and perpetuates social-behavioral tendencies that can prevent or promote loneliness during adolescence.

The Role of Personality

A distinct personality profile is associated with the tendency to feel lonely. A recent meta-analysis of studies with adults and adolescents (Buecker et al., 2020) found that loneliness was most strongly associated with three of the Big Five personality traits: extraversion ($r = -.37$), neuroticism ($r = .36$), and agreeableness ($r = -.24$). Extraverts enjoy and feel energized by social interactions and social gatherings more than introverts (John et al., 2008) and lower extraversion predicts greater loneliness in adolescents (Wieczorek et al., 2021). Neuroticism, defined as greater tendency towards negative emotionality, has been linked to greater loneliness in adolescence (Vanhalst et al., 2013; Wieczorek et al., 2021) and higher emotional reactivity to social exclusion in young adulthood (Denissen & Penke, 2008).

Some evidence suggests the partial heritability of loneliness (.14 to .27 in genome-wide association studies, Spithoven et al., 2019) may be largely due to shared genetic risk with neuroticism (Abdellaoui et al., 2019), although neuroticism and loneliness also have a moderate environmental correlation after parsing out covariation due to genetics (Freilich et al., 2022), supporting the plausibility of a developmental pathway by which this personality trait can lead to loneliness. Finally, agreeableness refers to a propensity to avoid social conflict and strive to have pleasant social interactions, whereas disagreeableness, the low end of this trait, captures social abrasiveness (Buecker et al., 2020), which elicits social rejection and victimization (Jensen-Campbell et al., 2002). Agreeable adolescents report less loneliness (Teppers et al., 2013), likely because they gain peer acceptance and friendship more easily and report less conflict with others (Jensen-Campbell et al., 2002). Another personality dimension predictive of loneliness is shyness, a trait distinct from introversion (Schmidt & Buss, 2010). Whereas introversion captures low social motivation and desire to be with others (John et al., 2008), shyness captures reticence, behavioral inhibition, and nervousness around others, which is a risk factor for social withdrawal and social rejection in youth (Rubin et al., 2009), thus elevating loneliness risk. Overall, this literature supports personality's role in shaping predispositions towards loneliness during adolescence and adulthood.

Biological Mechanisms

Stress was initially theorized to trigger exclusively antagonistic or withdrawn ("fight-or-flight") social behaviors (Cannon, 1932). Taylor and colleagues (Taylor, 2006; Taylor et al., 2000) later synthesized evidence that humans can also respond to stress with increased "tend-and-befriend" behaviors (i.e., increases in altruism, helping behavior, empathy, affiliation, cooperation). Initially, Taylor's theory proposed that these profiles align with gender, with "fight-or-flight" being the prototypical male response and "tend-and-befriend" being the prototypical female response (Taylor et al., 2000). However, studies with adults have since documented that both men and women can show stress-induced increases in prosocial behavior (Singer et al., 2017; Sollberger et al., 2016; Tomova et al., 2017; von Dawans et al., 2019; von Dawans et al., 2012) or antisocial behavior (Bendahan et al., 2017; Kubzansky et al., 2012; Steinbeis et al., 2015). This evidence argues against strict biologically determined gender differences. Rather, the picture is more nuanced, whereby social, personality, cultural, and developmental factors appear to shape biobehavioral responses to stress in complex ways.

More research is necessary to understand the biological processes that promote weaker "tend-and-befriend" or stronger "fight-or-flight" stress-response profiles, increasing the risk of loneliness in both boys and girls. Integrating research on biological features of both "tend-and-befriend" and "fight-or-flight" tendencies in humans and animals, we propose prominent roles for oxytocin, HPA and ANS stress reactivity. In addition to these biological systems, systemic inflammation has also been linked to social withdrawal and loneliness (Eisenberger et al., 2017; Smith et al., 2020). We describe evidence linking the activity of these systems to social relationships and personality in childhood when available, and any known links with loneliness or deficient relationships in childhood or adolescence. We hypothesize that biological processes may serve to perpetuate and amplify the "vicious

cycle" of loneliness proposed in our theoretical model. As we discuss next, biological mechanisms may reveal new insights about the development of loneliness that would not be evident if behavioral measures were exclusively collected.

Oxytocin.—Oxytocin is a neuropeptide implicated in processes related to social affiliation, attachment and parenting, social cognition, prosocial behavior, and reduced stress responses (Carter, 1998; Hostinar et al., 2014; Wang et al., 2022). However, oxytocin has also been linked to negative social behaviors, such as intergroup hostility, aggression, envy, and jealousy (Shamay-Tsoory & Abu-Akel, 2016; Wang et al., 2022). One hypothesis that may explain these diverging effects is the social salience hypothesis, which proposes that oxytocin evolved to promote attention to the salience of social cues more generally rather than specific prosocial behaviors (Shamay-Tsoory & Abu-Akel, 2016).

