Self-conscious emotions are self-evaluative emotions that arise in relation to social rules (Lewis, 1993, 1997). They reflect the interpersonal self, that is, how the self relates to others (Hobson, 1990). Some self-conscious emotions, such as guilt and embarrassment after misbehavior motivate prosocial behaviors and evoke forgiveness and appeasement in others. Other self-conscious emotions, such as shame, are considered less socially adaptive, as they trigger withdrawal and avoidance, thereby inhibiting prosocial behaviors (Sznycer, 2019; Tangney, 1999; Tangney et al., 1996, 2007). A lack or surplus of self-conscious emotions could lead to problems in forming and maintaining social relationships, since self-conscious emotions help people navigate social situations in which they misbehaved or broke social rules (Muris et al., 2016; Tangney, 1999). Given the difficulties in navigating social relationships, children with more autistic traits might be prone to disturbances in self-conscious emotions after transgression.

Here, for the first time, we investigated the association between autistic traits and self-conscious emotions of guilt, embarrassment, and shame-like avoidance in young children. Although past empirical studies have shown that older children and adults with autism spectrum disorder (ASD) show disturbances in self-conscious emotions (e.g., Davidson et al., 2018; Muris et al., 2016), it is currently unknown whether disturbances in self-conscious emotions after transgression are related to autistic traits.
in early childhood. This is important for two reasons. First, it speaks to whether early-emerging autistic traits are related to disturbances in the interpersonal self thereby advancing the theory on autism, which has not focused extensively on disturbances in the self early in child development. Second, it allows us to elucidate early risk factors for later autism.

We tested the novel hypothesis that young children with more autistic traits display lower levels of guilt and embarrassment and greater shame after doing something wrong. We further examined whether children with more autistic traits experience these disturbances in self-conscious emotions due to lower levels of theory of mind (ToM). Because self-conscious emotions arise from understanding the social situation and evaluating the self through the eyes of others, difficulties with understanding others’ minds—the sociocognitive ability called ToM—could explain why children with more autistic traits display disturbances in self-conscious emotions.

Self-conscious emotions in early childhood

Three core self-conscious emotions that typically occur after breaking social norms or rules are guilt, shame, and embarrassment. All three self-conscious emotions are thought to be a reaction to social valuation that serves to motivate people to behave in socially appropriate ways (Sznycer, 2019; Tangney et al., 2007). They all require self-evaluation as well as the awareness of others’ evaluation of the self (Leary et al., 2007; Tracy & Robins, 2004). However, they also differ from each other in important ways. Guilt involves a negative sense or evaluation of one’s own displayed behavior—a specific action, but it does not inflict a negative evaluation of the whole self (Lewis, 2007; Tangney & Dearing, 2002). When individuals experience guilt, they regret their action and wish they behaved differently. Thus, feelings of guilt motivate individuals to show prosocial behavior and repair the negative consequences of the action that caused these feelings, such as by apologizing and repairing (Lewis, 1993; Tangney, 1999; Tangney et al., 2007; Tangney & Dearing, 2002). Observational studies show that even 2- and 3-year-olds show such guilt-related behaviors (Barrett et al., 1993; Drummond et al., 2017).

Embarrassment involves evaluations of the presented self, as opposed to the core self in shame (Lewis, 1993; Tangney, 1999). This generates more short-term and situation-specific negative evaluations about oneself (Tangney, 1999; Tangney et al., 1996). Expressions of embarrassment may serve as appeasement, a nonverbal acknowledgment of shared social standards, and a nonverbal apology (Miller, 2007). These expressions have been described as withdrawing behavior (e.g., gaze or head aversions) accompanied by a smile (Barrett et al., 1993; Lewis, 1993, 1997, 2007), also known as embarrassed or coy smiles (Reddy, 2001). Traditionally, it has been thought that embarrassment may occur only after children become self-aware at around 18 months old (Lewis, 2007). However, recent research has shown that embarrassment-related reactions, in the form of coy smiles (as a result of social exposure), may appear already in infancy (Colonnesi et al., 2013, 2020; Reddy, 2001).

Shame involves a negative sense about the entire self (Lewis, 2007; Tangney & Dearing, 2002). When individuals evaluate the whole self negatively, they may not be motivated to repair, as there is little they can do to repair the whole self. In fact, they may rather hide themselves (Lewis, 2007; Tangney et al., 2007; Tangney & Dearing, 2002). They may physically shrink as if to hide from evaluation (Lewis, 1993). Shame is often considered an inhibitor of prosocial behavior (Barrett, 2005; Tangney et al., 1996) and is reflected through withdrawal behaviors—such as aversion of the eyes, head, or the whole body—while having a neutral or negative facial expression (Barrett, 2005; Drummond et al., 2017; Lewis, 1993). These behaviors can be observed in toddlers, suggesting children can experience shame from an early age (e.g., Drummond et al., 2017). However, some scholars have argued that these behaviors are not rooted in shame but in fearful avoidance (Barrett, 2005; Hobson et al., 2006), perhaps because toddlers may not yet be able to experience shame as a distinct emotion (Tangney & Dearing, 2002). We, therefore, refer to these behaviors as shame-like avoidance.

The experience of self-conscious emotions can be captured, as with other emotions, by self-reports. However, in research with very young children, self-reports are unreliable as children start understanding self-conscious emotions only at school age (Lagattuta & Thompson, 2007; Olthof et al., 2000). Past studies investigating self-conscious emotions in toddlers and young children have, thus, adopted the functionalist approach to emotions, according to which self-conscious emotions serve a social function and are, therefore, shown through visible and measurable behaviors in social contexts in which they typically occur, such as after a misdeed or transgression (Barrett et al., 1993; Drummond et al., 2017; Kochanska et al., 1995). According to this approach, guilt may be defined through behaviors aiming at repairing a social relationship (Tangney, 1995), embarrassment through behaviors aiming to appease (Keltner & Buswell, 1997). On the contrary, shame may be defined through behaviors aiming at withdrawing and avoiding (Tangney, 1995). As such, individual differences in different self-conscious emotions can be measured in very young children through observations in specific social contexts.

