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Thinking of you: Relations between mind-mindedness, theory of mind, and social anxiety traits in middle childhood and adulthood

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Abstract

The mapping of developmental relations between social cognition and real-world social behaviors has theoretical and practical importance. In the domain of social anxiety, however, studies examining links between social cognitive ability and anxiety have produced mixed results. One potential explanation is that varied facets of social cognition are differentially linked to social anxiety across development. To better understand how social cognition relates to social anxiety, we assessed multiple facets of two important social cognitive capacities—mind-mindedness and theory of mind— in school-aged children aged 7–12 and young adults aged 18–24. We also measured social anxiety traits. We found that, across ages, mind-mindedness and theory of mind were not related to each other. Additionally, for children and adults, higher levels of social anxiety correlated with higher levels of mind-mindedness toward close social partners, indicating an increased propensity to describe partners using mental state terms. By contrast, social anxiety was not correlated with theory of mind, which measured the ability to decipher or attribute mental states to photographs, videos, or story characters. These findings offer insight into how different components of social cognition are related and how more naturalistic measures of social cognition involving relationships may relate to social anxiety across development.

1 | INTRODUCTION

Relations between social cognition and social behaviors are of interest in a variety of domains, including social anxiety (e.g., Beidel, Turner, & Dancu, 1985; Heimberg, Brozovich, & Rapee, 2010). Although social cognition is multi-dimensional, one important component is considering the mental states of others (Saxe, 2006). Under this broad framework fall two separate constructs: first, theory of mind (ToM), or the ability to represent the contents of others' minds (Wellman, 2017) and second, mind-mindedness, or the propensity to treat others as intentional agents with their own minds, particularly in the context of real-world relationships (McMahon & Bernier, 2017). ToM is typically assessed via measures in which individuals report on the mental states of characters and mind-mindedness is most often assessed by examining how individuals talk about or to close social partners, either during interviews or in dyadic interaction. Although ToM and mind-mindedness may appear conceptually similar, previous research has found minimal correlations between these two abilities (Barreto, Fearon, Osório, Meins, & Martins, 2016; Davis, Meins, & Fernyhough, 2014; Meins, Fernyhough, Johnson, & Lidstone, 2006). Less is known, however, about how varied facets of ToM and mind-mindedness relate to each other and to social anxiety across development.

Research examining links between ToM ability and social anxiety disorder in adults has produced mixed results. Some studies have found that adults diagnosed with social anxiety disorder show poorer performance on ToM tasks (Hezel & McNally, 2014; Washburn, Wilson, Roes, Rnic, & Harkness, 2016). Alongside these findings in clinical samples, a study examining trait-level social anxiety and ToM abilities found that individuals with high social anxiety traits showed similar mental state reasoning abilities to those with lower social anxiety traits, but were worse at interpreting neutral mental states from facial expressions (Lenton-Brym, Moscovitch, Vidovic, Nilsen, & Friedman, 2018). By contrast, other studies have found evidence for improved ToM in social anxiety, at least at the trait level (Sutterby, Bedwell, Passler, Deptula, & Mesa, 2012; Tibi-Elhanany & Shamay-Tsoory, 2011).

These disparate findings alternatively support two frameworks explaining the link between altered ToM and social anxiety: a deficit framework and a hypersensitivity framework (Nikolić et al., 2019). The deficit framework posits that social processing deficits lead to social anxiety (e.g., Banerjee & Henderson, 2001; Clark & Wells, 1995; Kashdan, Weeks, & Savostyanova, 2011; O'Toole, Hougaard, & Mennin, 2013), particularly biases in negatively interpreting ambiguous social stimuli (Christensen, Stein, & Means-Christensen, 2003). The hypersensitivity framework, by contrast, posits that those with social anxiety are skilled at intuiting the thoughts and feelings of others, leading to an increased self-consciousness that can increase social anxiety (Cutting & Dunn, 2002).

Most research on relations between social anxiety and social cognition has been conducted in adults, but middle childhood (approximately ages 7–12) is an important time for understanding these links. This period corresponds with significant changes in social cognitive abilities, including ToM (e.g., Longobardi, Spataro, & Rossi Arnaud, 2015). Social anxiety disorder also often emerges during or immediately after this developmental period (Wittchen & Fehm, 2003). Although understanding the social cognitive mechanisms underlying social anxiety is of interest in middle childhood, few studies have addressed this question. Banerjee and Henderson (2001) found that social anxiety traits in children aged 6 to 11 years were negatively related to understanding social faux pas and understanding why characters would sometimes lie about their true feelings, but were not related to second-order false belief understanding. Studies using vignettes to examine multiple components of ToM (including false

belief, emotion, and sarcasm) have also found links between lower ToM and both higher social anxiety (Colonnesi, Nikolić, Vente, & Bögels, 2017) and higher behavioral inhibition (Broeren & Muris, 2009). A recent longitudinal study of middle childhood found that, over time, higher ToM ability increased peer acceptance via links between greater ToM and lower levels of social anxiety traits (Ronchi, Banerjee, & Lecce, 2019). Attesting to the complexity of these relations, a recent study found a curvilinear relationship between ToM and social anxiety traits in children aged 8–12, such that both high and low levels of ToM were related to increased social anxiety (Nikolić et al., 2019). The link between high ToM and social anxiety was moderated by levels of self-consciousness, suggesting there may be multiple pathways linking ToM and social anxiety in middle childhood.

