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Social anxiety and the cortisol response to social evaluation in children and adolescents

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ABSTRACT

Contradictory findings have been reported on the relation between social anxiety and the cortisol response to social evaluation in youth. The present longitudinal study aimed to clarify this relation by taking pubertal development into account. Data were collected in two waves, two years apart, for a community sample of 196 participants, aged 8–17 years at Time 1. Pubertal development and social anxiety were assessed with self-report questionnaires. Salivary cortisol was obtained before and after participants completed the Leiden Public Speaking Task. Data were analyzed using regression analysis with clustered bootstrap. The dependent variable was the cortisol area under the curve. Social anxiety and pubertal development scores were decomposed into between- and within-participants components. Between participants, the relation between social anxiety and the cortisol response to public speaking varied with pubertal development: socially anxious individuals showed *higher* responses at low levels of pubertal development, but *lower* responses at high levels of pubertal development. Within participants, an increase in social anxiety over time was associated with a *lower* cortisol response. The results are in line with the suggestion that the responses of socially anxious individuals change from elevated in childhood to attenuated in adolescence and adulthood. Attenuation of the cortisol response is explained by theories proposing that the stress response changes with the duration of the stressor.

1. Introduction

Social Anxiety Disorder (SAD) is characterized by strong fear or anxiety about social situations in which one may be scrutinized by others (American Psychiatric Association, 2013). These fears vary along a continuum in the general population (Rapee and Spence, 2004). For adolescents with SAD or subclinical levels of social fears, public speaking is among the most commonly feared situations (Essau et al., 1999; Gren-Landell et al., 2009). Therefore, it has long been hypothesized that high socially anxious youth show larger cortisol responses to public speaking than low socially anxious youth. Van West et al. (2008) provided support for this hypothesis, but other studies found no difference (Martel et al., 1999; Schmidt et al., 1999; Miers et al., 2011; Krämer et al., 2012). Based on their review of physiological and neuroendocrine responses in socially anxious youth, Siess et al. (2014) suggested a developmental change from elevated responses in children to no difference and possibly attenuated responses in adolescents and adults. However, the studies available for review were mainly cross-sectional studies on physiological responses. To our knowledge, the current study presents the first longitudinal data on the relation between social anxiety and the cortisol response to public speaking in late childhood to adolescence.

Evidence for a shift from hypercortisolism in childhood to hypocortisolism in adolescence and adulthood has been provided by a few longitudinal studies on (general) internalizing problems and adverse life events. Recent appearance of internalizing symptoms predicted higher diurnal cortisol levels (Ruttle et al., 2011) and elevated responses to a social stress task in adolescence (Booij et al., 2013), whereas a history of internalizing problems predicted attenuated cortisol levels and responses (Booij et al., 2013; Ruttle et al., 2011). Moreover, a study by Trickett et al. (2010) provided evidence for a change within individuals. Female victims of childhood sexual abuse showed higher diurnal cortisol levels than control participants who were not sexually abused shortly after the abuse was disclosed. Sixteen years later, however, the victims showed lower cortisol levels than the control participants. These studies

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concluded that the time since stressor onset predicts the occurrence of hyper- or hypocortisolism. This conclusion was supported by a meta-analysis of predominantly adult studies, demonstrating elevated cortisol levels for recent stressors and increasingly attenuated cortisol levels with time since stressor onset (Miller et al., 2007).

Theoretically, attenuated cortisol levels and responses have been interpreted as adaptations to a history of many stressful events: to diminish allostatic load resulting from high cortisol levels (Fries et al., 2005), as adaptive calibration of the stress system to dangerous environments (Del Giudice et al., 2011), and through protective inhibition of motivation to engage in challenges that may exceed one's resources or induce allostatic load (Tops et al., 2015; Tops et al., 2016). Attenuation is often related to traumatic events (e.g. Miller et al., 2007; Trickett et al., 2010). The Protective Inhibition of Self-regulation and Motivation (PRISM) model (Tops et al., 2015; Tops et al., 2016) explains how attenuation can result from an accumulation of daily stressors.

Tops et al. (2014) proposed that behavior and homeostasis are controlled prospectively in predictable, safe situations and reactively in unpredictable, threatening situations. Because reactive control takes over when routinized, efficient responses cannot be applied and it is uncertain which responses are optimal, this control is associated with emergency ("just in case") high-intensity responses and allostatic load. PRISM serves to limit the time spent in reactive control mode (Tops et al., 2015; Tops et al., 2016). It does so by reducing motivation, through adaptation of one's subjective estimates of efforts needed to meet a challenge, efforts made and resources available (Tops et al., 2015; Tops et al., 2016). The PRISM model predicts that an initially high cortisol response to unpredictable, threatening situations turns into a low cortisol response when the situation persists (Tops et al., 2015).

