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Willing and able? Theory of mind, social motivation, and social competence in middle childhood and early adolescence

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Abstract

This study investigated the links between theory of mind, social motivation, and children's social competence in middle childhood and early adolescence. Two hundred and sixty four children (136 girls, 128 boys) aged between 8 and 13 years (M Age = 10.88 years, SD = 1.45) completed theory-of-mind tests and self-report questionnaires measuring social motivation. Teachers rated children's social competence at school. Teacher-rated social competence was associated with individual differences in both theory of mind and children's motivation to develop and maintain social relationships. Results suggest that while individual differences in social motivation and theory of mind are partially overlapping, both theory of mind ability and social motivation contribute to successful social interaction at school.

KEYWORDS

adolescence, individual differences, middle childhood, social competence, social motivation, theory of mind

1 | INTRODUCTION

In middle childhood and adolescence, the social lives of children in industrialized nations become increasingly more complex as they participate in compulsory formal education (OECD, 2018) and spend more time with peers outside the family (e.g., Lam et al., 2014). Understanding why children differ from one another in their ability to build, manage, and maintain social relationships (or "social competence") in middle childhood and early adolescence matters: poor social competence in middle childhood predicts later mental health difficulties, poorer academic outcomes, and even difficulties in work (Bornstein et al., 2010; Burt et al., 2008). Variability in children's social competence has been attributed to both individual differences in theory of mind ability (i.e., children's understanding of others' minds) (Hughes & Devine, 2015a) and social motivation (i.e., a willingness to engage in social interactions) (Ryan & Shim, 2006) but research has yet to integrate these two lines of research. The over-arching aim of the current study was to investigate, for the first time, how

children's theory of mind and social motivation contribute to individual differences in social competence in middle childhood and early adolescence.

1.1 | Theory of mind and social competence

In the past decade researchers have extended the focus of work on children's theory of mind beyond the preschool years documenting continued age-related growth (e.g., Banerjee et al., 2011; Devine & Hughes, 2013; Dumontheil et al., 2010; Lagattuta et al., 2016; Lecce et al., 2017; Osterhaus et al., 2016; Peterson & Wellman, 2019; Weimer et al., 2017) and individual differences in theory of mind in middle childhood and early adolescence (e.g., Devine et al., 2016). Investigations of theory of mind beyond the preschool years are interesting because, according to standard accounts, children should "possess" a basic understanding of beliefs and desires by about age 5 (Wellman et al., 2001). Studies of theory of mind beyond the preschool years

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provide new opportunities to examine the nature and correlates of individual differences in theory-of-mind use, the degree to which children mentalize appropriately in a given context (Lagattuta et al., 2015), and to re-examine existing theoretical accounts of theory of mind, which are based largely on data from early childhood (Apperly et al., 2009).

Sustained interest in children's understanding of others' minds arguably reflects the assumption that variation in theory of mind matters for children's social lives (e.g., Hughes & Devine, 2015a). This "social individual differences" account (Apperly, 2012) predicts that superior theory-of-mind performance benefits social competence over and above any influence of general cognitive factors (e.g., language, executive function). If, on the other hand, individual differences in theory of mind capture differences in general cognitive processes (and not socially meaningful variation), then there will be no association between theory of mind and social competence over language or executive function (Astington, 2003). Data based largely on 3- to 6-year-old typically developing children points to an association between theory of mind and prosocial behavior (Imuta et al., 2016), peer popularity (Slaughter et al., 2015), and reciprocated friendship (Fink et al., 2015). Compared with their peers, in middle childhood children with superior theory of mind report less loneliness (Koerber & Osterhaus, 2020), are less likely to be socially rejected (Banerjee et al., 2011), and more likely to be rated by teachers as socially skilled (Devine et al., 2016).

Despite these inroads two issues remain unclear. First, inconsistent results from different studies (Astington, 2003; Longobardi et al., 2016; Ronald et al., 2006) have challenged the assumption that theory of mind matters for all aspects of children's social competence (Ratcliffe, 2007). Distinctions between basic social competence (e.g., compliance with rules of acceptable social conduct) and high-level social competence (e.g., participation in activities requiring insights into others' minds) (Lalonde & Chandler, 1995) may explain inconsistencies in prior research and help refine the social individual differences account of theory of mind. Supporting this view, individual differences in forming and managing peer relationships (e.g., leadership, assertiveness, understanding the needs of others) are positively associated with theory of mind in early and middle childhood (Peterson et al., 2016; Peterson et al., 2007) while variation in basic social-communicative skills is only weakly associated with theory of mind (Brunsdon & Happé, 2014; Ronald et al., 2006).

Second, most studies have focused on associations between theory of mind and social competence within a relatively narrow age range. It is therefore unclear whether observed associations between theory of mind and social competence are consistent across middle childhood and early adolescence. Theory of mind may be more strongly associated with a particular aspect of social competence when children are mastering that skill than at later ages when that behavior has become habitual (Contreras-Huerta et al., 2020). The first aim of the current study was to extend existing research by examining the uniqueness and specificity of the association between individual differences in theory of mind and teacher-rated basic and high-level social competence across a wide age range spanning middle childhood and early adolescence.

Research Highlights

This study examines the relative contribution of theory of mind and social motivation to individual differences in social competence in school-aged children and adolescents.

Individual differences in children's understanding of others' minds were positively associated with children's social motivation (i.e., their expressed willingness to build and maintain social relationships).

Theory of mind and social motivation each contributed to variation in teacher-rated social competence when potential confounds were considered (e.g., socioeconomic status, verbal ability).

1.2 | Social motivation and social competence

Alongside the influence of theory of mind on individual differences in social competence, researchers have considered the extent to which social success reflects a willingness to participate in social behaviors or "social motivation" (Contreras-Huerta et al., 2020). Several studies point to reduced social motivation among children, adolescents, and adults with autism, who typically experience difficulties in social interaction and communication. For example, adolescents with autism report lower levels of social interest (measured using self-reported pleasure in social situations) than neurotypical adolescents (Chevallier, Grèzes, et al., 2012). Data from adults (aged 18–65) indicate that self-reported difficulties with social communication and interaction are negatively associated with enjoyment of social interaction and admiration from others (Foulkes et al., 2015). These results support the view that social motivation may explain differences in social competence (Chevallier, Kohls, et al., 2012).

