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Expressions of positive and negative shyness in preschool-age children: Temperamental correlates and visual attention to emotions

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ABSTRACT

Recent empirical evidence shows heterogeneity in the expression of shyness in children. Some children tend to express their shyness displaying positive affect along with gaze aversions (positive shyness), whereas others display more negative emotional reactions accompanied by gaze aversions (negative shyness). Temperamental differences in approach–avoidance tendencies are likely to explain these differences in shyness expression in children and influence their visual attention to social stimuli, yet little empirical attention has been devoted to these associations. Our study examined the temperamental profile (approach, fear, and inhibitory control) associated with positive and negative shyness and the relation between expression of shyness and attention to social stimuli in 47 children aged 3–6 years. Children's positive and negative expressions of shyness were assessed using a performance task. Visual attention to facial emotional expressions was measured with the dot - probe task, and temperament was measured with maternal reports. Positive shyness was found to be positively associated with temperamental dimensions of approach, inhibitory control, and fear. Positive shyness was significantly associated with attentional orientation to positive facial expressions and with less attentional avoidance of threatening facial expressions. Negative shyness was positively associated only with temperamental fear, and no associations were found with attention to social stimuli. Our study provides empirical support for the association between temperament and the multidimensional

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character of the expression of positive shyness and adds relevant evidence regarding the connection between the expression of shyness and attention to social stimuli.

Introduction

During the preschool years, the enhanced social understanding and the emergence of the multidimensional representation of self-concept increase children's sensitivity to social evaluation and manifestation of shy behaviors (Sette, Baldwin, Zava, Baumgartner, & Coplan, 2019). Shyness can be conceptualized as either a trait or state. Trait shyness refers to the recurrent and persistent experience of fear and wariness in response to social novelty across situations (Buss, 1986), whereas state shyness refers to the emotional and cognitive experience of shyness in response to a specific social situation (Colonnesi, Nikolić, de Vente, & Bögels, 2017). For example, children's facial expression of shyness within a social context can be conceptualized as one possible manifestation of state shyness (see Colonnesi et al., 2017). Asendorpf's model of shyness (Asendorpf & Meier, 1993) posits heterogeneity among children regarding behavioral and facial expressions of state shyness. In particular, some shy children show signs of ambivalent avoidance (combinations of affiliative behaviors such as gaze and smiling with gaze and/or head aversion), whereas others show only avoidance (avoidant behaviors in the absence of evident affiliation). In support of this model, recent empirical evidence shows heterogeneity in the expression of shyness in children (Colonnesi, Napoleone, & Bögels, 2014; Colonnesi et al., 2017; Colonnesi, Nikolić, & Bögels, 2020; Poole & Schmidt, 2019). We still do not know, however, to what extent the heterogeneity in the expression is a manifestation of specific temperamental traits and is related to visual attention to social stimuli.

Already during infancy children show coy smiles in response to positive social attention (Reddy, 2000). During toddlerhood, children tend to express their shyness displaying positive affect along with gaze and/or head aversion (positive shyness), whereas others more often display negative emotional reactions accompanied by gaze and/or head aversion (negative shyness). The expression of positive shyness is found to be associated with higher levels of sociability (Colonnesi et al., 2014; Poole & Schmidt, 2018), social understanding (Colonnesi et al., 2017), and lower levels of social anxiety (Colonnesi et al., 2014, 2017; Poole & Schmidt, 2018). Children's expression of positive affect might have the function to regulate their arousal and maintain their attention to the social agent, contributing to more adaptive social interactions (Colonnesi et al., 2014, 2017). Thus, positive affect may promote better regulation in response to social stress and broadened thinking and behavior (Fredrickson, 2001). On the other hand, negative shyness was found to be related to more maladaptive outcomes such as social anxiety symptoms and lower social understanding (Colonnesi et al., 2017; Nikolić, Colonnesi, Vente, & Bögels, 2016). Positive and negative shyness expressions are found to be moderately negatively related to each other (Colonnesi et al., 2014, 2017, 2020), meaning that every child prefers either positive or negative shyness expressions and as such these preferences might be driven by temperamental differences.

Individual differences in shyness expression may reflect individual differences in approach–avoidance tendencies and may influence visual attention to motivationally salient social stimuli. Hence, negative shy children might tend to regulate arousal during social exposure by having a dominant avoidance tendency, showing both negative affect and gaze aversion. This behavior has the effect to break the social interaction and direct the visual attention of children away from the salient social stimuli. Therefore, when confronted with a novel social situation, these children will resolve the approach–avoidance conflict by showing a more inhibited approach. Children with these behavioral characteristics have also been defined as shy–unsociable (Asendorpf & Meier, 1993). In contrast, positive shy children may have, despite their fearfulness, a higher approach tendency to engage in social contexts (Colonnesi et al., 2020). By showing this behavior, children communicate with a smile their

desire to maintain the social interaction and to re-engage their visual attention toward the salient social stimuli. To our knowledge, no published study has concurrently examined the temperamental profile associated with expressions of positive and negative shyness and the relation between expression of shyness and visual attention to social stimuli. Our study provides initial empirical evidence of the temperamental correlates of positive and negative shyness, and is a direct test of the way in which the expression of shyness relates to visual attention to facial emotional expressions.

Temperament and expression of shyness

Temperament refers to individual constitutional differences in emotional reactivity and self-regulation (Rothbart & Bates, 2006). Facial expression of shyness may be rooted in both temperamental emotional reactivity and self-regulation. Two specific reactive temperamental traits might underline the expression of shyness in young children. The first reactive trait is fearfulness—a subcomponent of negative emotionality temperament factor within Rothbart's framework (Rothbart & Bates, 2006). Fearfulness refers to the degree to which a child may experience intense negative emotional reactions to novel stimuli more broadly. The second reactive temperamental trait possibly involved in the expression of shyness is approach—a subcomponent of extraversion or surgency factor. Approach reflects the tendency to manifest enthusiasm or excitement in anticipation of gratifying activities, including social contexts (Rothbart & Bates, 2006).

Temperamental differences in approach and fearfulness might underline the observed heterogeneity in the expression of shyness. It has been proposed, for instance, that positive shy children have a higher approach tendency to engage in both social and nonsocial contexts in addition to their fearfulness (Schmidt & Poole, 2019). Although previous studies did not concurrently examine both approach–avoidance and regulatory temperamental tendencies in relation to positive and negative shyness, they documented that positive shy children scored higher on parent-reported temperamental sociability, in contrast to negative shy children who had higher fearfulness and less sociability (Colonnesi et al., 2014, 2017).