Cortisol is involved in the regulation of energy for the activation of physiological and neural systems to actively deal with challenges (Sapolsky et al., 2000). For instance, cortisol responses to a public speaking task produce a bias in cognitive processes towards stimuli associated with the challenge (Smeets et al., 2007; c.f. Joëls et al., 2006). The appraisal that overcoming the challenge through active coping is impossible or disproportionately effortful tends to result in low cortisol responses (Denson et al., 2009; Moons et al., 2010). Consequently, low cortisol is associated with fatigue, reduced motivation and perceived uncontrollability (Chida and Steptoe, 2009; Tops et al., 2016). Chronic or recurrent challenges are uncontrollable in the sense that, over time, coping attempts that activated physiological and neural systems have proven futile in overcoming them. Socially anxious individuals may often experience a threat of negative evaluation in everyday social situations and this may activate PRISM. Persistently high (or increasing) levels of social anxiety may therefore be associated with a low cortisol response to social evaluation (over time).

In adolescence, the cortisol response is not only affected by stressor history, but also by normative development. Several studies have demonstrated an increase in the cortisol response to social evaluation in adolescence (Klimes-Dougan et al., 2001; Gunnar et al., 2009; Stroud et al., 2009; Sumter et al., 2010). This normative increase appears more strongly related to pubertal development than to age (Van den Bos et al., 2014).

The present longitudinal study investigated whether social anxiety is related to attenuation of the cortisol response to public speaking in a community sample of children and adolescents. We also investigated the interaction between social anxiety and pubertal development, because PRISM may occur alongside the typical puberty-related increase of the cortisol response. We expected the cortisol response to our social-evaluative situation to be negatively related to social anxiety (between and within-participants). However, this relation may only become apparent with advancing pubertal development. Depression and a general measure of anxiety were included as control variables to check whether the relation is specific to social anxiety.

Table 1
Social Background Characteristics of Participants and Their Parents Assessed at Time 1.

Category	Frequency
Country of birth participants (N = 314)	
The Netherlands	299
Thirteen different countries	15
Country of birth parents (N = 455)	
The Netherlands	416
Twenty-two different countries	39
Living situation (N = 321)	
With both biological parents	266
With biological mother only	19
With biological mother and stepfather	17
With each biological parent in alternation	8
Other	11
Present education participants (N = 327)	
Primary school	126
Prevocational secondary education	24
Senior general/preuniversity secondary education (year 1)	38
Senior general secondary education (years 2-5)	66
Preuniversity secondary education (years 2-6)	73
Highest completed education parents (N = 505)	
Primary school or less	5
Prevocational education	88
Middle to higher secondary education	46
Middle vocational education	89
Higher vocational education	136
University	134
Other	7

Note: In the Netherlands, senior general education is a five-year program preparing for higher vocational education. Preuniversity education is a six-year program preparing for university. Students are selected for either program during the first (combined) year.

2. Method

2.1. Participants

The data were collected as part of the Social Anxiety and Normal Development (SAND) study, which was approved by the Leiden University Medical Ethical Committee and carried out in accordance with the Declaration of Helsinki. Parents provided active consent; written assent was obtained from participants themselves.

The SAND-study aimed for a normative sample. Participants were recruited through two primary schools and one secondary school in a middle-sized city in the Netherlands. Students with severe psychological problems or physical illness were excluded from participation. If such problems had been registered at school, students were not invited. To identify individuals with conditions unknown to the school, participants completed a health and medication history questionnaire probing for treatment by a mental health professional and physical complaints. All eligible children in the last three primary school grades were invited to participate. Pupils in the first four grades of secondary school completed the Social Anxiety Scale for Adolescents (SAS-A; La Greca and Lopez, 1998). Then, stratified random sampling was used to invite 204 participants (out of 488), with equal numbers of boys and girls of each age. This procedure resulted in a sample of 126 primary school participants and 173 secondary school participants that was representative of the general population. To address questions related to social anxiety, all remaining secondary school students with standardized SAS-A scores among the top 20% of their sex (n = 38) were invited to participate. The present study used the total sample, with