However, definitions of social motivation are often multi-faceted including a disposition to orient to the social world (i.e., social interest), a tendency to derive pleasure from social interactions (i.e., social pleasure), and a willingness to build and maintain social bonds (i.e., social maintenance) (Chevallier, Kohls, et al., 2012). Aspects of social motivation may vary in how they relate to children's social competence. Developmental theorists have distinguished between children who prefer solitude and children who are fearful and socially avoidant (Coplan et al., 2015). Supporting this view several studies highlight how, in contrast with fearful or avoidant children, socially disinterested school-aged children are no more likely than their peers to exhibit difficulties in building and maintaining social relationships (Coplan et al., 2013; Ladd et al., 2011). Accordingly, social disinterest is viewed as distinct from social competence.

Developmental theorists have also considered the goals that underpin children's social interactions (Ojanen et al., 2005; Rudolph et al., 2011; Ryan & Shim, 2006). Specifically, some children are driven by a desire to avoid social ridicule or an inclination to curry favor from others, referred to as "social demonstration avoidance" and "social



demonstration approach” goals respectively (Ryan & Shim, 2006). In contrast, others are motivated to build, maintain, and improve social relationships (“social development goals”) (Ryan & Shim, 2008; Wentzel, 1998). Different social motivation goals are related to social competence in distinct ways. Longitudinal data from pre-adolescents indicate positive associations between social development goals and friendship quality, between demonstration approach goals and popularity, and between demonstration avoidance goals and anxious solitary behavior (Ryan & Shim, 2008). Data from middle childhood show positive associations between social development goals and prosocial behavior and between demonstration approach goals and aggressive behavior, and negative associations between demonstration avoidance goals and popularity (Rodkin et al., 2013). On this account, willingness to build and maintain social relationships (rather than avoid ridicule or win approval) will be positively related to social competence. Our second aim was to examine the relations between self-reported social motivation (including measures of social pleasure, social interest, and social development goals) and social competence in middle childhood and early adolescence.

1.3 | Theory of mind and social motivation

Over the past decade, there has been a growing interest in the overlap between social motivation and social cognition (Chevallier, Kohls, et al., 2012; Contreras-Huerta et al., 2020). Few studies have directly investigated the links between social motivation and theory of mind in typically-developing children and none have studied these associations in middle childhood and early adolescence. False belief understanding in 4-year-old children was positively correlated with observed onlooker behavior (i.e., time spent watching other children), which may be viewed as an indicator of social interest (Moore et al., 2011). More recently, Burnside et al. (2018) reported a moderate association between preference for looking at faces (an indicator of social interest) and performance on an anticipatory looking false-belief task in 2- to 4-year-old children. Among healthy adults social apathy (an indicator of social motivation) was negatively associated with cognitive empathy (Lockwood et al., 2017). Together these studies point to an association between theory of mind and different aspects of social motivation.

One possibility is that individual differences in theory of mind overlap at least in part with social motivation. Socially motivated children may outperform their peers on tests of theory of mind because they are more interested in social situations and more willing expend effort to use their insights about others’ minds in different contexts (Chevallier, Grèzes, et al., 2012; Contreras-Huerta et al., 2020). While this line of reasoning informs social motivation accounts of social behavior in autism (e.g., Chevallier, Kohls, et al., 2012), research on typically developing children suggests that links between theory of mind and social motivation may be more nuanced.

Children who endorse social development goals (a willingness to build and maintain their social skills and relationships) or derive pleasure from social activities may seek out ways to understand new social situations, reflect more deeply on social interactions, and aim to refine their reasoning about others’ minds (Rudolph et al., 2011; Ryan & Shim,

2006). Consequently, there may be positive associations between theory of mind and these specific aspects of social motivation. In contrast, children who endorse social demonstration goals (who are motivated by avoiding negative judgment or gaining social approval) may be more cautious responding to unfamiliar social situations and less likely to persist with reasoning about unfamiliar others (Ryan & Shim, 2006). Furthermore, if social disinterest is distinct from social competence (e.g., Coplan et al., 2013), then children who prefer solitude may not differ from their peers in theory of mind. Supporting this view, Bosacki et al. (2020) found no significant association between self-reported sociability and emotion understanding in 13-year-old participants. We therefore sought to examine the associations between different aspects of social motivation and theory of mind.

Alongside investigating the links between theory of mind and social motivation, comparing the relative strength of the association between these variables and social competence will shed light on the nature of both constructs. The social individual differences account of theory of mind (e.g., Apperly, 2012; Hughes & Devine, 2015a) views variation in theory of mind as genuine and meaningful. That is, individual differences in theory of mind are systematic and uniquely predict social outcomes (over and above differences in other more general cognitive, personality, or demographic characteristics). Accordingly, although theory of mind and aspects of social motivation may overlap, reasoning about others’ minds may uniquely contribute to children’s social competence (e.g., Contreras-Huerta et al., 2020). Over-and-above a willingness to participate in social situations, superior understanding of others’ minds may benefit children’s social interactions at school. Similarly, social motivation may exhibit unique links with social competence (as distinct from theory of mind ability) in ways that have nothing to do with reasoning about others’ minds (e.g., socially motivated children may be more compliant or exhibit more positive affect). In contrast, if motivation underpins both theory of mind and social competence, then social motivation may account for previously reported links between children’s theory of mind and social competence (e.g., Chevallier, Kohls, et al., 2012). Our third aim was therefore to examine the relations between theory of mind and social motivation (i.e., social pleasure, preference for solitude, social development goals, social demonstration goals) in a sample of school-aged children. We also examined the distinctiveness of social motivation and theory of mind by testing the unique contribution of these constructs to social competence.

1.4 | Summary of aims

Our over-arching aim was to investigate how children’s theory of mind and social motivation contribute to social competence in middle childhood and early adolescence. Our first aim was to examine the unique association between theory of mind and teacher-rated basic- and high-level social competence across a wide age range spanning middle childhood and early adolescence. Our second aim was to study the relations between social motivation (including measures of social pleasure, preference for solitude, social development goals, and social demonstration goals) and social competence in middle childhood



and early adolescence. Our third aim was to investigate the relations between individual differences in theory of mind and social motivation and to consider the distinctiveness of social motivation and theory of mind by testing the unique contribution of these two constructs to children's social competence.

2 | METHODS

2.1 | Participants

The study aims and hypotheses were pre-registered on the Open Science Framework (Devine, 2019) prior to data collection. A target sample of 250 participants was determined a priori using Monte Carlo simulations in *Mplus* (Online Appendix). English-speaking children aged between 8 and 13 years were recruited from three state-funded primary schools and one state-funded secondary school in the East and West Midlands in the United Kingdom. Three hundred and forty seven children were enrolled in the relevant classes across the four schools (i.e., Years 4–8 in the English education system). Three hundred and twelve (89.9%) took part in the study. Teachers reported that 46 children had a statement of special educational needs and were therefore ineligible to participate in the study. Two further children completed testing but did not provide demographic data and were excluded from further analysis.

