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Environmental Sensitivity in Children Is Associated With Emotion Recognition

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Children differ significantly in their emotion recognition, which represents an important component of social competence. According to theory and initial empirical studies in adults, individual differences in the trait of environmental sensitivity have been associated with emotion recognition, but this has not been studied in highly sensitive children yet. Highly sensitive children are generally understood to perceive and process environmental stimuli, including social ones, more easily and deeply than other children. We hypothesized that highly sensitive children would perform better in an objective emotion recognition task and be rated as more socially competent compared to low sensitive children. Ninety-seven 7- to 9-year-old U.K. primary school children (47% girls) completed the Reading the Mind in the Eyes test's child version on a computer one-on-one with a researcher during school hours on school premises. Teachers rated children's sensitivity using the Highly Sensitive Child in School scale and also reported on children's social competence. Children completed the Highly Sensitive Child scale. The data were collected in 2022. Teacher-reported sensitivity emerged as a significant predictor of the Reading the Mind in the Eyes test's child version and social competence, while child-reported sensitivity was not associated with emotion recognition. Teacher-reported overstimulation of children was negatively associated with social competence. This study is the first to report links between children's environmental sensitivity, emotion recognition skills, and social competence. Findings are consistent with theories on environmental sensitivity and highlight the potential benefits of high sensitivity but will need to be replicated in more ethnically diverse samples.

Keywords: environmental sensitivity, highly sensitive children, emotion recognition, reading the mind in the eyes, sensory processing sensitivity

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Positive relationships with others are crucial for child mental health and well-being (Butler et al., 2022). The ability to develop and sustain important relationships is strongly influenced by children's socioemotional competence, which includes basic abilities such as empathy, perspective-taking, cooperation, and controlling one's emotions (Hunter et al., 2018). One important aspect underpinning socioemotional competence and empathy, particularly the aspect of understanding others' feelings, is emotion recognition. According to empirical studies, children differ significantly in their ability to read others' emotions from their facial expressions (Baron-Cohen, Wheelwright, Hill, et al., 2001) with generally lower emotion recognition skills found in males (Greenberg et al., 2023) and children with psychiatric disorders (Collin et al., 2013). However, what has not been considered yet is whether children's emotion recognition skills are also influenced by the temperament trait of environmental sensitivity, which captures differences in the extent to which children perceive and process their environment (Pluess, 2015). Given that highly sensitive individuals generally tend to be more perceptive of subtleties in their environment (Aron et al., 2012), they may perform especially well in emotion recognition (e.g., Tabak et al., 2022), which could also contribute to heightened social competence (Hirn et al., 2019). However, these associations

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have not yet been investigated in sensitive children. The current article bridges this gap by investigating associations between children's environmental sensitivity, emotion recognition, and socioemotional competence.

Environmental Sensitivity

In the past decades, several psychological theories have proposed that individuals differ in their sensitivity to environmental influences. The framework of *environmental sensitivity* (Pluess, 2015) integrates three independent lines of research which all propose individual differences in susceptibility, reactivity, and sensitivity to internal and external stimuli and suggest that these differences in sensitivity moderate the impact of both adverse and supportive environmental influences (Aron & Aron, 1997; Belsky & Pluess, 2009; Boyce & Ellis, 2005). When conceptualizing sensitivity as a temperament trait in line with *sensory processing sensitivity* (Aron & Aron, 1997), empirical work across various samples and age groups suggests that around a third of children are highly sensitive (Pluess et al., 2018). Consistent with theory, highly sensitive children are more affected by both positive and negative parenting (Slagt et al., 2018), school-based programs (e.g., Pluess & Boniwell, 2015), and school transitions (Iimura & Kibe, 2020).

Sensitivity in children is typically assessed using self- or parent reports (Pluess et al., 2018; Slagt et al., 2018; Sperati et al., 2024). The most widely validated scale, the *Highly Sensitive Child* scale (HSC; Pluess et al., 2018), has been developed for 8- to 18-year-olds and captures the same three factors as the adult *Highly Sensitive Person* (HSP) scale (Aron & Aron, 1997): *Aesthetic Sensitivity* (*AES*), *Low Sensory Threshold* (*LST*), and *Ease of Excitation* (*EOE*; Smolewska et al., 2006). AES captures sensitive individuals' tendency to perceive more nuance in their environment and draw enjoyment from positive sensory stimuli. The intake and deep processing of stimuli can also be overwhelming in certain situations, manifesting as overstimulation or higher perceived stress during tasks (Aron et al., 2012; Gerstenberg, 2012). This dark side of sensitivity is captured in the HSC factors EOE and LST (Pluess et al., 2018; Smolewska et al., 2006), as well as in the *overstimulation* scale recently developed along the Highly Sensitive Child in School (HSC–School) scale (Kähkönen et al., 2024). These scales include items on disliking loud noises and finding it unpleasant to have a lot going on at once. While the total HSC score moderates the effects of the quality of the environment (e.g., Iimura & Kibe, 2020), the positive and negative subscales are often linked to disparate outcomes (e.g., Gulla & Golonka, 2021), highlighting that sensitivity can be both a strength and a weakness, depending on the quality of the developmental context and environment.