It has been theorized that experiencing self-conscious emotions requires more complex cognitive and emotional abilities than basic emotions (e.g., happiness, sadness, and anger), which explains why self-conscious emotions may appear later in children’s development (Lewis, 2007). The experience of self-conscious emotions may be contingent...
on several sociocognitive abilities. First, children need self-awareness (Lewis, 2007), which typically develops between 18 and 24 months (Lewis, 2007). Second, children need to be able to realize they did something wrong. To do so, they need to internalize social rules and norms and be aware that their own behavior conflicted with such rules and norms. This ability emerges around the age of 3 years (Lewis, 1993, 2007). Third, children need to be aware of and able to reflect on how other people think and feel about them (Lewis, 1997). Self-awareness is related to ToM—the ability to accurately understand others’ mental states and predict others’ behaviors accordingly that starts developing in toddlerhood and develops further throughout childhood (Saxe et al., 2004).

There are, however, scholars that question the rigidity of these developmental sequences and the necessity of these sociocognitive skills for self-conscious emotions to appear (Colonnesi et al., 2013; Reddy, 2005; Zinck, 2008). These scholars have argued that young children can experience and display rudimentary forms of self-conscious emotions before explicit self-awareness (typically measured through self-recognition in the mirror; Amsterdam, 1972) and explicit ToM (typically measured through the explicit false-belief understanding; Wimmer, 1983) are typically acquired (Zinck, 2008). This is because young children may possess implicit self-awareness and implicit ToM early in development (Perner & Clements, 2000; Reddy, 2010; Rochat, 2018). Supporting these ideas, several studies have demonstrated expressions of self-conscious emotions, such as guilt, embarrassment, and shame when exposed to others’ attention or after a misbehavior already in toddlers (Barrett, 2005; Barrett et al., 1993; Colonnesi et al., 2020; Drummond et al., 2017) and expressions of embarrassment even in infancy (Reddy, 2001).

Together, these theories and findings show that self-conscious emotions emerge early in development and have important social consequences. Whereas guilt and embarrassment after a transgression may help individuals repair and maintain social relationships (Miller, 2007; Tangney, 1999; Tangney & Dearing, 2002), not experiencing any guilt or embarrassment, or experiencing more shame, may instead inhibit prosocial behavior and, consequently, disrupt the formation or maintenance of close social relationships (Tangney et al., 1996). In the present research, we build on these findings to understand the early manifestations of autistic traits in children.

**Autistic traits, ToM, and self-conscious emotions**

Autism spectrum disorder is a neurodevelopmental disorder associated with severe and pervasive deficits in social interaction (Schaller & Rauh, 2017). Some of the main autistic traits are diminished social awareness and social communication, limited affective engagement, and stereotyped motor mannerisms (Volkmar et al., 2005). Whereas children with ASD have no difficulties in conceptual self-awareness (i.e., they recognize themselves in the mirror), they do show disturbances in interpersonal self (i.e., they have difficulty understanding their role in social interactions and how others may see them as social agents; Hobson, 1990; Reddy et al., 2010). This disturbed interpersonal self may be reflected through less attuned self-conscious emotions in social situations (Hobson, 1990; Reddy et al., 2010). There is preliminary evidence for this idea in children with ASD. For example, when children with ASD see themselves in the mirror, they recognize themselves and show interest in their mirror image; however, they do not show self-conscious emotions, such as embarrassment and coyness (Lewis & Brooks-Gunn, 1979; Reddy et al., 2010). Less attuned self-conscious emotions seen in children with ASD may be due to sociocognitive deficits, such as deficits in ToM.

Theory of mind represents the ability to accurately attribute mental states, such as feelings, thoughts, and intentions, to oneself and others and to understand and explain others’ and one’s own behaviors based on mental states (Mazza et al., 2017). False belief—the realization that others can have beliefs that are different from one’s own—is an important aspect in the development of ToM, and typically develops, in an explicit way, around the age of 4 years (Mazza et al., 2017). Other aspects of ToM, such as understanding of intentions and emotions, develop earlier, between the ages of 2 and 5 years (Saxe et al., 2004). Emotion recognition—the ability to accurately assess emotions based on external cues, such as facial expressions—is the necessary first step for emotion understanding (Saxe et al., 2004), and thus also an important part of ToM and children’s social functioning.

As preschool-aged children start to advance in the understanding of their own and others’ minds, they become increasingly sensitive to others’ evaluations, and thus, may become more prone to experiencing self-conscious emotions in social situations in which they misbehaved or broke a rule (Lagattuta & Thompson, 2007). This is because self-conscious emotions stem from how a person thinks about oneself and how a person imagines others think and feel about them. Thus, some ToM skills, such as understanding that others have their own beliefs (including first-order beliefs and false beliefs) and their own emotions (emotion recognition and emotion understanding) may be crucial for experiencing self-conscious emotions (Beer, 2007; Lagattuta & Thompson, 2007).

Impairments in ToM abilities may contribute to disturbances in self-conscious emotions after transgression. If children do not understand they broke a norm or hurt somebody’s feelings and do not understand another person’s perspective (e.g., they broke a friend’s toy and they do not understand that this event made the friend sad), they are unlikely to experience guilt and embarrassment. And if children do not understand accurately another person’s feelings and thoughts and cannot predict their behaviors, they may focus on the self, feelings of
failure, and experience shame and show more avoidance and withdrawal. This idea is based on past research that indicated that children with lower ToM abilities cannot accurately predict others' reactions in social situations because they do not understand others' mental states, experience these social situations as stressful and unpredictable, and, therefore, show avoidance and withdrawal in social situations (Colonnese et al., 2017; Nikolic et al., 2019). Similarly, there is experimental evidence showing that compared with people experiencing guilt, people experiencing shame before engaging in a perspective taking task, show worse perspective taking (Yang et al., 2010). Therefore, the experience of guilt and embarrassment may be related to advanced ToM abilities whereas the experience of shame may be related to lower levels of ToM abilities.

As children with more autistic traits have been shown to have lower ToM abilities (e.g., Gokcen et al., 2016), they may show less guilt and embarrassment and more shame-related withdrawal, partly caused by impairments in ToM (i.e., difficulties in recognizing and understanding others' emotions and beliefs. Heerey et al., 2003; Muris et al., 2016; Schaller & Rauh, 2017). It is of note that we do not expect impairments in ToM to be the sole cause of unattuned self-conscious emotions. There may be alternative pathways of autistic traits to unattuned self-conscious emotions, such as communication deficits (Rosello et al., 2020), lower levels of affective empathy (Baron-Cohen, 1988; Hillier & Allinson, 2002) or elevated levels of fear or anxiety (Davidson et al., 2017).