Although no studies have examined the role of oxytocin in promoting a vicious cycle of increasing loneliness over time, some evidence from primates suggests that monkeys with more aggressive temperaments exhibit more pronounced drops in plasma oxytocin after stress induction (Witczak et al., 2018). In humans, there is some evidence linking alterations in the oxytocin system to the quality of early-life social relationships early. For example, children with previous experiences of social deprivation in the form of orphanage rearing showed lower levels of urinary oxytocin after interactions with their adoptive mothers (Fries et al., 2005) or reduction in cortisol stress responses (Hostinar et al., 2015a) after social interactions with their adoptive parents, even though they report having supportive parents on questionnaires (Hostinar et al., 2015a). These results suggest that early social deprivation may lead to the experience of having access to social partners but still feeling lonely. Consistent with this notion, studies in adults have linked attachment disruptions to the experience of "emotional loneliness" (DiTommaso & Spinner, 1997) and have shown that childhood trauma is correlated with lower levels of oxytocin in cerebrospinal fluid and plasma in adult women (Bertsch et al., 2013; Heim et al., 2009), particularly in women with borderline personality disorder, who have difficulties forming stable relationships (Bertsch et al., 2013).

There are few human studies of oxytocin in youth (Torres et al., 2018), but some evidence suggests adolescents have lower levels of both baseline and post-stress urinary oxytocin compared to children (Doom et al., 2017). This developmental difference requires further investigation, as it may play a role in adolescents' greater vulnerability to loneliness compared to children. In-person or phone contact with one's mother after a stressor resulted in higher urinary oxytocin compared to having no contact or communicating via instant messaging among girls ages 7–12 years old (Seltzer et al., 2012), suggesting lower oxytocin may index reduced social interaction in youth. However, it is unclear if lower levels of oxytocin indicate deficient social relationships, as some studies have revealed *higher* levels of basal plasma oxytocin were associated with loneliness among international college students upon arrival in their host country (Gouin et al., 2015) and in women experiencing more relationship distress (Taylor et al., 2006; Turner et al., 1999). It has been proposed that, in nonclinical samples, oxytocin may increase as an impetus to restore social connection among those experiencing interpersonal distress (Taylor et al., 2006). In youth ages 6–18, more oxytocin in cerebrospinal fluid and plasma was associated with lower trait

anxiety, suggesting a possible social buffering effect of oxytocin on anxiety (Carson et al., 2015). More longitudinal research is needed to understand links between oxytocin, anxiety, and social behavior in human adolescents, although accumulating evidence shows similar correlations with human social behavior as seen in the animal literature (Torres et al., 2018).

HPA axis and ANS.—The two major stress-response systems, the HPA axis and the ANS, are sensitive to experiences of loneliness (Cacioppo et al., 2015), with one study linking loneliness in children and adolescents ages 8–15 with HPA activity (lower morning cortisol and flatter diurnal cortisol slopes, Zilioli et al., 2017). The activity of these stress-response systems can be buffered (i.e., dampened) by supportive relationships (Hostinar, 2015). However, adolescents show less social buffering of their cortisol stress responses by parent support compared to children (Hostinar et al., 2015b), and increased cortisol responses to stress when their best friend provides support before a stressor (Doom et al., 2017), suggesting friends may amplify stress responses during this period. Adolescents' shift from parents to friends as a primary source of support, coupled with the social-evaluative nature of some interactions with friends, may create conditions for experiencing loneliness.

In adults, lonelier individuals show higher glucocorticoid reactivity to stress in some studies and lower glucocorticoid reactivity in others (Brown et al., 2018). This is consistent with evidence that chronic social stressors elevate glucocorticoids in the short term, but lead to hyposecretion of glucocorticoids in the long term, which has been linked to social avoidance during adolescence in nonhuman animals (Perry et al., 2019). Studies also have reported either higher or lower cardiac ANS reactivity to acute stress in lonely individuals compared to non-lonely individuals (Brown et al., 2018). This heterogeneity may be driven by subgroups with divergent social-behavioral and biological profiles after stress ("fight-or-flight" versus "tend-and-befriend") as proposed by Taylor's theory. More research is needed to test this hypothesis.

Inflammation.—Studies of youths (Murphy et al., 2013; Scott & Manczak, 2021) and adults (Cole, 2013; Smith et al., 2020) suggest that loneliness and social rejection may be linked with heightened expression of select proinflammatory genes. This may lead to heightened levels of inflammatory markers such as interleukin-6 (IL-6) and C-reactive protein (CRP) in circulation. A systematic review showed that peer rejection was associated with elevations in youth's inflammatory markers (Scott & Manczak, 2021), as seen in several studies (e.g., de Bruine et al., 2019; Giletta et al., 2018; Murphy et al., 2013), whereas positive peer experiences and general peer-related stress were not reliably associated with inflammation (Scott & Manczak, 2021). In adults, a recent meta-analysis revealed associations of social isolation with the inflammatory marker CRP and of loneliness with IL-6, though effect sizes were small (Smith et al., 2020). Inflammation has been linked to a behavioral "sickness" response in humans and animals, which includes social withdrawal and other behaviors that conserve energy and avoid further exposure to threats (Dantzer & Kelley, 2007). However, more research is needed to understand the contribution of inflammation to reinforcing the hypothesized "vicious cycle" of loneliness in adolescence.

