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Social anxiety disorder (SAD) is one of the most prevalent mental disorders with serious individual impairments and societal costs. Little is known about the mechanisms involved in SAD development. Here, I propose that dysregulated social emotions (social fear and shyness) are crucial for SAD development and that these dysregulated social emotions originate in the disturbances in socio-cognitive abilities. The research from our lab confirmed this. It showed that behavioural and physiological indices of social fear contribute to the development of SAD in toddlerhood and early childhood. Later in childhood, between ages 4.5 and 7.5, we found a new risk factor for SAD—dysregulated shyness. Specifically, we found that negative shy expressions and prolonged physiological blushing (temperature increase) contribute to SAD development. Whereas elevated fear may be rooted in deficits in socio-cognitive skills, dysregulated shyness may be rooted in advanced socio-cognitive abilities. These findings imply that dysregulated social emotions play an important role in SAD and should be explicitly targeted in clinical treatments of SAD.
becomes psychopathology, called social anxiety disorder (SAD; American Psychiatric Association [APA], 2013).

SAD is one of the most prevalent disorders in the Western world – around one in every ten people is diagnosed with SAD during their lifetime (Furmark, 2002; Kessler et al., 2005). The disorder is associated with serious individual impairments and societal costs, such as loneliness, poor academic functioning and work productivity, low quality of life, high comorbidity with other mental disorders, and increased medicine use (Fehm, Beesdo, Jacobi, & Fiedler, 2008; Patel, Knapp, Henderson, & Baldwin, 2002). SAD has an early onset with the average age of onset being 10–13 years (Hudson & Rapee, 2000; Rapee, 1995). However, the first social anxiety symptoms can appear much earlier, when first socio-evaluative fears develop at the preschool age (Rapee, 1995). These early symptoms of social anxiety may pose risk for later SAD development (Goodwin, Fergusson, & Horwood, 2004). Once developed, SAD may have a chronic course and low recovery rate, even in children (Hudson et al., 2015).

Serious individual and societal burdens of SAD and the poor treatment outcomes highlight the importance of investigating the factors that are involved in the development of the disorder. Understanding the early risk factors of SAD may help practitioners prevent the development of SAD and improve current clinical treatments of SAD by targeting the specific mechanisms that contribute to SAD development. Recently, there has been a call to identify proximal aetiological factors of SAD development (Spence & Rapee, 2016) in line with the work on maintaining factors of SAD in adults. Cognitive models of SAD (Clark & Wells, 1995; Rapee & Heimberg, 1997) have been dominant models for explaining the maintenance of SAD in adults. These models propose a prominent role of cognitive factors such as attention, interpretation, and negativity bias in the maintenance of SAD. However, DSM-5 defines SAD primarily in terms of emotional disturbances, namely, experiencing persistent fear of others’ negative evaluation and being embarrassed (APA, 2013). The dysregulated emotional reactivity may be not only a symptom of SAD, but also a mechanism in its development.

Building on the previous theoretical work on SAD, I propose that dysregulated emotions play a central role in the development of SAD—the way children feel in social situations may influence how they behave in these social situations, such as whether they avoid the social situation or not. This avoidance of social situations, in turn, maintains
Social anxiety over time, impairs daily functioning, and develops into SAD (APA, 2013). I also assume that dysregulated social emotions are rooted in disturbances in social cognition—the way children think about themselves and others in social situations.

Social emotions in the development of social anxiety disorder

Emotions that arise in social situations, that is, in relation to other people and social norms are called social emotions (Bennett & Gillingham, 1991). People with SAD are characterized by disturbances in these emotions – they experience excessive evaluative fears and heightened self-conscious emotional reactivity (APA, 2013). Although it is known that dysregulated social emotions are symptoms of already developed SAD, it has been unknown whether they may also be a premorbid vulnerability factor for SAD.

Here, we describe studies from our lab that examined whether social fear and self-conscious emotions, such as shyness have an aetiological role in SAD. To do so, we investigated whether behavioural and physiological manifestations of fear and shyness exist in young children with high levels of social anxiety and whether they contribute to the development of SAD symptoms later in childhood.