So far, the association between autistic traits or ASD and self-conscious emotions has been investigated only in older children and adolescents. One self-report study found that 7- to 14-year-old children with ASD show less guilt than children without ASD (Davidson et al., 2018). A multi-informant study found that 4- to 18-year-old children and adolescents with ASD show less guilt and more shame than children and adolescents without ASD (Muris et al., 2016). An observational study found that, during an embarrassment-eliciting task, 6- to 12-year-old children with ASD show reduced signs of embarrassment and shyness (Hobson et al., 2006). Another observational study showed that preschool children with ASD, unlike other children, showed fewer coy smiles when seeing themselves in the mirror, suggesting reduced shyness and altered interpersonal self (Reddy et al., 2010). Also, a parent-report study found that 2- to 14-year-old children with ASD showed more avoidant symptoms than typically developing children (Davis et al., 2011). Together, these empirical findings confirm that older children with ASD have disturbed self-conscious emotional expressions. Yet, it is unknown whether these disturbances emerge early in development and what their underlying mechanisms are. It is, however, highly important to intervene as early as possible in the onset of autistic traits. A recent study showed that for children who are at risk of developing ASD, early intervention that starts before the age of 2 greatly reduces the chance of developing ASD later in life (Lombardo et al., 2021). Therefore, early recognition of autistic traits, possibly expressed by showing less attuned self-conscious emotions, may facilitate treatment and even prevention of ASD. Our study, for the first time, examined self-conscious emotions in young children with more autistic traits, and deficits in sociocognitive abilities as a possible mechanism of these less attuned emotions.

**Present study**

We investigated the association between autistic traits and self-conscious emotions after a misbehavior in young children aged 2-5 years. We hypothesized that children's levels of autistic traits would be associated with less guilt, less embarrassment, and more shame-like avoidance. We also hypothesized that these associations would be partially due to the deficits in ToM and that they would already emerge in toddlerhood.

In addition to generating a framework for understanding self-conscious emotions in relation to autistic traits, our study extends prior work in four ways. First, we focus on young children, uncovering whether disturbed self-conscious emotions already characterize autistic traits from early in life. Second, whereas most research used self-reports and informant reports of emotions, we used structured observations of self-conscious emotions in ecologically valid settings. Third, whereas past work focused on a narrow range of emotions, we included the most central self-conscious emotions that occur after misbehaviors (i.e., shame, embarrassment, and guilt). Fourth, our work investigates deficits in ToM as a possible mechanism that links autistic traits to less attuned self-conscious emotions. Thus, our work is the first comprehensive and ecologically valid examination of the association between early-occurring autistic traits and various self-conscious emotions in young children.

**METHOD**

**Participants**

Participants were 98 children aged 2-5 years (24-72 months, M = 48.54, SD = 13.50; 92% White; 50% girls), accompanied by one of their parents, ages 22-48 years (M = 35.76, SD = 6.14; 83% mothers). Parents mostly had a Dutch ethnicity (81.6%), were relatively highly educated (11% doctorate, 30% university degree, 35% college degree, 24% high school/vocational degree) and were, based on monthly household income, from various socioeconomic status (42% €0-€4000, 31% €4000-€6000, 22% €6000-€8000, 5% unwilling to share this information). Participants were recruited by letters sent out via primary schools, daycare centers, and preschools; and handed
out at crowded public areas frequently visited by families with young children) and through advertising on social media. Parents provided active informed consent for themselves and their child. The only inclusion criterion was child age (2–5 years). The study has been approved by the ethics committee of the University of Amsterdam (n. 2018-CDE-8675). The study was conducted at the Family Lab at the University of Amsterdam. Data were collected from March 2018 till June 2019. The study has both confirmatory and exploratory aspects as we formulated and tested a priori directional hypotheses, and additionally conducted exploratory post hoc analyses. The study data and materials, including a full study protocol and codebook, are available on OSF: https://osf.io/g6efa/?view_only=6ce6dfe23d84b7489a9a2d7ca231ab2.

Children's levels of ASD traits reported by parent

We used the parent-report Social Responsiveness scale—Preschool Version (SRS; Constantino & Gruber, 2012; Pine et al., 2006) to measure children’s autistic traits. It consists of 65 items with a four-point rating scale ranging from not true to always true, regarding the child’s ability to engage in an emotionally appropriate way in interactions with others (Constantino et al., 2003). An example item is: “My child avoids starting social interactions with peers or adults”. The SRS measures autistic traits as a continuous scale, with higher scores representing more autistic traits. The test–retest reliability of the SRS measured by Constantino et al. (2003) was 0.83. Internal consistency was excellent in previous studies, $\alpha = .93$ (Constantino et al., 2003), and internal consistency for the SRS found in the present study was good, $\alpha = .82$. The preschool version only differs from the SRS on the basis of developmental appropriateness of the wording to describe behaviors of children in the respective age group, and analysis revealed no effects of test version (Pine et al., 2006).

Measurement of ToM

We used a shortened version of the ToM test-Revised (ToM test-R; Steerneman & Meesters, 2009) to measure ToM. This is a structured interview with 14 short stories about which the child had to answer 36 questions for measuring ToM and its precursors. In this study, four different milestones in the development of ToM that are relevant for young children (Hiller et al., 2014) were measured with the ToM test-Revised: pretense (item 1), emotion understanding (item 1, 3), first-order belief (i.e., the ability to understand that others will act according to their belief; item 3, 4, 5), and false belief (i.e., the ability to understand that others can have beliefs diverging from one’s own or reality; item 4, 5). The four items are described in more detail in Supporting Information. These four ToM abilities have been shown to develop gradually from the age of two and can be reliably and validly measured in young children (e.g., Ensor & Hughes, 2010; Hiller et al., 2014). Subsequent items of the test battery were excluded in the present study because of the children’s young age (Colonnesi et al., 2017). Items were scored either correct (1) or incorrect (0) with higher scores indicating more developed ToM. Internal consistency of the complete ToM test-R in a previous study was excellent, $\alpha = .92$ (Muris et al., 1999), and internal consistency in the present study was good, $\alpha = .89$.

We used an adapted version (Pears & Fisher, 2005) of the emotion understanding task (Denham, 1986) to measure emotion recognition in young children. This task used four pictures of a boy or girl, matched on participant gender, showing happy, sad, scared, and angry emotions. The task was divided into two subscales: expressive emotion recognition, by asking the child: “How does the boy/girl in this picture feel?”, and receptive emotion recognition, by asking the child: “Can you point to the picture where the boy/girl looks happy/sad/scared/angry?” (Pears & Fisher, 2005). Earlier studies showed the emotion understanding task had good internal consistency, $\alpha = .84$ (Pears & Fisher, 2005), and is valid for use in toddlers (Ensor & Hughes, 2010). Internal consistency in the present study was acceptable for the receptive emotion understanding task, $\alpha = .74$, but unacceptable, $\alpha = .31$, for the expressive emotion recognition task. Therefore, we only used the results of the receptive emotion recognition task. The score on the receptive emotion recognition task and the items of the ToM test-Revised were averaged into a composite score for our final ToM measure.