Another important component of social cognition—mind-mindedness—has not yet been investigated in the social anxiety literature. Mind-mindedness is the propensity to treat known others as though they are independent mental entities with their own thoughts, feelings and desires (McMahon & Bernier, 2017). Even though the bulk of mind-mindedness research has examined parents' tendencies to attribute mental states to their young children, mind-mindedness outside of the parent-child context is also an important component of social development. Mind-mindedness in older children and adults is typically assessed via having individuals describe a social partner and measuring the amount of language referring to the partner's mental states (e.g., Meins, Fernyhough, & Harris-Waller, 2014). Previous research has found links between lower mind-mindedness and higher levels of internalizing disorders (Lok & McMahon, 2016; McMahon & Meins, 2012; Schacht, Hammond, Marks, Wood, & Conroy, 2012; Walker, Wheatcroft, & Camic, 2011). Additionally, higher mind-mindedness has been related to relationship closeness in young adults (Meins et al., 2014) and better friendships in older adults (Lecce, Ceccato, & Cavallini, 2019). Thus, as mind-mindedness assesses the tendency to consider mental states in real-world relationships, it may contribute to social behaviors and outcomes, including social anxiety.

Understanding whether and how ToM and mind-mindedness relate to social anxiety informs larger discussions about mental state understanding throughout development. Increasing theoretical and empirical literature has targeted the question of whether the consideration of others' mental states is a unitary or multifaceted construct (e.g., Apperly, 2012; Schaafsma, Pfaff, Spunt, & Adolphs, 2015; Warnell & Redcay, 2019). For example, prior research has found that a child's own mind-mindedness does not relate to their own ToM and a parent's own mind-mindedness does not relate to their own ToM (Barreto et al., 2016; Davis et al., 2014). Even within the domain of ToM, different ToM tasks show minimal levels of correlation in children and adults (Warnell & Redcay, 2019). As social anxiety is a well-studied component of social behavior with an inconsistent literature on how it connects to social cognition, examining how ToM and mind-mindedness relate to social anxiety in a cross-sectional sample will help dissociate varied facets of mental state processing.

One theoretical reason to hypothesize a dissociation between ToM and mind-mindedness is that whereas mind-mindedness measures a propensity to consider mental states in real-world relational contexts, conventional ToM measures focus more on an underlying ability to represent mental states, typically in third-person contexts (e.g., characters in stories). For example, a mother's mind-mindedness about their child and romantic partner are related yet their mind-mindedness about a close partner is not related to the amount of mental state language used when describing a famous person (Meins et al., 2014). Thus, the relational context of mind-mindedness may be integral to the construct. By contrast, ToM tasks are conventionally designed to assess a broader ability to represent mental states. Thus, it is possible that the basic capacity to represent others' mental states may differentially relate to mental health concerns than the propensity to dynamically consider those states in relationships (cf. Schilbach, 2016).

Although the current literature has raised interesting questions about interrelations between social cognitive measures and how these varied measures relate to social anxiety, there are still large gaps in our knowledge of how these constructs relate throughout development. Thus, the current study cross-sectionally investigated links between mind-mindedness, ToM, and social anxiety. Our overarching aim was to understand how two important components of social cognition—mind-mindedness and ToM—were related to social anxiety in both middle childhood and young adulthood. One possible finding is that relations between social anxiety and social cognition

show continuity at multiple age points because middle childhood lays the foundation for adult social outcomes. Alternatively, early social anxiety may impact social cognition, but, by adulthood, compensatory skills allow for intact social cognitive performance. Finally, adults may show stronger relations between social anxiety and cognition than children because the impacts of social anxiety on cognitive skills are cumulative over time. Additionally, developmental patterns could vary across tasks such that earlier difficulties in both ToM and mind-mindedness become specific to mind-mindedness by adulthood as individuals learn compensatory mechanisms for explicit ToM tasks. Although the current cross-sectional study cannot fully answer these mechanistic questions, it is a first step in understanding developmental relations between social anxiety and mind-mindedness.

Our study's secondary goal was to more precisely characterize relations between ToM and mind-mindedness, and we thus included multiple ToM measures and assessed mind-mindedness toward both a close and distant partner. To our knowledge, this is the first study to directly contrast mind-mindedness between two personal relationships that vary in level of closeness. Beyond the importance of this comparison to the mind-mindedness literature, the relationship-specific nature of mind-mindedness (e.g., Meins et al., 2014) could reveal different associations between social anxiety and mind-mindedness for close versus distant partners. One possibility is that individuals who are more socially anxious show increased mind-mindedness in the context of close relationships, given the increased saliency of these relationships (e.g., Hur et al., in press). Alternatively, close relationships may be more comfortable than distant ones and thus less prone to hypervigilant attention to mental states. Titrating the relations between social anxiety and specific social cognitive abilities will inform understanding of the mechanisms underlying social anxiety and inform research on developmental relations between specific components of social cognition. Thus, our analyses first examined relations among social cognitive measures and then investigated developmental relations between these varied facets of social cognition and social anxiety. Additionally, we examined relations between social cognition and generalized anxiety in order to help determine the specificity of our findings to social anxiety.

2 | METHOD

2.1 | Participants

This study was conducted with the formal approval of the local Institutional Review Board and in accordance with the 1964 Helsinki Declaration. All adult participants provided informed consent and all child participants provided informed assent along with parent/guardian consent. A total of 53 children (27 males) aged 7–12 years (M = 9.94y, SD = 1.66y) were recruited via a database of local families, community listervs, flyers, community events, and word of mouth. All children, as assessed via parent report, were native English speakers, with normal or corrected-to-normal hearing and vision, without a history of developmental disabilities, and no first-degree relatives with autism or schizophrenia. The parents of six children failed to complete the assessment of child anxiety and one child failed to complete the mind-mindedness measure and thus the final sample consisted of 46 children (25 males; M = 10.05y, SD = 1.71y, range: 7.09–12.99y). Children also completed the Kaufman Brief Intelligence Test (KBIT-2; Kaufman & Kaufman, 2004). Children's verbal IQ ranged from 82–141 (M = 115.63, SD = 13.91), nonverbal IQ ranged from 80–142 (M = 113.33, SD = 12.93), and full-scale IQ ranged from 84–141 (M = 117.11, SD = 13.86), with full-scale IQ used in subsequent analyses.