According to theory, some of the central aspects of sensitivity include depth of processing, emotional reactivity, and empathy (Aron et al., 2012). More specifically, heightened sensitivity is considered to stem from a more sensitive nervous system, which allows for deeper processing (Acevedo et al., 2021; Aron et al., 2012). Highly sensitive individuals have also been shown to feel more deeply and to be more emotionally reactive, both in response to positive (Jagiellowicz et al., 2016) and negative stimuli (Van Reyn et al., 2023), despite the classic sensitivity measures (e.g., HSC) not assessing these aspects explicitly. However, newer sensitivity measures have incorporated some of these central aspects of sensitivity more specifically into the assessment, for example, the new teacher-reported HSC–School measure (Kähkönen et al., 2024) focuses on depth of thinking and feeling.

Emotion Recognition

Accurate perception of emotions is a crucial skill for successful social interaction as it facilitates higher order processes, such as social competence (Hall et al., 2009; Hirn et al., 2019), emotional intelligence (Mayer et al., 2003), empathy (Shamay-Tsoory, 2011), and theory of mind (Mier et al., 2010). Importantly, interventions on improving emotion recognition skills have shown significant reductions in behavioral problems and improvements in child mental health (Wells et al., 2021), underscoring the importance of this skill. Moreover, low emotion recognition skills are considered a transdiagnostic risk factor, with a range of child psychiatric disorders coinciding with difficulties in emotion recognition (Collin et al., 2013). Importantly, children in middle childhood tend to have well-developed emotion recognition skills for certain emotions (e.g., sadness, anger) while recognition of other emotions (e.g., fear) tends to improve in adolescence (Lawrence et al., 2015). Moreover, around age 7–9 years, children's emotion comprehension expands with the development of understanding of desires, beliefs, and hidden emotions (Pons et al., 2004). Hence, exploring individual differences in children's emotion recognition skills in middle childhood may be of value for understanding the development of emotion processing, particularly as improvements in emotion recognition also promote mental health and behavior (Wells et al., 2021).

While various paradigms for the assessment of emotion recognition exist (e.g., see Schlegel et al., 2014), the most widely used measure to date is the Reading the Mind in the Eyes test (RMET; Baron-Cohen, Wheelwright, Hill, et al., 2001), where participants are required to infer a mental state based on the emotional expression in people's eyes. The child version of this test (Reading the Mind in the Eyes test's child version [RMET-C]; Baron-Cohen, Wheelwright, Spong, et al., 2001) has been widely used to identify differences in children's emotion recognition abilities. For example, Dorris et al. (2022) collected normative data across different age groups, starting in childhood. Furthermore, the RMET-C is also useful outside of clinical samples to investigate associations with challenges in childhood. For instance, one study found a moderate negative association with children and adolescents' conduct problems and RMET-C performance in a community sample (Sharp, 2008). However, we do not know yet whether highly sensitive children perform better than less sensitive children in this emotion recognition task.

Emotion Recognition and Environmental Sensitivity

There is mounting evidence from neural, self-report, and qualitative studies showing that environmental sensitivity is associated with concepts related to emotion recognition, such as emotional and cognitive empathy and interpersonal sensitivity (Acevedo et al., 2014; Bas et al., 2021; Kiou, 2018; Roth et al., 2023; Roxburgh, 2023; Schaefer et al., 2022; Tabak et al., 2022). However, few studies have focused explicitly on *emotion recognition skills* in sensitive individuals, and these studies are limited to adults with somewhat mixed results. For example, a study with more than 200 individuals using the Geneva Emotion Recognition Test (Schlegel et al., 2014) found that while sensitivity subscales EOE and AES related to emotion recognition performance, these effects disappeared when controlling for personality traits of neuroticism and openness (Hellwig & Roth, 2021). However, Tabak et al. (2022) showed in two American samples including over 1,000 individuals that AES predicts emotion recognition performance assessed with RMET (Baron-Cohen, Wheelwright, Hill, et al., 2001) above and beyond the Big Five personality traits. Furthermore, the total score of the HSP scale did predict RMET performance in a small British sample (Kiou, 2018) but not in a Turkish sample (Karaca Dinç et al., 2021). In sum, heightened emotion recognition skills appear to relate more strongly to the positive side of sensitivity, namely, AES, but detecting this effect may require large samples.

While the findings above support the notion that highly sensitive individuals might be more perceptive of others' emotions, as manifested in greater emotion recognition, empathy, and social sensitivity, current knowledge on emotion recognition and social competence in highly sensitive children remains limited.