Measurement and coding of self-conscious emotions

We used the Broken Toy mishap (Barrett et al., 1993; Cole et al., 1992), adapted from Drummond et al. (2017), to observe children’s expressions of self-conscious emotions. During the lab visit, the parent received an instruction letter that informed them about the task, and the task was only performed with their active permission. Parents were instructed to remain as neutral as possible during this task and asked to sit on the other side of the room and fill in questionnaires on the laptop. The experimenter presented a teddy bear (“Teddy”) to the child, emphasizing the emotional value of Teddy by mentioning it was the experimenter’s favorite childhood toy. Teddy was then attached to the wall with a Velcro patch and the children were told that they could play with Teddy while the experimenter was gone “to pick up some papers”. Teddy was rigged so that the arm or leg fell off when the child pulled it to start playing with it (Figure 1). Around 2 min after the child broke Teddy, the experimenter returned to the room and then expressed...
and positive facial expressions, $\kappa = .61$ for gaze aversion during neutral, negative, and positive facial expressions, $\kappa = .83$ for body aversion during neutral, negative, and positive facial expressions, $\kappa = .95$ for not talking about Teddy, $\kappa = .83$ for talking about Teddy, $\kappa = .95$ for repairing Teddy.

A principal component analysis using Oblimin rotation, which allows for factors to correlate, was performed to find which coding behaviors loaded onto the same factor, underlying a specific self-conscious emotion. Based on the scree plot, four latent factors were used, as they had eigenvalues larger than 1 (Kaiser criterion; Kaiser, 1960; see Supporting Information). Together, the factors explained 71% of the variance. The factor loadings indicated that the children's responses to the Broken Toy mishap were organized in four patterns that are consistent with theory, and similar to previous studies (Barrett, 2005; Drummond et al., 2017): guilt, embarrassment, and two types of shame-like avoidance: (1) Guilt consists of repairing behavior, and verbal expressions of comforting the experimenter and expressing concern. (2) Embarrassment consists of gaze and head aversion while smiling. (3) Nonverbal shame-like avoidance consists of gaze, head, and body aversion. (4) Verbal shame-like avoidance consists of a high latency to speak to the parent and to the experimenter, and fewer verbal expressions that indicate taking responsibility or adopting the experimenter's perspective. The different behaviors belonging to the same latent factor were standardized and averaged to make the composite self-conscious emotion variable.

We coded children's expressions of self-conscious emotions using coding systems of Barrett (2005) and Drummond et al. (2017), which we broadened to also include verbal expressions indicative of self-conscious emotions (Vaish et al., 2016). Descriptions and examples of coded behaviors and the derived self-conscious emotions are displayed in Table 1. Coded behaviors were not mutually exclusive, so different behaviors could happen at the same time. Two trained master students coded the behaviors of all participants and their inter-rater reliability was established on 12 observations (12 double-coded pairs of observations). In addition, two master students were trained to code for reliability purposes and coded 10 observations; inter-rater reliability was established between two of them and between each of them and the original coders resulting in 26 double-coded pairs. In total, we, thus, calculated inter-rater reliability, which was acceptable to excellent, on 38 double-coded pairs of observations. Cohen's kappa corrected for kappa max was $\kappa = .61$ for gaze aversion during neutral, negative, and positive facial expressions, $\kappa = .74$ for head aversion during neutral, negative, and positive facial expressions, $\kappa = .83$ for body aversion during neutral, negative, and positive facial expressions, $\kappa = .95$ for not talking about Teddy, $\kappa = .83$ for talking about Teddy, $\kappa = .95$ for repairing Teddy.

Our composite self-conscious emotions measures were highly similar to those from previous studies using the same task with young children (Barrett et al., 1993; Drummond et al., 2017; Kochanska et al., 1995). Previous studies using these measures showed that guilt and shame after transgression did not relate to related broader constructs such as fearfulness, sadness, impulsivity, and effortful control (Barrett et al., 1993; Drummond et al., 2017). We also investigated the association of observed self-conscious emotions with children's internalizing behaviors (as reported by parents,
using the Internalizing scale, SCBE-30, LaFreniere & Dumas, 1996) in our sample and found that observed self-conscious emotions were not significantly related to internalizing behaviors. The observed self-conscious emotions were not related to general, parent-reported social withdrawal, \( r_{\text{guilt}} = -0.22, p = 0.082; r_{\text{embarrassment}} = 0.02, p = 0.850; r_{\text{verbal shame-like avoidance}} = 0.06, p = 0.662; r_{\text{nonverbal shame-like avoidance}} = 0.10, p = 0.446. This suggests that observed self-conscious emotions after transgression are not a reflection of broader constructs such as temperamental fearfulness or social anxiety.

Relatedly, previous studies using these measures of self-conscious emotions showed that children who were more likely to show either more guilt or shame after transgression did not differ in these behaviors before the task (Barrett et al., 1993; Drummond et al., 2017). This suggests that observed self-conscious emotions after transgression are specific to situations, which involve transgression rather than a more general behavioral disposition. In our sample, observed guilt and shame were not related to children’s general guilt and shame proneness. Observed guilt was not significantly related to guilt proneness as reported by parents, \( r = 0.24, p = 0.067, \) however, the effect was of a medium size indicating that, although observed guilt seems to be specific of the social situation, it may also somewhat be a reflection of more general disposition. Observed verbal shame and observed nonverbal shame were also not significantly related to shame proneness as reported by parents and the effects were small, \( r_{\text{verbal shame}} = -0.09, p = 0.482; r_{\text{nonverbal shame}} = 0.13, p = 0.311, \) indicating that observed expressions of shame after transgression were not due to more general dispositional shame proneness.