Young adults were recruited for course credit through a university participant pool, consistent with previous studies of social cognition and social anxiety traits (e.g., Lenton-Brym et al., 2018). In total, 101 adults (45 males) aged 18–24 years (M = 20.32y, SD = 1.49y) participated. All participants had normal or corrected-to-normal hearing and vision. Several adult studies have found that the use of mental state language is not correlated with general cognitive abilities (Barreto et al., 2016; Meins, Fernyhough, Fradley, & Tuckey, 2001) and due to time constraints,

adults did not complete an IQ test. Children and adults completed a larger battery, but only the tasks relevant to the current study are reported here.

2.2 | Mind-mindedness measures

2.2.1 | Children

The mind-mindedness procedure for children was adapted from the task Meins et al. (2006) used with a similarly aged sample. The experimenter asked children a set of six questions: (1) do you have a best friend, (2) what is your best friend's name?, (3) can you describe [friend] for me?, (4) what do you like about [friend]?, (5) what sort of person is [friend]?, and (6) is there anything else you'd like to tell me about [friend]? If children thought of more than one best friend, they were asked to pick one. All children were able to think of at least one best friend. After children completed the task about their best friend, the experimenter then asked them to think of someone in their class who they did not know as well. The experimenter then asked them questions 3–6 from above, replacing the best friend's name with the classmate's name. Children's responses were recorded and transcribed.

We followed the coding scheme of Meins and colleagues (Meins et al., 2006; see Meins & Fernyhough, 2015 for coding manual). Each response (for both the close and distant social partner) was split into clauses and then coded into one of four mutually exclusive and exhaustive categories: (1) mental, (2) behavioral, (3) physical, and (4) general. Mental statements referred to beliefs, desires, will, interests, knowledge, or metacognition. Behavioral statements referred to the partner's behavior, including behaviorally observable personality traits. Any comments referring to physical attributes about appearance, age, or gender were coded as physical. Other comments that referred to the partner but did not fit into any of the above categories were coded as general. Repetition of specific statements was only coded once (e.g., repeatedly calling a friend 'nice'). Statements which did not refer to the partner at all were excluded from analyses. Statements were coded into categories by two independent coders. Inter-rater reliability was high (Krippendorf's alpha = .87). Consistent with the coding manual and existing mind-mindedness studies, behavioral likes (e.g., "he likes playing soccer") were coded as behavioral whereas mental preferences (e.g., "he likes schoolwork") were coded as mental. Similarly, although emotions were coded as mental, their behavioral manifestations were coded as behavioral (e.g., "He's happy" vs. "He laughs a lot"). Disagreements between coders were resolved by the senior author using the suggestion in the coding manual to rely on context clues to determine if the statement was intended to describe a mental state (e.g., whether "helpful" refers to mental recognition of others' needs).

2.2.2 | Adults

The adult mind-mindedness procedure was adapted from a Meins et al. (2014) study of adults. Specifically, participants typed out their answers to the following question: "Think of your current romantic partner/a person you regard as a very close friend. Please use the box below to tell us a little about this person". Participants next answered the following prompt: "Now think of someone that you don't know as well, such as a classmate, a coworker, or a neighbor. Please use the box below to tell us a little about this person". In order to facilitate comparison between children and adults, we used the same coding scheme. Thus, two independent coders coded statements into either mental, behavioral, physical or general categories. Inter-rater reliability was high (Krippendorf's alpha = .84). One adult participant and one child participant failed to provide data for the distant partner, but their data for the close partner were still used.

2.3 | Theory of mind measures

2.3.1 | Children

Given increasing theoretical and empirical work that ToM may not be a unitary construct in middle childhood or early adulthood (e.g., Schaafsma, Pfaff, Spunt, & Adolphs, 2015; Warnell & Redcay, 2019), we included multiple ToM measures for both age groups. As it was not possible to capture all potential facets of ToM in a single battery, we selected measures that produced robust individual differences, with a focus on measures used in past studies of social anxiety and ToM. To this end, children completed three ToM measures: (1) school-aged Reading the Mind in the Eyes (Baron-Cohen, Wheelwright, Scahill, Lawson, & Spong, 2001); (2) Strange Stories (White, Hill, Happé, & Frith, 2009); and (3) Faux Pas understanding (Baron-Cohen, O'Riordan, Jones, Stone, & Plaisted, 1999). For the Mind in the Eyes, children were shown 28 pictures with different pairs of eyes and were asked to select which of four displayed words best described the mental state in the photo. Children received one point for each correct answer, resulting in potential scores of 0–28. For the Strange Stories, children were presented with eight stories involving different nuanced mental situations (e.g., white lie, double crossing) and had to identify what mental state led a character to make a particular statement. Children's answers were scored on a 0–2 scale (White, Hill, Happé, & Frith, 2009), resulting in a possible range of scores from 0–16. Finally, in the Faux Pas task, children were presented with eight vignettes and had to identify whether a verbal faux pas was committed and what made that statement a faux pas (e.g., insulting someone when you did not realize they were in the room). Children received one point for each correct identification, resulting in a score range from 0–8. All ToM scores were converted to percentages for analyses.

2.3.2 | Adults

The selection of adult measures was more difficult, given that adults score at ceiling on many ToM instruments. In order to facilitate comparison with existing social anxiety literature and with the child data, and in order to draw nuanced comparisons with conventional mind-mindedness measures, adults completed two measures of ToM: (1) Reading the Mind in the Eyes (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) and (2) Spontaneous Theory of Mind Protocol (STOMP; Rice & Redcay, 2015). As with the school-aged version of the Mind in the Eyes, adults were presented with black-and-white photographs of the eye region and asked to decide, out of four choices, what mental state was depicted. Adults were presented with 36 items and received a point for each correct answer.