The final sample consisted of 264 children (136 girls, 128 boys) aged between 8.46 and 13.53 years, M Age = 10.88 years, SD = 1.45. There were 23 8 year olds (M Age = 8.73, SD = 0.13, 12 girls), 60 9 year olds (M Age = 9.47, SD = 0.29, 33 girls), 69 10 year olds (M Age = 10.44, SD = 0.26, 35 girls), 34 11 year olds (M Age = 11.44, SD = 0.28, 14 girls), 52 12 year olds (M Age = 12.50, SD = 0.28, 31 girls), and 26 13 year olds (M Age = 13.30, SD = 0.15, 11 girls). The children were socioeconomically and ethnically diverse: 24.2% spoke languages in addition to English at home and 15.9% received Free School Meals (given to pupils whose caregivers are in receipt of state income support). Children who spoke languages in addition to English at home (M = 14.64, SD = 2.95) did not differ from those who spoke English only (M = 14.59, SD = 2.97) in receptive vocabulary scores, $t(252) = 0.127$, $p = 0.899$, and were therefore treated the same in the analyses.

2.2 | Procedure

The University of Birmingham Research Ethics Committee approved all study procedures. Children took part in a whole-class testing session lasting approximately 60 minutes led by a trained graduate research assistant. Children completed tests and questionnaires guided by the research assistant in a fixed order: Children's Depression Screener, Silent Film Task, Preference for Solitude Questionnaire, Strange Stories, Social Achievement Goals Questionnaire, Mill Hill Vocabulary Test, Pleasure Scale for Children, Spatial Working Memory. Teachers completed a questionnaire about each child assessing demographics and social competence. A fixed running order is recommended in research on individual differences to minimize additional variance arising

from counter-balanced and randomized running orders (Goodhew & Edwards, 2019).

Several steps were taken to ensure that high quality data were obtained. First, the researcher followed a detailed protocol to ensure that measures were administered consistently across each classroom. Second, children were seated facing a large screen with their own test booklet and instructed to work in silence during the session. Third, the activities were paced by the researcher so that children could not move on to the next activity without the researcher. Prior to playing each clip the researcher asked children to look at the screen and monitored the children's attention. Fourth, children were monitored throughout the session by classroom teaching assistants and the researcher to prevent disruption or sharing results. Classroom teachers were present throughout the testing session but were unaware of how each child performed on the test battery as children recorded their answers in silence into anonymous booklets. Whole-class testing procedures have been used in numerous studies of children's mindreading (e.g., Osterhaus et al., 2016), yield reliable results in test-retest studies (Devine & Hughes, 2016), and exhibit construct validity (Obradović et al., 2018). Pilot data from two age-matched groups of 12- to 13-year-old children indicated that total test scores on the Silent Film task measured in group settings, $M = 6.93$, $SD = 2.19$, $N = 160$, did not differ from total scores on the Silent Film task measured during one-to-one testing sessions, $M = 6.68$, $SD = 2.20$, $N = 194$, $t(352) = 1.04$, $p = 0.297$.

2.3 | Measures

2.3.1 | Theory of mind

In the *Strange Stories* task (Happé, 1994), children listened to five vignettes depicting different social situations (e.g., lying, misunderstanding, double bluff) while the story text remained visible on the projector screen. Each story was followed by a single open-response question in which children were required to explain a character's behavior with reference to the character's mental states. Correct responses involving explicit mentalizing received two points, partially correct responses received one point, and inaccurate or irrelevant responses scored zero points (see White et al., 2009 for details on coding). Item scoring exhibited acceptable inter-rater reliability, $N = 30$, $0.76 < \kappa < 1.00$, all $ps < 0.0001$.

In the *Silent Film Task* (Devine & Hughes, 2013) children watched five short film clips from a classic silent comedy depicting instances of deception, misunderstanding, and false belief. Children responded to a single question about each clip (read aloud by the research assistant), which required an explanation of a character's behavior. The research assistant did not play the next clip until all children had recorded an answer in their response booklet. Children received two points for an accurate explanation, one point for partially correct responses, and zero points for inaccurate or irrelevant responses (see Devine & Hughes, 2016 for details on coding). Item scoring exhibited acceptable inter-rater reliability, $N = 30$, $0.70 < \kappa < 1.00$, all $ps < 0.0001$. The *Strange Stories* and *Silent Film* tasks show excellent test-retest reliability in whole-class testing (Devine & Hughes, 2016). The validity of these

tasks is supported by longitudinal evidence showing that false-belief task performance at age 6 predicts performance on both the tasks at age 10 (Devine et al., 2016).

We estimated a model in which all items from the Strange Stories task and Silent Film task loaded onto a single latent factor (Devine & Hughes, 2016) using a mean- and variance-adjusted weighted least squares estimator in *Mplus* Version 8 (Muthèn & Muthèn, 2017) as each test item was scored using a categorical rating. The model provided an acceptable fit to the data, $\chi^2(44) = 49.44$, $p = 0.265$, CFI = 0.974, TLI = 0.967, RMSEA = 0.02, 90%CI [0, 0.05]. With one exception (i.e., Silent Film Task Item 1, Est. = 0.18, SE = 0.11, $Z = 1.73$, $p = 0.08$), all items loaded significantly onto the single latent factor. We created factor scores for the theory-of-mind latent factor by calculating the mean of imputed plausible values using Bayesian estimation in *Mplus* (Asparouhov & Muthèn, 2010). Latent factor scores were used in subsequent data analysis (Ordinal $\alpha = 0.70$).

2.3.2 | Social motivation

Children completed three questionnaires to measure social motivation. The *Pleasure Scale for Children* (Kazdin, 1989) measured individual differences in pleasure derived from social interactions. Children indicated whether particular activities made them feel “Very Happy” (two), “Happy” (one), or “Wouldn’t Matter” (zero). Seventeen statements described social activities (e.g., “Someone that you like very much calls you and asks you to come and spend time with them”) and seven statements described physical activities (e.g., “You are cycling down the street very fast”). High scores on the social pleasure items indicated high levels of pleasure derived from social activities. Supporting construct validity adolescents with autism (presumed to experience diminished social motivation) had lower social pleasure scores than age- and intelligence-matched typically developing adolescents (Chevallier, Grèzes, et al., 2012). Items were summed and age residualized to create a social pleasure score ($\alpha = 0.82$).

The seven-item *Child Preference for Solitude Questionnaire* (Coplan et al., 2013) captured differences in children’s interest in social interactions. Children indicated how much they liked solitary and social activities on a five-point scale ranging from “Not ever” to “All of the time” (e.g., “I like spending time alone in my room”). High scores (five) indicated a preference for solitude and low scores (one) indicated a preference for social activities. Supporting its validity, 9- to 12-year-old children’s self-reported preference for solitude was correlated with observer-rated social withdrawal (Coplan et al., 2013). Items were averaged and age residualized to create a preference for solitude score ($\alpha = 0.79$).