### Data analysis

Data were checked for outliers (±3 SD) and the distributions of the residuals were checked on normality. Outliers were Winsorized by changing the value to the closest value within the ±3 SD range (Wilcox, 2005). Six outliers above the range of 3 SD were Winsorized (Wilcox, 2005), two for latency to start talking about Teddy, one for embarrassment, and two for guilt. Despite adjusting the outliers, the residuals of these variables were not normally distributed. To improve the distributions of the residuals and reduce the skewness, guilt was square root transformed, skewness \( \text{guilt} = 0.60 (SE = 0.30), \) and latency to start talking about Teddy was \( e \) logarithm transformed, skewness \( \text{latency} = 0.58 (SE = 0.30). \) As embarrassment was still skewed after transformations, the winsorized but nontransformed variable was used in the analyses, skewness \( \text{embarrassment} = 2.10 (SE = 0.30). \)

There was a total of 22.76% missing values, and Little’s missing completely at random test failed to reject the null hypothesis that the data were missing completely at random, \( \chi^2(104) = 124.29, p = 0.085. \) Four children had missing values on the SRS due to the parent not filling out the questionnaire, 32 children had missing values on the broken toy mishap task (due to the parent not agreeing to perform this task \( n = 4 \), the child did not play with and break Teddy \( n = 14 \), not performing the task at all during the lab visit due to parent/child wanting to...
finish the visit (n = 7). Teddy breaking before the experimenter left the room (n = 2), Teddy not breaking while playing (n = 3), or the child repairing Teddy before the experimenter returned to the room (n = 2), 11 children had missing values for the ToM task due to unwillingness of the child to perform this task, and 7 children had missing values for child age due to not or incorrectly filling out date of birth.

To test our hypotheses, we conducted path analyses using lavaan in R (Rosseel, 2012). In one model, we tested (1) whether autistic traits predicted expressions of self-conscious emotions; (2) whether ToM mediated the association between autistic traits and self-conscious emotions; (3) whether these effects existed after accounting for child age. To test the direct effects, we modeled paths from autistic traits to all four indicators of self-conscious emotions. To test indirect effects, we modeled a path from autistic traits to ToM and from ToM to all four indices of self-conscious emotions. To control for child age, we modeled paths from the covariate to all the study variables in the model.

We used an alpha level of α = .05 for all significance tests. We used bootstrapping on 1000 samples to obtain the bias-corrected bootstrapped 95% confidence intervals. We used full information maximum likelihood (FIML) estimation to handle missing values, and repeated the analyses with multiple imputation (Supporting Information). Standardized regression coefficients were interpreted for effect sizes with coefficients of ≥0.1 indicating small effects, ≥ 0.3 moderate effects, and ≥0.5 large effects (Cohen, 1992). Power calculations for structural equation models (Jak et al., 2021; α = .05, power = 80%) showed that in order to detect moderate direct effects (i.e., standardized slopes = 0.3) from our predictor to mediator, mediator to outcome, or predictor to outcome, n = 80, n = 73, or n = 70 participants would be needed if data were complete. With the obtained sample size of n = 98, we would have had power of .88, .90, and .92 to detect these moderate effects. However, missing values can attenuate power. To obtain the most conservative estimate of power using only n = 58 complete cases (i.e., listwise deletion, which is inferior to using FIML; Little et al., 2014), Our lowest possible power would be 0.67, 0.71, and 0.73 to detect moderate direct effects from predictor to mediator, mediator to outcome, and predictor to outcome, respectively. However, by using FIML estimation, we preserve power by using all available data from n = 98 participants, our true power is somewhere in the estimated range (e.g., between 0.67 and 0.88 for the predictor-to-mediator path), with exact power depending on the unknown missing data mechanism.

In the case of moderate direct effects (i.e., standardized slopes = 0.3), the indirect effects would be small (0.3 × 0.3 = 0.09). Monte Carlo power analysis for these small indirect effects (Schoemann et al., 2017) showed that we would need n = 109 participants to have 80% power using α = .05. With the obtained sample size of n = 98, we would have power of .74 to detect indirect effects.

In order to evaluate the relative support for our theory-based hypotheses and null hypotheses, we used generalized order-restricted information criterion approximation (GORICA) for structural equation models (Kuiper, 2021). Using GORICA, we evaluated to what extent our data supported an effect in our hypothesized direction, a null-effect, or in the opposite direction. Because failing to reject a null hypothesis is inconclusive (i.e., it does not provide evidence in favor of the null or the alternative hypotheses), we used GORICA to evaluate which hypotheses our data were most consistent with. Although GORICA is not a test statistic, it is an information criterion that can provide evidence in support of any number of competing hypotheses (e.g., support not only for the null hypothesis of no effect, but for an effect in our hypothesized direction or for an effect in the opposite direction).

RESULTS

Preliminary results

The average level of autistic traits in our sample (M = 37.91) was comparable to average scores of autistic traits in community samples of preschool aged children in Japan and U.S. M = 35.90 and M = 40.70, respectively (Constantino & Gruber, 2012; Stickley et al., 2017). There were no significant sex differences in autistic traits, ToM, or self-conscious emotions, ps > .10. We, therefore, excluded children’s sex from the analyses. Table 2 presents descriptive statistics and correlations. As there were significant associations between children’s age and ToM and guilt, we added children’s age to the model as covariate.

Relation between autistic traits and self-conscious emotions through ToM

We examined a saturated model (Figure 2) with autistic traits as predictor, ToM as mediator, and guilt, embarrassment, verbal shame-like avoidance, and nonverbal shame-like avoidance as the outcomes along with child age as covariate. Table 3 presents the unstandardized and standardized parameter estimates. Figure 2 presents standardized direct effects. Table 4 presents the GORICA results.

ToM

Autistic traits were significantly and negatively related to ToM, β = −.18, p = .017, indicating that children with more autistic traits had lower levels of ToM.
Guilt

Autistic traits were not significantly related to guilt directly, $\beta = -0.02$, $p = .867$. The indirect effect of autistic traits on guilt via ToM, $\beta = -0.05$, $p = .208$, and the total effect, $\beta = -0.07$, $p = .583$, were not significant, indicating that there was no support for the idea that children with more autistic traits display less guilt.

Based on the GORICA weights for the direct and total effect, our data most supported the idea that autistic traits are not related to guilt: this null-effect was 1.62 times as supported as our hypothesis that autistic traits related to less guilt, and 1.67 times as supported as the opposite idea that autistic traits relate to more guilt. There was equal support for either a negative, null, or positive indirect effect of autistic traits on guilt via ToM. Therefore, our analyses indicated that there is no compelling support for either our hypothesis that autistic traits are related to less guilt or for the idea that autistic traits are not related to guilt.