The Present Study

The present study advances the field by exploring objectively assessed emotion recognition of sensitive *children* in a sample of primary school pupils resident in the United Kingdom and considering multiple informants. Teachers reported on their pupils' sensitivity using the novel HSC–School scale (Kähkönen et al., 2024), which captures the core aspects of sensitivity with items on depth of thinking and feeling. Teachers also reported on children's social competence. Children completed the established HSC scale (Pluess et al., 2018). Emotion recognition skills were examined using the RMET-C (Baron-Cohen, Wheelwright, Spong, et al., 2001). We hypothesized that sensitivity would be positively associated with RMET-C and socioemotional competence and that RMET-C performance would predict higher socioemotional competence.

Method

Participants

The present analysis concerns cross-sectional data from a longitudinal study that focused on third graders, which originally intended to serve as replication for a similar longitudinal study conducted in Switzerland. The Swiss children were followed from the first year of primary school, which Swiss children begin at Age 7. The U.K. longitudinal sample was then recruited to match the same age, beginning with 7-year-old third graders and following them until Year 4. The U.K. longitudinal study spanned from Autumn 2021 to Autumn 2022, and the data relevant to the current analysis were collected during the third and fourth wave of the study in 2022 (Wave 3: June–July 2022; Wave 4: September–November 2022). Power analysis run on G*Power 3.0.10 suggested that at least 100 children were required for the planned longitudinal analyses. To account for potential attrition over the study and to adjust for multiple testing, we aimed for a sample of 150–200 children. The recruitment period coincided with the end of COVID-19 lockdown when schools had limited resources. Despite contacting around 200 schools in Greater London, only three primary schools agreed to participate. From this original sample of 102 children, three had changed schools by data collection for the present study, one was consistently absent, and one completed the emotion recognition task but moved before the teacher data collection and was not included in the child survey. Thus, we obtained full teacher-reported sensitivity and emotion recognition data on 97 (51 boys, 46 girls) 7- to 9-year-old (M = 7.99, SD = 0.34) British primary school children from state primary schools in Greater London. Most of the emotion recognition data were collected at the end of Year 3 (n = 78), and the remaining children (n = 19) completed the activities in the beginning of Year 4. Teachers and children reported child characteristics. The present analyses concern ratings from seven teachers, with 2–22 children rated per teacher (M = 14.14). Parents were also invited to partake in surveys, but given that only a small number of parents completed surveys (n = 29), parent data were not considered in the current article, and we do not have detailed demographic information on the children.

Ethical Considerations

Teachers and parents provided informed consent for their participation. Due to low parent engagement, an opt-out approach was adopted in some of the participating schools with parents being given multiple opportunities to opt out and contact the research team. Children provided verbal assent for the emotion recognition activity and the first round of child surveys and provided a computerized assent for the second round of surveys. The study was approved by the Queen Mary Ethics of Research Committee (QMERC20.380).

Measures

A wide range of measures was collected to address the various research questions of the longitudinal study. Here, we introduce the variables central to the reported analyses. Information on all other measures is provided in Supplemental S1.

Environmental Sensitivity

Environmental sensitivity was assessed using the novel teacher-reported HSC–School scale (Kähkönen et al., 2024) that teachers provided at each study wave. This scale taps into sensitivity behaviors that can easily be identified by teachers. The item content differs from existing questionnaires on child sensitivity (e.g., Pluess et al., 2018) in that it focuses more specifically on depth of processing, thinking, and feeling with items that are observable in the school context. Thus, teacher-reported sensitivity is assessed with six items (e.g., "Is thinking deeply about things," "Appears to feel things deeply," "Easily notices how others are feeling") which capture central aspects of sensitivity. In addition, the measure includes a three-item scale on overstimulation (e.g., "Feels easily overwhelmed when under pressure"), which can be used to identify challenges highly sensitive children may be facing at school. Items are scored on a 1–7 Likert scale (1 = *not at all*, 7 = *extremely*). Sensitivity and overstimulation scores are considered separately. Scores are obtained by averaging the items for each scale, resulting in a continuous score ranging from 1 to 7. Most of the children tested in Year 4 did not have Wave 3 teacher survey data due to teacher absence. Thus, we used the most concurrent teacher ratings of sensitivity (i.e., children who completed the emotion recognition activity in Year 3 had their sensitivity rated by their Year 3 teacher in Year 3, whereas children tested in Year 4 were rated by their Year

4 teacher in Year 4). The sensitivity scale had a good internal consistency (α = .82), and overstimulation had an acceptable internal consistency (α = .72).