The *Social Achievement Goals* questionnaire (Rudolph et al., 2011) captured children’s social goal orientation. Children rated the extent to which statements were true descriptions of how they behave with their peers ranging from “Not at all true”, to “Somewhat true”, to “Very true”. Six items captured children’s endorsement of social development goals, that is, a willingness to enhance social skills and develop relationships (e.g., “I like to learn new skills for getting along with other kids”). High scores indicated that children were motivated to build, maintain, and improve their social relationships. Supporting the validity of the

social development goals scale, children’s endorsement of social development goals is positively associated with seeking advice from teachers about how to respond to peer aggression (Rudolph et al., 2011). The remaining items focused on social demonstration goals. These items captured the extent to which children sought to demonstrate social competence through gaining approval (demonstration-approach goals: e.g., “I want to be friends with popular kids”) and avoiding negative judgments (demonstration-avoidance goals: e.g., “When I am around other kids, I mostly just try not to mess up”). Items were summed and age residualized to create a social development goals score ($\alpha = 0.74$), a demonstration-avoidance score ($\alpha = 0.70$), and a demonstration-approach score ($\alpha = 0.86$).

2.3.3 | Social competence

Teachers completed two questionnaires to capture individual differences in children’s social competence. We measured high-level social competence using the *Peer Social Maturity Scale* (Peterson et al., 2007). The scale captures peer-oriented social behaviors independently of age by asking teachers to rate children relative to their same-age peers in domains such as leadership, assertion, social play, social sensitivity, and group entry. Teachers rated each target child’s maturity using a seven-point scale ranging from “Very much less mature” to “Very much more mature” across seven items (Fink et al., 2013). High scores (7) indicated mature peer social interaction skills and low scores (1) indicated immature social interaction skills. Item scores were averaged to create a high-level social competence score. Internal consistency of the scale was high ($\alpha = 0.95$). The scale shows convergent validity with longer teacher-rated measures of social competence and peer-nominated social acceptance (Fink et al., 2013).

We assessed basic social impairment using the *Childhood Autism Syndrome Test* (CAST) (Ronald et al., 2008). This 20-item questionnaire was designed for teachers to rate children in non-clinical settings on behaviors associated with autism spectrum traits including difficulties with basic social interaction (e.g., “Social behavior is very one-sided and always on his/her own terms”), communication (e.g., “Sometimes loses the listener because of not explaining what s/he is talking about”), and restricted interests and repetitive behaviors (e.g., “Likes to do things in the same way over and over again in the same way all the time”). Teachers rated each item as “Not at all true”, “Somewhat true”, or “Definitely true”. The questionnaire shows excellent test-retest reliability in middle childhood and moderate agreement with parent and child self-report ratings (Ronald et al., 2008). We used the fifteen social and communication difficulties items to create a measure of basic social impairment. Items were summed and age residualized to create a total basic social impairment score ($\alpha = 0.83$) with high scores indicating impaired social and communication skills.

2.3.4 | Covariates

Children completed the multiple-choice section of the *Mill Hill Vocabulary Scale* (Rust, 2008) to measure verbal ability. This test measures receptive vocabulary in 7- to 18-year-old children in group settings. Children selected a synonym for a target word from six possible



response options and received one point for each correctly identified word. Items were summed and age residualized to create a total verbal ability score. To measure executive function, children completed a *Spatial Working Memory* test based on the spatial span task (Milner, 1971; Shiels et al., 2008) adapted for group administration. Children held in mind a sequence of numbers displayed on a grid and reproduced this sequence in a test booklet. Children saw a grid containing 20 squares comprising eight target locations (grey squares) and 12 filler locations (white squares) on an overhead projector. Numbers appeared one-by-one (separated by 1 s intervals) on one target locations. When the final number in a sequence was shown (for 1 s) the numbers disappeared from the target squares. Children recorded the location of the numbers on a response grid in their test booklet. There was one demonstration item, one three-digit test item, two four-digit test items, and two five-digit test items. Children's received one point for each correct sequence. Items were summed and age residualized to create a total working memory score. Children completed the eight-item *Children's Depression Screener* (Frühe et al., 2012) to measure depressive symptoms. Children rated how much they agreed (on a four-point scale ranging from "Agree" to "Disagree") with statements describing how they felt in the past two weeks (e.g., "I get upset quickly"). Items were summed and age residualized to create a total score with high scores indicating high levels of depressive symptoms ($\alpha = 0.84$).

3 | RESULTS

3.1 | Descriptive statistics and correlations

Table 1 shows the descriptive statistics and correlations for each measure included in the study. Replicating prior work, there were significant age-related differences in theory of mind between ages 8 and 13 (Figure S1). Attention-check items were embedded within each questionnaire in the children's test booklet. These items were used to capture inattentive responding. Where children failed an attention-check item by selecting an incorrect response, data for that questionnaire were treated as missing. When children scored $3SD$ below the mean for their age on the Mill Hill Vocabulary scale, their data for the item were treated as missing. We used linear regression multiple imputation (with all analysis variables) to impute missing values for six continuous measures over 20 imputations: teacher-rated social competence ($N = 1$), verbal ability ($N = 10$), social development goals ($N = 16$), preference for solitude ($N = 21$), social pleasure ($N = 22$), and depressive symptoms ($N = 1$). We used the mean of these plausible values in our analyses. Missing data on social motivation questionnaires were due to attention-check item failures and one incomplete social pleasure scale ($N = 1$).

3.2 | Analysis strategy

Thirteen teachers provided ratings of social competence for all children (M cluster size = 20.3, range: 12–25). Nesting of teacher-rated

data meant that the assumption of independent observations was violated (Geiser, 2013). In a departure from the pre-registered analysis plan (suggested by an anonymous reviewer), we assessed the degree of non-independence in teacher-rated social competence using an unconditional model with teacher as a random intercept (Heck & Thomas, 2020) in Stata 16 (StataCorp, 2019). Unconditional models revealed significant variance associated with between-classroom differences in teacher-rated high-level social competence, $ICC = 0.175$, 95%CI [0.07, 0.37], teacher-rated basic social impairment, $ICC = 0.201$, 95%CI [0.09, 0.40], and theory-of-mind latent factor scores, $ICC = 0.08$, 95%CI [0.02, 0.25].