Regarding temperamental differences in self-regulation, the broad temperamental factor associated with self-regulation is effortful control. Effortful control encompasses active and voluntary recruitment of higher-order cognitive processes that can modulate reactivity (i.e., fearfulness, approach). Such regulatory behaviors in preschoolers include inhibitory control of behavior as well as control of attention. Temperamental differences in effortful control were not previously investigated in relation to facial expressions of positive and negative shyness. Although children who express positive shyness may have higher levels of effortful control, previous research on shyness and effortful control employed only measures that tap into trait shyness (Eggum-Wilkens, Reichenberg, Eisenberg, & Spinrad, 2016; Hassan, Day, Van Lieshout, & Schmidt, 2019; Hassan, Poole, & Schmidt, 2020) or behavioral inhibition—a temperamental style characterized by wariness to novel stimuli more broadly (Henderson & Wilson, 2017; White, McDermott, Degnan, Henderson, & Fox, 2011). These studies have yielded mixed results about the relation between temperamental self-regulation and shyness. Some studies reported a negative association between higher levels of temperamental self-regulation (e.g., inhibitory control) and shyness (Eggum-Wilkens et al., 2016), whereas others demonstrated a positive association (White et al., 2011). These findings suggest that there may be individual differences in the adaptiveness of effortful control in relation to shyness, yet previous research did not analyze the adaptive role of effortful control in relation to the expression of shyness. We believe that this analysis might be extremely relevant given that positive and negative expressions of shyness may have different temperamental profiles and, as suggested previously (Henderson & Wilson, 2017), higher temperamental effortful control might be either a protective or risk factor, depending on other associated temperamental factors.

Expression of shyness and visual attention to facial emotional expressions

Visual attention to facial emotional expression has a central role in modulating the way in which social and emotional information is processed by shy children, which can further affect their socioemotional behavior (Gunther, Youatt, & Pérez-Edgar, 2020). Positive shy children compared with

negative shy children may be better at employing and maintaining their attentional resources toward salient social stimuli, which allows them to further process these stimuli and disconfirm their initial negative beliefs about the potential harm.

Two lines of past research that measured either fearful temperament, behavioral inhibition or trait shyness have investigated the association between visual attention to facial emotional expressions and shyness. However, no previous studies analyzed these associations in relation to the expression of shyness. One of these research lines has focused on how children with higher levels of trait shyness interpret facial emotional expressions and showed that these children have the tendency to overestimate the probability and negative consequences of being observed by a negative facial expression and also to negatively interpret happy facial expressions (e.g., Kokin, Younger, Gosselin, & Vaillancourt, 2015). Moreover, on the neural level, a study by Lewis, Todd, and Honsberger (2007) found that facial expressions of interpersonal hostility (e.g., angry faces) enhanced amplitude and speed of the frontal N2 in temperamentally fearful children, which reflects more urgent engagement of attentional resources in order to regulate anxiety in these children.

The other line of research has examined visual attention to facial emotional expression, known as attentional biases to threat, in behaviorally inhibited or fearful children (Abend et al., 2020; White et al., 2017). In general, some of these studies showed increased sensitivity to threat-related emotional faces (e.g., angry faces) in temperamentally fearful children. In particular, it has been suggested that a core feature of temperamentally fearful children is avoidance of angry faces (Liu & Bell, 2020; Morales, Pérez-Edgar, & Buss, 2015). This is also the case for some forms of anxiety, such as social anxiety and separation anxiety, that are conceptually and empirically related to shyness given their common denominator, namely fear of social situations. This avoidance can be expressed as the tendency to orient attention away from the angry faces after initial orientation toward them, possibly as an attempt to regulate arousal (Lisk, Vaswani, Linetzky, Bar-Haim, & Lau, 2020; Liu & Bell, 2020). For example, fearful temperament at 2 years of age predicted greater attentional biases away from angry faces at 6 years of age (Morales et al., 2015). Alternatively, some studies showed that temperamentally fearful children exhibited hypervigilance toward angry faces (Abend et al., 2020; LoBue & Pérez-Edgar, 2014; Pérez-Edgar et al., 2010; Szpunar & Young, 2012; White et al., 2017), whereas others failed to find evidence of a threat-related attention bias in these children (Broeren, Muris, Bouwmeester, Field, & Voerman, 2011; Cole, Zapp, Fettig, & Pérez-Edgar, 2016; Yang et al., 2017).

The research reviewed above suggests that in temperamentally fearful or behaviorally inhibited children there is significant heterogeneity in expressions of attentional biases (e.g., attentional biases toward and away from angry faces or no biases). Methodological explanations, as well as theoretical ones, were advanced in order to interpret these divergent findings. As such, researchers have proposed that heterogeneity in attentional biases emerges on a trial-by-trial basis throughout an assessment such as that the same individual can have a bias both toward and away from threat during a single task (Fu & Pérez-Edgar, 2019). However, these dynamic changes from trial to trial of attentional biases have not been captured by the manner in which traditional bias scores are calculated. Specifically, traditional bias scores are computed from the average of all reaction times reflecting the speed of responding to threat-congruent stimuli, replacing threat (vs. incongruent, replacing non-threat stimuli) probes across the experimental trials. With this computation approach, biases toward and away from threat will cancel "each other out when they are averaged, leading to a score reflecting no or little bias" (Dennis-Tiwary, Roy, Denefrio, & Myruski, 2019, p. 887). Therefore, researchers (Zvielli, Bernstein, & Koster, 2015) have proposed that trial-level bias scores should be computed to capture this within-participant heterogeneity in attentional biases. As far as we know, only Yang et al. (2017) reported a study with children employing a dynamic measure of attentional biases in relation to behavior inhibition, where no significant relation was found between behavior inhibition and traditional attention bias scores or trial-level bias scores. In general, the evidence that temperamental fearfulness or behavioral inhibition is unrelated to threat-related attentional biases comes mostly from studies that employed nonclinical unselected samples compared with those studies that found a significant association but focused on children displaying patterns of extreme fearful temperament.