Children also reported on their own sensitivity using the 12-item self-report scale which is rated on a 1–7 Likert scale (1 = *not at all*, 7 = *extremely*; Pluess et al., 2018). The items capture three factors: four items on AES ("Some music can make me really happy"), three items on LST ("Loud noises make me feel uncomfortable"), and five items on EOE ("I don't like it when things change in my life"). Child data were collected across two waves: first in Summer 2022 with pen and paper ($n = 80$) and then in November 2022 per computer ($n = 91$). Children's self-reports had low internal consistency (Wave 3: α = .60, Wave 4: α = .64), and correlation between waves was relatively low, $r(74) = .29$, $p = .01$. To create more robust sensitivity scores, we computed an HSC composite by averaging scores across the two assessments. Where a second assessment was unavailable, the score consisted of the average across available items from one wave. Ninety-five children had at least one child survey. For more detailed information on the child surveys and the internal consistency of the subscales, see Supplemental S1.

Emotion Recognition

To measure emotion recognition ability, we used the RMET-C (Baron-Cohen, Wheelwright, Spong, et al., 2001) which uses simpler language than the adult version. This task consists of 28 photos depicting pairs of eyes alongside four response options with different emotions or mental states. Children need to select the option that most accurately describes the emotion presented in the photo. The task was computerized and administered following the original protocol: One image at a time, the researcher asked the child to look at the eyes and think about what the person was thinking or feeling. To minimize any effects that children's reading skills, experience in computer usage, and vocabulary could have on the task, the researcher read each response option aloud, controlled the computer with children indicating their choice either verbally or by pointing, and advised children to ask if they had questions regarding the meaning of any of the response options. The stimuli varied in difficulty. The RMET-C has been widely used (e.g., Chapman et al., 2006). The outcome is a continuous RMET-C score, which is the sum of correct responses with a maximum value of 28.

Social Competence

Teachers reported on a 10-item social–emotional competence scale (Conduct Problems Prevention Research Group, 1995; Hunter et al., 2018). The items vary from items tapping into social behavior to items regarding understanding and controlling emotions (e.g., "Controls temper when there is a disagreement," "Shares with others," "Understands other people's feelings," "Expresses needs and feelings appropriately," "Resolves problems with other children on his or her own"). Each item was rated on a 1–6 Likert scale (1 = *never*, 6 = *always*). The scores are created by taking an average across all items. The scale had good internal consistency (α = .92). As with teacher-reported sensitivity, we used the most proximal teacher ratings of social competence (i.e., children who completed the emotion recognition activity in Year 3 had their social competence rated by their Year 3 teacher in Year 3, whereas children tested in Year 4 were rated by their Year 4 teacher in Year 4).

Covariates

Child gender (female/male) was reported by teachers and added as a covariate. Gender was included as a covariate due to reported gender differences in emotion recognition tasks (Greenberg et al., 2023) and self-reported sensitivity (Pluess et al., 2018).

The year of schooling (summer Year 3 vs. autumn Year 4) during which data collection took place was added as a covariate to control for the potential difference in development between these grades and differences in social skills of third and fourth graders. The class change was considered a more important control than age as the children underwent changes in their class composition, teacher, or both when moving from Year 3 to Year 4. In contrast, children's age did not differ substantially, with six of the third graders being 7 years old, and five of the fourth graders having turned 9 in the autumn. Most of the participating children were 8 years old ($n = 86$). Hence, age was not included as a covariate.

Finally, given that several studies detected associations between mood and emotion recognition performance (e.g., Schmid et al., 2011), we recorded children's mood before and after the emotion recognition task as well as how difficult they found the activity. Children reported on their mood at baseline and after RMET-C on a visual analogue scale 1–100 (1 = *very sad*, 100 = *very happy*). We also calculated change in mood by subtracting the post-RMET-C mood score from the baseline mood score. After, the RMET-C children reported on perceived difficulty of the task on a visual analogue scale 1–100 (1 = *very easy*, 100 = *very difficult*).

Procedure

The original longitudinal study involved repeated teacher surveys across multiple time points, but some teacher changed during the course of the study and reports were not available for all children at each time point. Subsequently, the present analyses are based on the teacher report that was closest to the child when completing the emotion recognition activity. In more detail, teachers completed surveys for each participating child in their classrooms outside of class hours via Qualtrics within the same 2-month period as the RMET-C data collection. Child surveys were collected in small groups on pen and paper in the summer of Year 3 and on computers via Qualtrics in Year 4, and the available scores were averaged. The researchers were present to facilitate children's survey completion.

RMET-C data were collected on school premises in different rooms depending on availability (e.g., school library, computer room, piano room). Researchers recorded any potential distractions (for details, see Supplemental S2). The researcher first introduced the structure of the session to the child and told that participation is voluntary, and the child has the right to stop the activity at any point if they wanted to return to the classroom. Then, their verbal assent was obtained. Children first rated their current mood at baseline. Then, all children completed the RMET-C, which was followed by other computer tasks. After each task, children rated their mood and how difficult they found the activity.

