School of Psychology
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Restrictive and Repetitive Behaviours and Anxiety: A Systematic Review and Autistic traits and Anxiety: The mediating role of Coping Style

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Summary of thesis

This DClinPsy thesis has been written in the format of three papers: a systematic review, an empirical paper and a critical reflection paper. Papers 1 and 2 will be submitted for publication in the journal entitled *Research in Autism Spectrum Disorders*. Paper 3 is not intended for submission.

Paper one presents a systematic review investigating the relationship between Restrictive and Repetitive Behaviours (RRB) and anxiety symptoms.

Paper two presents a quantitative study which explores the mediating role coping style has between autistic traits and symptoms of anxiety.

Paper three presents a critical reflection on the process of conducting the research along with the methodological strengths and limitations contained in this thesis. The implications of the research for clinical practice and the relevance for clinical psychology are discussed.

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Restrictive and Repetitive Behaviours and Anxiety: A Systematic Review

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Prepared according to instructions for *Research in Autism Spectrum Disorders* (see Appendix A)

Abstract

Purpose

Restrictive and Repetitive Behaviours (RRB) are a core feature of Autism Spectrum Disorders (ASD). RRB can be classified as repetitive sensory and motor behaviours (RSMB) and Insistence of Sameness (IS). Higher levels of RRB have been found to be positively associated with both somatic and cognitive symptoms of anxiety. However, the relationships between RRB subtypes and anxiety are not clear-cut. The current review sets out to systematically appraise papers that have investigated such relations.

Method

A systematic review was carried out to summarise English-language research about relationships between RRB and anxious symptomology across the ASD continuum. The quality of studies was appraised using the Effective Public Health Practice Project Quality Assessment Tool (EPHPP).

Results

Six databases for studies were published up to 20 July 2018. Of the 1,125 publications retrieved, 19 cross-sectional studies and two longitudinal studies met the inclusion criteria. RRB was positively associated with symptoms of anxiety in each study. There was inconsistent evidence for either IS or RSMB being associated with anxiety. Many of

the studies relied on parent-informed measures to assess anxiety and RRB, and were limited in capturing the full array of RRB behaviours integral to ASD.

Conclusion

These findings support the notion that RRB are associated with anxiety. Further studies, employing more comprehensive measures of RRB and measures of anxiety adapted for ASD, need to be considered to develop a broader understanding of the association between RRB and anxiety.

Keywords

Autism spectrum disorders (ASD); Restrictive and Repetitive Behaviours (RRB); Insistence of Sameness (IS); Repetitive Sensory and Motor Behaviours (RSMB); Anxiety.

1. Introduction

Autism Spectrum Disorder (ASD) is currently defined as difficulties in social communication in addition to restricted and repetitive patterns of interests and behaviours (American Psychiatric Association, 2013). This definition is based upon Happe and Ronald's (2008) fractionable model of ASD which proposes that ASD can be divided into social and nonsocial features that characterise ASD. The latest edition of the Diagnostic and Statistical Manual of Mental Health Disorders 5th edition (DSM-5; APA, 2013) provides a dimensional model of ASD whereby social communication and repetitive behaviours exist on a continuum grading from mild to severe symptoms (Faroy, Meiri, & Arbelle, 2016). This continuum of symptoms is hypothesised to be continuously distributed throughout the general population in the form of 'autism traits' (Palmer et al., 2015; Ruzich et al., 2015). Autism traits are considered to range from typicality to disorder, with the upper end of this continuum reflecting individuals formally diagnosed with ASD. In other words, behaviors allied with ASD can be present at a subclinical level for all individuals within the general population (Stewart et al., 2009; Wheelwright et al., 2010).

Restrictive and repetitive behaviours and/or interests (RRB) have been the focus of much research over the last decade (Barrett et al., 2015; Joyce, Honey, Leekam, Barrett, & Rodgers, 2017; Lin & Koegel, 2018). In accordance with the DSM-5, RRB describes a range of behaviours including fixation on a specific topic, object or subject (e.g. having very specific knowledge about trains) and adherence to specific routines (e.g. insisting on taking a certain route home,

performing the same daily routine, etc.), and repetitive motor manners (e.g. hand flapping, rocking, flicking, etc.). RRB have been reported by both professionals and parents to have a deleterious impact on emotional, social and adaptive functioning of the person with ASD (Sethi et al., 2018; Woodgate, Ateah, & Secco, 2008). Despite the heterogeneous nature of RRB, factor analyses (Bishop et al., 2013; Leekam, Prior, & Uljarevic, 2011; Mooney et al., 2009; Richler et al., 2010) indicated that RRB can be classified into two groups of behaviours, namely repetitive sensory and motor behaviours (RSMB) and Insistence on Sameness (IS) behaviours. The RSMB factor encompasses behaviours such as performing the same action over and over, and repetitive use of objects. The IS factor includes behavioural rigidity, compulsions, set rituals and resistance to change. These groups of behaviour have been found to have different neural pathways (Langen, Durston, Kas, Van Engeland, & Staal, 2011) and emerge differently in the early stages of development (Arnott et al., 2010).

RRB have been found to have an association with heightened levels of anxiety (Halim, Richdale, & Uljarević, 2018; Lidstone et al., 2014; Rodgers, Riby, Janes, Connolly, & McConachie, 2012; van Steensel, 2013). Anxiety reflects an unpleasant emotional state or affect, characterised by both cognitive and somatic symptoms (Beidel & Frueh, 2018). Cognitive symptoms of anxiety can include worry, negative thoughts and rumination, whilst somatic symptoms can include palpitations, sweating and physical complaints. Anxiety symptoms which impact on a person's everyday functioning and cause distress increase the risk of reaching the diagnostic criteria for an anxiety disorder (Bystritsky et al., 2013).

The link between RRB and anxiety could imply that RRB reflects a vulnerability for experiencing worsened levels of anxiety. For example, the desire to engage in RRB may cause

conflict in a specific social setting and lead to negative responses from others which cause anxiety (Goodwin, Groden, Velicer, & Diller, 2007). However, it is unclear as to whether IS, RSMB or other repetitive and restrictive behaviours are consequences of, or behaviours executed to cope with, anxiety (Gillott, Furniss, & Walter, 2001). Some studies have found IS, but not RSMB, behaviours to be positively associated with anxiety (Lidstone et al., 2014; Rodgers et al., 2012), whilst others have found a relationship between both IS and RSMB behaviours with anxiety (Joyce et al., 2017; Wigham et al., 2015). Potential explanations for these discrepancies may stem from methodological differences in data collection. For example, some studies have relied on parent and teacher reports (Lecavalier, 2006) and self-report measure (Joyce et al., 2017), whilst others relied on clinician-administered measures (Eussen et al., 2013; Simonoff et al., 2008). Further to this, some of these studies have analysed IS but not included a measure of RSMB (Gotham et al., 2015). Consequently, examining these constructs individually may provide further insights into the function of RRB and anxiety.

The relation between ASD and anxiety may be impacted by individual differences that extend beyond the hallmark symptoms of ASD. For example, the chronological age of someone with ASD has been positively associated with heightened levels of anxiety (Vasa et al., 2013). Distinct differences in cognitive and adaptive functioning have also been considered a factor associated with anxiety and ASD. For instance, there has been a positive association between IQ scores and heightened levels of anxiety within ASD populations (Mayes, Calhoun, Murray, Zahid, 2011; Niditch, Varela, Kamps, & Hill, 2012; Sukhodolsky et al., 2008). Similarly, Rieske et al. (2013) observed that higher adaptive ability as indexed by the Battelle Developmental Inventory-Second

Edition (BDI-2; Newborg, 2005) was associated with enhanced levels of anxiety in toddlers and infants who have ASD.

A previous published systematic review by Spain, Sin, Linder, McMahon and Happé (2018) examining social anxiety in individuals with ASD reviewed 24 studies and noted that social communication difficulties in ASD were associated with symptoms of social anxiety. Specifically, poorer social skills and social competence were associated with an exacerbation of symptoms of social anxiety. However, the authors concluded that there was limited evidence to support a relationship between RRB and social anxiety. A limitation of Spain et al.'s review was that the authors did not specifically search for papers that included key search terms such as IS, RSMB or similar variants. In addition, Spain et al. exclusively focused on social anxiety as opposed to other subtypes of anxiety, or more general anxious symptomology. Social anxiety has been found to be one of the most common types of anxiety disorders in ASD populations (White et al., 2014), yet several studies also report an association between more generalised types of anxiety and ASD symptoms (Lever & Geurts, 2016; Murray et al., 2019). Taken together, the link between RRB and a wide breadth of anxiety symptoms warrants attention.

The aim of the present review is to systematically examine empirical research regarding associations between RRB and anxiety. The review bridges a gap in the literature by focusing on the differential relations between RRB subtypes and anxiety symptoms. Understanding the association between these two constructs may shed further light on the function of different types of RRB and their relation with anxiety. This may allow clinicians and researchers to identify individuals who are high risk for anxiety and contribute to designing early interventions for managing such distress.

2. Methods

2.1 Search Strategy

Six databases (PsychINFO, Medline, PubMed, Web of Science, Cinhal, and Child Development & Adolescent Studies) were searched between 16 and 20 July 2018 to identify relevant articles. Databases were searched for the following key words: a) autis* OR Asperger* OR development* disorder*; b) Stereotyp* behavi* OR Motor Stereotyp* OR Repetitive OR repetitive sensorimotor OR insistence on sameness OR Repetitive speech OR Repetitive motor behavi* OR circumscribed interest* OR self-stimulatory OR stimming OR self-restricted behavi* OR repetitive sensory motor behavi*; c) anxi*. These groups were then combined using the Boolean operator AND. Searches were limited to those published in English, in peer-reviewed journals and involving human participants only. No limits were placed on publication date as no reviews were found related to the current aims. To strengthen the sensitivity of the search, the reference lists of relevant articles were examined to identify further papers. Key journals in this area were also hand searched *(Autism, Research in Autism Spectrum Disorders* and *Journal of Autism and Developmental Disorders*).