Although visual attention to positive facial emotional expressions, such as happy faces, might also be modulated by feelings of uneasiness in social situations that are experienced by shy and social anxious children, fewer studies have investigated attentional biases toward happy faces for these children

(Keil et al., 2018; White et al., 2017). For example, Keil et al. (2018) showed that social anxiety disorder in children was associated with reduced pupil dilation at later information processing stages, meaning cognitive avoidance of both happy and angry faces, whereas in the study conducted by White et al. (2017) some children with behavioral inhibition presented a pattern of attentional orientation toward happy faces and others avoided them. Behavioral inhibition, however, did not predict anxiety in children who oriented their attention toward happy faces (White et al., 2017).

Purpose of the current study

The current study sought to analyze, in a sample of preschool children, a conceptual model linking temperament, expressions of shyness, and visual attention to social stimuli. Our first aim was to analyze to what extent temperamental traits of fearfulness, approach, and effortful control components (inhibitory control and attentional control) influence the expression of positive and negative shyness. We expected the expression of positive shyness to be positively related to all three aspects of temperament (fearfulness, approach, and effortful control), and we expected the expression of negative shyness to be negatively related to approach and effortful control and positively related to fearfulness. Our second aim was to investigate direct paths from both positive and negative shyness to visual biased attention to social stimuli—that is, both threat-related (angry and fearful) and positive (happy) facial expressions. We expected positive shyness to be associated with more attentional orientation to positive facial stimuli and with less attentional avoidance of threat-related stimuli. We also postulated indirect pathways between temperament and visual attention to social stimuli through positive and negative expressions of shyness.

Children's facial expressions of shyness were assessed during a context of social exposure, namely a performance task, in which children were invited to give a performance in front of a small audience. Children's visual attention to both threatening (angry and fearful) and positive (happy) facial expressions was assessed with the dot- probe task, which represents a measure of biased visual spatial orienting toward (or away from) emotional stimuli. To capture dynamic changes of biases toward and away from emotional faces, we employed trial-level bias scores. Fear, approach, and effortful control temperament characteristics were measured by maternal reports.

Method

Participants

A total of 47 children (M_{age} = 51.97 months, *SD* = 9.74, range = 37–79; 26 boys and 21 girls) together with their primary caregivers (for this sample the mothers) participated in the study. Families were recruited from Cluj-Napoca, the second most populous city in Romania, through flyers distributed in kindergartens by directors and child-care educators. Mothers were from the middle and upper classes, and their educational level (on a scale ranging from 1 [primary education] to 11 [graduate studies]) was high, with 82.9% having a bachelor's degree.

Procedure

Before starting the study, the procedure was reviewed by the Ethics Committee of Babeş-Bolyai University. After mothers filled in and returned the informed consent form, they were asked to complete the Children's Behavior Questionnaire at home. For the observational task, children and their mothers were invited to the Developmental Psychology Lab located on the university campus. The performance task took place in an experimental room equipped with an advanced audio–video system that allowed recording children's face and upper body. Children were tested in the lab in a separate room with the computerized dot probe task for the assessment of visual attention to emotional facial expressions. All experimenters were trained graduate psychology students.

Measures

Child temperament

Fear, Approach, and Effortful Control scales of the Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) were completed by mothers in order to assess children's temperamental fear, approach, and effortful control. The CBQ is tailored for measuring the temperament of 3- to 7-year-old children, which makes it appropriate for our sample. The Fear scale is composed of 12 items and measures the amount of worry or unease a child might feel in distressing or potentially threatening conditions (e.g., "Is afraid of the dark"). The Fear scale is related to the Negative Affectivity temperamental dimension. The Positive Anticipation (Approach) scale is composed of 13 items assessing the enthusiasm or excitement a child might feel in anticipation of gratifying activities (e.g., "Looks forward strongly to the visit of loved relatives"). The Positive Anticipation (Approach) scale is related to the Extraversion temperamental dimension. The Attentional Focusing, Attentional Shifting, and Inhibitory Control scales were used to assess Effortful Control. Example items include "When drawing or coloring in a book, shows strong concentration" (for Attentional Focusing scale), "Can easily shift from one activity to another" (for Attentional Shifting scale), and "Can wait before entering into new activities if s/he is asked to" (for Inhibitory Control scale). All items were scored on a 7-point Likert scale, with 1 meaning that the item is *not at all relevant* to the child's behavior and 7 meaning that the item is *very relevant.* We determined the average score for all CBQ scales.

Cronbach's alpha values were also calculated for the scales, resulting in α = .71 for the Fear scale and α = .73 for the Positive Anticipation (Approach) scale. Given that the Attentional Shifting scale has only five items and the Cronbach's alpha was low (.55), we created (similar to previous studies, e.g., White et al., 2011) an Attentional Control scale composed of both attentional focusing and shifting. Cronbach's alpha for the Attentional Control scale was .80, whereas for the Inhibitory Control scale it was .82.

Positive and negative facial expressions of shyness

Children's positive and negative expressions of shyness were assessed using a performance task implementing the procedure described by Colonnesi et al. (2017). We told the children that they would sing a short song of their choice and that they would have a small audience: their mother, an experimenter (E1) with whom they were familiar (having participated in other tasks together), and an unfamiliar experimenter (E2). E2 used a high-quality zoom camera to film the performance. Initially, the children were given the choice of a costume, could stand on a small stage, and could use a stand microphone. A stage light was also provided. We then told them that we would invite another person into the room to video-record their singing as a gift for their parents. The children were next encouraged to sing. The familiar experimenter announced each child with the following sentence: "Now, the superstar [child's name] will perform for us [song's name]!" At the end of the act, the public clapped and congratulated the child.

Behavioral coding of facial expressions of positive and negative shyness. Children's expressions of positive and negative shyness were coded using the validated coding of Colonnesi et al. (2017). We coded facial expressions (positive, negative, and neutral) as state events (i.e., behaviors that take a period of time) and coded apex of the smile, gaze and/or head aversion as point events. We ran the coding with Interact Version 17.1.11 (Mangold, Arnstorf, Germany) and started after the experimenter presented the children in front of the audience (also when the children did not sing) and lasted 60 s (for children whose performance lasted less than 60 s, a corrected number of behaviors was calculated). Coding was performed by two blind research assistants after they were trained by the first author, and independently coded 21.27% (n = 10) of the observations. Coding discrepancies were discussed, and adequate inter-rater reliability was achieved (κ > .75). Using data visualization after coding had been completed, positive shyness was operationalized as the number of positive facial expressions in which an aversion of gaze, head, or both occurred 2 s or less before the occurrence of the apex of the smile, whereas negative shyness was operationalized as the number of negative facial expressions in which an aversion of gaze, head, or both occurred in a temporal episode of 2 s.

