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There's that scary picture: Attention bias to threatening scenes in Williams syndrome

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ABSTRACT

There is increasing evidence that Williams syndrome (WS) is associated with elevated anxiety that is non-social in nature, including generalised anxiety and fears. To date very little research has examined the cognitive processes associated with this anxiety. In the present research, attentional bias for non-social threatening images in WS was examined using a dot-probe paradigm. Participants were 16 individuals with WS aged between 13 and 34 years and two groups of typically developing controls matched to the WS group on chronological age and attentional control ability, respectively. The WS group exhibited a significant attention bias towards threatening images. In contrast, no bias was found for group matched on attentional control and a slight bias away from threat was found in the chronological age matched group. The results are contrasted with recent findings suggesting that individuals with WS do not show an attention bias for threatening faces and discussed in relation to neuroimaging research showing elevated amygdala activation in response to threatening non-social scenes in WS.

1. Introduction

Williams syndrome (WS) is a rare genetic disorder caused by a microdeletion of approximately 28 genes on one copy of chromosome 7 (Ewart et al., 1993). WS is associated with a mild to moderate intellectual impairment, facial dysmorphology, medical complications and an outgoing, hyper-social personality (Bellugi, Lichtenberger, Jones, & Lai, 2000; Einfeld, Tonge, & Florio, 1997; Mervis & Klein-Tasman, 2000). In striking contrast to this fearless social behaviour, individuals with WS experience significant anxiety that is 'non-social in nature' (Jarvinen-Pasley et al., 2008, p. 7). Recent research has begun to delineate the neural and cognitive processes that underpin this dissociation between social and non-social anxiety in WS (Dodd & Porter, 2010b; Meyer-Lindenberg et al., 2005; Munoz et al., 2010). However, the majority of research has remained focused on WS social behaviour (Haas et al., 2009; Martens, Wilson, Dudgeon, & Reutens, 2009; Santos, Silva, Rosset, & Deruelle, 2010) and only a small body of research has examined cognitive processes associated with non-social anxiety in this population. The present research aims to address this gap in the literature by examining attentional processing associated with elevated non-social anxiety in WS.

Early indications that WS was associated with high levels of anxiety, fears and worries came from questionnaire measures of psychopathology (e.g. Einfeld et al., 1997; Udwin, 1990). These observations have since been supported by studies using diagnostic interviews validated against the Diagnostic and Statistical Manual for Mental Disorders (DSM; American Psychiatric Association, 1994). For example, in the most comprehensive assessment of clinical anxiety in WS conducted to date, Leyfer, Woodruff-Borden, Klein-Tasman, Fricke, and Mervis (2006) assessed 119 children with WS and found that rates of GAD (12%) and Specific Phobia (54%) were unusually high relative to the typically developing population. Similar prevalence rates have also been found in samples of adults with WS (Dodd & Porter, 2009; Dykens, 2003). Interestingly, however, there is little evidence that rates of Social Phobia are elevated in this population; prevalence rates and levels of anxiety symptoms tend to be consistent or lower than those reported in typically developing groups (Dodd & Porter, 2009; Dodd, Schniering, & Porter, 2009; Leyfer et al., 2006).

In an influential study, Meyer-Lindenberg et al. (2005) found that patterns of amygdala activation in WS were highly consistent with this pattern of dissociated social and non-social anxiety; relative to typically developing controls, individuals with WS exhibited *elevated* amygdala activation in response to threatening non-social stimuli and *attenuated* amygdala activation in response to threatening social stimuli. Further analyses revealed abnormalities in the prefrontal system involved in down-regulation of the amygdala

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in the WS participants. These findings, recently replicated (Munoz et al., 2010), provided initial insight into the neurological processes that may underpin the dissociation between social and non-social anxiety in WS. Subsequent research has extended these findings and demonstrated that, although individuals with WS exhibit attenuated amygdala activation in response to fearful faces, elevated amygdala activation, relative to typically developing controls, is found in response to happy faces (Haas et al., 2009).

Both the amygdala and the prefrontal cortex (PFC) have been implicated in cognitive models of attention in anxiety (Bishop, 2007; Mathews & Mackintosh, 1998). Building on biased competition models of selective attention these models propose that when multiple stimuli compete for attention, the outcome depends upon the interaction of bottom-up threat detection mechanisms and top-down control mechanisms. These competing inputs are thought to be underpinned by the amygdala and the PFC, respectively. That is, the amygdala is theorised to support the early threat-detection mechanism and the initial orienting of attention and the PFC is thought to underpin the control of attentional resources required to inhibit further processing of selected stimuli (Bishop, 2007, 2009; Cisler & Koster, 2010; Pine, 2007). It seems plausible; therefore, that the pattern of amygdala and PFC activation observed in WS might indicate atypical attentional deployment to certain stimuli. Two recent studies have found initial support for this hypothesis. Dodd and Porter (2010a) used a dot-probe paradigm (described below) and found that individuals with WS were biased to attend to happy faces but not to angry faces and Santos et al. (2010) found decreased detection of angry faces in WS using a visual search task compared to typically developing individuals. Both of these findings are consistent with the patterns of amygdala activation reported for social stimuli, outlined above (Haas et al., 2009; Meyer-Lindenberg et al., 2005). To date, however, there is no comparable research examining attentional processing related to non-social stimuli in WS. If the patterns of amygdala activation found in previous research are genuinely associated with abnormalities in attentional deployment in WS, an attention bias for images depicting non-social threat would also be expected. The present research addresses this hypothesis using a dot-probe task based on that used by Dodd and Porter (2010a).