For the STOMP, participants viewed two silent video clips depicting complex social interactions (e.g., a collaborative heist; a romantic date gone awry). After viewing each clip, participants were told to type 7–10 lines (approximately 150 words) describing what had happened in the scene. Responses were split into clauses and each clause was assigned to a category: simple physical, physical inference, emotion, goal/intention, and belief state (see Rice & Redcay, 2015 for more details on the coding scheme). For analyses, the two physical categories were combined into a number of total external statements, and the emotion, goal/intention, and belief statements were combined to generate a number of internal statements. For each participant, a STOMP Index was created by dividing the number of internal statements by the number of total statements, multiplied by 100 (i.e., the percentage of the response describing internal states). Two independent coders classified statements into each category and inter-rater reliability was high for both the two broad categories (internal vs. external; Krippendorf's alpha = .89) and the five specific subcategories (Krippendorf's alpha = .78). One participant did not complete this measure. The STOMP is a particularly interesting measure because it does involve spontaneous description of a complex social scene, but is decontextualized from social relationships and is based on a brief film clip rather the description of a specific person based on a history of real-world interaction (i.e., our mind-mindedness measure).

2.4 | Social and generalized anxiety assessment

2.4.1 | Children

The parent accompanying the child to the session completed the Screen for Child Anxiety Related Disorders (SCARED; Birmaher et al., 1997). This 41-item questionnaire assesses children's anxiety across a variety of situations (e.g., "My child doesn't like to be with people he/she doesn't know well") that respondents answer on a 0–2 scale (0 = not true or hardly ever true, 1 = sometimes true, and 2 = true or often true). Scores are created by summing across items and the SCARED generates five subscales: somatic/panic disorder, generalized anxiety disorder, separation anxiety disorder, social anxiety disorder, and significant school avoidance. The SCARED has high test-retest reliability and high internal and external validity (e.g., Birmaher et al., 1999; Su, Wang, Fan, Su, & Gao, 2008), and has been extensively used in studies of anxiety traits (e.g., Jones, Lebowitz, Marin, & Stark, 2015; Warnell, Pecukonis, & Redcay, 2018). For children, overall SCARED scores ranged from 1–30 (M = 9.59, SD = 7.54), social anxiety scores ranged from 0–12 (M = 2.78, SD = 2.94), and generalized anxiety scores ranged from 0–16 (M = 3.00, SD = 3.40). These scores are in line with past studies of community samples (e.g., Bowers et al., 2020; Rappaport, Pagliaccio, Pine, Klein, & Jarcho, 2017). Given that the children in our sample had not received official clinical diagnoses and were recruited via community sampling, we included the full sample in final analyses. There was no relation between social or generalized anxiety and age (rs < .1).

2.4.2 | Adults

To assess generalized anxiety, adults completed the Generalized Anxiety Disorder-7 (GAD-7), a 7-question scale that includes symptoms of generalized anxiety disorder and asks about how often each symptom may have occurred in the last 2 weeks (Spitzer, Kroenke, Williams, & Löwe 2006). The GAD-7 has been validated for use in the general population to assess mild to severe generalized anxiety symptoms in normative samples (Löwe et al., 2008) and scores can range from 0–21. In our sample, generalized anxiety scores ranged from 0–21 (M = 8.33, SD = 6.14). To assess social anxiety, adults completed the Social Interaction Anxiety Scale (SIAS; Mattick & Clark, 1998), which targets the fear of general social interaction with friends, strangers, and potential romantic partners. Sample items include "I feel tense if I am alone with just one other person" and "I worry about expressing myself in case I appear awkward" and are scored on a 0–4 scale based on how true they are for the participant. We used the 19-item version of the assessment (cf. Hart, Jack, Turk, & Heimberg, 1999), so that possible scores ranged from 0–76. The SIAS has high test-retest reliability and internal and external validity (Brown et al., 1997; Heimberg, Mueller, Holt, Hope, & Liebowitz, 1992). In our sample, social anxiety scores ranged from 2–70 (M = 24.99, SD = 14.82). Although these SIAS scores are higher than those of some community samples (e.g., Heimberg et al., 1992), they are consistent with other recent studies of college students (e.g., Hofmann, Korte, & Suvak et al., 2009; Lyvers, Hanigan, & Thorberg, 2018; Rahm-Knigge, Prince, & Conner, 2019). We thus retained all participants in our analyses.

2.5 | Analyses

We first examined performance on our social cognitive measures. For all our mind-mindedness analyses, we followed literature suggesting that ratio scores can be problematic (e.g., by inflating scores for a respondent who makes only two statements, both of which are mentalistic, contrasted to a participant who makes 15 statements, 10 of which are mentalistic; Hughes, Devine, & Wang, 2018). We thus included total number of mental statements in our analyses of mind-mindedness and controlled for total number of nonmental statements in order to account for verbosity differences, consistent with other recent mind-mindedness literature (Gagné, Bernier, & McMahon, 2018; Hill &

McMahon, 2016; Hughes et al., 2018). Given the limited research on mind-mindedness in middle childhood and for distant social partners, we also explored whether and how participant gender and age influenced mind-mindedness, in addition to our main research questions about relations between social anxiety and social cognition.

To investigate these main research questions, we first examined coherence among the varied social cognitive assays, and we next examined relations between our social cognitive measures and social anxiety. To further ensure specificity of our results, we also examined relations with generalized anxiety. Additionally, as literature from adults has suggested that social anxiety may be related to differential performance on positive (e.g., friendly, playful), negative (e.g., upset, hostile), and neutral (e.g., contemplative, reflective) expressions on the Mind in the Eyes (Hezel & McNally, 2014; Lenton-Brym et al., 2018; Washburn et al., 2016), we also conducted exploratory analyses comparing performance on these three types of expressions. For the adult data, we classified expressions based on the guidelines of Harkness and colleagues (2005). For the school-age Mind in the Eyes, we repeated these same analyses. Three of the school-age stimuli were not used with adults, so we classified these based on their correct responses (i.e., "happy" as positive and "sad" as negative).