We used random intercept regression models to examine child-level correlates of individual differences in child-level variables (i.e., social competence and theory of mind) as fixed effects (Heck & Thomas, 2020). To account for the small number of clusters we used a restricted maximum likelihood estimator (REML) with Kenward-Rogers adjustment (McNeish, 2017). This approach reduces the likelihood of biased standard errors and works well in data simulations with fewer than ten clusters (McNeish & Stapleton, 2016). All independent variables were mean-centered within cluster with the exception of age and dichotomous dummy variables (Heck & Thomas, 2020). In each model we controlled for potential confounds by regressing the dependent variable scores onto age, gender (0 = girl, 1 = boy), verbal ability, spatial working memory, and a dummy variable representing free school meal status (1 = in receipt of free school meals).

3.3 | Multi-level models

3.3.1 | Theory of mind and social motivation

We first examined the relations between self-reported social motivation and children's theory of mind. We regressed theory of mind onto each measure of social motivation. Table S2 shows the unique association between each variable in the model and theory of mind. Of the three measures of social goals only social development goals (i.e., willingness to build and maintain relationships) was uniquely positively associated with theory of mind, $B = 0.07$, $SE = 0.02$, $t = 2.92$, $p = 0.004$, 95%CI [0.02, 0.12] (Model 1). The reduction in residual variance (Heck & Thomas, 2020) in theory of mind scores within classrooms (relative to a covariates-only model) uniquely attributed to social development goals was $\Delta R^2 = 0.028$. Pleasure derived from social activities was positively associated with theory of mind, $B = 0.05$, $SE = 0.02$, $t = 2.19$, $p = 0.029$, 95%CI [0.01, 0.10], $\Delta R^2 = 0.017$ (Model 2). In contrast there was no significant association between preference for solitude and theory of mind, $B = -0.001$, $SE = 0.03$, $t = -0.04$, $p = 0.968$, 95%CI [-0.05, 0.05] (Model 3). Next, we compared the contribution of social development goals and social pleasure to theory of mind by entering both predictors into the model simultaneously (Figure 1). Only individual differences in willingness to build and maintain social relationships was uniquely associated with theory of mind, $B = 0.06$, $SE = 0.03$, $t = 2.20$, $p = 0.029$, 95%CI [0.01, 0.11] (Model 4). The association was not moderated by age, $B = 0.01$, $SE = 0.02$, $t = 0.84$, $p = 0.42$, 95%CI [-0.02, 0.05].

TABLE 1 Descriptive statistics and correlations

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|--------------------------------|-------------|--------|--------------|--------|--------|--------|--------|-------|--------|-------|--------------|-------|-------|
| 1 High-Level Social Competence | | | | | | | | | | | | | |
| 2 Basic Social Impairment | -0.51** | | | | | | | | | | | | |
| 3 Theory of Mind | 0.20** | -0.11 | | | | | | | | | | | |
| 4 Social Dev. Goals | 0.21** | -0.04 | 0.162** | | | | | | | | | | |
| 5 Social Approach | -0.16* | -0.03 | -0.11 | 0.06 | | | | | | | | | |
| 6 Social Avoidance | 0.03 | 0.004 | -0.06 | 0.09 | 0.20** | | | | | | | | |
| 7 Social Pleasure | 0.13* | -0.08 | 0.13* | 0.30** | 0.04 | -0.004 | | | | | | | |
| 8 Pref. for Solitude | 0.02 | 0.04 | 0.02 | 0.01 | -0.04 | -0.03 | -0.02 | | | | | | |
| 9 Verbal Ability | 0.11 | 0.03 | 0.27** | -0.03 | -0.15* | -0.15* | 0.09 | 0.04 | | | | | |
| 10 Working Memory | 0.03 | -0.06 | 0.06 | -0.05 | -0.06 | 0.09 | -0.02 | 0.01 | 0.20** | | | | |
| 11 Age | 0 | 0 | 0.27** | -0.002 | 0.01 | -0.007 | -0.02 | 0.01 | -0.01 | 0 | | | |
| 12 Gender (Boy) | -0.17** | 0.08 | 0 | -0.04 | 0.17** | -0.07 | -0.13* | -0.03 | 0.03 | -0.01 | 0.01 | | |
| 13 Free School Meals | -0.07 | 0.09 | -0.002 | -0.02 | -0.04 | -0.03 | -0.01 | -0.11 | -0.04 | -0.10 | 0.05 | 0.01 | |
| M | 4.24 | 4.95 | 0.002 | 8.33 | 3.25 | 4.70 | 22.43 | 2.82 | 14.60 | 3.23 | 10.89 | 48.5+ | 15.9+ |
| SD | 0.97 | 3.50 | 0.406 | 2.62 | 2.89 | 2.31 | 6.08 | 0.72 | 2.96 | 1.35 | 1.45 | - | - |
| Range | 1.78 - 7.00 | 0 - 15 | -1.18 - 1.07 | 0 - 12 | 0 - 10 | 0 - 8 | 3 - 34 | 1 - 5 | 7 - 20 | 0 - 5 | 8.46 - 13.53 | - | - |

** $p < 0.01$.* $p < 0.05$. M, SD and Range reported in original metric with exception of theory of mind, which is reported as latent variable factor score. Correlations calculated using imputed values.

+ Percent of participants. Social Dev. Goals = Social Development Goals. Pref. for Solitude = Preference for Solitude. Basic Social Impairment was measured using the Childhood Autism Syndrome Test where greater social competence is indicated by smaller scores. High-level social competence was measured using the Peer Social Maturity Scale where greater social competence is indicated by larger scores.

