



Research report

Autonomic arousal in childhood anxiety disorders: Associations with state anxiety and social anxiety disorder

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ABSTRACT

Background: Psychophysiological theories suggest that individuals with anxiety disorders may evidence inflexibility in their autonomic activity at rest and when responding to stressors. In addition, theories of social anxiety disorder, in particular, highlight the importance of physical symptoms. Research on autonomic activity in childhood (social) anxiety disorders, however, is scarce and has produced inconsistent findings, possibly because of methodological limitations.

Method: The present study aimed to account for limitations of previous studies and measured respiratory sinus arrhythmia (RSA) and heart rate (HR) using Actiheart heart rate monitors and software (Version 4) during rest and in response to a social and a non-social stressor in 60 anxious (30 socially anxious and 30 'other' anxious), and 30 nonanxious sex- and age-matched 7–12 year olds. In addition, the effect of state anxiety during the tasks was explored.

Results: No group differences at rest or in response to stress were found. Importantly, however, with increases in state anxiety, all children, regardless of their anxiety diagnoses showed less autonomic responding (i.e., less change in HR and RSA from baseline in response to task) and took longer to recover once the stressor had passed.

Limitations: This study focused primarily on parasympathetic arousal and lacked measures of sympathetic arousal.

Conclusion: The findings suggest that childhood anxiety disorders may not be characterized by inflexible autonomic responding, and that previous findings to the contrary may have been the result of differences in subjective anxiety between anxious and nonanxious groups during the tasks, rather than a function of chronic autonomic dysregulation.

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1. Introduction

Anxiety disorders, and social anxiety disorder in particular, are common in childhood, are frequently chronic if left untreated, and are associated with emotional distress as well as impairment in social and academic functioning (Essau et al., 2000; Ezpeleta et al., 2001; Mychailyszyn et al., 2010; Newman et al., 1996). Even though childhood anxiety can be treated effectively through the use of Cognitive Behavior Therapy (CBT), in approximately 40% of cases CBT does not lead to a substantial reduction of anxiety symptoms (In-Albon and Schneider, 2007) and, notably, the presence of social anxiety disorder has been found to be associated with especially poor treatment outcomes from generic treatments (Hudson et al., 2010). In order to

improve treatment outcomes for anxious children, particularly those with social anxiety disorder, a better understanding of potential maintaining processes is required.

Psychophysiological theories suggest that anxiety disorders may be associated with chronic dysregulation of the autonomic nervous system. Friedman's (2007) autonomic flexibility-neurovisceral integration model proposes that individuals with anxiety disorders evidence inflexibility in their autonomic response both in the absence of stress and when responding to stressors. In relation to activity of the parasympathetic nervous system in particular, the model predicts that, in comparison to nonanxious populations, individuals with anxiety disorders will (i) display increased heart rate (HR) and diminished respiratory sinus arrhythmia (RSA) (respiratory linked heart-rate variability (HRV)) at baseline, (ii) fail to substantially increase HR and decrease RSA in response to a stressor, and (iii) recover more slowly once the stressor has passed.

Studies investigating the role of autonomic parasympathetic arousal in childhood anxiety disorders have produced conflicting

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findings, with some studies showing higher HR and/or lower RSA at baseline in children and adolescents with anxiety disorders when compared to controls (Henje Blom et al., 2010; Monk et al., 2001; Sharma et al., 2011a) and others failing to show such differences (Kossowsky et al., 2012; Kristensen et al., 2014; Sharma et al., 2011b; Yeragani et al., 2001). In addition, while one study has found lower reactivity to a stressor (i.e., less change from baseline in response to a task) in anxious groups in comparison to control groups (Monk et al., 2001), another study has shown greater reactivity (Kossowsky et al., 2012), and some studies have found no differences (Beidel, 1991; Kristensen et al., 2014; Sharma et al., 2011b). Interpreting these mixed findings is difficult because of a number of methodological factors. Specifically children participating in these studies have typically been drawn from a broad age range (6–18 years) (Monk et al., 2001; Sharma et al., 2011a, 2011b), anxiety disorder and comparison groups have not been matched on age and gender (Monk et al., 2001), studies have relied on one single stressor only (Kossowsky et al., 2012), or employed physiological rather than psychological stressors (Monk et al., 2001; Sharma et al., 2011b), and/or the effects of respiration have not been taken into account (Beidel, 1991).