2.2 Inclusion and Exclusion Criteria

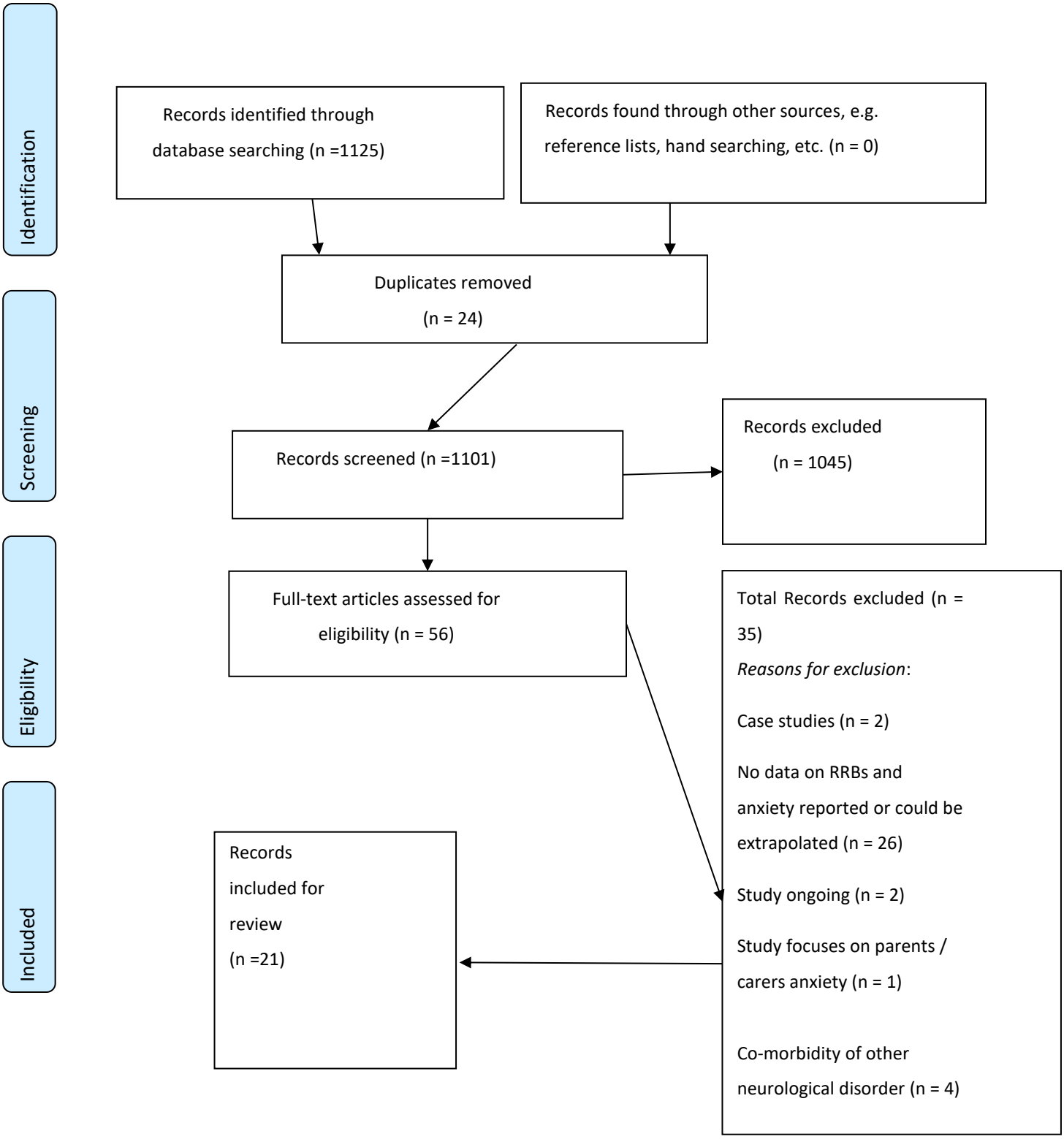
The review set out to examine RRB across the developmental lifespan. Therefore, papers were included for review if they met the following criteria: 1) included a measure of restrictive and repetitive behaviours and/or interests; and 2) included an assessment measure of anxiety. For inclusivity, the review was not limited to a specific type of anxiety; therefore, both disorder specific measures (e.g. obsessive compulsive disorder, social phobia, etc.) and more generalised measures of anxiety (e.g. Beck Anxiety Inventory) were included in the review. Papers were excluded if co-occurring neurological or genetic diagnoses were present within participants (e.g. Alzheimer's disease, Parkinson's disease, Down syndrome, etc). Studies were excluded if they explored the profile of anxiety disorders in ASD, but which did not measure relations between anxiety and RRB, or where no RRB data could be extrapolated.

2.3 Study Selection

Figure 1 illustrates the sifting process set out by the PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009). Upon removal of duplicates and screened titles and abstracts that were not appropriate, 56 articles were rated against the inclusion criteria. Of these, 35 of the articles did not meet the inclusion criteria. N = 2 of the studies were case studies about patients with ASD and did not include any measures of RRB or anxiety. N = 26 studies investigated autism traits and anxiety, but did not report any data or information on RRB and anxiety. N = 2 studies were incomplete and had yet to carry out data collection. N = 1 study focused on the anxiety of the

parents in relation to having a child with ASD. Lastly, N = 4 studies included participants with ASD but who had genetic disorders such as Down syndrome and Prada-Willi. A total of N = 21 studies were included in the systematic review.

Figure 1 Systematic Review Process



2.4 Method of Quality Appraisal

The methodological quality of the studies was established using the Effective Public Health Practice Project Quality Assessment Tool (EPHPP; Jackson & Waters, 2005). The EPHPP assesses the overall quality of quantitative studies by calculating subscale scores in six key domains including: study design, selection bias, the presence of confounding variables, blinding, data collection methods and withdrawals and drop-outs. Intervention integrity and data analyses are domains that can also be evaluated but are not included in the global rating. Each domain is allocated a rating of strong, moderate or weak. Following the guidelines by Thomas et al. (2004), a global rating of weak was assigned to the study if two or more individual domains were rated weak, moderate, or if there was one weak and some moderate domains; it was rated as strong if there were no weak and at least two strong domains.

In the first domain 'Selection Bias', studies are awarded a higher rating if their sample of participants are considered likely to be representative of the target population. For example, studies which randomly select participants from a comprehensive list in the target population are allocated a strong rating. Moderate ratings would be given to studies which recruited participants from a single source in a systematic way (i.e. a clinic or hospital). Studies whereby participants self-referred to participate in the study or whereby the sample was not reflective of the target population are allocated a weak rating. For example, a study that targeted the general population but only used Psychology students would be allocated a weak rating.

The second domain, 'Study Design', studies are rated on the type of design which is likely reduce bias. Stronger ratings are awarded to study designs which are Randomised Controlled

Trials and Controlled Clinical Trial (CCT). However, the allocation of a strong rating is also dependent on the use of a control group and the quality of randomization of groups (if applicable). Moderate ratings are given to studies described as cohort analytic study, a case control study, a cohort design or an interrupted time series. Weaker ratings are allocated to studies that did not state the method use.

The third domain 'Confounders', refers to any variable in the study that may have impacted on the outcome. Studies which obtain strong ratings would have accounted for at least 80% of relevant confounders. Moderate ratings are be allocated to that controlled for 60 – 79% of relevant confounders. Weak ratings are allocated to studies that controlled for less than 60% confounding variables or did not describe how confounds were controlled for.

In line with both Butchart et al. (2017) and Spain et al. (2018), the fourth domain 'Blinding' was excluded from the appraisal, given that the selected studies included in the review were predominantly cross-sectional as opposed to interventional.

The fifth domain refers to 'Data collection method'. Ratings for this domain are based on whether the measures used in the study demonstrate validity and reliability. Studies obtain a rating of strong if measures are both reliable and valid. Moderate ratings are given to studies whereby the measure is valid but not reliable. Weak ratings are given to studies which do not describe the measures or if they have used a measure that is not valid or reliable.

The sixth domain 'Withdrawals and drop-outs' refers to the number of participants who complete the study. Strong allocations are assigned when the follow-up rate is 80% or greater and details of drop-out and withdrawals are explained. Moderate ratings are assigned when the

follow-up rate is 60 – 79%. Weak ratings are allocated to studies with less than 60% follow-up or if the withdrawals and drop-outs were not described.

3. Results

In total, N = 21 studies were included for review (see Table 1) (Arildskov et al., 2016; Black et al., 2017; Cashin et al., 2018; Duvekot et al., 2017; Factor et al., 2016; Factor et al., 2017; Gotham et al., 2013; Hallet et al., 2013; Halls, Cooper, & Creswell, 2015; Huntly, Shui, & Malow, 2016; Joyce, Honey, Leekam, Barrett, & Rodgers, 2012; Lidstone et al., 2013; Liew, Thevaraja, Ryan, & Magiati, 2014; Magiati et al., 2016; Rodgers et al., 2011; Rodgers, Glod, & Connolly, 2012; Stratis & LeCavalier, 2013; Sukhodolsky et al., 2007; T-eh, 2017; Uljarević et al., 2017; Wigham et al., 2014).

3.1 Overview Of studies

Studies were conducted in the USA (N = 8), UK (N = 6), Asia (N =3), Scandinavia (N =1), Netherlands (N = 1), Australia (= 2) and in both UK and USA (N = 1). Nineteen studies were cross-sectional and two studies were longitudinal. Four studies investigated between group differences. One study compared typical developing children to children with ASD. One study examined the differences between individuals who had a high anxiety and a low anxiety, all of whom had a diagnosis of ASD. One study examined the differences between two groups of typically developing children with and without social anxiety disorder. Finally, one study examined the between-group differences between individuals with ASD and Williams Syndrome. Seventeen studies recruited children and adolescents (aged 18 and under). Three studies recruited across the age spectrum. Three studies involved recruiting non-clinical samples. The majority of participants were male.

Table 1 Summary of information for all studies included in review

Study Number, Author and Year	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
1. Arildskov et al. (2016)	Denmark Norway, Sweden	257 children and adolescents with OCD	12.79 (2.75) 7-17 years	49% males	ASSQ CY-BOCS	Motor/tics/OCD subscale of ASSQ was positively related to OCD severity (β = .539, 95 % CI [.262, .816], t (244) = 3.832, p < .001.)
2. Black et al. (2017)	York & Canada	79 children: 39 with ASD and 40 TD children	ASD = 12.1 (2.6) 7-17 TD = 11.0 (3.0) 7-18	ASD = 7 6%, male TD = 40 % male	RBQ-2 SCAS-P	IS was positively correlated in ASD group with anxiety: specific phobia (r = 0.50, p = 0.001), separation anxiety (r = 0.54, p < 0.0001), and social anxiety (r = 0.33, p = 0.04).

Table 1 continued

Study Number, Author and Year	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
3. Cashin et al. (2018)	Australia, New Zealand, Ireland, UK, USA & Canada	58 children with ASD	11.66 (SD not reported) 5-17	86% male	RBQ SCAS-P	SCAS-P positively correlated with total RBQ score (rs = 0.61, p < 0.01). Both IS (rs = 0.72, p < 0.00) and RSMB (rs = 0.42, p < 0.01) correlated with total SCAS-P score.
4.Duvekot et al. (2018)	Netherlands	130 ASD children	6.7 (2.2) 2-10	81% male	SRS-2 CBCL	RRB domain positively correlated with CBCL anxiety (r = .31, p < .01).
5. Factor et al. (2016)	USA	44 children with ASD	6.91 (3.64)	80% male	RBS-R CBCL	IS but not RSMB was positively correlated with anxiety (r. = 46).