All activities took approximately 25–45 min in total to complete. The children received a science sticker as a reward for participation.

Data Analysis

Bivariate Correlations

We first computed bivariate correlations to explore associations between the study variables and identify potential confounding variables. Significant associations between sensitivity variables and RMET-C scores were tested further by controlling for covariates in regression and multilevel models.

Regression Models and Multilevel Modeling

Continuous variables were standardized prior to regression analyses to reduce the risk of multicollinearity. The data set consisted of children nested within classrooms with the same teacher reporting on all children's sensitivity in their class. Thus, observations were not independent. We ran intraclass correlation coefficients (ICCs), with values higher than .10 suggesting that data within classrooms are highly correlated. RMET-C performance was not highly correlated within classrooms (ICC = .08), but teacher-rated sensitivity and social competence were (ICC = .29, ICC = .26, respectively), suggesting that adding teacher-level nesting would control for dependencies within the data. Thus, to test the first hypothesis that teacher-reported sensitivity predicts RMET-C, we tested a multilevel nested model with RMET-C score as the outcome variable, sensitivity as a predictor variable, and gender and year of schooling as control variables. Teacher IDs were used as nesting variables to account for the interdependence of the teacher-reported measures. Second, we investigated whether social competence was predicted by RMET-C when controlling for the teacher-nesting, in models with and without control variables. Third, we predicted social competence with sensitivity. For completeness, we ran a final model with both RMET-C and sensitivity as predictors of social competence. In the event that the multilevel model converged, we reported the multilevel model, but also ran multiple regression as a sensitivity analysis to make sure the results remained stable without controlling for the nesting layer. All analyses were run in *R* (v3.6.2; R Core Team, 2019).

Sensitivity Analysis

Most RMET articles use the total score across all items (e.g., Rutherford et al., 2012; Sharp, 2008). To ensure that our results are not biased by potentially problematic items, we removed items that have a smaller percentage of correct responses than would be expected by chance (i.e., less than 25%) or items with ceiling effects of more than 75% of respondents answering correctly. Thus, to ensure that our results are not affected by guesses or items that are too easy, we reran the final nested model with a reduced RMET-C score derived by removing all items that had less than 25% and more than 75% correct responses.

Transparency and Openness

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study, following the Journal Article Reporting Standards (Appelbaum et al., 2018). This study's design and its analysis were not preregistered. Materials, anonymized data, and code can be obtained from the authors upon reasonable request. All statistical analyses were conducted in *R* (v3.6.2; R Core Team, 2019).

Results

Descriptives

RMET-C scores ranged from 9 to 25 ($M = 18.30$, $SD = 3.36$) with the maximum possible score being 28. Girls had higher average scores (range = 9–24, $M = 19.07$, $SD = 3.12$) than boys (range = 10–25, $M = 17.61$, $SD = 3.45$), $t(95) = 2.19$, $p = .03$, 95% CI [0.13, 2.78]. For both genders, data followed a normal distribution. Results were similar in range yet somewhat higher on average than in a sample of 6- to 9-year-olds in the literature (boys $M = 15.2$, girls $M = 16.3$; Chapman et al., 2006). Children tested in Year 4 (range = 14–25, $M = 19.95$, $SD = 2.66$) performed better than children in Year 3 (range = 9–24, $M = 17.90$, $SD = 3.40$), $t(34) = -2.84$, $p = .007$, 95% CI [−3.51, −0.59]. For mean and standard deviations, see Table 1.

Bivariate Correlations

For bivariate correlations between all variables of interest, see Table 1. Teacher-reported sensitivity was not associated with child-reported sensitivity. As hypothesized, children's RMET-C score was correlated with teacher ratings of sensitivity ($r = .28$). RMET-C did not correlate with child-rated HSC. Hence, child-rated HSC was not explored further in the more complex models. Children's reports of mood and difficulty did not relate to RMET-C performance and were thus not included as control variables. Teacher-rated overstimulation did not relate to RMET-C but had a negative association with social competence ($r = -.26$).

Regression Models and Multilevel Modeling Results

To address the hypothesis that sensitivity predicts emotion recognition skills, we ran multilevel models accounting for the nested nature of teacher-rated sensitivity scores. When teacher-nesting was controlled for, sensitivity remained as a significant predictor of RMET-C scores, $B = 0.30$ (0.10), $t = 2.94$, $p = .004$, and explained 8.7% of the variance in RMET-C scores. Adding gender and year of testing made the model singular, meaning that differences in slopes between classes were no longer meaningful and teacher-nesting was no longer necessary. Thus, the teacher-nesting was removed to simplify the model, and the final model was run as a regression model. The results were stable with sensitivity remaining a significant predictor of RMET-C and year of data collection also being a significant predictor with older children performing better. Gender did not have a significant impact, but the trend was in the same direction as in the literature with boys performing slightly worse (see Table 2). The full model was significant, $F(3, 93) = 8.32$, $p < .001$, and explained 18.6% of the variance.