Visual attention to threatening and positive facial expressions

The dot- probe task adapted from Bradley, Mogg, Falla, and Hamilton (1998) was employed as a measure of visual spatial orienting toward (or away from) emotional stimuli. This task was designed using E-Prime 2 Version 2.0 (Psychology Software Tools, Pittsburgh, PA, USA) and displayed on a Lenovo LCD computer monitor. During the task, a trial began with a 500-ms fixation, followed by a horizontal display of a pair of faces, side by side, showing human facial expressions for 500 ms. The pair of faces was succeeded by a probe (an asterisk), which replaced one of the facial expressions and disappeared only when the participants pressed one of two previously selected keys, each indicative of the possible positions of the probe on the screen. Children were instructed to press, as quickly and accurately as they could, either the A key when the probe appeared on the left side of the screen or the L key when the probe appeared on the right side. The break between trials lasted 500 ms and consisted of a white screen. Before the experimental trials, there was a training phase composed of 6 trials during which, instead of pictures of facial expressions, neutral stimuli from the International Affective Pictures System (IAPS; Lang, Bradley, & Cuthbert, 2008) were presented. The facial expressions that were used during the experimental trials were selected from the NimStim set of facial expressions (Tottenham et al., 2009). A total of 10 Caucasian actors were chosen (5 female). We were constrained to use only Caucasians because Romanian children are mostly accustomed to these particular features. Each pair of pictures had 800 × 600 pixels, whereas each face inside these pairs had 290 × 415 pixels. The images with facial expressions were shown across 140 trials split into two experimental blocks. The 140 trials formed four experimental conditions, namely Happy–Neutral (40 trials), Angry–Neutral (40 trials), Fearful–Neutral (40 trials), and Neutral–Neutral (20 trials). The probe's position in relation to the emotional face determined another type of trial classification such as congruent trial (CT) when the probe appeared in the same location as the emotional face (angry, fearful, or happy) and incongruent trial (IT) when the probe occurred in the same location as the neutral face. As for the Neutral–Neutral trials, the probe appeared in either location.

Reaction time data computation for dot- probe. As a first step, we employed a filtering procedure aimed to clean the reaction time (RT) data. This procedure was similar to the procedure in previous studies involving children (e.g., Morales et al., 2015). As such, we identified and eliminated the RT outliers, meaning RTs less than 200 ms and more than 3 standard deviations above each participant's own mean RT across each condition and trial type.

Trial-level bias scores (TLBSs) were calculated based on the procedure proposed by Zvielli and colleagues (2015) for each emotional expression. This procedure allowed us to estimate orientation away from and/or toward an emotional facial expression from trial to trial, consequently having a more dynamic account of children's attentional bias. Before the calculation of any of these TLBSs for each participant, we matched the CT or IT with the corresponding neutral trial (NT), meaning that each NT was paired either with a CT or an IT, that was no further than 5 trials away (either before or after). Afterward, we subtracted from ITs the CTs for each pair. The results of these subtractions were used in calculating two TLBSs that provide separate indices for biased attention toward and away from each emotional facial expression for each participant. The first TLBS computed was Mean Positive TLBS (TLBS > 0 ms), which indicates individual differences in the degree to which the attention is oriented toward the emotional face. The second TLBS is Mean Negative TLBS (TLBS < 0 ms), which reflects individual differences in the degree to which the attention is oriented away from the emotional face. Mean TLBSs have been proved to be relevant and reliable measures of attentional orientation patterns in relation to emotional information (Carlson & Fang, 2020; Davis et al. 2016; Egan & Dennis-Tiwary, 2018). Internal consistency for each TLBS was calculated using a permutation-based split-half approach with 5000 random splits. The Spearman–Brown corrected split-half internal consistency was r_{SB} = .85 for the Happy Mean Positive TLBS and r_{SB} = .78 for the Happy Mean Negative TLBS. The reliability estimates were r_{SB} = .78 for the Angry Mean Positive TLBS and r_{SB} = .74 for the Angry Mean Negative TLBS. Finally, Spearman–Brown reliability estimates were r_{SB} = .78 for the Fear Mean Positive TLBS and r_{SB} = .73 for Fear Mean Negative TLBS.

Statistical approach

No missing data were present. First, data were checked for outliers ($z > 3.29$) that may exert a disproportionate influence on the results. The variables temperamental fear, negative shyness, attention bias toward happy, attention bias away from angry, and attention bias away from fear included one outlier. We assigned the outliers with scores 1 unit larger than the next most extreme scores (Tabachnick & Fidell, 2013). Second, we checked the normal distribution of the study variables (skewness/SE and kurtosis/SE). Positive skewed distributions were found for negative expressions of shyness and attention bias toward happy, whereas negative shewed distributions were found for attention bias away from angry and toward fear. Log transformations were performed for attention bias toward happy, and square transformations were performed for attention bias away from angry and toward fear. The analyses with and without the transformed variables led to similar results. The untransformed variables were used in the final analyses. Because children's expressions of negative shyness were sparse (i.e., 11 children displayed at least one negative expression of shyness), the variable was dichotomized for the following analyses.

A path model was performed using structural equation modeling (AMOS 23.0, IBM SPSS Version 22; IBM, Armonk, NY, USA). To overcome the concern regarding biased standard errors, because of the limited sample size, we calculated bias-corrected bootstrap 95% confidence intervals (CIs) for all parameter estimates of the investigated effects with 5000 replications. Multiple measures were used to analyze the fit of each model to the observed data: a chi-square measure of the overall goodness of fit, the Comparative Fit Index (CFI), and the root mean square error of approximation (RMSEA). A nonsignificant chi-square coefficient indicates that the hypothesized model does not significantly deviate from the model present in the data. A CFI value close to or greater than .95 warrants that the model is at least a better reflection of the data than a model where all correlations are assumed to be zero. The RMSEA coefficient suggests adequate fit when it is close to or less than .08. The size and significance of indirect effects were tested with a calculator using a Monte Carlo approach, which is appropriate for structural equation models (Falk & Biesanz, 2016). Significant specific indirect effects were calculated by multiplying the path coefficients. To calculate the statistical power of this study to reject false null hypotheses, we conducted a statistical power analysis using G*Power for multiple regression models. With three predictors for the expressions of shyness and two predictors for visual attention, a medium effect size (f^2) of. 25, alpha error probability of .05, and power of .80, a minimum of 42 to 47 participants are required (N of the current study = 47).