Table 1 continued

Study Number	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
6. Factor et al. (2017)	USA	57 children and adolescence with ASD	7.25 (3.85) 3-17	82% male	SRS-2 CBCL	RRB was positively associated with anxiety (r. = .44, p < .001).
7.Gotham et al. (2013	USA	1,429 children and adolescence with ASD	10.2 (3.1) 5-18	86% male	ADI-R CBCL	IS only was related to CBCL (r.= .28 , < .05).

Table 1 continued

Study Number	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
8. Halls, Cooper & Creswell (2015)	Reading, UK	404 children with an anxiety disorder.	121.57 (19.41) in G1+. 120.85 (18.97) in G2-. 6-13 years.	49% male.	SCQ SCAS-P ADIS	Children with SAD scored significantly higher on RRB measure than anxious children (t(353) =3.15, p=.002, d=.37, r=.18).
9. Hundly, Shui & Malow (2016)	USA and Canada	459 children and adolescence with ASD	6.2 (3.3) 2-17 years.	85% male	ADI-R CBCL	IS was positively associated with anxiety problems (r. = .43, *p* <.001).
10. Liew, Thevaraja, Ryan, & Magiati (2014)	Singapore	250 University students	20.6 (1.73) 18-29 years	35% male	IDAS RBS-R OCR-R PSWQ SIAS	RBS-R was positively associated with all measures (p < .05).

Table 1 continued

Study Number , Author and Year	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
11. Magiati et al. (2016)	Singapore	241 parents of children with ASD	10.4 (36.0) 5.7-17.6 years	81% male	DBC-A SCAS-P	DBC-RRB positively correlated with all SCAS anxiety subscales (r. = .2-.4, $p < .001$) besides social phobia.
12. Rodgers, Glod, & Connolly (2011)	North East of England	67 children and adolescents with ASD	Anxious Group (N = 33) 11.6 (1.8) Non-anxious group (N = 34). 12.2 (1.7) 8-6 years	87% male 85% male	SCAS-P RBQ	Within the anxiety group IS positively correlated with total SCAS-P score (r = .36, p = .03) but RSMB did not correlate with SCAS-P.

Table 1 Continued

Study Number	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
13. Rodgers et al. (2012)	North East of England	34 young people with ASD and 20 children with William Syndrome (WS)	ASD = 12.17 (2.12) 8-16 years WS = 9.4 (3.45) 6-15 years	85% male	RBQ SCAS-P	RBQ total score and SCAS-P (r = .692, p < .001).
14. Stratis & LeCavalier (2013)	USA	72 children with ASD,	11.0 (3.3) 5-17 years	88% male	RBS-R CSI-4	RBS-R total score positively correlated with CSI-4 (r. 558, p < .001). All RBS-R subscales positively and significantly correlated with CIS-4 (r = .302-.594).

Table 1 continued

Study Number	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
15. T-eh et al. (2017)	Singapore	54 children with ASD	120.7 months; (32.8) 5-17 years	32% male	DBC-A SCAS-P	DBC-A positively and significant correlated with total SCAS-P (r =.433, *p* <.001).
16. Uljarević et al. (2017)	Australia	71 young adolescents and adults with ASD	18.71 (SD = 2.51 14–24 years	70% male	RBQ-2A DSM-5 DAS	IS was positively associated with DSM-5 DAS anxiety scores (r = .45, *p* < .001).
17. Lidstone et al. (2014)	South Wales and South East England	49 children and adolescents with ASD	10.7 (3.10) 3-17 years	91% male	RBQ-2 SCAS-P	RBQ-2 Total score (r = .41) and IS (r = .46) positively and significantly correlated.

Table 1 continued

Study Number	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
18. Wigam et al. (2015)	North East England and USA	53 children with ASD	12.49 (2.3) 8–16 years	88% male	RBQ SCAS-P	RBQ IS was positively associated with SCAS-P total (r =. 613, p <.001) and RBQ RSMB was positively associated with SCAS-P (r = 402, *p* <.001).
19. Sukhodolsky et al. (2008)	USA	171 children with ASD	8.2(2.6) 5-17 years		ADI-R CASI	ADI-R stereotype behaviour was positively associated with CASI (r = .22, *p* <.01).

Table 1 continued

Study Number	Location	Total sample size	Mean age (SD) and range of sample(s)	Gender of total Study (%)	Measures for RRB and Anxiety	Results
20. Joyce et al. (2017)	East of England	19 families and 13 children with ASD	16.81 (2.39) 13-20	84% male	RBQ-2 RBQ-2A SCAS-P SCAS-C	Total RBQ-2 and SCAS-P positively and significant correlated (r = .680, p <.001). RBQ-2A and SCAS-C positively and significantly correlated (r = .595, *p* = .032)
21. Hallet et al. (2013)	England and Wales	7,311 twin pairs at age 7 with or suspected ASD. Multiple epidemiological samples	ASD Group; 13.5 (1.7) Co-twin Group; 13.5 (0.7) BAP Group; 13.4 (0.6)	85% male 37% male 78% male	ADI ARBQ	RRB correlated most strongly with generalised anxiety both phenotypically and genetically.

	Control Group; 12.8 (1.1)	69%

RRB measures: ASSQ - Autism Spectrum Screening Questionnaire; SRS - Social Responsiveness Scale; RBS - Repetitive Behaviour Scale Revised; RBQ - Repetitive Behaviour Questionnaire; RBS-R - Repetitive Behaviour Scale-Revised; ADI-R - Autism Diagnostic Interview-Revised; RBQ-2 - Repetitive Behaviour Questionnaire-2; RBQ-2A - The Adult Repetitive Behaviour Questionnaire-2; DBC-A - Autism Screening Algorithm; *Measures of anxiety*: SCAS-P - Spence Children's Anxiety Scale (Parent report); SCAS-C - Spence Children's Anxiety Scale (Child report); CASI - Child and Adolescent Symptom Inventory; DSM-5 DAS - DSM-5 Dimensional Anxiety Scales; CBCL - Child Behaviour Checklist; CSI-4 - Child Symptom Inventory-4; IDAS - Inventory of Depression and Anxiety Symptoms; PSWQ - Penn State Worry Questionnaire; OCR-R - Obsessive–Compulsive Inventory Revised; RCADS- The Revised Child Anxiety and Depression Scale; SIAS - Social Interaction Anxiety Scale; CY-BOCS - Children's Yale-Brown Obsessive Compulsive Scale.

Table 2 – Quality appraisal of studies included in review

Study Number, Author and Year	Selection Bias	Study Design	Confounders	Data collection	Withdrawals / drop-outs	Global Ratings
1 Arildskov et al. (2016)	W	W	W	M	S	W
2 Black et al. (2017)	M	W	W	M	S	W
3 Cashin et al. (2018)	M	W	W	M	W	W
4 Duvekot et al. (2018)	M	M	W	M	M	M
5 Factor et al. (2016)	M	W	W	M	W	W
6 Factor et al. (2017)	M	W	W	M	S	W
7 Gotham et al. (2013)	S	M	M	M	S	S
8 Halls, Cooper, & Creswell (2015)	W	W	W	M	S	W
9 Hundly, Shui, & Malow (2016)	W	W	W	M	S	W
10 Liew, Thevaraja, Ryan, & Magiati (2014)	W	W	W	W	W	W
11 Magiati et al. (2016)	M	W	W	W	W	W
12 Rodgers, Glod, & Connolly (2011)	M	W	W	M	M	W
13 Rodgers et al. (2012)	M	W	M	M	S	M
14 Stratis & LeCavalier (2013)	W	W	W	M	M	W
15 T-eh et al. (2017)	M	M	M	M	M	M
16 Uljarević et al. (2017)	M	W	W	M	W	W
17 Lidstone et al. (2014)	M	W	W	M	S	W
18 Wigam et al. (2015)	W	W	W	M	S	W
19 Sukhodolsky et al. (2008)	M	W	M	M	W	W
20 Joyce et al. (2017)	M	W	W	S	S	M
21 Hallet et al. (2013)	S	M	M	M	S	S

Ratings: W – weak; M – moderate; S – strong

3.2 Quality Appraisal using the EPHPP

Table 2 provides a quality assessment of the studies included in the review. The EPHPP framework has previously been used to evaluate a range of study designs and has been reported to have strong content and construct validity (Thomas, Ciliska, Dobbins, & Micucci, 2004). The EPHPP is able to assess a wide heterogeneity of study designs, which is suitable for the studies included in the current systematic review.

3.3 Quality of Studies

As illustrated in Table 2, two studies were considered to be strong in overall methodology quality (7, 21), four studies were considered to be medium (4, 13, 15, 20) and the remaining studies were considered to have weak overall quality. In general, it was difficult for studies to achieve a strong rating as a consequence of their cross-sectional design. However, there were a number of primary methodological limitations and characteristics which were indicative of studies being allocated weaker ratings.

Firstly, with the exception of three studies (7, 10, 21), all studies relied on recruiting participants from clinical and research contexts (e.g. ASD databases, hospitals, specialist schools, etc.) as opposed to including participants from epidemiological or non-treatment-seeking samples. Stronger ratings were allocated to two studies (7, 21), which recruited epidemiological samples alongside providing detailed sample frames about the social and demographic characteristics of the participants and families who participated in the study (e.g. ethnicity, occupation,

socio-economic status, level of education, etc.). In both studies, the sample sizes were significantly large, which suggested adequate power to detect relationships between anxiety measures and RRB. For instance, both studies had a sample size of over 1,000 participants, which was sufficiently powered for the data analyses that were carried out. Weaker rated studies (1, 8, 9, 10, 14) recruited participants with specific characteristics, which limited the generalisability of the findings. For example, four studies (1, 8, 9, 14) recruited participants with mental health problems and ASD but did not control for such characteristics within their analyses, whilst another study (10) recruited undergraduate students studying an introductory course in psychology. Furthermore, apart from one study (10) which recruited participants between the ages of 18 and 29 years of age, the remaining studies relied on children and young people as opposed to recruiting participants from across the age spectrum; therefore, the findings were limited to a specific developmental stage.

Secondly, with the exception of two studies (10, 20), all studies relied on an informant report as the primary method of data collection for assessing RRB and anxiety. Informant-based reports may have been influenced by numerous extraneous factors (e.g. parental anxiety, misattribution of anxiety/RRB, etc.). Studies that obtained a medium rating for data collection methods (1--,9,12--19,21) administered measures which reported high construct validity and reliability for assessing both RRB and anxiety. However, one study (20) used a multi-informant approach and included parent report and self-report versions to assess RRB and anxiety, thus obtaining a

strong rating. Two studies (10, 11) used an RRB measure that had poor psychometric properties and reliability.