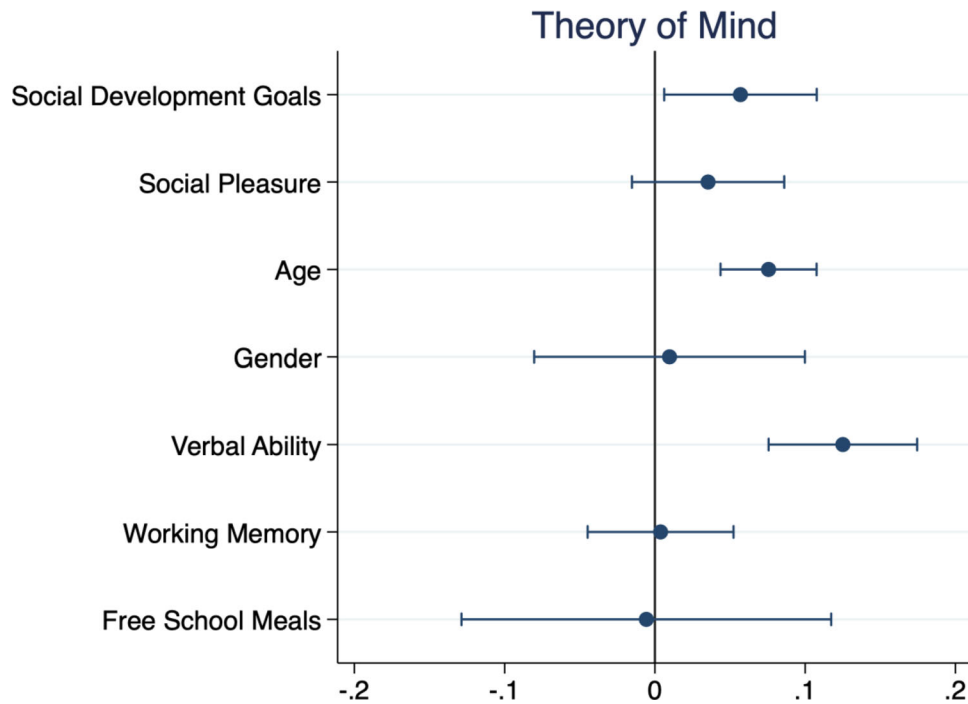


FIGURE 1 Restricted maximum likelihood fixed effect coefficient estimates for association between social motivation and theory of mind. Note. Error bars show 95% confidence intervals. Confidence intervals for statistically significant effects ($p < 0.05$) do not cross the vertical 0 line

3.3.2 | Theory of mind, social motivation, and social competence

We examined the associations between teacher-rated social competence and theory of mind by regressing scores for basic social impairment and high-level social competence onto theory of mind. Table S3 shows the unique association between each variable in the model and teacher-rated social competence. There were unique associations between theory of mind and teacher-rated high-level social competence, $B = 0.39$, $SE = 0.15$, $t = 2.69$, $p = 0.008$, 95%CI [0.10, 0.68], $\Delta R^2 = 0.029$ (Model 5A) and teacher-rated basic social impairment, $B = -0.35$, $SE = 0.15$, $t = -2.33$, $p = 0.021$, 95%CI [-0.64, -0.05], $\Delta R^2 = 0.018$ (Model 5B). Age did not moderate the association between theory of mind and teacher-rated high-level social competence, $B = -0.01$, $SE = 0.09$, $t = -0.12$, $p = .91$, 95%CI [-0.19, 0.17] or basic social impairment, $B = -0.10$, $SE = 0.09$, $t = -1.07$, $p = 0.28$, 95%CI [-0.29, 0.08], suggesting the link between theory of mind and social competence was consistent between ages 8 and 13 years.

We next regressed each measure of teacher-rated social competence onto self-reported social motivation (Table S4). Of the three measures of social goals only social development goals (i.e., willingness to build and maintain social relationships) was uniquely associated with high-level social competence, $B = 0.15$, $SE = 0.06$, $t = 2.60$, $p = 0.010$, 95%CI [0.04, 0.26], $\Delta R^2 = 0.022$ (Model 6A) and basic social impairment, $B = -0.12$, $SE = 0.06$, $t = -2.07$, $p = 0.039$, 95%CI [-0.24, -0.01], $\Delta R^2 = 0.013$ (Model 6B). Social pleasure was uniquely positively associated with high-level social competence, $B = 0.14$, $SE = 0.06$, $t = 2.41$, $p = 0.017$, 95%CI [0.02, 0.25], $\Delta R^2 = 0.019$ (Model 7A) but not with basic social impairment, $B = -0.10$, $SE = 0.06$, $t = -1.71$, $p = 0.088$,

95%CI [-0.22, 0.02] (Model 7B). Social disinterest (measured using the preference for solitude scale) was not uniquely associated with either high-level social competence, $B = 0.04$, $SE = 0.06$, $t = 0.63$, $p = 0.529$, 95%CI [-0.08, 0.15], or basic social impairment, $B = 0.02$, $SE = 0.06$, $t = 0.31$, $p = 0.754$, 95%CI [-0.10, 0.14] (Model 8A, Model 8B).

Finally, we compared the unique associations between theory of mind, social motivation, and teacher-rated social competence by regressing social competence onto social motivation and theory of mind (Figure 2). We selected social development goals (i.e., willingness to build and maintain social relationships) as the measure of social motivation as it was the only aspect of social motivation associated with both high-level social competence and basic social impairment. Both theory of mind, $B = 0.34$, $SE = 0.15$, $t = 2.29$, $p = 0.023$, 95%CI [0.05, 0.63], $\Delta R^2 = 0.017$, and social motivation, $B = 0.12$, $SE = 0.06$, $t = 2.02$, $p = 0.044$, 95%CI [0.01, 0.23], $\Delta R^2 = 0.012$, made unique contributions to high-level social competence (Model 9A) (Table S4). In contrast, while theory of mind was uniquely associated with basic social impairment, $B = -0.31$, $SE = 0.15$, $t = -2.01$, $p = 0.045$, 95%CI [-0.60, -0.01], $\Delta R^2 = 0.012$, social motivation was not associated with basic social impairment, $B = -0.10$, $SE = 0.06$, $t = -1.66$, $p = 0.099$, 95%CI [-0.21, 0.02] (Model 9B) (Table S4).

3.3.3 | Follow-up analyses

We examined interactions between social motivation (social development goals) and theory of mind. We extended Model 9A and 9B by adding a multiplicative interaction between theory of mind and social development goals. The interaction term was not significantly

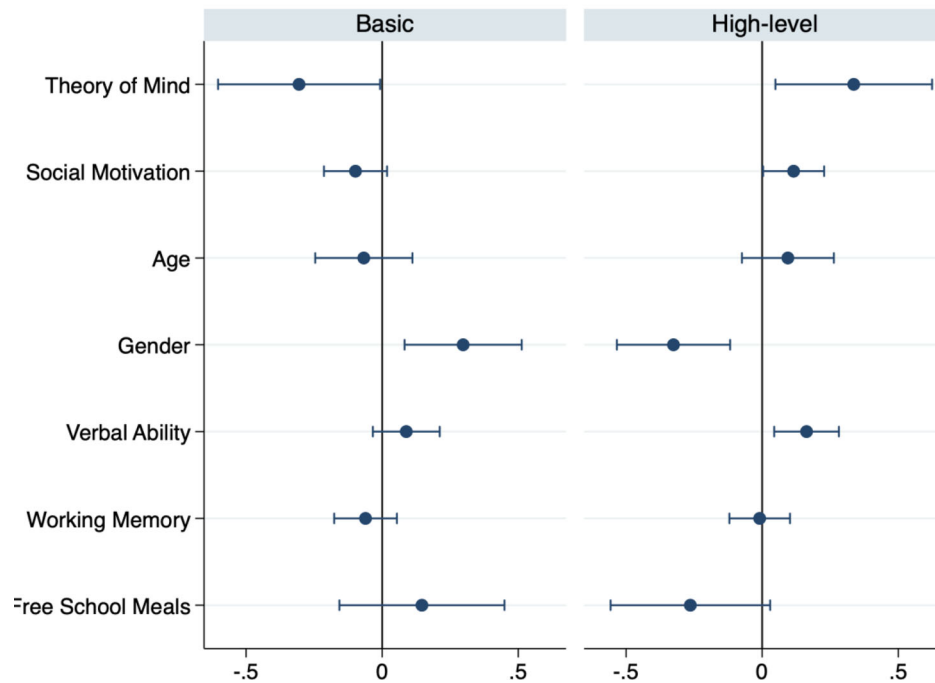


FIGURE 2 Restricted maximum likelihood fixed-effects coefficient estimates comparing theory of mind and social motivation as predictors of social competence.