The findings partially supported the hypothesis that higher emotion recognition predicts higher social competence. The multilevel model predicting social competence with RMET-C scores showed a significant main effect of RMET-C, $B = 0.24$ (0.09), $t = 2.66$, $p = .009$. The association was attenuated somewhat when controlling for gender and year of testing ($B = 0.18$, $p = .053$, see

Table 1
Bivariate Correlations Between RMET-C, Sensitivity, and Covariates

Variable	*M* (*SD*)	1	2	3	4	5	6	7	8	9	10	11
1. RMET-C	18.29 (3.34)	—										
2. Sensitivity	4.4 (1.0)	.28**	—									
3. Overstimulation	4.5 (1.2)	−.07	.30**	—								
4. HSC	4.8 (0.7)	−.00	−.08	.13	—							
5. Year		.24*	−.30**	−.15	.08	—						
6. Gender		−.22*	−.33**	.03	−.14	.05	—					
7. Baseline mood	79.80 (20.49)	−.20	.07	.07	.10	−.16	.06	—				
8. Posttask mood	81.06 (19.76)	−.18	−.06	.03	.11	−.15	.09	.75	—			
9. Mood change	−1.27 (14.10)	−.03	.19	.05	−.01	−.02	−.03	.39***	−.30**	—		
10. Difficulty	39.75 (25.45)	.16	.07	.02	.00	.06	−.23*	−.23*	−.25*	.03	—	
11. Social competence	4.4 (0.9)	.32**	.19	−.26*	−.12	.49***	−.13	−.12	−.16	.05	.02	—

Note. RMET-C = Reading the Mind in the Eyes task child version score; Sensitivity = teacher-reported sensitivity (Highly Sensitive Child [HSC]–School subscale); Overstimulation = teacher-reported overstimulation (HSC–School subscale); HSC = child-reported HSC composite score across two assessments; Year = children's school year (Year 3/Year 4); Gender = child gender (with negative correlations meaning lower scores in boys); Baseline mood = baseline mood (1–100) with higher scores indicating better mood; Posttask mood = postmood (1–100); Mood change = mood change from baseline to posttask; Difficulty = perceived difficulty of the Reading the Mind in the Eyes task (1–100) with higher scores indicating higher difficulty; Social competence = teacher-rated social competence.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2 for details) but supports the hypothesis that sensitivity is associated with social competence (See Table 2). Exploring additive effects of RMET-C and sensitivity in prediction of social competence showed that only sensitivity was significantly associated with social competence (see Table 2). These models were repeated with additional control variables (i.e., child age) in order to test robustness of findings. None of these variables were significantly associated with RMET-C scores, and their inclusion did not change the findings (see Supplemental S3).

Sensitivity Analysis

To identify whether the association between sensitivity and RMET-C scores remains after accounting for ceiling and floor effects in RMET-C performance, we computed a new RMET-C score, only retaining correct answers in response to items that had success rates higher than 25% and lower than 75%. This resulted in 15 items and scores ranging from 4 to 13 ($M = 8.1$, $SD = 2.3$), or in other words, success rates ranged from 27% to 87%. We repeated the final model predicting RMET-C scores with sensitivity and controlling for gender and year of data collection using this adjusted RMET-C score (see Table 3). According to results, the full model was significant, $F(3,93) = 7.82$, $p < .001$, and teacher-reported sensitivity remained as a significant predictor of emotion recognition. However, in contrast to the model with all RMET-C items, gender had a significant effect on adjusted RMET-C scores, with boys performing worse than girls.

Discussion

The present research investigated the relationship between environmental sensitivity and emotion recognition by exploring how

Table 2
Regression and Multilevel Models Predicting RMET-C and Social Competence

	RMET-C score			Social competence			Social competence			Social competence		
Predictor	Estimate	95% CI	*p*	Estimate	95% CI	*p*	Estimate	95% CI	*p*	Estimate	95% CI	*p*
(Intercept)	−0.04	[−0.34, 0.25]	.764	−0.07	[−0.39, 0.26]	.679	−0.22	[−0.58, 0.13]	.214	−0.22	[−0.57, 0.14]	.228
Sensitivity	0.35	[0.15, 0.56]	**.001**				0.40	[0.21, 0.59]	**<.001**	0.37	[0.17, 0.57]	**<.001**
Gender [2]	−0.24	[−0.63, 0.15]	.221	−0.22	[−0.58, 0.13]	.212	−0.04	[−0.39, 0.31]	.817	−0.02	[−0.37, 0.33]	.909
Year [4]	0.89	[0.41, 1.38]	**<.001**	1.07	[0.48, 1.65]	**<.001**	1.49	[0.86, 2.11]	**<.001**	1.40	[0.75, 2.06]	**<.001**
RMET-C score				0.18	[−0.00, 0.36]	.053				0.08	[−0.09, 0.26]	.352
Random effects												
σ^2					0.70			0.61			0.61	
τ_{00}					$0.04_{\text{TeacherID}}$			$0.07_{\text{TeacherID}}$			$0.07_{\text{TeacherID}}$	
ICC					0.06			0.10			0.10	
N					$7_{\text{TeacherID}}$			$7_{\text{TeacherID}}$			$7_{\text{TeacherID}}$	
Observations		97			97			97			97	
R^2/R^2 adjusted		0.212/0.186			0.265/0.307			0.355/0.420			0.357/0.424	