Embarassment

Autistic traits were not significantly related to embarrassment directly, $\beta = -0.15$, $p = .229$, via an indirect effect of autistic traits on embarrassment through ToM, $\beta = -0.05$, $p = .251$, or via the total effect, $\beta = -0.20$, $p = .168$, indicating that there is no support for the idea that children with more autistic traits display less embarrassment.

Based on the GORICA weights for the direct and total effect, there was most relative support in our data for our hypothesis that autistic traits relate to less embarrassment: the negative effect was 1.44 times as supported as the idea that autistic traits are not related to embarrassment, and 2.38 times as supported as the opposite idea that autistic traits relate to more embarrassment. There was equal support for either a negative, null, or positive indirect effect of autistic traits on embarrassment via ToM. Therefore, our analyses indicated that there is no compelling support for either our hypothesis that autistic traits are related to less embarrassment or for the idea that autistic traits are not related to embarrassment.

Verbal shame-like avoidance

Autistic traits were not significantly related to verbal shame-like avoidance directly, $\beta = .20$, $p = .061$, and there was no significant indirect effect of autistic traits on
When direct and indirect effects were combined in the total effect of autistic traits on verbal shame-like avoidance, there was a significant positive effect, $\beta = .26, p = .004$, indicating that children with more autistic traits displayed more verbal shame-like avoidance, but not due to lower ToM solely.

Based on the GORICA weights for the direct and total effect, our data most supported our hypothesis that autistic traits are related to more verbal shame-like avoidance: this positive effect was 3.44 times as supported as the idea that autistic traits did not relate to verbal shame-like avoidance, and 5.68 times as supported as the opposite idea that autistic traits relate to less verbal shame-like avoidance. There was equal support for either a negative, null, or positive indirect effect of autistic traits on verbal shame-like avoidance via ToM. These results confirmed our path model finding that autistic traits are related to more verbal shame-like avoidance, but if this process includes intermediary variables, there is no support for the hypothesis that ToM is one of those mediators.

### Nonverbal shame-like avoidance

Autistic traits were not significantly related to nonverbal shame-like avoidance directly, $\beta = .20, p = .145$, and there was no significant indirect effect of autistic traits

### TABLE 3 Path analyses with autistic traits as predictor, theory of mind (ToM) as mediator, self-conscious emotions as outcome, and child age as covariate.

<table>
<thead>
<tr>
<th></th>
<th>Autistic traits</th>
<th></th>
<th>ToM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (SE)</td>
<td>Std.</td>
<td>[bootstrapped 95% CI]</td>
</tr>
<tr>
<td>ToM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$-3.59 (1.50)^*$</td>
<td>$-0.17$</td>
<td>$[-6.39, -0.55]$</td>
</tr>
<tr>
<td>Guilt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$-0.03 (0.18)$</td>
<td>$-0.02$</td>
<td>$[-0.38, 0.28]$</td>
</tr>
<tr>
<td>Indirect</td>
<td>$-0.06 (0.05)$</td>
<td>$-0.05$</td>
<td>$[-0.19, 0.01]$</td>
</tr>
<tr>
<td>Total</td>
<td>$-0.09 (0.17)$</td>
<td>$-0.07$</td>
<td>$[-0.43, 0.23]$</td>
</tr>
<tr>
<td>Embarrassment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$-0.01 (0.01)$</td>
<td>$-0.15$</td>
<td>$[-0.02, 0.01]$</td>
</tr>
<tr>
<td>Indirect</td>
<td>$-0.003 (0.003)$</td>
<td>$-0.05$</td>
<td>$[-0.01, 0.001]$</td>
</tr>
<tr>
<td>Total</td>
<td>$-0.01 (0.01)$</td>
<td>$-0.20$</td>
<td>$[-0.03, 0.01]$</td>
</tr>
<tr>
<td>Verbal shame-like avoidance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$0.75 (0.42)$</td>
<td>$0.20$</td>
<td>$[-0.10, 1.56]$</td>
</tr>
<tr>
<td>Indirect</td>
<td>$0.23 (0.20)$</td>
<td>$0.06$</td>
<td>$[-0.13, 0.69]$</td>
</tr>
<tr>
<td>Total</td>
<td>$0.98 (0.34)^{**}$</td>
<td>$0.26$</td>
<td>$[0.29, 1.59]$</td>
</tr>
<tr>
<td>Nonverbal shame-like avoidance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$0.84 (0.60)$</td>
<td>$0.20$</td>
<td>$[-0.47, 1.91]$</td>
</tr>
<tr>
<td>Indirect</td>
<td>$-0.19 (0.19)$</td>
<td>$-0.05$</td>
<td>$[-0.64, 0.11]$</td>
</tr>
<tr>
<td>Total</td>
<td>$0.65 (0.55)$</td>
<td>$0.16$</td>
<td>$[-0.51, 1.59]$</td>
</tr>
<tr>
<td>Child age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ToM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$0.27 (0.03)^{**}$</td>
<td>$0.75$</td>
<td>$[0.22, 0.32]$</td>
</tr>
<tr>
<td>Guilt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$0.01 (0.004)$</td>
<td>$0.27$</td>
<td>$[-0.002, 0.02]$</td>
</tr>
<tr>
<td>Embarrassment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$-0.000 (0.000)$</td>
<td>$-0.11$</td>
<td>$[-0.000, 0.000]$</td>
</tr>
<tr>
<td>Verbal shame-like avoidance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$0.03 (0.02)$</td>
<td>$0.38$</td>
<td>$[-0.01, 0.06]$</td>
</tr>
<tr>
<td>Nonverbal shame-like avoidance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>$-0.02 (0.01)$</td>
<td>$-0.30$</td>
<td>$[-0.05, 0.01]$</td>
</tr>
</tbody>
</table>

Abbreviation: Std., standardized effects.

* $p < .050$; ** $p < .010$. 

verbal shame-like avoidance via ToM, $\beta = .06, p = .234$. When direct and indirect effects were combined in the total effect of autistic traits on verbal shame-like avoidance, there was a significant positive effect, $\beta = .26, p = .004$, indicating that children with more autistic traits displayed more verbal shame-like avoidance, but not due to lower ToM solely.
on nonverbal shame-like avoidance via ToM, $\beta = -0.35$, or total effect, $\beta = 0.16$, $p = 0.220$, indicating that children with more autistic traits did not display more nonverbal shame-like avoidance.