Note. Basic social impairment was measured using the childhood autism syndrome test where greater social competence is indicated by lower scores. High-level social competence was measured using the Peer Social Maturity Scale where greater social competence is indicated by higher scores. Error bars show 95% confidence intervals. Confidence intervals for statistically significant ($p < 0.05$) effects do not cross the vertical 0 line

associated with children's high-level social competence, $B = -0.11$, $SE = .15$, $t = -0.78$, $p = 0.44$, 95%CI $[-0.40, 0.17]$, or with children's basic social impairment, $B = 0.12$, $SE = 0.15$, $t = 0.85$, $p = 0.40$, 95%CI $[-0.17, 0.43]$. Although theory of mind and social development goals were correlated, each made a non-overlapping contribution to children's social competence.

We examined whether children's mood accounted for observed associations between social motivation and theory of mind. Even when self-reported depressive symptoms were entered into the regression model, willingness to build and maintain social relationships remained uniquely associated with theory of mind, $B = 0.06$, $SE = 0.03$, $t = 2.44$, $p = 0.016$, 95%CI $[0.01, 0.11]$. Likewise, when self-reported depressive symptoms were considered, theory of mind remained uniquely associated with high-level social competence, $B = 0.31$, $SE = 0.14$, $t = 2.18$, $p = 0.03$, 95%CI $[0.03, 0.59]$. When depressive symptoms were considered, the association between theory of mind and basic social impairment was no longer significant, $B = -0.24$, $SE = 0.15$, $t = -1.63$, $p = 0.11$, 95%CI $[-0.52, 0.05]$.

4 | DISCUSSION

The current study of 264 8- to 13-year-old children investigated the relations between theory of mind and social motivation and the distinct contribution of individual differences in these domains to

social competence in middle childhood and early adolescence. Three findings emerged from our study. First, there were unique associations between individual differences in theory of mind and social competence across middle childhood and early adolescence. Second, there were specific associations between children's theory of mind ability and variation in social motivation, specifically children's willingness to build and maintain social relationships. Third, despite partial overlap, both children's theory of mind ability and their willingness to build and maintain social relationships made unique contributions to high-level social competence. We now discuss the implications of these results for existing theory and future research.

4.1 | Individual differences in theory of mind

Empirical interest in individual differences in theory of mind extends back more than 25 years, but the nature of variation in theory of mind remains unclear (e.g., Apperly, 2012; Hughes & Devine, 2015a; Lagattuta et al., 2015). Rather than reflecting a temporary lag in the grasp of basic mental concepts or performance differences related to executive function or language, one account of individual differences in theory of mind proposes that variation in children's mindreading is genuine and meaningful (Hughes & Devine, 2015b; Lecce & Devine, 2021). That is, there is systematic variation in children's theory of mind and this variation contributes to real-world social outcomes (e.g., Lecce & Devine,



2021). Our data support this view in two ways. First, there were individual differences in theory-of-mind task performance across the ages covered (Figure S1) and this variance was not entirely accounted for by age, verbal ability, working memory, or demographic factors. Second, there were unique links between theory of mind and social competence even when potential cognitive and demographic confounds were considered.

Our results extend existing work on theory of mind in two ways. First, our data indicate specific links between individual differences in theory of mind and “high-level” peer social interaction skills rather than general links with basic social and communication skills. Consistent with previous research (e.g., Peterson et al., 2016; Ronald et al., 2006) when covariates (including depressive symptoms) were considered, theory of mind was not uniquely associated with basic social-communicative impairments (measured on the CAST) but was associated with more complex peer social interaction skills (measured on the Peer Social Maturity Scale). Basic social interaction and communication skill impairments (e.g., “solitary and tends to play alone”; “unusual eye gaze, facial expression, voice or gestures”) may not be related to theory of mind in middle childhood and early adolescence. Instead, understanding others’ minds may only matter in complex social exchanges, which involve co-operation (e.g., asserting oneself appropriately to express opinions or convince peers) (Peterson et al., 2007). Basic social and communication skills are likely to form the foundation of co-operation with others, but the overlap between these facets of social competence may not be due to theory of mind.

Second, our results contribute to existing work on theory of mind by showing consistent links between understanding others’ minds and social competence across middle childhood and early adolescence. The strength of the association between theory of mind and social competence did not vary between ages 8 and 13. The consistency of the link between theory of mind and social competence across middle childhood and early adolescence can be interpreted in at least two ways. One possibility is that theory of mind supports the construction or further development of high-level social interaction skills beyond early childhood. Alternatively, mindreading abilities may be intrinsic to social interaction skills even in adolescence and adulthood (Apperly et al., 2009). Investigating the relative strength of the links between theory of mind and different aspects of social competence from early childhood through to adolescence will provide clarity about the social individual differences account of theory of mind (e.g., Apperly, 2012). Longitudinal and intervention designs (e.g., Lecce et al., 2014) are necessary to understand whether theory of mind is involved in the construction of different facets of social competence, whether it is intrinsic to mature social competence, or whether it plays different roles for different aspects of social competence (e.g., Lecce & Devine, 2021).

Although growing evidence indicates that theory of mind in early and middle childhood is associated with various indicators of social competence, by conventional guidelines (i.e., $r = 0.10, 0.30, 0.50$), these effects can be viewed as small to medium in magnitude (Cohen, 1988). Conventional effect size guidelines are arguably too stringent and meta-analytic results indicate that the median effect size in psychological research is $r = 0.19$, with $r = 0.30$ representing a relatively

large effect (Gignac & Szodorai, 2016). The magnitude of association between theory of mind and social competence (reported here and elsewhere in the literature) does not undermine the claim that individual differences in theory of mind are socially meaningful as effects on social outcomes may be cumulative (Funder & Ozer, 2019). Instead, results highlight the need for specificity in claims about links between children’s theory of mind and social outcomes. After all, many social interactions do not require insights into others’ thoughts, desires, and feelings and instead rely on familiarity, prior knowledge, routines, and conventions (e.g., Astington, 2003). Identifying those social interactions that rely most on theory of mind remains an important challenge for future research (Lecce & Devine, 2021).