Results

Descriptive and preliminary analyses

Table 1 reports descriptive analyses of the study variables. Preliminary analyses were conducted to test the possible effect of children's gender and age on the study variables. No significant differences were found between girls and boys. Children's age was significantly associated with temperamental fear, $r(46) = .37$, $p = .011$, trial-level attention bias toward happy, $r(46) = -.49$, $p < .001$, as well as trial-level attention bias away from angry, $r(46) = .49$, $p = .001$, and fear, $r(46) = .36$, $p = .013$.

Correlations between the study variables are reported in Table 2. No significant associations were found between temperamental measures of approach, inhibitory control, and fear. However, temperamental attentional control was positively and significantly associated with inhibitory control. As expected, positive and negative expressions of shyness were significantly and negatively related to each other. Positive shyness was also significantly and positively associated with approach and trial-level attention bias toward happy, and it was significantly and negatively associated with trial-level attention bias away from angry. No significant correlations were found between positive shyness, negative shyness, and Fear Mean Positive and Fear Mean Negative TLBSs. Therefore, no path analysis was performed with Fear TLBSs. In line with previous findings (Clarke et al., 2020; Davis et al., 2016), we observed high correlations among TLBSs, which was expected given the mathematical interrelations between these metrics. Therefore, we chose to examine the two TLBSs trial-level attention

Table 1
Descriptive statistics of the study variables.

Variable	*M*	*SD*	Range
Temperament			
Approach	5.30	0.65	3.33–6.42
Inhibitory control	4.36	0.76	2.69–5.92
Attentional control	4.07	0.69	2.59–5.71
Fear	3.58	0.97	1.33–5.34
Shyness			
Positive	1.48	1.53	0.00–6.00
Negative	0.31	0.69	0.00–2.49
Trial-level bias scores			
AB Happy Mean Negative TLBS	−643.18	596.45	−3206.94 to −83.31
AB Happy Mean Positive TLBS	732.89	626.73	91.13–3562.09
AB Angry Mean Negative TLBS	−693.73	549.61	−2919.70 to −89.18
AB Angry Mean Positive TLBS	765.57	862.82	79.60–4452.00
AB Fear Mean Negative TLBS	−765.16	802.19	−4424.09 to −75.47
AB Fear Mean Positive TLBS	676.35	537.07	123.15–2086.64

Note. AB Happy Mean Negative TLBS, trial-level attention bias score away from happy; AB Happy Mean Positive TLBS, trial-level attention bias score toward happy; AB Angry Mean Negative TLBS, trial-level attention bias score away from angry; AB Angry Mean Positive TLBS, trial-level attention bias score toward angry; AB Fear Mean Negative TLBS, trial-level attention bias score away from fear; AB Fear Mean Positive TLBS, trial-level attention bias score toward fear.

bias score (AB Happy Mean Positive TLBS and AB Angry Mean Negative TLBS) score away from angry as they relate to the expressions of shyness in separate analyses to avoid duplicate analyses.

Path analyses

A first path analysis model included children's expressions of shyness as predicted by the temperamental traits approach, inhibitory control and fear, and being associated with their trial-level attention bias away from angry. Children's age was included as a control variable. Fig. 1 displays the path analysis. The model closely fits the observed data, $\chi^2(6) = 6.00$, $p = .423$, CFI = 1.00, RMSEA = .005. Children's expression of positive shyness was positively associated with temperamental measures of approach, $B = 0.68$ ($SE = 0.30$) CR (critical ratio) = 2.26, $p = .024$, inhibitory control, $B = 0.67$ ($SE = 0.26$) CR = 2.62, $p = .009$, and fear, $B = 0.49$ ($SE = 0.21$) CR = 2.29, $p = .022$. For negative expressions of shyness, a significant association was found with fear, $B = 0.13$ ($SE = 0.07$) CR = 1.97, $p = .049$, whereas no significant associations were found with inhibitory control, $B = -0.06$ ($SE = 0.08$) CR = 0.76, $p = .448$, or approach, $B = -0.12$ ($SE = 0.09$) CR = −1.30, $p = .194$. When looking at the association between the expression of shyness and trial-level attention bias, the positive expression of shyness was significantly associated with less attentional avoidance of angry faces, $B = -129.41$ ($SE = 45.82$) CR = −2.82, $p = .005$. No significant associations were found, however, between negative expressions of shyness and trial-level attention bias away from angry, $B = -190.54$ ($SE = 164.80$) CR = −1.16, $p = .248$. Significant specific indirect effects were found with positive expression of shyness as mediator of approach and trial-level attention bias away from angry, $B = -87.63$, 95% CI [−247.67, −3.23], $p = .041$, as mediator of fear and trial-level attention bias away from angry, $B = -63.25$, 95% CI [−219.74, −6.86], $p = .017$, and as mediator of inhibition and trial-level attention bias away from angry, $B = -86.98$, 95% CI [−307.14, −2.41], $p = .035$. No significant specific indirect effects were found with negative expression of shyness as mediator.