Based on the GORICA weights for the direct and total effect, there was most relative support in our data for our hypothesis that autistic traits relate to more nonverbal shame-like avoidance: the positive direct effect was 1.78 times as supported as the idea that autistic traits are not related to nonverbal shame-like avoidance, and 2.94 times as supported as the opposite idea that autistic traits relate to less nonverbal shame-like avoidance. The positive total effect was 1.77 times as supported as the null-effect, and 2.93 times as supported as a negative total effect. There was equal support for either a negative, null, or positive indirect effect of autistic traits on nonverbal shame-like avoidance via ToM. These results indicated that there is some support for the hypothesized positive effect of autistic traits on nonverbal shame-like avoidance, although not confirmed by our path model findings.

### DISCUSSION

Using insights from functionalist theories of emotions and developmental theories of autism, we theorized that children with more autistic traits often experience less attuned self-conscious emotions due to deficits in understanding other people's minds (i.e., Theory of Mind). In addition, we theorized that these less attuned self-conscious emotions may already be present in early childhood, when children start acquiring ToM. The present study was the first to investigate these hypotheses. Overall, we found evidence that children with more autistic traits show more verbal shame-like avoidance. There was also some evidence for more nonverbal shame-like avoidance; however, the evidence lacks statistical significance. Our findings did not support the idea that children with more autistic traits show less guilt and embarrassment after transgression. Although children with more autistic traits showed lower ToM levels, disturbances in self-conscious emotions were not due to lower ToM in children with more autistic traits. More broadly, these findings highlight that children with more autistic traits may express disturbances in

#### Exploratory analyses

In post hoc exploratory analyses, we reran our analyses with ToM divided into two separate parameters: emotion understanding, and (first-order and false) beliefs (see Supplemental Material). This way, we could unfold the effect of autistic traits on verbal shame-like avoidance. Results for guilt, embarrassment, and nonverbal shame-like avoidance remained the same (i.e., associations did not change in their significance, for both ToM parameters). In this model, autistic traits were significantly and negatively related to less ToM belief skills, but not to ToM emotion understanding skills. Regarding verbal shame-like avoidance, autistic traits were significantly and positively related to verbal shame-like avoidance, and ToM emotion understanding skills were significantly and negatively related to verbal shame-like avoidance, but ToM belief skills were not. Significance of indirect and total effects did not change compared to our main model: indirect effects were insignificant for both ToM parameters, and the total effects for both ToM parameters were significant and positive. These results indicate that children with more autistic traits displayed more verbal shame-like avoidance, but not due to lower ToM. Children with more autistic traits had lower levels of first-order and false-belief understanding, but less first-order and false-belief understanding was not, however, associated with more verbal shame-like avoidance. Verbal shame-like avoidance was significantly related to another ToM ability, that is, emotion understanding, in the way that children who had lower levels of emotion understanding showed more verbal shame-like avoidance.

We also reran our main analyses to test whether the effects were dependent on children's age. We included an interaction between age and autistic traits as an additional variable and tested whether its effect on ToM and self-conscious emotions was significant (see Supplemental Material). These effects were not significant, suggesting that age did not moderate any of the associations found in the main model. This indicated that the effects of autistic traits on ToM and self-conscious emotions remained relatively stable between ages 2 and 5 years.

#### TABLE 4

<table>
<thead>
<tr>
<th>AUTISTIC TRAITS AND EMOTIONS IN CHILDREN</th>
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<tbody>
<tr>
<td><strong>GORICA weights</strong></td>
</tr>
<tr>
<td><strong>DV</strong></td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Guilt</td>
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<td></td>
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<td></td>
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<tr>
<td>Embarrassment</td>
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<tr>
<td>Verbal shame-like avoidance</td>
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<td></td>
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<tr>
<td>Nonverbal shame-like avoidance</td>
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</tbody>
</table>

*Note: When one hypothesis had greater support than its competitors, the highest GORICA weight is highlighted in bold font. Abbreviation: DV, dependent variable.*
some but not all self-conscious emotions and may experience deficits in ToM already in early childhood, but these deficits do not necessarily translate into less attuned self-conscious emotions at this age.

**Theoretical implications**

Our findings only partly support our hypothesis of less attuned expressions of self-conscious emotions in children with more autistic traits. We did not find evidence that children with more autistic traits showed less guilt or embarrassment. This stands in contrast to previous studies showing significantly fewer expressions of guilt (Davidson et al., 2018; Muris et al., 2016) and embarrassment in children with ASD (Hobson et al., 2006; Reddy et al., 2010). A possible explanation is that the majority of previous studies was done with older children and/or clinical samples. It may be that disturbances in guilt and embarrassment are, thus, not early precursors of autism but rather a symptom that occurs later in child development and in more severe ASD symptoms. Children with more autistic traits show more shame-like avoidance. This is consistent with earlier work (Davis et al., 2011; Muris et al., 2016). As shame-like avoidance inhibits a prosocial response after making a social transgression (Barrett, 2005), elevated levels of shame-like avoidance may cause problems in the repairing and maintenance of social relationships.

Our findings do not support our hypothesis that ToM functions as mechanism in the relation between autistic traits and less attuned self-conscious emotions. Children with more autistic traits showed lower levels of ToM, yet this did not, in turn, relate to less guilt, less embarrassment, or more shame-like avoidance. Our post hoc findings indicated that children with lower levels of emotion understanding show more verbal shame-like avoidance, but children with more autistic traits do not show deficits in this ToM ability. However, children with more autistic traits showed deficits in belief understanding, but this ToM ability was unrelated to shame-like avoidance. These findings are in line with the idea that difficulties with understanding others’ emotions causes uncertainty in complex social situations and, therefore, more shame-like avoidance. More advanced ToM skills such as first order and false belief seem, however, unrelated to shame-like avoidance. These findings also shed light on the likely reasons of why ToM is not a mechanism through which autistic traits are related to disturbances in self-conscious emotions. Children with higher autistic traits seem not to show any deficits in the ToM ability that may matter for the experience of self-conscious emotions—emotion understanding, but only in belief understanding, which, importantly, does not seem to play an important role in the experience of self-conscious emotion, as we hypothesized.