Thirdly, in terms of confounding effects, only ten studies (2, 4, 5, 6, 9, 10, 12, 13, 11, 18) examined IQ whilst evaluating the relationship between RRB and anxiety. However, two of these studies did not have available IQ scores for all their samples (5, 6).

Finally, regarding withdrawals and dropout rates. In the two longitudinal studies (4, 15), 60% or more participants completed follow-up assessments which led to a medium rating. However, neither study provided information about inclusion/exclusion criteria. Studies that attained a strong rating (7, 21) provided comprehensive details about the participant sample, including reasons for exclusions and explanations as to why certain participants withdrew from the study. Weaker rated studies were studies that did not provide any details of why participants dropped out or were excluded.

3.4 Summary of Results

All studies demonstrated a positive and significant association between a measure of RRB and anxiety: higher RRB were associated with increased anxiety symptoms, which remained constant when some of the studies controlled for potentially confounding influences such as age and IQ. The strength of the relationships between RRB and anxiety ranged from low to medium, with effect sizes between 0.2 and 0.6. Although the relationship between RRB and anxiety held for all

studies, not all studies reliably established a relationship between the same constructs of RRB and anxiety. However, many of the studies utilised weak designs. The methodological limitations of the identified studies indicate that the positive associations between RRB and anxiety should be treated with caution. The studies that obtained medium to strong overall methodological quality are summarised below.

Gotham et al. (2013) found that anxiety symptoms were significantly correlated to insistence on sameness behaviours. Further to this, anxiety and insistence on sameness did not demonstrate a relationship with the hallmark features of ASD. Notwithstanding, it was observed that only anxiety symptoms, not IS behaviours, were related with other psychiatric difficulties in ASD. However, the authors did not include a measure of RSMB behaviours.

Hallet et al. (2013) reported that children with higher RRB scores, as indexed by the ADI-R, were associated with heightened OCD and panic symptoms. However, RRB were indexed by a limited number of items included in the ADI-R and were not separated into different dimensions of RRB.

Rogers et al. (2012) reported that children with ASD who had high anxiety scores had significantly higher levels of RSMB and IS behaviours in comparison to participants with ASD, but also who had a low level of anxiety. Within-group analysis found that IS behaviours were associated with higher levels of anxiety in the anxious group only. No associations were found between RSMB and anxiety within each group. In terms of specificity of subtypes of anxiety, Rogers et al. report that IS behaviours in

the anxiety group were associated with separation anxiety and fear of physical health problems. However, no other relationships were reported.

The two studies that employed longitudinal designs had different conclusions in relation to one another. Although both studies found significant associations between anxiety and RRB at both time points, Teh et al. (2017) found that RRB total score significantly predicted higher levels of anxiety when followed up after 2 years. In contrast, Duvekot et al. (2018) did not report any statistically significant associations from anxiety symptoms to experiencing RRB at different time points. Joyce et al.'s (2014) findings revealed that parent reports of autistic children reported that IS and RSMB behaviours were positively associated with symptoms of anxiety. However, this association was not significant when self-report measures from autistic adolescents were used. Furthermore, Joyce et al.'s analysis indicated poor inter-rater reliability between parent and child self-report measures of RRB and anxiety.

4. General Discussion

It has been proposed that anxiety in autistic individuals may be partly associated with the presence of RRB (Joyce et al., 2017; Rodgers et al., 2012; Sukhodolsky et al., 2008). This review examined the quality of N=21 studies looking at RRB and anxiety. Given the diversity in methodological design and measures employed, a meta-analysis was not considered appropriate (Borenstein, Hedges, Higgins, & Rothstein, 2011). In addition, only N=6 studies were of acceptable methodological quality. The methodological limitations of the published studies indicate that the associations between RRB and anxiety should be interpreted with caution and that there is insufficient evidence to suggest that specific types of RRB are associated with specific symptoms of anxiety.

The inconsistencies in findings may have stemmed from different methodological approaches such as the use of self-report (Joyce et al., 2017) and parent-based report (Rogers et al., 2012). The parent report has been found to be contradictory when compared to self-report measures completed by children with ASD. Three studies (Joyce et al., 2007; Mazefsky et al., 2011; White et al., 2012) have highlighted informant discrepancies when comparing parent report and child self-report measures on both RRB and anxiety, whereby such findings have revealed inconsistent correspondence among parent/carer and children (e.g. over versus under-reporting). One explanation for the limited number of studies that used self-report measures relates to the developmental age of the participants included in the study. In

many of the studies included in the current review, children as young as two were included in participant samples. Further to this, only one self-report measure for adults, the Adult Repetitive Behaviours Questionnaire-2 (RBQ-2A; Barrett et al., 2015; Barrett et al., 2018), has recently been developed for adults. In line with Joyce et al. (2007), future studies should consider adopting a multi-informant approach for the assessment of both RRB and anxiety. This could be extended to include other significant individuals in the child's life such as teachers, older siblings and key workers. A multi-informant perspective will allow for the identification of RRB and anxiety symptoms across home and school contexts. One way to achieve this can be through structural equation modelling whereby a latent construct can be created on anxiety and RRB which is based on multiple measures.

Research findings have supported the existence of IS and RSMB behaviours as two distinct RRB domains (Bishop et al., 2013; Honey, McConachie, Turner, & Rodgers, 2012; Lidstone et al., 2014). However, only two of the studies in the current review with acceptable quality (Joyce et al., 2017; Rogers et al., 2012) had measures assessing both of these subtypes. The measures used to assess RRB did not allow for the detection of the full range of RRB. For example, Gotham et al. (2013) did not include a measure of RSMB behaviours and limited the assessment to IS behaviours, whilst Hallet et al. (2013) relied on a six items to assess both IS and RSMB behaviours. Furthermore, Duvekot et al. (2018) used a single measure to capture RRB and did not demarcate this score into IS and RSMB behavioural domains. In light of these findings, further research should employ measures of RRB that can differentiate between the

RRB behaviours. Given the wide heterogeneity of RRB, it would be worthwhile to have a questionnaire that includes items relating to RSMB and IS behaviours.

In all of the studies included in the review, anxiety was measured using standardised measures of anxiety that have yet to be adapted, or psychometrically investigated in ASD populations. Emerging research using independent samples has challenged the appropriateness of administering such measures in ASD populations. For example, the Spence Children's Anxiety Scale (SCAS) and the Child and Adolescent Symptom Inventory (CASI) have been found to be unsuitable for measuring symptoms of anxiety in ASD populations (Glod, Honey, Riby, & Rogers, 2017; Jitlina, Zumbo, Mirenda et al., 2017; Magiati, Lerh, Uljarević et al., 2017). Notably, items were limited in the way that they overlapped with ASD characteristics, making it difficult to distinguish between anxiety symptomology and ASD traits. Furthermore, earlier research findings report that individuals with ASD have reduced affect recognition, which leads to different expressions of communicating thoughts to others (Harms et al., 2010). Future research should take into consideration that anxiety in ASD may present differently to anxiety in typical developing individuals. For instance, some theorists have differentiated between 'typical' and 'atypical' anxiety presentations in ASD populations (Kerns et al., 2014). The former presentation is equivalent to anxiety symptoms seen in individuals without ASD and resembles symptoms akin to the DSM-5 criteria of anxiety disorders (APA, 2013), whilst the latter reflects anxiety that may be associated with sensory difficulties and neurocognitive atypicalities that are part of ASD. In other words, some individuals with ASD present differently when anxious,

which is likely to be missed when anxiety measures are administered that have been standardised on typically developing individuals. Finally, Rogers et al.'s (2012) and Hallet et al.'s (2013) differing associations between subtypes of anxiety symptom and RRB further compound the challenges in using traditional anxiety-based measures. In Hallet et al., the association between OCD symptoms and RRB may have been misinterpreted by parents attributing behaviours such as repetitive questioning as symptoms of anxiety when, in fact, they reflect general ASD behaviours. Indeed, earlier research by Gjevik et al. (2010) has emphasised how items on questionnaires of ASD behaviors and OCD are difficult to tease apart. Furthermore, it is probable that parental understanding of demarcating anxiety from ASD behaviour may be limited (Hurtig et al. 2009). Collectively, these observations outline a critical role for future research to consider employing a measure of anxiety that is suitable for assessing anxiety in ASD whilst accounting for the core features and symptoms of ASD.

Finally, this study's cross-sectional nature of the majority of the studies in the review does not facilitate an understanding of the direction of the relationship between types of RRB and anxiety. Indeed, the reliance on cross-sectional designs limits the quality of the research methodology. Both longitudinal designs identified in this review (Duvekot et al., 2018; T-eh et al., 2017) yielded opposing findings, which challenge the idea that RRB has an association with anxiety over time. Beyond both studies using limited measures to capture both RRB and anxiety, they each had small sample sizes. Future research should aspire to recruit larger numbers of participants over a longer duration, and include participants from a wide range of ages. This is

especially pertinent as there is evidence to suggest that both RSMB and IS behaviours change over the course of an individual's lifetime (Esbensen et al., 2009; Harrop et al., 2014).

4.1 Limitations

There are several limitations of the current research. Only a small number of studies were of an acceptable level of methodological quality. The majority of the studies in this systematic review used only male participants, with a minority of studies were comprised of female and male participants. As a result, it is not possible to confirm that the relationships between RRB and anxiety would extend to female populations. Given that ASD presents differently across genders (Kopp & Gillberg, 2011; Kreiser & White, 2014; Muggleton, MacMahon, & Johnston, 2019), exploring RRB in females would be a worthwhile pursuit.

Aside from three studies (Gotham et al., 2013; Hallet et al., 2013; Liew et al., 2015), the studies limited their recruited samples to participants with a clinical diagnosis of ASD. Contemporary views of ASD propose that social and non-social autistic traits extend across the general population and present to various degrees (Happé & Ronald, 2008). Examining such traits in non-clinical samples would allow for relationships between RRB and anxiety to be explored without the potential confounding effects of language ability and co-occurrence of other mental health problems (Coury et al., 2012; Sharda, Khundrakpam, Evans, & Singh, 2016). This

approach would also shed light on whether anxiety presents differently in people with and without ASD.

Finally, all studies included in the review did not include any participants who were non-verbal. This suggests that the findings cannot be generalised to all individuals with ASD. Consequently, in order to advance the relations between anxiety and RRB across the ASD continuum non-verbal ASD participants need to be examined. Unfortunately, few studies exist of people with nonverbal ASD and anxiety.