Social fear

Social fear refers to fear over the possibility of being evaluated negatively by other people in social situations, such as interacting with new people or being in the centre of attention (Leary, 1983). On the behavioural level, fear is typically expressed through facial and bodily signs such as escape behaviours, gaze and head aversions, freezing, verbal vocalizations and verbalizations of fear, verbal hesitancy, and latency of response to the situation (Goldsmith & Rothbart, 1996). A tendency to react with fearful behaviours is typically referred to as behavioural inhibition (BI). BI is defined as a temperamental style of extreme withdrawal and avoidance in novel situations such as meeting an unfamiliar person or interacting with a new toy (Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984). A few previous studies found evidence that BI in toddlerhood and early childhood (2–6 years old) predicts the onset of SAD in late childhood (e.g., Hirshfeld-Becker et al., 2007) and adolescence (e.g., Schwartz, Snidman, & Kagan, 1999). Thus, it is clear that children who are inhibited in early years
of their life have higher chances of developing SAD later in life. However, it is still unclear how and when BI plays a significant role in the development of SAD. This knowledge would help us understand at which point exactly in child development BI poses risk for SAD, thereby allowing clinical practitioners to act and prevent the development of the disorder.

In a longitudinal study, we measured social BI (i.e., behavioural inhibition in social situations, such as a conversation with a stranger) during toddlerhood (2.5 years) and early childhood (4.5 years) in a stranger-approach situation in which an unknown male enters the room and starts a friendly conversation with a child. We measured early social anxiety symptoms reported by both parents at the age of 4.5 years, and SAD symptoms diagnosed by the clinician and reported by parents in late childhood at 7.5 years, when relationships with others become increasingly important (Beidel & Turner, 1988) and fear of negative evaluation becomes prominent (Gullone, 2000), thus, the chances that social anxiety symptoms result in impairments in daily life and transit to a formal diagnosis increase (Rapee & Spence, 2004). In this study, we were able to disentangle the timing of the effect of social BI on childhood SAD symptoms (Nikolić, Majdandžić, Colonnesi, de Vente, Möller, & Bögels, 2020). We found that social BI at 2.5 and 4.5 years of age predicts early onset of social anxiety symptoms at 4.5 years and that these symptoms, in turn, predict the development of SAD symptoms later in childhood, at 7.5 years. Thus, social BI contributes to the development of SAD indirectly, by influencing the onset of social anxiety symptoms in early childhood. It is, therefore, in the period of toddlerhood and early childhood that social BI poses risk for later SAD development.

On the physiological level, fear is typically accompanied by physiological hyperarousal (Ekman, 1992) due to the activation of sympathetic and/or withdrawal of parasympathetic autonomic nervous system (Berntson, Cacioppo, Quigley, & Fabro, 1994). The activation of the sympathetic system may be measured through increased electrodermal activity (EDA), whereas parasympathetic withdrawal may be measured through reduced high-frequency heart rate variability (HF-HRV). Increased heart rate (HR) is assumed to be a reflection of both sympathetic and parasympathetic influences (Kreibig, 2010).

We investigated whether physiological hyperarousal in social situations is associated with high social anxiety levels in early childhood, before SAD is typically diagnosed (Nikolić, de Vente, Colonnesi, & Bögels, 2016). We measured children’s HR, HRV, and EDA in a social
performance task in which children were asked to perform a song in front of a small audience (father, experimenter, and unknown woman who was recording) while being video-recorded and in the watching-back task in which children watched-back their performance in the presence of the same audience. In this task, children are asked to dress up like a pop star, stand on stage in front of the audience, and sing a song of their choice after being introduced by the experimenter. We found that physiological hyperarousal (increased sweating and reduced HRV) was associated with greater social anxiety levels in these children.

We further investigated whether physiological hyperarousal contributes to SAD symptoms development in a prospective study. Specifically, we examined whether physiological hyperarousal in a stranger-approach situation at the age of 2.5 and 4.5 predicts SAD symptoms at the age of 7.5 (Nikolić, Aktar, Bögels, Colonnesi, & de Vente, 2018). We found that children who displayed increased HR, reduced HRV while interacting with a stranger and increased sweating in baseline and while interacting with a stranger in toddlerhood and early childhood had more SAD symptoms at the age of 7.5.

These studies provided the first evidence that physiological hyperarousal in early childhood may be a biological vulnerability factor for the later development of SAD. Particularly, children who display increased HR, reduced HRV, and more sweating during social situations may be at increased risk for developing SAD.