Note. σ^2 = variance of random effects at Level 1; τ_{00} = variance explained by the nesting layer (Level 2). Significant *p* values are presented in bold. Model 1 = a regression model with RMET-C predicted by teacher-reported core sensitivity; Model 2 = a multilevel model with social competence predicted by RMET-C; Model 3 = a multilevel model with social competence predicted by teacher-reported core sensitivity; Model 4 = a multilevel model with social competence predicted by both teacher-reported sensitivity and RMET-C score; Year = children's school year (Year 3/Year 4); RMET-C = Reading the Mind in the Eyes test's child version; CI = confidence interval; ICC = intraclass correlation coefficient; Teacher ID = Teacher identification number for the teacher-nesting variable.

Table 3
Regression Model With the RMET-C Scores Adjusted for Floor and Ceiling Effects

	RMET-C score (adjusted)		
Predictor	Estimate	95% CI	p
(Intercept)	0.05	[−0.25, 0.34]	.757
Sensitivity	0.25	[0.05, 0.46]	**.016**
Gender	−0.41	[−0.80, −0.02]	**.039**
Year 3/4	0.87	[0.38, 1.35]	**.001**
Observations		97	
R^2/R^2 adjusted		0.201/0.176	

Note. RMET-C and sensitivity are standardized values. Gender and year are coded as factors. Significant p values are presented in bold. RMET-C = Reading the Mind in the Eyes test's child version; CI = confidence interval.

teacher-reported and child-reported sensitivity relate to children's performance in an established emotion recognition task. In addition, we explored whether children with higher sensitivity and emotion recognition skills were also perceived as more socially competent. As hypothesized, teacher-reported sensitivity positively predicted children's emotion recognition skills, explaining 8.7% of the variance in RMET-C. Sensitivity was also a significant predictor of social competence when covariates were controlled for. These findings align with literature showing that the positive side of adults' sensitivity, as captured by the AES subscale in the HSP and HSC scales, predicts emotion recognition performance and positive interpersonal sensitivity (Tabak et al., 2022). Moreover, this provides novel evidence for individual differences in emotion recognition in childhood and aligns with theoretical notions of sensitivity with attention to details, empathetic processes, and pause-to-check behaviors (Aron et al., 2012). As sensitive individuals tend to pause in novel situations to consider the situation and to see how to proceed, they may also read others' cues and expressions on how to behave in novel situations, becoming particularly attuned to others. Given that sensitivity reflects both genetic and environmental influences (e.g., Assary et al., 2021), it is conceivable that sensitive children have an inherent aptitude for emotion recognition but are also more likely to learn to recognize emotions due to environmental influences. This notion needs to be investigated in longitudinal studies spanning childhood and adolescence and including measures of home environment. Early engagement with others' emotions and the associated advanced social adjustment (Leppänen & Hietanen, 2001) may create a positive cycle of development during adolescence which is a period typically characterized by improvements in emotion recognition skills (Lawrence et al., 2015). Better emotion recognition may serve as promotive or protective factors for sensitive children's relationships, particularly if the sensitive child tends to be shy in unfamiliar and new environments (Aron, 2002). Indeed, previous studies have found a buffering effect of good emotion knowledge on shy children's peer relations, with shy children with good emotion knowledge showing no withdrawal or peer rejection unlike shy children with worse emotion knowledge (Sette et al., 2016). Finally, good emotion recognition skills may protect highly sensitive children from internalizing problems (Dede et al., 2021), which some highly sensitive children are prone to (e.g., Boterberg & Warreyn, 2016).

Although the observed effect size for the association between sensitivity and RMET-C is modest, the identified effect is of typical size for developmental studies (Schäfer & Schwarz, 2019). For example, previous research with a similar sample size reported a moderate association between the reading the mind in the eyes and children's conduct problems (Sharp, 2008).

Meanwhile, teacher-rated overstimulation did neither promote nor impede emotion recognition skills in the present study, aligning with previous research showing that the negative side of sensitivity holds no predictive power on emotion recognition skills (Tabak et al., 2022). Teacher-rated sensitivity did not predict socioemotional competence, but according to bivariate correlations, there was a small negative association between overstimulation and socioemotional competence. Although this association needs to be considered in light of the fact that teachers reported both outcomes, it may be that overstimulation impedes some socioemotional skills such as emotion regulation.