4.2 Conclusion

This is the first systematic review to examine the methodological quality of studies that had examined the relationship between RRB and anxiety. In conclusion, there is evidence that higher RRB associate with heighted levels of anxious symptoms. However, the quality of such studies requires that any interpretations are made with caution. In addition, more appropriate measures are required to delineate both RRB and anxiety symptoms before clear testable models and clinical interventions can be devised.

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Autistic traits and Anxiety: The mediating role of coping style

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Abstract

Background

Individuals with autistic traits are often found to have heightened levels of anxiety, yet how such individuals cope with stress has not been comprehensively examined. The current study sets out to explore whether coping styles mediate the relationship between autistic traits and symptoms of somatic and cognitive anxiety.

Methods

The Adult Repetitive Behaviours Questionnaire-2 (RBQ-2A), Autism-Spectrum Quotient (AQ), Coping Inventory for Stressful Situations (CISS) and the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA) were administered online. Data from 234 adults aged 18–69 (*M*=35.14, *SD*=12.42; 42 men and 188 women) were analysed using mediation analysis.

Results

Emotion-oriented coping positively and significantly mediated the relationship between autistic traits (social communication difficulties and repetitive sensory motor behaviours) and both cognitive and somatic symptoms of anxiety. Task-oriented coping was a significant and negative mediator for the same autistic behaviours and cognitive symptoms of anxiety. The relationship between insistence on sameness behaviours and cognitive and somatic anxiety was unaffected by coping styles.

Conclusion

This was the first study to demonstrate that coping skills have a significant mediating effect of anxiety symptoms in individuals with high levels of autistic traits**.** Interventions addressing coping styles may help reduce anxiety in individuals with a high degree of autistic traits.

Keywords

Autism spectrum disorders (ASD); Restrictive and Repetitive Behaviours (RRB); Insistence of Sameness (IS); Repetitive Sensory and Motor Behaviours (RSMB); Coping Styles; Coping; Anxiety.

1. Introduction

Individuals with a diagnosis of autism spectrum disorder (ASD) experience higher levels of anxiety compared to people without ASD (Kerns & Kendall, 2012; ; MacNeil et al., 2009; White et al., 2009). Anxiety can be experienced as both somatic (e.g. palpitations, dry mouth, nausea, headache) and cognitive (e.g. worry, fear, rumination) symptoms. Such symptoms are part of normal experience, but become clinically significant if they lead to a marked deterioration in an individual's everyday functioning (Forouzanfar et al., 2016). ASD is recognised as a lifelong condition that is currently defined by difficulties in social communication and restricted and repetitive behaviours and interests (RRB) (APA, 2013). RRB comprise of two core domains that reflect repetitive sensory and motor behaviours (RSMB) and insistence on sameness (IS). RSMB include hand mannerisms, excessive smelling or touching of objects and rocking, while IS reflects more abstract behaviours including adherence to specific rituals and routines, circumscribed interests, and a drive for sameness (Leekman et al., 2011).

A plethora of research findings have demonstrated that the hallmark features of ASD are continuously distributed throughout the general population (Constantino & Todd 2003; Ruzich et al., 2015). In this context, autistic traits are hypothesised to extend throughout the general population until they become clinically significant under ASD diagnostic criteria. Autistic traits can be indexed using psychometrically-validated self-report scales, including the Autism Spectrum Quotient (AQ; Baron-Cohen

et al., 2001), and their investigation is a useful way of broadening the understanding of both ASD and typical development (Landry & Chouinard, 2016; Robinson et al., 2011). Individuals who self-report a high number of autistic traits but who do not meet the diagnostic criteria for ASD are found to have an increased likelihood of reporting anxious symptoms (Kunihira et al., 2006; Liew et al., 2015; Romano, Osborne, & Reed, 2014; Zhou, Wang, & Chasson, 2018).

The association between autistic traits and anxiety has yet to be fully elucidated. One explanation put forward by Wood and Gadow (2010) proposed that autistic traits might lead to conflict with social demands and expectations, which may lead to heightened anxiety. For example, social difficulties and challenges in responding to social cues is likely to cause a degree of anxiety. In addition, the drive to carry out specific routines or RSMB may deviate away from social norms and induce a negative response from others, which leads to anxiety (Gillott & Standen, 2007; Goodwin, Groden, Velicer, & Diller, 2007). For example, using a non-clinical sample, Liew et al. (2015) found that both aversive sensory experiences in daily life and experiences of being punished, or prevented from engaging in RRB, mediated the relationship between autistic traits and anxious symptoms. Other theoretical accounts have put forward the idea that RRB function as buffers to alleviate anxiety as a consequence of being over or under aroused by sensory stimulation (Green et al., 2012; Joosten, Bundy, & Einfeld, 2009; Lidstone et al.,2014). Finally, RRB have also been hypothesised to occur because of anxiety (Sofronoff et al., 2005; Sukhodolsky et

al., 2008). It is possible, therefore, that distinct types of autistic traits have differential associations with anxiety.

It is now well established that expressions of anxiety are often mediated by the way a person copes with actual or perceived stress (Folkman, 1984; Pereira-Morales et al., 2018). Coping is a multidimensional psychological construct, which typically involves applying cognitive and behavioural strategies in an attempt to overcome specific external and internal difficulties (Compas et al., 2001; Lazarus & Folkman, 1984). In line with earlier theorists (Endler & Parker, 1994), coping can be conceptualised as three principal dimensions or styles: task oriented, emotional, and avoidant. Task-oriented coping refers to problem-solving abilities, acquiring information and making attempts to alter the stressful situation. This style of coping is found to be negatively associated with both symptoms of depression and anxiety and positively associated with higher personal resilience and well-being (Goodarzi, Shokri, & Sharifi, 2015; Mayordomo-Rodríguez et al., 2015; Smith, Saklofske, Keefer, & Tremblay, 2016). Emotion-oriented coping includes emotional reactions that are self-orientated in an attempt to reduce stress. When experiencing a stressful situation, this style of coping involves engaging in behaviours such as ruminating, becoming angry, blaming others and becoming upset. Perhaps unsurprisingly, emotion-oriented coping has been found to relate to worse mental health outcomes including anxiety and depression (Leandro & Castillo, 2010; Tsujimoto et al., 2015). Lastly, avoidant coping describes activities and cognitive changes aimed at avoiding the stressful situation. This can be exercised via distracting oneself with other situations or tasks (distraction

oriented) or via social diversion (social oriented) as a means of lessening stress. Avoidant-oriented coping has been found to be associated with worsening levels of anxiety and depression (Leandro & Castillo, 2010; McWilliams, Cox, & Enns, 2003).

Personality plays an important part in the perception of stressful situations and is often an indicator of how someone is likely to cope during a stressful situation (Dumitru & Cozman, 2012). For example, individuals who report high degrees of neuroticism have been found to rely less on task-oriented coping (Carver & Connor-Smith, 2010) and are likely to engage in a more emotion-oriented style of coping (Otonari et al., 2012; Zhou et al., 2017). Conversely, extraversion is associated with task-oriented coping and negatively associated with emotion-based coping (Campbell-Sills, Cohan, & Stein, 2006). Furthermore, personality characteristics that reflect openness and conscientiousness are related to a task-oriented style of coping (Afshar et al., 2015). Individuals with a high level of autistic traits may perceive a stressful situation in a different way that may bias them to certain coping styles. For instance, autistic traits reflect difficulties in social communication, which may imply they are less likely to seek out social support when stressed. It can be speculated that autistic traits may be associated with an emotion-oriented style of responding, which may partially explain the association between autistic traits and anxiety. However, there is paucity in research that has attempted to directly explore this relationship.

To date, a limited number of studies have attempted to investigate the association between autistic traits and coping style. In a non-clinical sample, Rosbrook

and Whittingham (2010) found that worse scores on a questionnaire of social problem-solving ability partially mediated the relationship between autistic traits and anxiety symptoms. Social problem-solving ability can be seen to draw parallels with task-oriented coping in the way that it has been defined as "cognitive-affective-behavioural process by which a person attempts to identify, discover, or invent effective or adaptive coping responses for specific problematic situations encountered in everyday living" (D'Zurilla & Nezu, 1990, p. 156). Furthermore, in contrast to control groups, several studies (Channon, Charman, Heap, Crawford, & Rios, 2001; Goddard, Howlin, Dritschel, & Patel, 2007) have reported that, when autistic individuals are presented with a scenario of a social problem, they make less effective solutions. Collectively, such findings highlight the possibility that individuals with high levels of autistic traits might be prone to anxiety partly because their problem-solving of every day difficulties is not optimal. In fact, earlier findings in typically developing populations have reported a moderate and positive association between poor problem-solving ability and anxiety symptoms (Anderson et al., 2007; Haugh, 2006; Marx et al., 1992).

Aside from poor social problem-solving, other studies (Konstantareas & Stewart, 2006; Patel, Day, Jones, & Mazefsky, 2017) have reported poorer emotion regulation skills in autistic populations, which may signal a more emotion-oriented style of coping. Emotion regulation refers to an individual's ability to draw on a range of different emotions to cope effectively in a diverse range of situations and interactions with others (Amstadter, 2008; Cisler, & Olatunji, 2012). Individuals with ASD have been found to display less adaptive emotional responses in times of stress,

such as becoming upset, engage in rumination and display poor anger control (Jahromi, Meek, & Ober-Reynolds, 2012; Laurent & Rubin, 2004). These findings indicate that individuals with ASD may use emotion-oriented coping style in times of stress. More directly, Pinsula et al. (2015) found that autistic traits, as indexed by the AQ, were positively correlated with emotion-oriented coping and negatively associated with the social diversion style of avoidant-oriented coping. However, anxiety was not measured in the sample, thus the mediating role that coping between autistic traits and anxiety has yet to be explored and remains speculative. In addition, as demonstrated through several factor analytic studies, the AQ has been reported to be a poor assessment of RRB in non-clinical populations (Kloosterman et al., 2011; Lau et al., 2013). Given that Pinsula et al. used the total score AQ, the study investigated a general measure of autistic traits, which did not allow for the specific contribution of different core traits to be independently assessed. Consequently, it remains to be examined whether specific autistic traits are associated with a specific coping style. Understanding the relationship between autistic traits and coping styles may have implications for understanding the development or maintenance of anxiety symptoms in people with high levels of autistic traits.

The present study sets out to expand Pinsula et al. (2015) whilst developing a greater understanding of the relationships between autistic traits, coping style and anxiety. To broaden Pinsula et al.'s findings, in addition to administering the AQ, the study includes an independent measure of RRB along with a validated measure of anxiety. The current study employs the Adult Repetitive Behaviours Questionnaire-2

(RBQ-2A; Barrett et al., 2015; Barrett et al., 2018), which is a self-report questionnaire for adults that enquiries about restricted and repetitive behaviours. These measures will allow for a comprehensive exploration of autistic traits, coping style and anxiety. Given the dearth of research available on coping styles and autistic traits, the study set out to investigate the mediating effect of coping styles on the association between different subtypes of autistic traits and anxiety. Based on previous research, it was hypothesised that emotion-oriented coping would positively mediate the relationship between autistic traits and anxiety symptoms. It was also hypothesised that task-oriented coping would negatively mediate the relationship between autistic traits and anxiety.