The same mediation analysis was performed with children's trial-level attention bias toward happy. The model closely fits the observed data, $\chi^2(6) = 4.38$, $p = .625$, CFI = 1.00, RMSEA < .001. Children's trial-level attention bias toward happy was positively and significantly associated with children's expression of positive shyness, $\beta = .39$, $B = 158.68$ ($SE = 51.44$) CR = −3.09, $p = .002$, but not with children's expression of negative shyness, $\beta = .17$, $B = 241.31$ ($SE = 185.01$) CR = 1.30, $p = .192$. Again, significant specific indirect effects were found with positive expression of shyness as mediator of approach and trial-level attention bias toward happy, $B = 107.45$, 95% CI [3.62, 295.94], $p = .040$, as

Table 2
Intercorrelations for study variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Temperament					.							
1. Approach	–	−.02 (.878)	−.16 (.299)	.19 (.204)	.33 (.024)	−.12 (.412)	.13 (.385)	.04 (.794)	.07 (.634)	−.09 (.560)	.07 (.666)	−.08 (.614)
2. Inhibitory control	−.02 (.878)	–	.80 (<.001)	−.15 (.313)	.26 (.080)	−.15 (.328)	.15 (.318)	.02 (.907)	−.01 (.956)	−.12 (.406)	.15 (.305)	−.09 (.532)
3. Attentional control	−.16 (.299)	.80 (<.001)	–	−.10 (.492)	.17 (.253)	−.05 (.730)	.09 (.533)	.13 (.380)	−.07 (.632)	−.02 (.873)	.04 (.813)	.07 (.626)
4. Fear	.19 (.204)	−.15 (.311)	−.13 (.379)	–	.24 (.10)	.27 (.062)	.21 (.156)	−.10 (.508)	.10 (.487)	−.18 (.240)	.18 (.250)	−.09 (.543)
Shyness												
5. Positive	.33 (.024)	.26 (.080)	.17 (.253)	.24 (.10)	–	−.38 (.008)	−.16 (.293)	.35 (.018)	−.32 (.026)	18 (.237)	−.14 (.349)	.22 (.142)
6. Negative	−.12 (.412)	−.15 (.328)	−.14 (.352)	.27 (.062)	−.38 (.008)	–	.03 (.838)	−.05 (.751)	.07 (.664)	−.08 (.578)	09 (.553)	−.06 (.708)
Trial-level bias scores												
7. AB Happy Mean Negative TLBS	.13 (.385)	.15 (.318)	.09 (.533)	.22 (.142)	−.16 (.293)	−.02 (.910)	–	−.75 (<.001)	.82 (<.001)	−.92 (<.001)	−.93 (<.001	−.80 (<.001)
8. AB happy Mean Positive TLBS	.04 (.794)	.02 (.907)	.13 (.380)	−.11 (.473)	.35 (.018)	−.02 (.866)	−.75 (<.001)	–	−.91 (<.001)	.82 (<.001)	.75 (<.001)	.79 (<.001)
9. AB Angry Mean Negative TLBS	.07 (.634)	−.01 (.956)	−.07 (.632)	.12 (.439)	−.32 (.026)	. 03 (.836)	.82 (<.001)	−.91 (<.001)	–	−.83 (<.001)	.77 (<.001)	−.85 (<.001)
10. AB Angry Mean Positive TLBS	−.09 (.560)	−.12 (.406)	−.02 (.873)	−.18 (.231)	.18 (.237)	−.06 (.705)	−.92 (<.001)	.82 (<.001)	−.83 (<.001)	–	.96 (<.001)	−.73 (<.001)
11. AB Fear Mean Negative TLBS	.07 (.666)	.15 (.305)	.04 (.813)	.18 (.214)	−.14 (.349)	.05 (.740)	−.93 (<.001)	.75 (<.001)	.77 (<.001)	−.90 (<.001)	–	−.84 (<.001)
12. AB Fear Mean Positive TLBS	−.08 (.614)	−.09 (.532)	.07 (.626)	−.10 (.507)	.22 (.142)	−.03 (.864)	−.80 (<.001)	.79 (<.001)	−.85 (<.001)	−.73 (<.001)	−.84 (<.001)	–

Note. p-values are in parentheses. AB Happy Mean Negative TLBS, trial-level attention bias score away from happy; AB Happy Mean Positive TLBS, trial-level attention bias score toward happy; AB Angry Mean Negative TLBS, trial-level attention bias score away from angry; AB Angry Mean Positive TLBS, trial-level attention bias score toward angry; AB Fear Mean Negative TLBS, trial-level attention bias score away from fear; AB Fear Mean Positive TLBS, trial-level attention bias score toward fear.

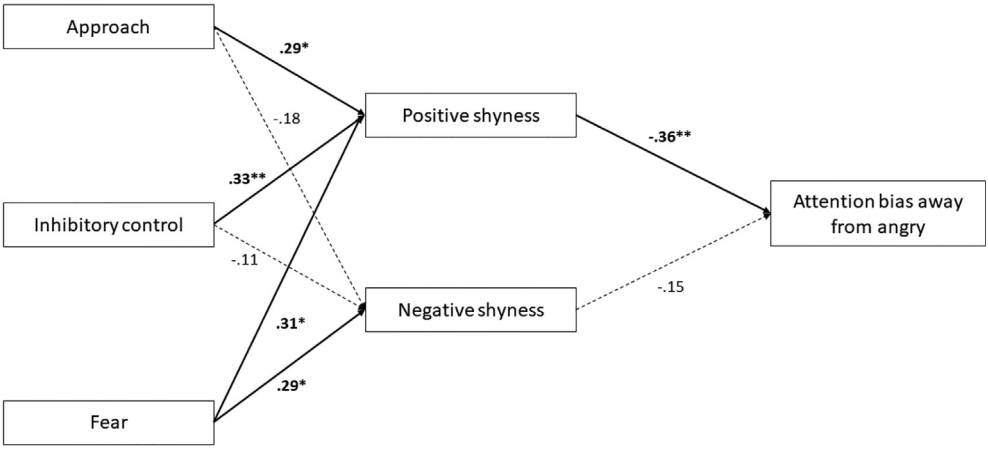

Fig. 1. Path analysis with approach, inhibitory control, and fear as predictors of positive and negative shyness and with positive and negative shyness as predictors of attention bias away from angry, with children's age as covariate. Coefficients presented are standardized. Dotted lines represent nonsignificant relations, and bold lines represent significant relations. $^{*}p < .05$; $^{**}p < .01$.

mediator of fear and attention bias toward happy, $B = 77.55$, 95% CI [11.66, 279.06], $p = .015$, and as mediator of inhibition and trial-level attention bias toward happy, $B = 106.66$, 95% CI [3.77, 370.42], $p = .032$. No significant specific indirect effects were found with negative expression of shyness as mediator.