4.2 | Individual differences in social motivation

We adopted multiple measures of social motivation derived from research on children’s social development (e.g., Coplan et al., 2013; Rudolph et al., 2011) and autism research (e.g., Chevallier, Grèzes, et al., 2012). We found little overlap between self-reported pleasure in social activities, interest in social situations, desire to gain social approval and avoid negative social judgment, and willingness to build and maintain social relationships. This is consistent with prior work (e.g., Rudolph et al., 2011) and suggests that measures of “social motivation” capture distinct constructs.

Furthermore, each social motivation measure exhibited different patterns of association with social competence further supporting the view that these measures capture distinct constructs. Consistent with prior work, social disinterest was unrelated to either basic social impairment or high-level social competence (Coplan et al., 2013). Likewise, in line with social achievement goal theory, individual differences in social demonstration goals (i.e., seeking social approval or avoiding rejection) were not associated with basic social impairment or high-level social competence (e.g., Ryan & Shim, 2006) whereas children’s willingness to build and maintain social relationships (or social development goals) was positively associated with high-level social competence. A tendency to find social activities pleasurable or interesting may therefore be distinct from a willingness to expend effort in building or maintaining social relationships (e.g., Contreras-Huerta et al., 2020).

Social motivation has been measured using different methods in developmental and cognitive neuroscience research including self-report questionnaires (e.g., Chevalier, Grèzes, et al., 2012), experimental tasks, which capture individual differences in learning or effort in response to social (e.g., smiling faces) and non-social rewards (e.g., money) (Dubey et al., 2018), and observational methods (e.g., preferences for social vs. non-social stimuli) (e.g., Burnside et al., 2018). One obvious direction for future work is to examine change and stability in each of these different markers of social motivation and the degree to which these measures capture distinct or related constructs. This will provide insight about whether early social interest predicts later willingness to build and maintain social relationships, for example. Another fruitful direction will be to examine the agreement between



experimental and questionnaire-based measures of social motivation within a specific developmental period. For example, there is some evidence for associations between experimental measures of social reward processing and self-reported social pleasure (Chevallier et al., 2016). Extending this work to typically developing children will shed light on whether experimental and self-report measures of social reward capture the same dispositions. Adopting multiple measures of each domain of social motivation (i.e., social orienting, social interest, and social maintenance) is necessary to establish whether social motivation is a unitary or multi-dimensional construct and to understand individual differences in social motivation.

4.3 | Social motivation and theory of mind

Our study extends recent work with preschool children and adults examining the relations between social motivation and theory of mind (e.g., Burnside et al., 2018; Lockwood et al., 2017) by investigating the association between social motivation and theory of mind in middle childhood and early adolescence. We found a modest but unique association between children's theory of mind and their willingness to build and maintain social relationships. This supports the view that individual differences in theory of mind cannot be viewed purely as an index of theory-of-mind capacity but instead may reflect in part a willingness to expend effort reasoning about social situations (e.g., Contreras-Huerta et al., 2020). While there was some degree of overlap between theory of mind and social motivation, both ability and willingness made unique contributions to individual differences in children's social competence. This suggests that the contribution of theory of mind and social motivation to children's social competence can be disentangled. To some extent these results challenge social motivation accounts of autism, which posit that social motivation (and not theory of mind) is a primary explanation for the social characteristics of autism (Chevalier, Kohls, et al., 2012).

The association between theory of mind and children's willingness to build and maintain social relationships raises interesting questions about the developmental relations between ability and motivation. One possibility is that children's willingness to build and maintain social relationships emerges as a result of their developing insights into others' minds. An alternative possibility is that social motivation drives the development of children's theory of mind. That is, children who find social interactions pleasurable may be more willing to expend effort in building and maintaining social relationships and as a consequence pay greater attention to the minds of others (Dawson et al., 2004). Examining the interplay between early social experience, social motivation, and theory of mind may illuminate how parent-child interactions or peer play give rise to individual differences in theory of mind (Devine & Hughes, 2018). Longitudinal work will be invaluable in examining developmental relations between social motivation and theory of mind.

Research on the interplay between theory of mind, social motivation, and social competence can be extended in at least two ways. First, it is important to recognize that the ability to reason about others' men-

tal states is a socially neutral tool, which can be used to achieve both prosocial and antisocial ends (Hughes & Devine, 2015b). Individual differences in social motivation may moderate the association between theory of mind and social outcomes depending on whether these outcomes are antisocial or prosocial. For example, skilled mindreading may be associated with ring-leader bullying among children who are strongly motivated by social approval from others (i.e., demonstration-approach goals) (e.g., Smith, 2017). Second, alongside the dispositional view of individual differences in both theory of mind and social motivation, future work should consider whether fluctuations in social motivation due to situational factors influence theory of mind in children. Induced changes in mood (Todd & Simpson, 2016) and the cultural similarity of the targets of mindreading (Perez-Zapata et al., 2016) can alter adults' performance on theory-of-mind tasks. Together these studies suggest that situational factors may alter mindreading performance via social motivation.

4.4 | Caveats and conclusions

Two limitations deserve note. First, we measured receptive vocabulary and spatial working memory as proxies for language ability and executive function respectively. That said, our results are similar to earlier studies of the relations between language ability and theory of mind in middle childhood (e.g., Banerjee et al., 2011) and between spatial working memory and theory of mind in middle childhood (e.g., Lecce et al., 2017). Related to this point, although teachers are a reliable source of data about children's social competence, multi-informant measures of children's social competence (including direct observation) will provide greater detail about the specific aspects of social competence that rely on children's theory of mind (Lecce & Devine, 2021). Second, although cross-sectional designs provide a starting point for developmental research, intervention studies may shed light on the nature of links between theory of mind, social motivation, and social competence. Recent research using a short-term intervention has shown that gains in 9- to 10-year-old children's theory of mind were associated with declines in self-reported loneliness (Caputi et al., 2021). Our results provide a case for further work examining developmental relations between theory of mind, social motivation, and social competence.

Our study breaks new ground by drawing together previously distinct strands of research on theory of mind, social motivation, and social competence. We have shown that individual differences in social competence are related to both the ability to reason about others' minds and a willingness to build and maintain social relationships. Our results indicate that social motivation and theory of mind are related but distinct constructs and add further weight to the view that individual differences in theory of mind are genuine and socially meaningful.

DATA AVAILABILITY STATEMENT

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

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