3 | RESULTS

3.1 | Social cognitive descriptive statistics

3.1.1 | Mind-mindedness

Overall, the mind-mindedness task produced variability in children and adults (Table 1). Given our interest in mind-mindedness differences between middle childhood and young adulthood, we first examined the effects of relationship closeness and statement type in a 2 (close, distant) x 4 (mental, behavioral, physical, general) repeated-measures ANOVA with age group (child, adult) entered as a between-participants factor. We found significant main effects of relationship closeness ($F(1,143) = 70.38$, $p < .0001$), statement type ($F(3,429) = 33.82$, $p < .0001$), as well as a significant two-way interactions between closeness and statement type ($F(3,429) = 2.90$, $p = .035$) and statement type and age group ($F(3,429) = 5.02$, $p = .002$), and a three-way interaction between closeness, statement type, and age group ($F(3,429) = 7.215$, $p < .0001$).

In probing this three-way interaction, post hoc tests indicated that children used significantly more total ($t(44) = 5.15$, $p < .0001$), behavioral ($t(44) = 2.16$, $p = .037$), physical ($t(44) = 3.54$, $p < .001$), and general statements ($t(44) = 2.48$, $p = .017$) when describing a close than a distant partner, but there was no difference in mental statements ($t(44) = 1.34$, $p = .19$). When describing a close versus a distant social partner, adults used more total ($t(99) = 8.77$, $p < .0001$), mental ($t(99) = 9.08$, $p < .0001$), behavioral ($t(99) = 3.64$, $p<.001$), and general statements ($t(99) = 2.18$, $p = .032$), but there was no difference in physical statements ($t(99) = 1.30$, $p = .20$). There were no significant differences between children and adults in the total number of statements used to describe either partner (close: $t(145) = 0.53$, $p = .60$; distant:$t(143) = −1.42$, $p = .16$). Adults, however, did use significantly more mental ($t(145) = 3.86$, $p < .001$) and fewer physical statements ($t(145) = 2.57$, $p = .011$) when describing a close partner than children did when describing a close partner.

We next examined the effects of gender and age in years within age groups, given potential interacting effects of sex and age on social networks (Feiring & Lewis, 1991; Rose & Smith, 2009). Separately for adults and children, we conducted a 2 (close, distant) × 4 (mental, behavioral, physical, general) repeated-measures ANOVA with age entered as a covariate and sex entered as a between-participants variable.

For children, there were significant effects of age ($F(1,42) = 6.68$, $p = .013$) and sex ($F(1,42) = 4.80$, $p = .034$), as well as a significant three-way interaction between closeness, statement type, and sex ($F(3,126) = 3.18$, $p = .026$). No interactions with age were significant. In probing the effect of age, we found that age in months was significantly related to the total number of statements about both the close ($r(44) = .30$, $p = .045$) and the distant

TABLE 1 Social cognitive descriptive statistics

Measure	Middle childhood		Early adulthood	
Theory of mind				
Mind in the Eyes	64.04 (11.67) 42.86–85.71		72.25 (9.85) 47.22–97.22	
Strange Stories	72.55 (12.74) 50.00–100		–	
Faux Pas	71.47 (15.74) 37.50–100		–	
STOMP	–		29.61 (9.97) 8.70–55.26	
	Middle childhood		**Early adulthood**	
Mind-mindedness	**Close partner**	**Distant partner**	**Close partner**	**Distant partner**
Total	10.39 (5.91) 2–26	7.69 (4.86) 1–20	10.97 (6.33) 3–48	6.74 (3.08) 2–19
Mental	1.67 (1.85) 0–6	1.38 (1.71) 0–6	3.34 (2.64) 0–14	.99 (1.37) 0–6
Behavioral	4.35 (2.79) 0–11	3.42 (2.44) 0–9	3.77 (3.04) 0–20	2.79 (2.23) 0–11
Physical	2.37 (2.30) 0–9	1.58 (1.82) 0–8	1.40 (2.05) 0–11	1.18 (1.51) 0–5
General	2.00 (2.30) 0–11	1.31 (1.66) 0–7	2.47 (2.78) 0–14	1.89 (1.70) 0–9

Note: Values are mean (standard deviation) and range. As the Mind in the Eyes task has different items and answer choices across ages, values are not directly comparable between children and adults. Theory of mind values are percentages and mind-mindedness values are the raw number of statements.

Abbreviation: STOMP, Spontaneous Theory of Mind Protocol.

partner ($r(43) = .32$, $p = .033$), with the largest relations seen in mental statements (close: $r(44) = .33$, $p = .023$; distant: $r(43) = .28$, $p = .055$) and general statements (close: $r(44) = .40$, $p = .006$; distant: $r(43) = .33$, $p = .025$). In examining the effect of gender, there were no gender differences when describing the more distant partner, but, for the close partner, boys and girls significantly differed on the number of behavioral statements ($M_{Girls} = 5.52$, $SD_{Girls} = 2.62$; $M_{Boys} = 3.36$, $SD_{Boys} = 2.43$; $t(44) = 2.81$, $p = .007$) and total statements ($M_{Girls} = 12.29$, $SD_{Girls} = 6.48$; $M_{Boys} = 8.80$, $SD_{Boys} = 4.97$; $t(44) = 2.06$, $p = .045$), with a marginal difference in the number of general statements ($M_{Girls} = 2.62$, $SD_{Girls} = 2.69$; $M_{Boys} = 1.48$, $SD_{Boys} = 1.81$; $t(44) = 1.71$, $p = .095$). In adults, by contrast, there were no significant main effects of age ($F(1,97) = .35$, $p = .56$) or sex ($F(1,97) = .019$, $p = .89$), nor were there any significant interactions with age or sex and any of the mind-mindedness variables. Finally, in children, IQ was significantly related to the number of physical statements about a close ($r(44) = .34$, $p = .022$) and distant social partner ($r(43) = .33$, $p = .026$), but not any other metrics.