2. Method

2.1 Participants

Participants were recruited through social media platforms such as Twitter and Facebook, including platforms associated with the School of Psychology and the Wales Autism Research Centre. Participants were offered the opportunity to participate in a prize draw to win one of four £50.00 Amazon vouchers.

The study was accessed by 330 participants. Of these, 247 finished the study by completing all of the questionnaires. Participants were excluded for being under the age of 18 at the time of completing the study (N = 1). By investigating the length of time

participants took to complete the study, it was suggested that the bottom 5th percentile of the sample (N = 12) should be excluded from the main analysis as their responses were considered to be too quick to meaningfully complete the study (< 5 minutes). Two participants were also excluded as they had failed to complete one full questionnaire. This led to the final sample including 234 participants (Male = 42, Female = 188, other = 4) with a mean age of 35.14 (*SD* = 12.42) and a range of 18-69. Two-hundred and thirty-two participants reported currently being a resident in the UK, whilst the remaining participants (N = 2) did not. A diagnosis of ASD was reported by 11.9% (N = 28) of the sample. Within the ASD sample, 71.4% (N = 20) reported having at least one co-occurring diagnosis of an anxiety disorder, while 17.8% (N = 5) of the ASD sample reported having a diagnosis of an 'other' mental health problem. Of the participants without a diagnosis of ASD, 21.7% (N = 45) of the sample reported currently having at least one diagnosis of an anxiety disorder, while 17.8% (N = 37) of the sample reported having a diagnosis of an 'other' mental health problem. Table 1 shows a further breakdown of the demographic characteristics and clinical diagnoses of the sample.

Table 1 Demographic and clinical characteristics of sample (N = 234)

Gender (N = 234)	42 (17.9%) Male 188 (80.3%) Female 4 (1.7%) Other
Age (years)	*M*=35.14, *SD*=12.42 Range: 18-69
UK Resident Status	232 (99.1%) Yes 2 (0.8%) No
Diagnosis of ASD (N = 28)	8 (28.5%) Male 16 (21.4%) Female 4 (14.2%)Other
Age (years)	*M* =30.00 *SD* = 10.87 Range: 18-52
Diagnosis of Anxiety Disorder within ASD sample only (N = 25)	9 (36%) Generalised Anxiety Disorder 3 (12%) Obsessive Compulsive Disorder 4 (16%) Post-Traumatic Stress Disorder 4(16%) Social Anxiety Disorder 5 (20%)Other+
Diagnosis of Anxiety Disorder in non-ASD sample (N = 81)	23(28.3%) Generalised Anxiety Disorder 3(3.7%) Obsessive Compulsive Disorder 7(8.6%) Post-Traumatic Stress Disorder 9(11.1%) Social Anxiety Disorder 2(2.4%) Panic Disorder 1(1.2%) Specific Phobia 36 (44.4%) Other*

+Other diagnosis within ASD sample included; Depression, Bipolar Affective Disorder, Attention deficit hyperactivity disorder (ADHD), Anorexia and Tourette syndrome. *Other diagnosis in non-ASD sample included; Depression, Bipolar affective disorder, anorexia and Complex Post-traumatic Stress Disorder (CPTSD).

2.2 Measures

2.2.1 Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001)

The AQ is a self-report questionnaire comprising 50 items which assess the degree to which an adult endorses autistic traits. The AQ cannot be used to clinically diagnose someone with an ASD, instead it is used to assess behavioural and cognitive features that characterise the distinct features typically pertinent to ASD. For each item, the participants rate on a four-point scale whether they definitely disagree, slightly disagree, slightly agree, or definitely agree with each statement. The AQ supports the computation of a total score and five subscale scores: Social skill, Communication, Attention switching, Imagination, and Attention to detail (Baron-Cohen et al., 2001). The AQ items are scored in a binary fashion, whereby a response is computed as a '1' if it endorses an autistic trait and '0' if it does not. Item scores are then summed to produce a total score that ranges from 0 to 50. Increasing scores indicate more traits of ASD. Baron-Cohen and colleagues (2001) determined the optimal cutoff to be 32 or higher for identifying individuals who endorse clinically significant levels of autistic traits. Earlier studies have consistently reported acceptable internal consistency for the total AQ score (e.g. Austin, 2005; $\alpha = .82$). Each item on the AQ can be allocated a score of 1, 2, 3 or 4 to provide a more sensitive measure of ASD severity, whereby total scores can range from 50 to 200 (Lundqvist & Lindner, 2017). All analyses for current study were conducted using this latter scoring criteria. However, given that the AQ includes some items that may overlap with items pertinent to RRB (e.g. It does not upset me if my daily

routine is disturbed), only items relating to social and communication difficulties were included in the analysis. Items relating to social and communication difficulties were encapsulated in the Social Skills and Communication subscales. Given their strong positive correlation (r. = .82), they were summed to create a composite social communication score. Scores on this measure ranged from 20 to 79, with higher scores reflecting worsening social and/or communication skills. The remaining subscales (Attention to detail, Imagination and Attention switching) were excluded from the main analysis for two reasons; firstly, several studies using factor analysis have found inconsistent evidence for the five individual subscales (Austin, 2005; Auyeung et al., 2008; Hoekstra et al., 2008). However, in each of these studies the Social skills and Communication subscales are found to be the two subscales that emerge consistently. Secondly, since the conception of the AQ, the DSM-5 (APA, 2013) now combines social and communication difficulties into a unitary construct. Consequently, examining subscales relating to social skills and communication provides strong theoretical insights to the hallmark features of ASD.

2.2.2 The Adult Repetitive Behaviours Questionnaire-2 (RBQ-2A; Barrett et al., 2015, Barrett et al., 2018)

The RBQ-2A is a 20 item self-report questionnaire for adults that enquires about how frequently a person engages in RRBs. All items are scored on a 3 or 4-point Likert scale. Higher scores reflect a higher frequency in carrying out an RRB. However, using a large autistic population sample, Barrett et al. (2015) reported there was no difference

in results for RBQ-2A if either a 3 or 4-point scale is given. Consequently, all items whereby participants provide a score of 4 are re-coded as 3. Based on analysis presented in Barrett et al. (2018), items are considered to reflect either RSMB (6 items) or IS behaviours (11 items), whereby three items did not load on either factor. RSMB items include “Do you spin yourself around and around?” and “Do you pace or move around repetitively?”. IS items include “Do you insist on wearing the same clothes or refuse to wear new clothes?” and “Do you get upset about minor changes to objects? (e.g. flecks of dirt on your clothes, minor scratches on objects?)”. A mean score across items is then computed for each participant, with a maximum of 3. Barrett et al. (2018) reported a high level of internal consistency as determined by a Cronbach’s α for the RSMB scale (α = .70) and the IS scale (α = .81).

2.2.3 Coping Inventory for Stressful Situations (CISS; Endler & Parker, 1990, 1999)

The CISS is a 48-item self-report questionnaire which encourages participants to rate how often they engage in a specific activity as a way of coping with stress. Responses range from 1 (Not at all) to 5 (Very much) with higher scores reflecting the activity being carried out more frequently. The CISS includes three 16-item scales, as follows. Emotion-oriented coping (Emotion scale), which include items such as “Get angry”, “Blame others” and “Become very upset”. Task-oriented coping (Task scale), which includes items such as “Outline my priorities”, “Analyse the problem before reacting” and “Focus on the problem and see how I can solve it”. Avoidance-oriented coping (Avoidance scale), which can be separated further into Distraction (8 items) and

Social diversion (5 items) scales with the remaining three items not related to either Distraction or Social diversion. Distraction items include “Try to sleep”, “Go for a walk” and “Watch TV”. Social diversion items include “Spend time with a special person”, “Phone a friend” and “Try to be with other people”. Previous research (Creech & Borsari, 2014; Endler & Parker, 1990; McWilliams, Cox, & Enns, 2003) has reported high internal consistency for each of the subscales (α’s > .8) within clinical and non-clinical populations.

2.2.4 State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA; Grös, Antony, Simms, & McCabe, 2007)

The STICSA is a 42 item self-report questionnaire which has items that assess both state and trait anxiety. Twenty-one items focus on how anxious a participant is feeling in the present moment (state), whereas the remaining 21 items focus on how a participant usually feels (trait). Items are further subdivided into both cognitive (10 items) and somatic symptoms of anxiety (11 items). Cognitive items include “Feel agonised over problems” and “Can’t get thoughts out of mind”. Somatic items include “Breathing is fast and shallow” and “Butterflies in the stomach”. Item responses are scored using a Likert scale which ranges from 1 to 4, with 1 meaning “not at all” and 4 meaning “very much”. Roberts, Hart and Eastwood (2016) report that both trait and state scales demonstrate good internal consistencies (α’s ≥ .92) and validity. Total scores for state and trait range from 21 to 84. Higher scores signal higher anxiety levels. As the interest was in general levels of anxiety, the trait-based scores were used in the analyses.

2.3 Procedure

Participants who accessed the study link were presented with a description of the study, followed by the option to participate. Those who opted to participate provided electronic informed consent and completed a series of self-report measures which included a demographic questionnaire. All questionnaires were completed through a secure online survey platform (Qualtrics). All questionnaires were randomised in order to prevent order effects. No time limits were enforced for completing the study.

3. Results

Univariate outlier analysis using box plots and z-scores indicated the absence of univariate outliers for all the continuous variables. Data was analysed using Statistical Package for Social Sciences (IBM, SPSS, 21). Mean scores, standard deviations, ranges and Cronbach's alphas for all measures are presented in Table 2.