**Shyness**

Shyness is a self-conscious emotion defined through ambivalence—a conflict between the motivation to approach and avoid social stimuli (Asendorpf, 1990; Colonnesi, Napoleone, & Bögels, 2014). Shy children wish to interact and experience interest in social situations, but at the same time, they feel nervous and concerned about being rejected or negatively evaluated (Colonnesi et al., 2014; Nikolić, Colonnesi, de Vente, & Bögels, 2016). Shyness can be approach-dominant or avoidance-dominant. Approach-dominant shyness is displayed through positive shy expressions (i.e., coy-smiles) which include smiling, along with gaze/head aversions (Colonnesi et al., 2014; Reddy, 2001). By contrast, avoidant-dominant shyness is displayed through negative shy expressions, such as gaze and/or head aversions accompanied by negative facial expressions (Colonnesi et al., 2014).
Children who display high number of negative shy expressions are assumed to be more socially anxious because these children avoid and withdraw from social situations, which precludes them from gaining confidence through social experiences (Colonnesi et al., 2014). Positive shy expressions, however, are displays not only of avoidance, but also of social interest and involve positive affect in combination with aversions (Colonnesi et al., 2014; Nikolić et al., 2016). They are assumed to be more adaptive than negative shy expressions because they may increase interpersonal liking and appease others in situations in which negative evaluation is expected (Keltner & Buswell, 1997). Because they can bring about positive feedback from others and positive social experiences, they are assumed to be protective of high social anxiety.

Most of past research defined shyness as a form of fear, inhibition, and avoidance in the presence of others (e.g., Rubin, Coplan, & Bowker, 2009), thus, only the avoidant (negative) component of shyness has been captured. We, however, observed both positive and negative shyness during social performance and we examined their associations with social anxiety symptoms at the age of 4.5. As expected, we found that negative shy expressions were positively related to social anxiety symptoms whereas positive shy expressions were negatively related to social anxiety symptoms (Colonnesi, Nikolić, de Vente, & Bögels, 2016; Nikolić, Colonnesi, de Vente, & Bögels, 2016). Thus, the way children express their shyness may result in different developmental outcomes.

On the physiological level, self-conscious emotions, such as shyness may be indexed through blushing. Like shyness, blushing is thought to reflect ambivalence between the desire to approach and avoid social situations (van Hoof, 2012) and appears with heightened self-consciousness, when people are concerned about others’ opinions of them (Crozier, 2004; Darwin, 1872/1998; Leary, Britt, Cutlip, & Templeton, 1992). Blushing manifests in reddening of the face, neck, or upper chest in social situations in which there is a possibility of negative evaluation (Leary et al., 1992). People with SAD are assumed to blush more easily and more frequently in social situations because they fear others’ negative evaluation (American Psychiatric Association, 2013; Bögels et al., 2010). This was confirmed in our meta-analysis on blushing and social anxiety, which showed that people with SAD (symptoms) blush more in social situations (Nikolić, Colonnesi, de Vente, Drummond, & Bögels, 2015).
Blushing may be captured with blood flow and temperature changes (Shearn, Bergman, Hill, Abel, & Hinds, 1990). Blood flow is usually measured with photoplethysmography. The fluctuating alternating current (AC) component of plethysmography is called blood volume pulse and represents fast changes in blood volume with each heartbeat. The direct current (DC) component corresponds to the average level of blood volume and represents blood pooling in the arteries, veins, and capillaries, which varies slowly (Allen, 2007). Another measure of blushing response is facial temperature, which is often incorporated additionally to blood flow. Increases in blood volume pulse, blood volume, and temperature are taken to represent the physiological blushing response.

We investigated physiological blushing in relation to SAD symptoms concurrently and longitudinally in two samples of children: one in early childhood (4.5–7.5 years old) and the other in late childhood (8–12 years old). At the age of 4.5, we found that more physiological blushing indexed as temperature increase during the social performance and watching back the performance in front of a small audience was related to more social anxiety symptoms at the same age (Nikolić, de Vente, Colonnese, & Bögels, 2016). We also examined whether blushing predicts SAD symptoms development longitudinally (from the age of 4.5 to 7.5 years) in the same sample. Again, we found that blushing, indexed as the temperature increase, predicts the development of SAD symptoms at 7.5 years, even after controlling for earlier social anxiety symptoms and fearful temperament (Nikolić et al., 2019). We found the same result in children aged 8–12 (Nikolić, van der Storm, Colonnese, Brummelman, Kan, & Bögels, 2019)—children with more SAD symptoms displayed higher increases in temperature during a performance in front of a small audience.