The experience of physiological symptoms occupies a central role in models of the maintenance of social anxiety disorder (Clark and Wells, 1995), yet few studies have investigated whether children with social anxiety disorder, specifically, show a different pattern of autonomic arousal compared to children with other anxiety disorders and nonanxious children. Two studies have shown that, compared to nonanxious children, children (8–12 years) with social anxiety disorder had higher HR and lower RSA at baseline, reacted to a social stressor with less change in HR and/or RSA, and took longer to return to their initial baseline levels once the stressor passed (Krämer et al., 2012; Schmitz et al., 2011). This pattern of restrictive autonomic flexibility has also been shown in a group of high socially anxious children in comparison to low socially anxious children drawn from a community population (Schmitz et al., 2013). All of these studies, however, lacked a non-social anxiety disordered comparison group. Thus it remains unclear whether the findings are specific to social anxiety disorder or apply to anxiety disorders in general. In addition, the absence of a non-social stressor makes it difficult to establish whether differences in autonomic activity are only detectable during disorder-specific tasks or whether they generalize to other situations. Furthermore, the socially anxious children in these studies reported elevated levels of anxiety during the task compared to nonanxious children, and therefore differences between the groups might have been a reflection of their current state rather than trait anxiety.

The present study was designed to overcome some of the limitations of previous studies by measuring HR and RSA in children with a primary diagnosis of social anxiety disorder, children with an anxiety disorder other than social anxiety disorder, and healthy control

children, with measurements made at baseline and in response to a social and a non-social stress task. The design allowed for the testing of the following specific hypotheses:

1. Children with a current anxiety disorder will display higher HR and lower RSA at baseline in comparison to nonanxious children.
2. Children with a current anxiety disorder will display reduced HR reactivity and RSA reactivity in response to a stressful task in comparison to nonanxious children. This effect will be amplified among socially anxious children in a social stress task, compared to other anxious and nonanxious children.
3. Children with a current anxiety disorder will display reduced HR recovery and RSA recovery after a stressful task in comparison to nonanxious children. This effect will be amplified among socially anxious children in a social stress task, compared to other anxious and nonanxious children.

In addition, the impact of differences in children's state anxiety during the tasks on differences in autonomic activity was examined in response to and during recovery from stressful tasks.

2. Method

2.1. Participants

Ninety children aged 7–12 years took part in the study. Thirty children met diagnostic criteria for a primary diagnosis of social anxiety disorder (SA), 30 met diagnostic criteria for an anxiety disorder but not social anxiety disorder (ANX), and 30 were selected on the basis of having anxiety levels within a non-clinical range (NONANX). The number of male ($n=14$) and female ($n=16$) participants in each group was the same and groups were of similar age ($F(2, 89)=.03, p=.96$) (see Table 1).

Children in the clinical groups were by referred to the Berkshire Child Anxiety Clinic (BCAC) at the University of Reading by local health and education service personnel as part of a larger investigation. In addition to the specified age, the other requirement for inclusion was that they meet criteria for a current primary anxiety disorder diagnosis. Exclusion criteria were (a) significant physical or intellectual impairment (where this would impede reliable completion of measures), (b) current prescription of psychotropic medication (or if on medication this should have been stable for a month), however none of the participants was prescribed psychotropic medication at the time of the assessment; and (c) previous receipt of six or more sessions of cognitive behavior therapy (i.e., treatment specifically targeting the processes under investigation by the larger study). Following referral, children and their primary caregiver were invited for an initial clinical assessment where they were interviewed

Table 1
Sample characteristics.

	SA	ANX	NONANX	
	$N=30$	$N=30$	$N=30$	
	Mean (SD)	Mean (SD)	Mean (SD)	
Age (years)	9.30 (1.62)	9.40 (1.50)	9.36 (1.40)	$F(2, 89)=.03$
Gender (% female)	53%	53%	53%	$\chi^2(1)=1.00$
BMI	18.58 (3.57)	17.44 (1.99)	17.85 (3.14)	$F(2, 78)=.99$
SCAS-c total	39.70 (17.93) ^a	31.23 (18.91)	22.10 (12.52) ^a	$F(2, 86)=7.98^{***}$
SCAS-c social phobia	7.38 (3.72) ^{a, b}	4.51 (3.40) ^b	4.25 (3.07) ^a	$F(2, 81)=6.88^{**}$
SCAS-p total	39.84 (17.82) ^{a, c}	30.44 (11.82) ^{b, c}	11.36 (6.94) ^{a, b}	$F(2, 82)=36.75^{***}$
SCAS-p social phobia	11.61 (9.72) ^{a, c, b}	6.37 (4.16) ^{b, c}	3.92 (2.65) ^c	$F(2, 80)=10.70^{***}$

BMI: Body Mass Index; SCAS-c/p: Spence Children's Anxiety Scale- child/parent report; ^a, ^b and ^c denote groups that significantly differ.

** $p < .01$.

*** $p < .001$.

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