Discussion

The current study examined the temperamental profiles associated with children's observed expressions of positive and negative shyness and the relation between these two forms of shyness and visual attention to social stimuli. Our findings showed that, in line with our hypotheses, the expression of positive shyness was positively associated with temperamental dimensions of approach, inhibitory control, and fear. With regard to the visual attention to social stimuli, positive shyness was related to more attentional orientation to positive facial expressions (happy faces) and to less attentional avoidance of threatening facial expressions (angry faces). Observed expression of negative shyness was positively associated only with temperamental fear, and no associations were found with visual attention to social stimuli. Our findings provide relevant insights into the temperamental traits underlying the expressions of positive and negative shyness and into the ways in which positive and negative shy children direct their attention to social stimuli.

Temperamental correlates of positive and negative expressions of shyness

Our findings show that both positive and negative expressions of shyness are positively associated with temperamental fear. However, next to negative shyness, positive expressions of shyness are also positively related to higher levels of temperamental approach and temperamental inhibitory control. Possible temperamental determinants of positive and negative expressions of shyness have already been theoretically proposed by Schmidt and Poole (2019), who postulated that an approach-dominant temperamental profile in combination with higher temperamental self-regulation may characterize positive shy children despite their fearfulness, whereas negative shy children may be characterized by higher temperamental avoidance (high fearfulness in the absence of an approach-drive to engage in social contexts) and lower temperamental self-regulation. Our findings corroborate this theory and previous findings showing that positive shyness is positively related to parent-

reported temperamental sociability (Colonnesi et al., 2014, 2017). Thus, our results present empirical support for the conceptualization of positive shyness as an approach-dominant form of shyness. That is, although positive shy children may feel fear in a social context, they may also feel the need to approach the social agent in these situations. On the contrary, negative shyness seems to be directly related to social fear and can be seen as an avoidant-dominant form of shyness or in terms of Asendorpf's model unsociable shyness (Asendorpf & Meier, 1993). This finding adds to a series of studies conducted in younger children (Colonnesi et al., 2014, 2020) and older children (Poole & Schmidt 2019) showing a direct association between children's expressions during shyness-eliciting situations and their temperamental predisposition as reported by parents.

Furthermore, our data show that maternal evaluation of children's temperamental inhibitory control abilities—a subcomponent of the regulatory dimension of temperament—was positively associated with children's observed expression of positive shyness but not negative shyness. This result provides a novel empirical contribution to the idea that children's expression of positive shyness during social interactions reflects their higher regulatory abilities in modulating fear during social situations (Colonnesi et al., 2014, 2017; Nikolić et al., 2016; Poole & Schmidt, 2020). In other words, children who were better at engaging higher-order cognitive processes, such as the ability to suppress inappropriate actions or responses, were also expressing more positive shyness during the performance task. The fact that higher levels of temperamental inhibitory control play an important role in the manifestation of positive shyness, considered an adaptive form of shyness (Poole & Schmidt, 2020) represents an important contribution of the current study. This is because previous data (Henderson & Wilson, 2017) suggested that individual differences in the adaptiveness of temperamental inhibitory control in relation to shyness depend on other temperamental factors. Although in the current study no significant association was found between negative shyness and temperamental inhibitory control, higher temperamental inhibitory control was shown in some previous studies to be problematic in shy children (e.g., with higher social anxiety and lower social initiative) who are also characterized by higher temperamental avoidance (see, e.g., Henderson & Wilson, 2017; Sette, Hipson, Zava, Baumgartner, & Coplan, 2018). The fact that higher ability to self-regulate may act differently for positive shy children, operating as a protective factor against maladaptive developmental outcomes, is supported by a recent study (Poole & Schmidt, 2020) indicating that frontal heightened delta–beta correlation (a neural marker of emotion regulation) was linked to expressions of positive shyness but not negative shyness. This heightened delta–beta correlation was further associated with lower levels of parent-reported school avoidance for positive shy children.

To conclude, positive and negative expressions of shyness seem to share temperamental fear, but they differ from each other because of the higher-level social approach and control in positive shyness as opposed to negative shyness. These findings are in line with a general theory of shyness proposed by Asendorpf (1990). According to this conceptual framework, some shy individuals, namely the avoidant shy ones, have lower levels of motivation to interact with others, whereas ambivalent shy individuals manifest a strong desire to affiliate with others in combination with the fear of doing so. Our results provide empirical support for this distinction between avoidant or unsociable shyness and ambivalent shyness. In particular, we showed that, in terms of behavioral expressions, positive shy children present a combination of gaze and/or head aversion with smiling, whereas negative shy children show gaze and/or head aversion in the absence of positive affect. In terms of the temperamental profile, these shy behaviors were associated with an approach-dominant drive and higher regulation for positive shy children as compared with an avoidance-dominant tendency for negative shy children. In addition, Asendorpf (1990) considered that the manifestation of ambivalence as a combination of smiles and gaze aversion reaches a peak at 3 or 4 years of age, which can explain the higher frequency of positive shy expressions during the performance task in our preschool sample. However, the developmental paths of positive shyness are rooted during early infancy given Reddy's (2000) findings of 2- to 4-month-old infants presenting coy smiles in response to adults who were asked to face and talk to the infants or to themselves in a mirror. Moreover, recent evidence obtained by Ioannou et al. (2021) showed that 2- and 3-month-old infants, during positive interactions with a stranger, had no signs of sympathetic arousal (i.e., skin temperature was significantly higher when interacting with the stranger in a positive way) and gazed longer at the stranger compared with the mother.

Expression of positive and negative shyness and visual attention to social stimuli

As expected, positive shy children showed less attentional avoidance of angry faces and more attentional orientation toward happy faces. This attentional profile in relation to social stimuli, in conjunction with a temperamental profile characterized by higher self-regulation and approach, may explain why positive shyness tends to be associated with more adaptive outcomes such as lower levels of social anxiety (Colonnesi et al., 2014, 2017; Nikolić et al., 2016; Poole & Schmidt, 2018, 2020). Specifically, for positive shy children, less avoidance in relation to threats (angry faces) may facilitate elaborate processing and habituation to anxiety-provoking stimuli, whereas attentional orientation to positive information (happy faces) may be related to reward processing, which can further promote approach-related behavior in social contexts.