Table 2

Descriptive Statistics for all measures for sample (N = 234)

Measure	Minimum	Maximum	Mean	SD	Cronbach α
AQ Total	60	193.00	123.32	28.23	.95
AQ Social Communication	20	79.00	49.48	13.60	.93
RBQ-2A: Total	1.00	2.75	1.65	.43	.91
RBQ-2A: RSMB	.86	2.57	1.35	.42	.79
RBQ-2A: IS	1.00	3.00	1.70	.47	.87
CISS: Task	20.00	76.00	51.23	11.17	.90
CISS: Emotion	16.00	74.00	61.75	12.86	.90
CISS: Avoidant	20.00	77.00	41.98	10.42	.80
CISS: Social	5.00	25.00	13.48	5.04	.83
CISS: Distraction	10.00	40.00	22.55	5.67	.65
STICSA: Trait Total	21.00	83.00	45.85	13.76	.94
STICSA: Trait cognitive	10.00	40.00	25.62	8.13	.93
STICSA: Trait somatic	11.00	43.00	20.22	6.66	.90
STICSA: State Total	21.00	71.00	39.20	12.36	.93
STICSA: State cognitive	10.00	39.00	22.34	7.87	.91
STICSA: State somatic	11.00	36.00	16.82	5.70	.88

Autism Measures*:** AQ Total – Total Autism Quotient score; AQ Social Communication – summed score of AQ Social Skills and AQ Communication subscales; RBQ-2A: IS – Repetitive Behaviour Questionnaire for adults Insistent on Sameness factor; RBQ-2A: RSMB – Repetitive Behaviour Questionnaire for adults Repetitive Sensory Motor Behaviour factor. ***CISS; Coping Inventory for Stressful Situations: CISS: Task – CISS Task-oriented coping; CISS: Emotion – CISS Emotion-oriented coping; CISS: Avoidant – CISS Avoidant-oriented coping; CISS: Social – CISS Avoidant coping - Social diversion subscale; CISS: Distraction - CISS Avoidant coping – Distraction items; ***Anxiety Measures:*** STICSA; State-Trait Inventory for Cognitive and Somatic Anxiety: STICSA: Trait Total – total trait score (cognitive and somatic items); STICSA: Trait cognitive – Trait score for cognitive anxiety; STICSA: Trait somatic – State score for cognitive anxiety; STICSA: State Total – total state score (cognitive and somatic items); STICSA: State cognitive – State score for cognitive anxiety; STICSA: State somatic – State score for somatic anxiety.

3.1 Correlations between measures

As the initial step for further analysis, associations between autistic traits, coping style and anxiety were calculated using simple bivariate Pearson correlation analysis. The five AQ subscales all significantly correlated with one another, whereby effect sizes ranged from .6 to .9.

Correlation coefficients between all measures are provided in Table 3. All autism trait measures were significantly and positively correlated with both cognitive and somatic trait anxiety. All coping styles except CISS: Distraction (Avoidant coping) showed statistically significant correlations with autistic traits. AQ Social Communication, RBQ-2A: RSMB and RBQ: 2A: IS were positively and significantly associated with CISS: Emotion coping, which suggested that higher scores on these measures related to higher endorsement of emotion-oriented coping. All three measures of autistic traits were significantly negatively associated with both CISS: Social (Avoidant coping) and CISS: Task coping. In other words, higher autistic traits implied less use of social diversion and task-oriented coping. Bivariate correlations between variables of interest suggested that the assumption of multicollinearity (<0.90) was met and the planned analyses could be performed (Tabachnick & Fidell, 2014). These associations implied that the data met the preconditions to test meditational links between the three psychological constructs. However, as CISS: Distraction did not correlate with any of the autistic traits, the mediation analysis focused on avoidant coping using social diversion only.

Table 3

Correlational Analysis for all measures under investigation (N = 234)

	RSMB	IS	CISS: Task	CISS: Emotion	CISS: Avoidant	CISS: Social	CISS: Distraction	STICSA: Cognitive	STICSA: Somatic
AQ Social Communication	.45**	.63*	-.29**	.47**	-.37**	-.54**	.04	.49**	.43**
RBQ-2A: RSMB		.65**	-.22**	.38**	-.10	-.18**	.08	.42**	.44**
RBQ-2A: IS			-.17**	.39**	-.17**	-.27**	.07	.47**	.49**
CISS: Task				-.44**	.24**	.29**	-.01	-.44**	-.26**
CISS: Emotion					-.06	-.25**	.28**	.74**	.55**
CISS: Avoidant						.74**	.71**	-.13*	-.00
CISS: Social							.16**	-.29**	-.13*
CISS: Distraction								.23**	.27**
STICSA: Cognitive									.72**

* = p < .05 ; ** = p <.001

AQ Social Communication – summed score of AQ Social Skills and AQ Communication subscales; RBQ-2A: IS – Repetitive Behaviour Questionnaire for adults Insistent on Sameness factor; RBQ-2A: RSMB - Repetitive Behaviour Questionnaire for adults Repetitive Sensory Motor Behaviour factor. CISS: Task – CISS Task-oriented coping; CISS: Emotion – CISS Emotion-oriented coping; CISS: Avoidant – CISS Avoidant-oriented coping; CISS: Social – CISS Avoidant coping - Social diversion subscale; CISS: Distraction - CISS Avoidant coping – Distraction items; STICSA: Trait cognitive – Trait score for cognitive anxiety; STICSA: Trait somatic – State score for cognitive anxiety.

3.2 Mediation Analyses

After establishing variable correlations (Table 3), an examination of how the associations between specific autistic traits and cognitive and somatic anxiety were mediated by the coping style variables was conducted. The analysis involved performing a parallel mediation analysis using Hayes' (2014) Process Macro, version 3. Two mediation models were created, one with cognitive anxiety as the outcome variable and one with somatic anxiety as the outcome variable (see Figure 1 and Figure 2, respectively). All three types of autistic traits were included as predictors in the model and coping styles were used as the mediators. Confidence intervals were calculated based on 5,000 bootstrap samples, and were bias corrected. This test was selected because it does not assume that the sampling distribution of the indirect effect is normal, and has been demonstrated to be more powerful than other tests of significance in mediation analysis (e.g. the Sobel test; Hayes, 2009). In these analyses, mediation is significant if the 95% Bias Corrected and accelerated confidence intervals for the indirect effect do not include 0 (Preacher & Hayes, 2004; Preacher et al., 2007).

Mediated analyses indicated a number of significant direct effects. The direct effects for autistic traits and coping styles are the same for both models (path a in Figures 1 and 2), and between coping styles and somatic and cognitive anxiety symptoms (path b in Figures 1 and 2). Direct effects between autistic traits and anxiety are not shown in Figures 1 and 2 for ease of visual clarity, but are reviewed in the text (path c). All of the direct effects are reported in the context of other predictors in the model being controlled. Subsequently, the indirect effects are discussed.

3.2.1 Direct effects of Autistic traits on Coping Styles

Regarding CISS: Task, results indicated that the overall model was significantly different from zero F (3, 230) = 8.61, $p < .001$, $R^2 = .10$. As illustrated in Figures 1 and 2, mediation analyses indicate that the link between AQ: Social Communication score and CISS: Task (path a^1) was significant and negative, such that higher scores on AQ: Social Communication corresponded to lower scores on CISS: Task. This relationship also held for RBQ-2A: RSMB scores and CISS: Task (path a^2). Conversely, RBQ-2A: IS did not significantly predict CISS: Task (path a^3).

Turning to CISS: Emotion, results yielded that the overall model was significantly different from zero F (3, 230) = 26.93, $p < .001$, $R^2 = .26$. The relationship between AQ: Social Communication and CISS: Emotion coping (path a^4) was significant and positive, with higher scores on AQ: Social Communication associated with higher CISS: Emotion coping score. This relationship was also found between RBQ-2A: RSMB and CISS: Emotion coping score (path a^5). There was no relationship between RSM: IS and CISS: Emotion coping score (path a^6).

Finally, in CISS: Social, results revealed that the overall model was significantly different from zero F (3, 230) = 34.52, $p < .001$, with $R^2 = .31$. However, only AQ: Social Communication was significant and negative with CISS: Social (path a^7), such that higher scores on AQ: Social Communication related to lower scores on CISS: Social. RBQ-2A: RSMB and RBQ-2A: IS were not significantly associated with CISS: Social coping (paths a^8 and a^9).

3.2.2 Direct effects of Coping style on cognitive and somatic trait anxiety

Results revealed that the overall model was significantly different from zero, F (6, 227) = 59.20, $p < .001$, $R^2 = .61$. In Figure 1, CISS: Task was significantly and negatively associated with STICA: Cognitive (path b^1), such that higher scores on CISS: Task related to lower scores on STICA: Cognitive. CISS: Emotion was significantly and positively associated with STICA: Cognitive (path b^2), whereby higher scores on CISS: Emotion indicated higher scores on STICA: Cognitive. CISS: Social was not significantly associated with STICA: Cognitive (path b^3).

Regarding Figure 2, the results revealed that the model was significantly different from zero, F (6, 227) = 26.76, $p < .001$, $R^2 = .41$. CISS: Emotion was significantly and positively associated with STICA: Somatic (path b^2) such that higher scores on CISS: Emotion indicated higher scores on STICA: Somatic. CISS: Task and CISS: Social did not significantly predict STICA: Somatic (path b^1 and b^3). Thus, the indirect effect from autistic traits to test anxiety symptoms through social diversion coping was not significant, therefore mediation was not supported.

3.2.3 Direct effects of Autistic traits on Cognitive and Somatic anxiety

Considering STICA: Cognitive and autistic traits, the overall model was significantly different from zero F (3, 230) = 33.74, $p < .001$, $R^2 = .30$. There were significant and positive direct effects with AQ: Social communication (b =.18, $p < .001$)

and RBQ-2A: RSMB (b = 3.4, p = .01). This meant that as these autistic traits increased so did the level of cognitive anxiety experienced. However, RBQ-2A: IS did not demonstrate a significant effect with STICA: Cognitive (b = 2.6, p = .06).

Pertaining to STICA: Somatic and autistic traits, the overall model was significantly different from zero F (3, 230) = 31.64, p < .001, R^2 = .29. There were significant and positive direct effects with AQ: Social communication (b =.09, p < .05), RBQ-2A: RSM (b = 3.1, p < .05), and RBQ-2A: IS (b = 3.3, p <.05). As autistic traits increased, so did the level of somatic anxiety that was experienced.