The dot-probe task is one of the most commonly used paradigms for assessing attention bias (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). In the dot-probe task, a neutral stimulus and a threatening stimulus are presented simultaneously, followed immediately by a probe in the same location as either the threatening or neutral stimulus. Participants are instructed to respond to the probe as quickly as possible. This paradigm has been used to assess both within-subjects and between-subjects attention biases. A within-subjects bias is found when a group responds significantly faster to the probe when it follows the threatening stimulus (congruent trial) than the neutral stimulus (incongruent trial). A between-subject bias occurs when significant differences in the size of the bias (congruent trials–incongruent trials) are found between two or more groups. Both types of bias are consistently found in anxious typically developing adults and children (Bar-Haim et al., 2007).

Although the dot-probe task has been used extensively to examine threat-related attention bias in anxious populations, there has been some debate regarding which components of attention the task measures. Derryberry and Reed (2002) highlighted that a faster response time on congruent than incongruent trials could occur for two reasons: because the threat image captures attention, which leads to a faster response time on congruent trials or, alternatively, because it is difficult to disengage attention from the threat image, which leads to a slower response time on incongruent trials. Koster, Crombez, Verschuere, and De Houwer (2004) explored these alternatives by including a baseline condition in which both images were neutral. By comparing congruent and incongruent trials to the neutral condition it was possible to differentiate between vigilance and disengage effects. Using this procedure, Koster et al. (2004) found that attention bias is primarily driven by disengage effects rather than enhanced vigilance for threat. Other research that has investigated vigilance and disengage effects has supported these findings (Salemink, van den Hout, & Kindt, 2007; Yiend & Mathews, 2001).

1.1. Aims and hypotheses

The aim of the present research was to examine whether individuals with WS exhibit an attention bias for non-social threat using a dot-probe task. In light of evidence that individuals with WS are at increased risk for GAD and Specific Phobia (Dodd & Porter, 2009; Dykens, 2003; Leyfer et al., 2006) and that individuals with WS exhibit elevated amygdala activation in response to threatening non-social stimuli (Meyer-Lindenberg et al., 2005; Munoz et al., 2010), it was hypothesised that the WS group would exhibit a significant within-subjects bias towards threatening stimuli and that the overall bias found in the WS group would be significantly larger than any bias exhibited by typically developing controls matched on attentional control or chronological age (between-subjects bias).

A neutral condition, in which two neutral images were presented, was included such that vigilance and disengage effects could be examined. Given previous findings that attention bias is primarily driven by difficulties disengaging from threat, it was hypothesised that any attention bias found in the WS group would be due to disengage effects rather than vigilance.

To examine whether any attention bias found was related to current anxiety in the WS group, the analyses were conducted with and without anxiety symptoms entered as a covariate and the overall bias was compared between WS participants who met criteria for a current anxiety diagnosis and those who did not.

2. Methods

2.1. Participants

The study involved 48 participants including 16 participants with WS, 16 typically developing participants individually matched to the WS group on attentional control and 16 typically developing participants individually matched to the chronological age of the WS group. Demographic data for each group is shown in Table 1.

2.1.1. Williams syndrome group

Participants were sixteen individuals with WS ($N = 16$, 9 male) aged between 13 and 34 years with a mean aged of 21.04 years. All participants had received a diagnosis of WS following a positive florescent in situ hybridization (FISH) test showing deletion of the elastin gene at 7q11.23 (Fryssira et al., 1997) and exhibited the typical WS phenotype. Participants were recruited through the Australian Williams Syndrome Association. Due to the attentional demands of the task, only individuals with a mild to moderate intellectual impairment who had a mental age of at least 6.5 years as assessed using the Woodcock–Johnson Test of Cognitive Ability – Revised (WJ-COG-R; Woodcock and Johnson, 1999) were invited to participate. The mental age of the participants with WS ranged from 6.75 years to 10.58 years, with a mean of 8.09. The standard scores for general cognitive functioning ranged from 48 to 77, with a mean of 64.

Current diagnostic status, according to DSM-IV criteria, was assessed through an interview with the primary caregiver using the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL; Kaufman, Birmaher, Brent, Rao, & et al., 1997). Seven of the WS participants met criteria for at least one anxiety disorder, six met criteria for a Specific Phobia and one met criteria for Generalised Anxiety Disorder.

2.1.2. Chronological age comparison group (CA)

Sixteen typically developing individuals individually matched to the WS group on chronological age, $t\ (15) = -0.023$, $p = 0.982$, were recruited via a university-administered register of teenagers and young adults who are interested in participating in research. The inclusion of a chronological age matched control group allows any influences of chronological age on attention bias to be assessed. This is necessary because the WS participants were markedly older than the participants in the attentional control comparison group (see Table 1).