Our path model also shows significant specific indirect effects with positive expression of shyness as a mediator in the relationship between child temperament (fear, approach, and inhibitory control) and attentional avoidance of angry faces, as well as attentional vigilance toward happy faces, although no significant associations were found between temperamental dimensions and attention to social stimuli. These results indicate that positive shyness is connected with both temperament and attention to social stimuli independently and serves as a mediator because it includes elements of both temperament and attention. Hence, positive shyness is the combination of an emotional reaction (positive emotionality) and an attentional reaction (gaze aversion). The emotional reaction can be the expression of temperamental factors, whereas the attentional reaction is connected to visual social attention. Our nonsignificant results regarding the association of temperament and attention to social stimuli are in line with several child studies reported in the literature that did not find cross-sectionally an association between temperament (e.g., temperamental fear or behavioral inhibition) and attention to facial emotional expressions, that is, angry faces (Broeren et al., 2011; Cole et al., 2016; Yang et al., 2017). However, longitudinal studies linking temperament and attention to threat (Nozadi et al. 2016; White et al., 2017) showed that although no concurrent relation was found between temperament and attention to threatening faces, attention toward threatening faces moderated the relation between behavioral inhibition and maladaptive developmental outcomes. For example, Nozadi et al. (2016) found that early during development (at 5 years of age) attention was not significantly related to behavioral inhibition, but attention to threat at 5 years moderated the link between temperament during toddlerhood and anxiety at 10 years. Thus, behavioral inhibition predicted anxiety at 10 years of age only for children who tended to orient their attention toward threat at 5 years. Moreover, the evidence that temperament is not associated with threat-related attentional biases comes mostly from studies that employed nonclinical unselected samples compared with those studies that found a significant association but focused on children displaying patterns of extreme fearful temperament.

Contrary to our hypothesis, we did not find a significant association between negative shyness and visual attention to facial emotional expressions. Although no research has empirically examined the link between expression of negative shyness and attention to emotional facial expressions, our nonsignificant effects may be related to lack of individual variability regarding expression of negative shyness in our sample, given that it was not preselected for scoring high on anxiety-related symptomatology or extreme temperamental fear. Specifically, in our sample a small number of children (only 23%) displayed at least one negative expression of shyness. However, this low percentage of negative shy children is not uncommon in general community samples like ours. A similar proportion was found by Kagan, Reznick, Clarke, Snidman, and Garcia-Coll (1984) when detecting a group of children with a high level of social behavioral inhibition. Negative shyness possibly reflects a significantly high level of social fear during the performance task. In addition, another possible explanation for these nonsignificant findings may be related to the performance task we used to elicit shyness. In particular, during the task children got compliments from the audience watching and hearing them sing, so it might be that this task was not sensitive enough to trigger negative shyness.

Although in our path model we did not include a measure of emotional dysregulation such as anxiety, based on the previous data showing a negative association between positive shyness and anxiety (Colonnesi et al., 2014, 2017; Nikolić et al., 2019; Poole & Schmidt, 2018), we speculate that less attentional avoidance when confronted with angry faces and higher attentional orientation toward happy

faces may be an adaptive attentional response in positive shy children. More specifically, it may allow these children to orient attention toward the socially salient stimuli in the environment and to further elaborate their processing. Moreover, when determining the adaptive and maladaptive nature of visual attention to facial expressions, several empirical studies have suggested the importance of taking into consideration self-regulatory abilities given that, for example, greater attentional orientation to threat is associated with maladaptive outcomes, such as anxiety, only among individuals with low self-regulation (Gorlin & Teachman, 2015; Liu & Bell, 2020, Susa, Pitică, Benga, & Miclea, 2012). Thus, lack of threat avoidance and attention orientation to happy faces may act differently in positive shy children, preventing maladaptive developmental outcomes such as anxiety-related symptoms. Future studies should investigate this hypothesis.

Strengths, limitations, and future directions

The current investigation has several theoretical and methodological contributions: (a) the investigation of the temperamental differences in both approach-related behaviors and self-regulation, along with fearfulness, in relation to positive and negative shyness; (b) the use of a micro-level coding system for positive and negative shyness; (c) the first-time analysis of the relation between two forms of shyness expression (positive and negative shyness) and visual attention to both positive and threatening social stimuli; (d) the employment of a trial-level bias scores approach in order to be able to capture dynamic changes of attentional biases toward and away from emotional faces; and (e) the use of a multi-informant approach to data collection (e.g., maternal evaluation of child temperament, observational assessment of child expressions of shyness, child reaction time task for visual attention to emotions). However, despite these contributions, our study has limitations as well. First, our study was cross-sectional and correlational, which limits any causal interpretation of the significant associations between the study variables. Based on our results, we can only suggest that positive shy behavior and visual attention in relation to emotional information are associated with each other and possibly influence each other. It would be extremely important for future studies to examine these associations longitudinally. Second, we did not include a measure of emotional dysregulation (e.g., social anxiety measure). Future work should include such measures and test whether, for example, lack of threat avoidance, in the case of positive shy children, is associated with more adaptive outcomes (e.g., fewer anxiety symptoms). It is also important to note that our nonsignificant results regarding the relation between negative shyness and visual attention to social stimuli should be interpreted with caution given our small sample size and little individual variability regarding the expression of negative shyness in our sample. Finally, the large range of attentional bias scores obtained in our sample, although in line with previous studies conducted with younger children (e.g. Morales et al., 2015), needs to be further replicated by future studies using more heterogeneous populations.

Conclusions

Our study shows that the way in which children express their shyness is directly related to their temperament and visual attention to social stimuli. Children who display more positive expressions of shyness are characterized by higher temperamental fear in combination with social enjoyment and regulation. In addition, these children are able to orient to positive facial expressions and to show less attentional avoidance when confronted with angry faces. On the contrary, children who display negative expressions of shyness seem to experience only higher temperamental fear and do not have a clear attentional strategy to social stimuli. These findings corroborate previous theoretical and empirical evidence about the adaptive and multidimensional character of positive shyness (Poole & Schmidt, 2020) and add relevant additional empirical evidence on the connection between shyness and visual attention to social stimuli.

CRediT authorship contribution statement

Georgiana Susa-Erdogan: Conceptualization, Methodology, Software, Formal analysis, Investigation, Resources, Writing – review & editing, Supervision, Project administration, Writing original draft. **Oana Benga:** Project administration, Funding acquisition, Conceptualization, Methodology, Software, Formal analysis, Investigation, Resources, Writing – review & editing, Writing original draft. **Cristina Colonnesi:** Conceptualization, Methodology, Supervision, Formal analysis, Software, Writing – review & editing, Writing original draft.

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