In contrast to teacher-reported sensitivity, we found no association between child-reported sensitivity and RMET-C scores. Similar inconsistencies are found among adults in predicting emotion recognition skills when using the total sensitivity score (Karaca Dinç et al., 2021; Kiou, 2018). However, the null findings regarding the child scale may mostly be due to the low reliability of the child-report scale in the current sample, especially regarding the subscales (see Supplemental S1). Given the limitations that we encountered in using self-reports of children aged 7–9 years, it may be more suitable to explore the association between RMET-C and self-reported HSC in older children.

Strengths, Limitations, and Future Directions

The present research benefits from multiple informants and data collection in a relatively naturalistic setting on school premises in the middle of the school day. The naturalistic setting and children's familiarity with the researchers due to the frequent presence of the researchers in the school across the longitudinal study may reduce the performance pressure that especially highly sensitive children could experience. While not using a standardized laboratory setting may have limitations, we did not observe distractions that influenced children's performance (see Supplemental S2).

Findings need to be considered in light of several limitations. First, the sample was relatively small. While the multilevel models were underpowered, the key findings remained stable at all levels of analysis (from correlations to more complicated models), indicating the robustness of the presented findings. However, associations between sensitivity, emotion recognition, and social competence could be investigated in more detail in a larger sample that allows for advanced mediation analyses with the help of structural equation modeling. Relatedly, the number of teachers was small and the multilevel models controlling for the shared informants may lack power in this sample, but the results were stable when removing the nesting layer. Nearly all children tested in Year 4 were from the same classroom and thus rated by the same teacher, which may explain why controlling for data collection year had such a large effect. However, the results were stable with and without this control variable. Third, we lacked access to data on neurodevelopmental conditions that would enable a direct comparison between children high in sensitivity and children with neurodevelopmental conditions. Future studies on emotion recognition skills of highly sensitive children should include such comparisons and consider other conditions that might influence emotion recognition skills (e.g., alexithymia; Oakley et al., 2016). Due to low parent engagement, we did not have sufficient data to explore effects of the rearing environment on child emotion recognition skills. Although a recent study found no association between RMET-C and family influence (Rosso & Riolfo, 2020), sensitive children's emotion recognition skills are likely to be more strongly impacted by their parenting as suggested by studies showing that sensitivity significantly moderates parenting effects on behavioral and socioemotional outcomes (Lionetti et al., 2019, 2022; Slagt et al., 2018). Thus, future research should investigate whether highly sensitive children's emotion recognition and socioemotional competence are more contingent on the quality of their family environment.

Although the emotion recognition task used here, RMET-C, has been widely used over the past two decades, some reviews question its validity (e.g., Higgins et al., 2024). Further research should explore whether highly sensitive children's advanced emotion recognition abilities extend to more complex aspects of the theory of mind by applying tasks that rely less on the ability to read emotions and focus more on complex social cognition of understanding others' mental states including intentions and thoughts (see, e.g., Dziobek et al., 2006). As studies show inconsistent patterns for individuals' performance across different theory-of-mind tasks with good performance on one not necessarily predicting great performance on another (Warnell & Redcay, 2019), a combination of theory-of-mind tasks as well as empathy measures would advance understanding of highly sensitive children's empathetic and sociocognitive skills. Finally, further research should investigate practical implications of greater emotion recognition skills in sensitive children, such as depletion due to the increased awareness of others' suffering (Roxburgh, 2023), particularly in settings characterized by high conflict.

Constraints on Generality

The present study aimed at capturing children from diverse backgrounds by reaching out to around 200 primary schools across Greater London. However, only Catholic primary schools volunteered to participate, somewhat limiting the ethnic and cultural diversity. Importantly, the data collection was conducted soon after the COVID-19 pandemic during which people were wearing face masks, and therefore, the reported sample may have been more accustomed to recognizing emotions based on eyes compared to other children (such as Chapman et al., 2006). Finally, given that teachers reported on the sensitivity of a large number of children in their classrooms, the study should be replicated featuring the inclusion of more teachers to account for individual differences in teachers' ability to recognize children's sensitivity.

Conclusion

The present research is the first to have empirically investigated the relationship between environmental sensitivity and emotion recognition abilities as well as social competence in children. Teacher-reported sensitivity, but not child-reported sensitivity, was positively associated with emotion recognition performance and social competence. These findings corroborate previous research on adults showing that the positive side of sensitivity is associated with greater emotion recognition, which may contribute to better social skills, empathy, and social competence, but may also burden sensitive children in some contexts. Future studies are needed to consider more complex aspects of empathy for a more thorough understanding of sensitive children's unique strengths.

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