3.1.2 | Theory of mind

The ToM assays also generated significant variability (Table 1). There were no gender differences on any of the ToM tasks for children or adults ($ps > .1$). In children, IQ showed positive relations with two of the three tasks:

(Mind in the Eyes: $r(44) = .29$, $p = .047$; Strange Stories: $r(44) = .34$, $p = .02$; Faux Pas: $r(44) = .01$, $p = .99$) and age showed a similar positive correlation with all three ToM tasks, although the correlation only reached significance for the Faux Pas task (Mind in the Eyes: $r(44) = .29$, $p = .052$; Strange Stories: $r(44) = .24$, $p = .11$; Faux Pas: $r(44) = .33$, $p = .024$). For adults, age was not related to either ToM task ($r < .15$). As children and adults completed different ToM measures, scores were not directly comparable.

3.2 | Testing main hypotheses

3.2.1 | Relations among social cognitive measures

Given literature suggesting that mind-mindedness is a relationship-specific quality (Meins et al., 2014), we examined the relation between levels of mind-mindedness in close versus distant relationships. In a model correcting for age, sex, and the total number of nonmental statements summed across close and distant partners, both children and adults showed a significant relation between mind-mindedness in the two social contexts (Table 2). By contrast, the ToM measures were not related to one another in children or adults. There were also no significant relations between any of the ToM measures and mind-mindedness at either age.

3.2.2 | Relations between social anxiety and social cognition

Social anxiety in both children and adults was positively correlated with mind-mindedness toward a close social partner, and this correlation remained significant in a model correcting for age, sex, and total number of nonmental

TABLE 2 Relations between social anxiety, mind-mindedness, and theory of mind in children and adults

Middle childhood	1	2	3	4	5	6
Social anxiety	–					
Mind-mindedness: close	.446**	–				
Mind-mindedness: distant	−.077	.365*	–			
Mind in the Eyes	.186	.102	.049	–		
Strange Stories	−.026	.050	.261#	.282#	–	
Faux Pas	.039	.122	.210	.110	.192	–
Early adulthood	**1**	**2**	**3**	**4**	**5**	
Social anxiety	–					
Mind-mindedness: close	.207*	–				
Mind-mindedness: distant	.121	.307**	–			
Mind in the Eyes	−.025	.085	.028	–		
STOMP	.001	.104	−.010	.129	–	

Note: All correlations are corrected for age and sex. Additionally, correlations with mind-mindedness are corrected for the number of nonmental statements about that social partner, with correlations between the two mind-mindedness measures corrected by the summed nonmental statements. Social anxiety was measured in children using the parent-report form of the Screen for Child Anxiety Related Disorders and was measured in adults using the self-reported Social Interaction Anxiety Scale. Bold values indicate significant correlations.

Abbreviation: STOMP, Spontaneous Theory of Mind Protocol.

**$p < .01$; *$p < .05$; #$p < .1$.
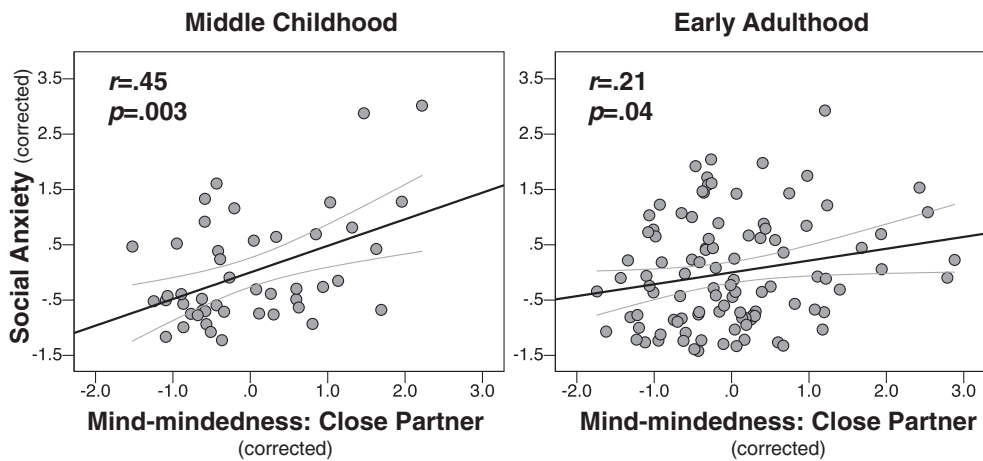
FIGURE 1 Across developmental periods, mind-mindedness toward a close social partner is positively related to social anxiety. Social anxiety and mind-mindedness values were first converted to z-scores within each age group. Adult correlations were then corrected for age, sex, and total number of nonmental statements about the close social partner. Child correlations were corrected for age, sex, full-scale IQ, and total number of nonmental statements about the close social partner. Social anxiety was measured in children using the parent-report form of the Screen for Child Anxiety Related Disorders and was measured in adults using the self-reported Social Interaction Anxiety Scale. Although the correlation coefficient is numerically higher in children, the difference between the two correlations is not significant.

statements (Figure 1; Table 2). The childhood relation between social anxiety and close partner mind-mindedness also remained significant in models that additionally corrected for IQ ($r(40) = .45$, $p = .003$). By contrast, relations between social anxiety and mind-mindedness toward a distant social partner were not significant for adults or children. The difference in correlation magnitude between social anxiety and close versus distant partners reached significance for children ($Z = 3.08$, $p < .01$), but not adults ($Z = .72$, $p = .47$). To test for the specificity of these relations, we examined the correlations between generalized anxiety and mind-mindedness toward a close social partner, again correcting for age, sex, and nonmental statements, and found no significant relation in children ($r(41) = .076$, $p = .63$; also correcting for IQ: $r(40) = .081$, $p = .61$) or adults ($r(96) = .11$, $p = .29$). The difference in correlation magnitude between mind-mindedness and social versus generalized anxiety was significant for children ($Z = 2.19$, $p = .028$), but not adults ($Z = .87$, $p = .39$). Correlations between social anxiety and nonmental statements were not significant ($ps > .05$; Supporting Information Table S1).