Additionally, our findings suggest that there is another mechanism than ToM at play in the relation between autistic traits and self-conscious emotions. It is suggested that there are more pathways to social impairments in autism than ToM, encompassing more broad impairments in social affective information processing (Tager-Flusberg, 2007). Regarding the elevated expressions of verbal shame-like avoidance in our study, it may be that children with more autistic traits have elevated levels of social anxiety, including elevated fear of negative evaluations, which, in turn, could explain more shame-like behaviors such as avoidance (Davidson et al., 2017). Overall, our findings imply that children with more autistic traits have more sociocognitive deficits and display less attuned verbal shame-like avoidance, but the latter is not necessarily rooted in the former. Despite experiencing more sociocognitive deficits, children with more autistic traits do not display less attuned self-conscious emotions other than shame-like avoidance. However, our findings show that impaired ToM skills are already present in early childhood in children with more autistic traits, even in a nonclinical sample. ToM deficits may not necessarily relate to problems in social behavior, such as unattuned self-conscious emotional expressions, but more so to communication deficits (Rosello et al., 2020). In our study, communication deficits could manifest as elevated verbal shame-like avoidance, which may be a precursor for later social impairments in ASD (Drash & Tudor, 2004).

**Implications for intervention**

Our findings have potential implications for early intervention for children with more autistic traits. Our results imply that impaired ToM skills, although related to more autistic traits, may not predict less attuned self-conscious emotions, at least not yet in early childhood. Previous intervention studies found that interventions for autism (focusing on ToM), improve ToM skills and autistic traits, but fail to result in wider improvements in social behavior, such as adhering to social rules, and social relationships (Fletcher-Watson et al., 2014). As ToM skills do not necessarily relate to disturbances in self-conscious emotions, interventions for regulating self-conscious emotions in ASD may have to focus on these emotions directly, possibly through directly targeting disturbed self-conscious emotions. For example, in the case of excessive shame experiences, enhancing (self-) compassion with mindfulness interventions may be a useful option (Cheang et al., 2019).

**Strengths, limitations, and future directions**

Our study bridges affective science, clinical science, and developmental science by showing that functional theories of emotion can help understand the early
manifestations of autistic traits. Our study extends existing work by examining, for the first time, self-conscious emotions in young children in relation to autistic traits using an ecologically valid and emotionally impactful task. Our study has several methodological strengths. First, our study is the first to use objective observations of self-conscious emotions after misbehavior while studying its relation to autistic traits. Second, our study focused on children aged 2–5 years, thereby showing that disturbances in shame-like avoidance already exist in early childhood, but expressions of guilt, embarrassment, and nonverbal shame-like avoidance seem unaffected at this age. Third, our study conceptualized ToM broadly, including pretense, emotion recognition, emotion understanding, first-order belief, and false belief, allowing us to consider different sociocognitive abilities that were thought to explain the association between autistic traits and self-conscious emotions.

Our study also has limitations. First, our study used a community sample and parent-reported levels of autistic traits. Children in our sample had an average level of autistic traits comparable to children from community samples in other studies (Constantino & Gruber, 2012; Stickley et al., 2017). A study assessing the prevalence of parent-reported ASD (clinical levels of autistic traits) in children reported a percentage of 1.7 (Russell et al., 2014). In the current sample, 9.6% (n = 9) of the children had clinical levels of autistic traits, which means the prevalence of clinical levels of autistic traits in this study was higher than in the general population. Future studies using a clinical sample could build on the results of the current study by assessing whether unattuned self-conscious emotions are present in children with ASD. Second, the amount of missing values may have attenuated our power to detect our hypothesized effects. However, preserved power by using FIML and checked robustness of our findings using multiple imputation. In addition, we used GORICA to evaluate the relative support for not only our theory-based hypotheses, but also null hypotheses. It is additionally noteworthy that missing data occurred mostly because children did not start playing with Teddy. Future studies using the broken toy mishap could adjust their study design to minimize missing values due to this reason. Third, we only tested ToM with an explicit ToM task, while it could be that self-conscious emotions are more strongly related to ToM measured with an implicit task considering that our sample consisted of very young children. Future studies could build on our findings by looking into the associations between autistic traits, ToM, and self-conscious emotions using implicit ToM tasks such as interactive helping tasks (Buttelmann et al., 2009; Knudsen & Liszkowski, 2012). Fourth, our study was cross-sectional, which does not allow drawing any causal conclusions (e.g., our mediation analyses do not prove temporal ordering or causality). Finally, children and parents in the current sample mostly had a Dutch ethnicity and parents were relatively highly educated, which makes the results hard to generalize to other populations.

Future studies may build on our findings by inspecting the development of self-conscious emotions in children with more autistic traits from early to late childhood. In addition, longitudinal studies can test possible bidirectional effects between autistic traits and self-conscious emotions over time. Moreover, mechanisms explaining the relationship between autistic traits and self-conscious emotions other than ToM can be investigated. For example, communication deficits (Rosello et al., 2020), lower levels of affective empathy (Baron-Cohen, 1988; Hillier & Allinson, 2002) or elevated levels of social anxiety (Davidson et al., 2017) may play a role in less attuned self-conscious emotions in children with more autistic traits.

**CONCLUSION**

Our work shows that children with more autistic traits have more deficits in ToM and show more shame-like avoidance after a transgression in early childhood. This implies that children with high levels of autistic traits may have difficulties in how they relate to other people early in development, especially when there is a threat to social status and existing relationships due to a transgression. As shame is known to hinder the repairment of social relationships after wrongdoing, it may cause young children with more autistic traits to feel not socially connected. Therefore, new intervention strategies to regulate shame through enhancing (self-) compassion, such as mindfulness interventions (Cheang et al., 2019), which have been found to be effective in preschool children (Flook et al., 2015) and in older children with ASD (e.g., Hartley et al., 2019; Ridderinkhof et al., 2017), may be considered when targeting children with more autistic traits.

**AUTHOR CONTRIBUTIONS**

Shanna van Trigt carried out recruitment and data collection, supervised master students to collect data, and formulated the research question and hypotheses. Milica Nikolić designed the study protocol in collaboration with Cristina Colonnesi and Eddie Brummelman. Shanna van Trigt performed the data analysis and interpretation under the supervision of Terrence D. Jorgensen and Milica Nikolić. Shanna van Trigt drafted the paper under the supervision of Milica Nikolić and Cristina Colonnesi, Eddie Brummelman and Terrence D. Jorgensen provided critical revisions. All authors approved the final version of the manuscript for submission.

**ACKNOWLEDGMENTS**

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presented here are publicly accessible. Data and code are available at the following URL: https://osf.io/fkvts/?view_only=481570afe24b448397eb023dbc2494d5. The materials necessary to attempt to replicate the findings presented here are not publicly accessible and the analyses presented not preregistered.

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**CONFLICT OF INTEREST STATEMENT**

No conflict of interest to report.

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AUTISTIC TRAITS AND EMOTIONS IN CHILDREN