An interesting question is why the temperature increase, but not the blood pulse amplitude and blood volume increase, relate to SAD symptoms. A possible explanation is that only with the temperature increase, children detect that their cheeks are getting hot and they infer that they blush (Cooper & Gerlach, 2012). The awareness of oneself blushing (rather than blushing itself) may then cause distress and avoidance in children, leading to SAD. Another possible explanation is that slow changes in temperature (but not the fast changes in blood pulse amplitude) reflect blushing that results from social stress due to prolonged social exposure (i.e., creeping blush) (Leary et al., 1992; Nikolić, Majdandžić, de Vente, Möller, & Bögels, 2019), which may be especially uncomfortable.
because it is lengthy and uncontrollable, and, thus, may lead to avoidance of similar situations in the future and result in increasing social anxiety.

The quick changes that are captured by blood pulse amplitude may, in contrast, indicate sudden blush that comes and goes quickly during social interactions. This kind of blush may be related to social sensitivity that does not result in fear and anxiety (Nikolić et al., 2019). For example, we found that blood pulse amplitude increase is related to positive shyness (Nikolić et al., 2016) and to well-developed socio-cognitive skills, such as mindreading (Nikolić et al., 2019)—the ability to detect and recognize others’ mental states based on external cues, such as people’s facial expressions (Baron-Cohen, Jolloffe, Mortimore, & Robertson, 1997). Unlike the prolonged blush that seems less adaptive as it contributes to SAD development, sudden blush may be adaptive in certain social situations because it helps the blusher appease others when, for example, there is a possibility of others’ negative evaluation (Leary et al., 1992).

However, in a situation in which there is no clear threat to the child’s social standing, even the sudden blush may be dysfunctional. For example, we found that children aged 8–12 with higher number of social anxiety symptoms display more blushing indexed as blood pulse amplitude when they receive inflated praise—‘You sang incredibly well’—about their performance from an ‘expert singer’ (Nikolić, Brummelman, Colonnesi, de Vente, & Bögels, 2018). Receiving inflated praise is not considered to be threatening because it does not put a child in a situation in which they may lose social status, therefore, blushing in this situation may be less adaptive. However, socially anxious children may dread inflated praise because they may perceive the praise as undeserved (Crozier, 2004) and may believe that they cannot live up to the inflated image other people hold of them (Brummelman, Thomaes, Orobio de Castro, Overbeek, & Bushman, 2014).

In sum, we found that prolonged blushing, indexed as temperature increases in socially threatening situations contribute to the development of SAD, but even sudden blushing indexed as blood pulse amplitude increases in situations in which children’s social status is not clearly threatened is associated with SAD symptoms.

Social cognition in the development of social anxiety disorder

The dysregulation of social emotions in social anxiety may be rooted in disturbances in socio-cognitive skills. Indeed, several studies found that
deficits in socio-cognitive skills are associated with higher social anxiety levels in children aged 4–11 (e.g., Banerjee & Henderson, 2001; Broeren & Muris, 2009). We found the same negative relation between Theory of Mind (ToM) – the ability to understand and predict other people’s behaviours on the basis of their mental states (Wellman, 1990) and social anxiety in children aged 4.5 (Colonnesi et al., 2016). In addition, we discovered that deficits in understanding emotions, rather than beliefs, are related to higher social anxiety levels in young children.

However, some studies found no relation between socio-cognitive skills and children’s social anxiety (e.g., Broeren, Muris, Diamantopoulou, & Baker, 2013) and one study even found that children with advanced socio-cognitive abilities are more sensitive to others’ criticism, which can bring about more social anxiety (Cutting & Dunn, 2002). Because some studies found low and some high levels of socio-cognitive skills in social anxiety, we suggested that the relation between socio-cognitive skills and childhood social anxiety may not be linear, as past studies assumed, but is rather quadratic, meaning that both low and high levels of socio-cognitive abilities may be related to SAD symptoms in children (Nikolić et al., 2019). We examined this idea using mindreading (Baron-Cohen et al., 1997).