No ToM measures were significantly related to social anxiety in either age group. These results were supported by Bayesian analyses, which better allowed us to quantify evidence for the null (i.e., that ToM tasks are not related to social anxiety; Wetzels & Wagenmakers, 2012; Supporting Information Table S2). Additionally, given concerns about potentially limited range in the mind-mindedness and social anxiety measures in children, we repeated our analyses using nonparametric models with Spearman rank-order correlations and found similar results, such that the only significant correlation with social anxiety was mind-mindedness toward a close social partner ($rho(41) = .36$, $p = .016$; Supporting Information Table S3).

Although we did not find significant relations between social anxiety and Mind in the Eyes ability, given previous literature, we additionally examined whether positive, neutral, and negative Mind in the Eyes items were differentially related to social anxiety. We found no effect of item valence, as across both adults and children none of the three categories significantly predicted social or generalized anxiety in either parametric or nonparametric analyses, nor was there evidence for quadratic relations between the Mind in the Eyes and social anxiety (cf. Nikolić et al., 2019; Supporting Information Table S4).

4 | DISCUSSION

In the current study, we examined the interrelations between mind-mindedness, ToM, and social anxiety traits in middle childhood and early adulthood. Our results indicate that mind-mindedness in close relationships positively correlates with social anxiety such that more socially anxious children and adults use more mental state terms when describing close social partners. These results were specific to social anxiety and close relationships as mind-mindedness was not related to generalized anxiety at either developmental stage nor was mind-mindedness toward a more distant social partner (e.g., classmate, acquaintance) related to social anxiety. Additionally, varied ToM measures were not related to social anxiety in either children or adults, nor were they related to mind-mindedness. These results have theoretical and clinical significance for understanding how different types of mental state processing relate to real-world social outcomes.

Two different theoretical frameworks have been advanced to explain how altered social cognition can underlie social anxiety: one framework argues that social anxiety is influenced by deficits in social cognition (Banerjee & Henderson, 2001; Hope, Heimberg, & Klein, 1990) and the other argues that social anxiety is influenced by hypersensitivity to others' mental states, such that those with high social anxiety are more attuned to others' thoughts and feelings (Cutting & Dunn, 2002). Our results support developmental continuity in the hypersensitivity framework, albeit cross-sectionally. Future longitudinal work should continue to explore developmental change in this association using larger developmental samples with a more expansive age range in order to more fully examine moderators that we did not have the power to consider in this initial work. For example, the relation between social cognition and social anxiety may bidirectionally unfold starting in early development, such that increased social anxiety leads to intense focus on others' thoughts and feelings, which in turn spurs more self-consciousness and social anxiety. Such longitudinal research should also consider experimental interventions in order to determine if decreasing social anxiety is accompanied by decreased mind-mindedness.

Some research has suggested that social cognition difficulties in social anxiety can be driven by a tendency to "overmentalize" by attributing exaggerated emotions or overinterpreted mental states (Hezel & McNally, 2014; Tibi-Elhanany & Shamay-Tsoory, 2011; Washburn et al., 2016). Thus, hypersensitivity to others' mental states may not always entail correct mental state attribution. The current study was unable to disentangle propensity from accuracy in the mind-mindedness task, as we did not collect data about the true nature of the social partners. Future work with children and adults should examine the accuracy of mind-minded statements made during interactions (as is often done in parent-infant dyads; McMahon & Bernier, 2017) or bring in dyads to evaluate the accuracy of their partner's description.

The link between social anxiety and an increased tendency to attend to mental states in close but not distant relationships suggests that, by middle childhood, increased mentalizing in social anxiety is sensitive to context. These results are consistent with existing evidence connecting social anxiety to difficulties in close relationships (e.g., Davila & Beck, 2002; Rodebaugh, Lim, Shumaker, Levinson, & Thompson, 2015; Sparrevohn & Rapee, 2009). For example, one recent ecological momentary assessment study in young adults found that social anxiety traits did not predict the frequency or valence of social interactions with distant social partners, but did relate to decreased time with close friends (Hur et al., in press). Thus, the tendency of those with social anxiety to overly ruminate on others' mental states may be specific to close relationships, perhaps due to the increased availability of relevant social information upon which to reflect. Additionally, these close relationships may be perceived as higher stakes and thus more anxious individuals may be hypervigilant when considering the mental states of these partners. Our finding that relations between mind-mindedness and social anxiety were specific to close relationships may appear to run contrary to findings that social anxiety is linked to difficulties interacting with strangers in a laboratory (e.g., Alfano, Beidel, & Turner, 2006; Glenn et al., 2019). One potential explanation is that other cognitive mechanisms than increased mentalizing drive social anxiety when interacting with distant partners, such as more general physiological arousal, and this possibility should be investigated in future work.

By contrast to some past research, we did not find significant relations between ToM and social anxiety. There are several potential explanations for these findings. First, several past studies finding relations have examined clinical samples (e.g., Hezel & McNally, 2014; Washburn et al., 2016; but see Lenton-Brym et al., 2018) whereas we examined trait-level correlations in a community sample. Subclinical levels of social anxiety may not affect the basic capacity to attribute mental states to others. Another possibility is that relations between social anxiety and social cognition are best captured by measuring their interplay at multiple time points, as some developmental research finding negative relations between ToM and social anxiety has employed longitudinal designs (Ronchi et al., 2019). Still another explanation is that relations between social anxiety and ToM are measure-specific. For example, one of the few studies that examined social anxiety and ToM in middle childhood found relations with more naturalistic but not more laboratory-based ToM measures (Banerjee et al., 2001). Interestingly, we found a null relation between spontaneous ToM in adulthood and social anxiety, suggesting naturalism alone may not create relations between a particular ToM measure and social anxiety. Accounting for null ToM findings by appealing to measure-specific effects, however, does not fully explain our null findings with the Mind in the Eyes task, which—at least for some subscales—has demonstrated relations with social anxiety in adults (Lenton-Brym et al., 2018) and children (Nikolić et al., 2019). Thus, future research should continue to examine psychometric properties of the Mind in the Eyes, as other factors than ToM ability, such as emotion perception, may influence performance (Baker, Peterson, Pulos, & Kirkland, 2014; Oakley, Brewer, Bird, & Catmur, 2016).