Conclusions

Adolescent loneliness is multifaceted and influenced by many social-environmental and personality factors, while also being maintained and amplified by biological stress feedback loops in a “vicious cycle” pattern. However, its complex nature also allows multiple points of entry for intervention (see Table 1 and Supplemental Material online for a discussion of possible intervention avenues). To address the rising rates of loneliness in adolescence, we call for further research to understand the determinants of loneliness and identify fruitful intervention strategies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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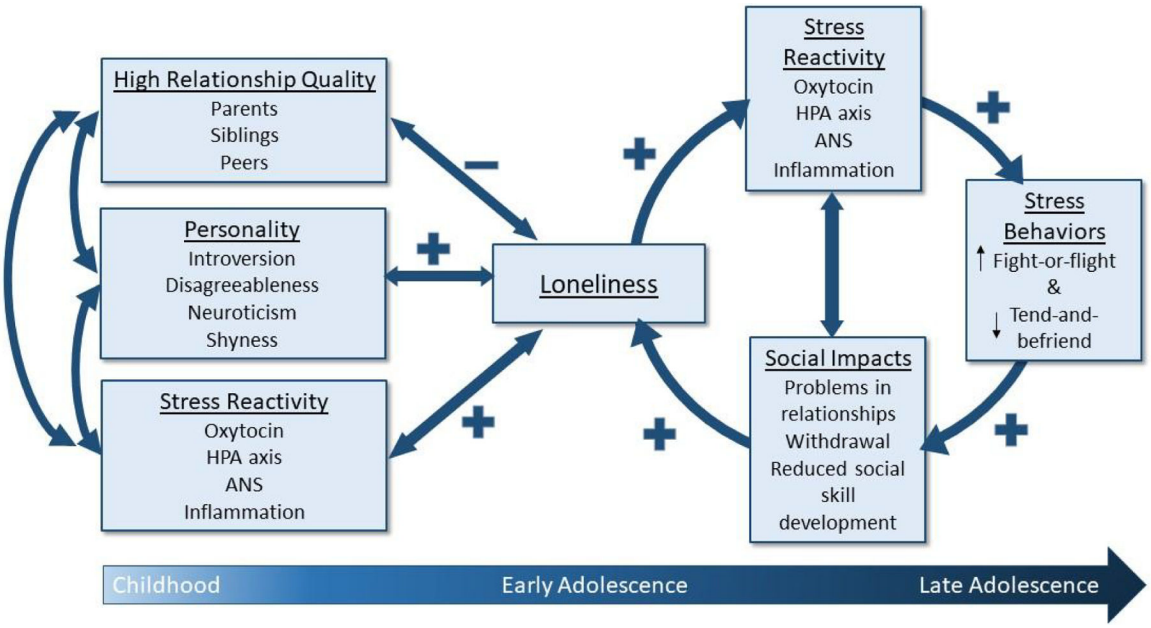

Figure 1.

The vicious cycle of loneliness. This model is a developmental extension of the "tend-and-befriend" model, proposing processes through which chronic loneliness increases across adolescence among those with specific social, personality, and biological risk factors.

Table 1.

Proposed avenues for intervention to reduce the prevalence of adolescent loneliness based on our theoretical model.

Domain	Intervention goal	Examples	References	Strength of evidence
Social relationships	Promote closeness to parents and peers, reduce social rejection	• Attachment and Biobehavioral Catch-up (ABC) Intervention • School anti-bullying programs • Social media interventions	• Bourne, Korom, & Dozier (2022) • Fraguas et al. (2021) • Hunt et al. (2018)	• Strong but indirect: RCTs show that attachment, bullying, social media use can be modified, but direct measurement of loneliness in adolescence as an outcome is lacking.
Personality targets	Teach socioemotional skills to compensate for or change shyness, neuroticism, introversion, and disagreeableness	• Programs for shy children: *Turtle Program and Cool Little Kids* • Cognitive-behavioral interventions to modify social anxiety or negative affectivity	• Chronis-Tuscano et al. (2022) • Lynch et al. (2023); Suveg et al. (2017)	• Strong but indirect: RCTs show shyness, negative affectivity and anxiety sensitivity can be modified in childhood or adolescence. RCTs measuring loneliness as an outcome and including a control group are lacking.
Stress behaviors	Teach about and modify stress-related changes in social behavior	• Psychosocial education to promote tend-and-befriend behaviors and reduce fight-or-flight behaviors	• Taylor (2006); Taylor et al. (2000)	• Speculative: such psychosocial interventions need to be developed and tested with RCTs.
Biological mechanisms	Modify stress-related biological pathways that foster loneliness	• Biological therapeutics such as oxytocin or anti-inflammatory treatments	• Jones et al. (2017) • Kohler et al. (2014)	• Speculative: these therapeutics have yet to be tested to address loneliness in adolescents but show some initial promise in reducing social anxiety or depression in adults or animal models.