**Mindreading**

Mindreading may be of particular importance for SAD because it requires the detection of others’ mental states based on external cues, most commonly facial expressions. Facial expressions are relevant for children with SAD because they signal disapproval or rejection (Rapee & Heimberg, 1997). We, therefore, measured this ability in children aged 8–12 and examined if it is associated with social anxiety symptoms. We assumed that both low and advanced mindreading may be related to social anxiety symptoms in children. On the one hand, deficits in mindreading may be related to social anxiety symptoms because not being able to decode accurately others’ feelings and thoughts may lead to inaccurate beliefs about others and inaccurate predictions of their behaviours. This may increase confusion and unpredictability in social situations, which may lead to fear, avoidance and, ultimately to SAD (Colonnesi et al., 2016; O’Toole, Hougaard, & Mennin, 2013). On the other hand, advanced mindreading may also be related to social anxiety symptoms in children because advanced mindreaders are more attuned to social
cues (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) and they may easily become aware that they are a subject of other people’s evaluation, which may be unfavourable and which can make them become highly self-conscious (Fenigstein, 1979). Heightened self-consciousness in social situations, in turn, may contribute to more social anxiety symptoms (Nikolić et al., 2019). We, indeed, found that both low and high levels of mindreading are related to higher number of social anxiety symptoms in children. Also, we found that high mindreading was related to social anxiety symptoms through blushing, thus, confirming our idea that advanced mindreading may give rise to heightened self-consciousness, which is, in turn, associated with concerns about being evaluated negatively.

**Theoretical and clinical implications**

The findings on social anxiety and SAD symptoms from our lab suggest that there may be two pathways to the development of SAD—one through fearful temperament, and the other through heightened self-conscious reactivity. We found that social BI and physiological hyperarousal in toddlerhood and early childhood (2.5 to 4.5 years) predicts the onset of social anxiety symptoms in early childhood, and these symptoms, in turn, predict SAD symptoms later in childhood. Thus, fearful reactions in social situations are especially important in these early years of child development when it influences the occurrence of the first evaluative concerns, which later may cause SAD.

What are the roots of the elevated fear response in young children? Clearly, fearful temperament is the core of high fear responding, but other factors may play role as well. Although we did not investigate this, it could be that the fear response in early childhood is, at least partly, rooted in the deficits in socio-cognitive skills, and possibly, they reinforce each other in early childhood eventually leading to SAD—fear unables children to gain social experiences and develop socio-cognitive skills and the deficits in socio-cognitive skills, in turn, lead to inaccurate understanding of social situations and more fear and avoidance. Eventually, when avoidance of social situations becomes extreme and impairs everyday social functioning, SAD is diagnosed in these children.

The other pathway to SAD through heightened self-conscious reactivity starts later in childhood, between 4.5 and 7.5 years. Heightened self-conscious reactivity that contributes to SAD is behaviourally expressed as
avoidant-dominant shyness and physiologically as prolonged blushing. What are the roots of heightened self-conscious reactivity? We found that heightened self-conscious reactivity may be rooted in advanced socio-cognitive skills (Nikolić et al., 2019). Children with advanced socio-cognitive abilities are socially sensitive – they are especially attuned to social cues from others (Baron-Cohen et al., 2001). Thus, they may easily become aware of being a subject of other’s evaluation. Because the evaluation might be negative, the awareness of this possibility may give rise to heightened self-consciousness (Fenigstein, 1979).

Of note, sudden blush and positive shy expressions, seem not to pose risk for the development of SAD symptoms and may be an adaptive way of coping with stressful social situations. It is only when these behaviours are displayed in non-threatening social situations (such as being praised) that they may also pose risk for SAD symptoms.

Because our findings suggest that dysregulated social emotions and deficits, as well as very high levels of socio-cognitive skills, may pose risk for SAD, the treatment of childhood SAD may specifically focus on (1) emotional experiences and their physiological component and (2) socio-cognitive skills. For example, task concentration training (Bögels, 2006) may train children to concentrate on the task rather than on the self and mindfulness and self-compassion-based treatment (Kabat-Zinn, 1982; Neff, 2003) may help children understand and accept their emotions as transient states, fostering emotion coping strategies. Finally, for children with low socio-cognitive skills, treatment may focus on enhancing socio-cognitive abilities, whereas for children with advanced socio-cognitive skills, they may focus on tackling and dealing with excessive mindreading.

Conclusion

SAD is an impairing disorder characterized by difficulties in social functioning. Our findings revealed that already early in childhood, dysregulated social emotions and disturbances in socio-cognitive skills are involved in the development of SAD. Specifically, those children who do not understand others’ intentions, emotions, and feelings and become fearful in social situations, and those who are highly attuned to social cues, advanced in understanding others’ mental states, and highly self-conscious are at risk for developing SAD, likely because they experience social situations as uncomfortable and avoid similar situations in the future. Clinical and prevention programmes of SAD in children should,
therefore, explicitly focus on understanding children’s emotions, and not only cognition in social situations.

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