Taken together, our results attest to the importance of measuring multiple facets of social cognition across development when attempting to understand the mechanisms underlying psychopathology. For example, we found that ToM tasks were not related to each other, consistent with mounting research indicating that ToM is not a unitary construct (e.g., Schaafsma et al., 2015; Warnell & Redcay, 2019). Additionally, we found that mind-mindedness and ToM were not related, again consistent with prior studies (Barretto et al., 2015; Davis et al., 2014; Meins et al., 2006). Thus, different measures of social cognition—even those purporting to measure similar constructs—may capture different dimensions of mental state processing. One such dimension is the capacity to represent mental states versus the spontaneous propensity to do so. Conventional ToM measures (including the majority used in the current study) solicit structured responses such that individuals pick one correct answer whereas mind-mindedness measures utilize a free response format. Another relevant dimension is that mind-mindedness and ToM have traditionally targeted different social contexts (e.g., real-world relationships versus third-person scenarios), which may be a particularly salient distinction in social disabilities that are most acute in real-world contexts (Schilbach, 2016). As with our inclusion of a more spontaneous ToM measure in the current study, future research should include multiple assays of social cognition that systematically vary along these dimensions, including extending traditional ToM measures to interactive contexts and mind-mindedness to third-person contexts, in order to identify the precise demarcations between these two broad concepts used in social cognition research.

In addition to improved measures of social cognition, future research should also assess social anxiety using multiple informants and modalities. One limitation of the current work is that we only included one assessment of social anxiety in each age group, and that social anxiety was measured with two different scales and different report types (parent for child and self for adult), limiting direct comparisons. Different measurements may be responsible for the relatively higher social anxiety scores (compared to conventional cut-offs) and larger range in our adult versus child samples, particularly given that parents tend to report lower levels of social anxiety in their children than children themselves do (Bowers et al., 2020; Rappaport et al., 2017). The levels of social anxiety in our college student sample may also reflect real increases in college student anxiety in the past decades (e.g., Booth, Sharma, & Leader, 2016). Further, attesting to the importance of measuring social anxiety during real-world interaction, recent research with children has indicated that blushing during interaction may influence the relationship between basic social cognitive capacity and manifest social anxiety (Nikolić et al., 2019).

Beyond social anxiety, the current results also offer interesting directions for understanding mind-mindedness throughout the lifespan. At both age points, levels of mind-mindedness toward a close social partner correlated with mind-mindedness toward a distant social partner. Existing studies with adults have suggested that while

mind-mindedness toward one close social partner (e.g., friend, romantic partner, child) is related to mind-minded-ness toward another close partner (Hill & McMahon, 2016; Meins et al., 2014), close partner mind-mindedness is not related to how one describes famous individuals or works of art (Meins et al., 2014). Our findings, however, indicate that mind-mindedness may be trait-like within the sphere of real-world relationships.

There are also some preliminary suggestions of age group and gender effects on mind-mindedness. For example, adults, but not children, showed an increase in mental statements based on relationship closeness. Children's lack of mentalistic differentiation could be due to smaller social networks (see Wrzus, Hanel, Wagner & Neyer, 2013 for a meta-analysis), meaning that there may be less of a gap between close and distant partners. Alternatively, there is some neuroimaging research in middle childhood and adolescence suggesting increased recruitment of the mentalizing network, even when mentalizing is not explicitly demanded (reviewed in Redcay & Warnell, 2018). Thus, perhaps these school-aged children show similar concerns about the mental states of all peers, regardless of closeness. Future research could probe this possibility by having participants describe individuals with whom they have no personal relationship, such as celebrities (cf. Meins et al., 2014).

We also found that adults used more mental states than children did when describing close partners. Consistent with this finding, age was positively related to the number of mental statements within middle childhood. Given the lack of relation between mind-mindedness and ToM, these age-related changes may not be driven by general improvements in social cognitive capacity, but instead by changes about how these capacities are used in rela-tional contexts. Further attesting to potential differences in how children and adults conceptualize relationships, children used more physical statements than adults did when describing close partners, suggesting that physical traits may be more salient to children. Supporting this idea, adults showed no differentiation between close and distant partners in their number of physical statements.

We also found evidence for gender effects in our child sample when describing close, but not distant, social partners. Overall, girls used more statements and this effect was driven by increased nonmental statements. The current study was unable to parse out whether this was due to general differences in peer relations or instead more domain-general differences in verbal ability or fluency, both of which are possibilities based on existing lit-erature on sex differences (e.g., Logan & Johnston, 2010; Rose & Smith, 2009). Importantly, no gender differences were seen in mental statements. Future research should more systematically ask children to describe both male and female social partners and gather data about the nature of the particular friendships.

One caveat to the current results is that although only the correlations between social anxiety and close mind-mindedness were significant in adults and children, just children showed significantly different correla-tions for generalized versus social anxiety and for close versus distant partners. Future research should explore whether this is a true developmental change (e.g., a weakening of the specificity of links between close partner mind-mindedness and social anxiety) or is instead due to measurement effects, such as differential assessments of social anxiety or even to the changing nature of relationships throughout the lifespan. Such rigorous follow-up research should also examine preregistered hypotheses in larger samples and explicitly correct for multiple com-parisons, which are two limitations of the current work.

Overall, our results lend further support to relations between social cognition and social anxiety, specifically finding that an increased tendency to consider the mental states of close social partners is related to higher levels of social anxiety in both middle childhood and early adulthood. Although results should be replicated in larger clinical samples, these findings indicate that as early as middle childhood, high levels of social anxiety are related to a heightened propensity to focus on others' internal states. By contrast, we did not find relations between more laboratory-based measures of ability to understand mental states, suggesting that, at least for subclinical social anxiety, mentalizing propensity in relationships instead of general mentalizing ability more strongly influences social anxiety. Future research connecting multiple facets of social cognition to social behavior will help illuminate the cognitive mechanisms underlying both typical and atypical social development.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.