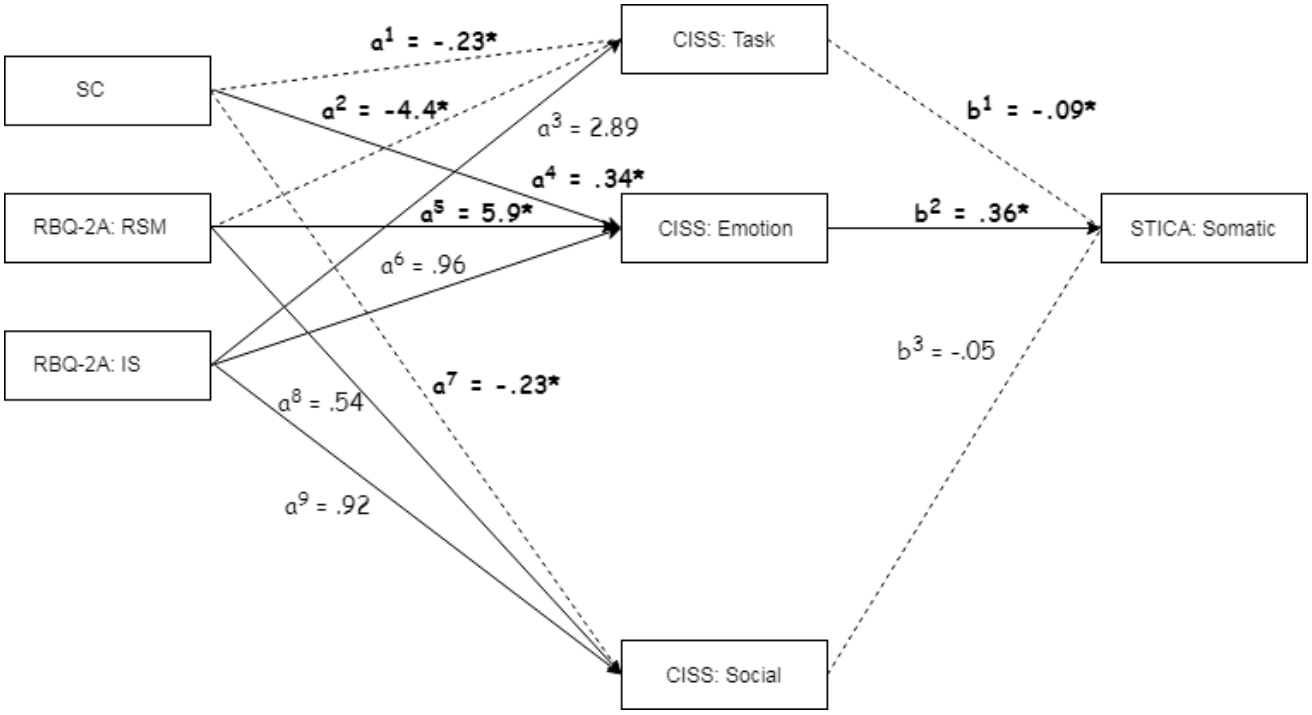
3.2.4 Indirect effects of cognitive anxiety symptoms

The combined indirect effect between AQ: Social Communication and STICA: Cognitive through CISS: Task was significant such that higher AQ: Social Communication scored related to lower CISS: Task, which led to higher scores on STICA: Cognitive (a^1b^1 = .02, 95% CI = .00, .04). The overall indirect effect of the relationship between AQ: Social Communication and STICA: Cognitive through CISS: Emotion was also significant (a^4b^2 = .12, 95% CI = .07, .18), whereby AQ: Social Communication leads to higher expressions of CISS: Emotion, which then predicts higher scores on STICA: Cognitive. RBQ-2A: RSMB indirectly influenced STICA: Cognitive through its effects of CISS: Task (a^1b^2 = .05, 95% CI = .00, .14) and also showed a significant indirect effect through CISS: Emotion (a^5b^2 = .26, 95% CI = .07, .46). There were no indirect effects of RBA-2A: IS on cognitive anxiety through CISS: Task or CISS: Emotion.

3.2.4 Indirect effects of somatic anxiety symptoms

The overall indirect effect of the relationship between AQ: Social Communication and STICA: Somatic through CISS: Task was not significant (a^1b^1 = .00, 95% CI = -.01, 02). The overall indirect effect of the relationship between AQ: Social Communication and STICA: Somatic through CISS: Emotion was significant (a^4b^2 = .06, 95% CI = .03, .10), whereby AQ: Social Communication led to higher CISS: Emotion, which led to higher scores on STICA: Somatic. There was no significant indirect effect between RBQ-2A: RSMB and STICA: Somatic through CISS: Task (a^2b^1 = .08, 95% CI = -.02, .58). The overall indirect effect of the relationship between RBQ-2A: RSMB and STICA: Somatic through CISS: Emotion was also significant (a^5b^2 = 1.1, 95% CI = .33, 2.1) such that RBQ-2A: RSMB led to higher CISS: Emotion, which resulted in higher scores on STICA: Somatic.

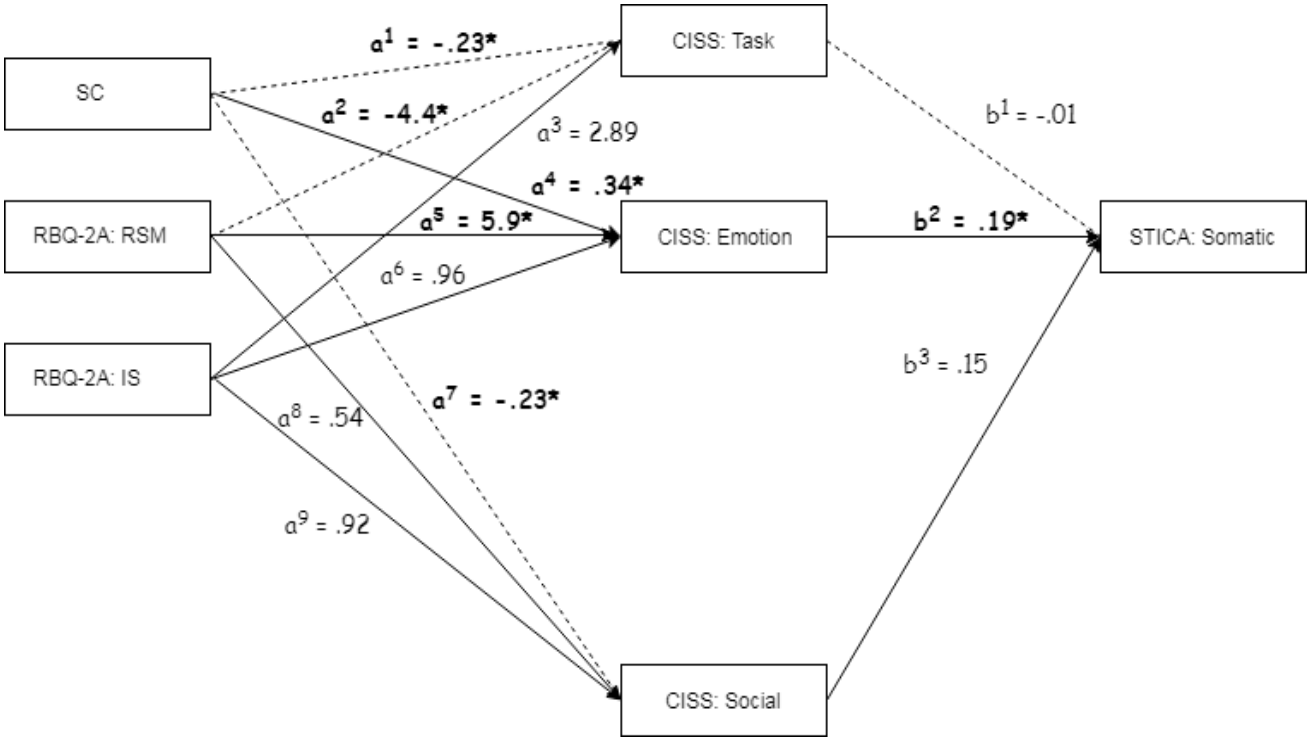
Figure 1 – Direct effects of predictors (Autistic traits) on coping styles and coping styles on cognitive anxiety



*** = p < .05**; a^1-a^9 = direct effect of predictor variable on mediator variable; b^1-b^3 = direct effect of mediator variables on outcome variable. Dashed lines show negative association. Solid lines shows positive association.

Key: AQ Social Communication – summed score of AQ Social Skills and AQ Communication subscales; RBQ-2A: IS – Repetitive Behaviour Questionnaire for adults Insistent on Sameness factor; RBQ-2A: RSMB - Repetitive Behaviour Questionnaire for adults Repetitive Sensory Motor Behaviour factor. CISS: Task – CISS Task-oriented coping; CISS: Emotion – CISS Emotion-oriented coping; CISS: Social – CISS Avoidant coping - Social diversion subscale; STICSA; State-Trait Inventory for Cognitive and Somatic Anxiety: STICSA: Trait cognitive – Trait score for cognitive anxiety

Figure 2 – Direct effects of predictors (Autistic traits) on coping styles and coping styles on somatic anxiety



*** = p < .05**; a^1-a^9 = direct effect of predictor variable on mediator variable; b1-b3 = direct effect of mediator variables on outcome variable. Dashed lines show negative association. Solid lines shows positive association.

Key: AQ Social Communication – summed score of AQ Social Skills and AQ Communication subscales; RBQ-2A: IS – Repetitive Behaviour Questionnaire for adults Insistent on Sameness factor; RBQ-2A: RSMB - Repetitive Behaviour Questionnaire for adults Repetitive Sensory Motor Behaviour factor. CISS: Task – CISS Task-oriented coping; CISS: Emotion – CISS Emotion-oriented coping; CISS: Social – CISS Avoidant coping - Social diversion subscale; STICSA; State-Trait Inventory for Cognitive and Somatic Anxiety: STICSA: Trait somatic – State score for cognitive anxiety.

3.2.5 Re-analysis of self-diagnosis

All mediated regression models were run with data from individuals with self-reported diagnoses excluded. With self-declared diagnoses excluded, patterns of results remained largely unchanged. The direct and indirect effects for each model did not change.

4. Discussion

The present study set out to examine whether coping styles mediate the relationship between autistic traits and anxiety symptoms. In light of earlier research, it was hypothesised that emotion-oriented coping would mediate the relationship between autistic traits and symptoms of anxiety (Austin, 2005; Pinsula et al., 2015; Wakabayashi, Baron-Cohen, & Wheelwright, 2006). It was also anticipated that task-oriented coping would negatively mediate the relationship between autistic traits and anxiety symptoms.

Consistent with previous findings, the current study found that individuals who rated themselves as having higher levels of autistic traits also reported higher levels of both somatic and cognitive anxiety symptoms (Kunihira et al., 2006; Liew et al., 2015; Romano, Osborne, & Reed, 2014; Zhou, Wang, & Chasson, 2018). However, when controlling for all autistic traits, the findings in the present study demonstrate that it was social communication difficulties and RSMB that were independently associated with higher levels of somatic and cognitive anxiety symptoms. IS behaviours were found to be positively associated with somatic anxiety, but not significantly associated

with cognitive anxiety. Such findings extend existing research by using self-report methodology as opposed to informant-based questionnaires of RRB (Stratis & LeCavalier, 2013; Wigam et al., 2014). Collectively, these findings suggest that self-reported RRB may reflect a vulnerability for experiencing anxiety symptoms within a general population sample.

When controlling for all autistic traits, direct effects within the mediation analysis revealed the presence of associations between social communication difficulties, RSMB and three coping styles: emotion-oriented coping, task-oriented coping, and avoidant-oriented coping using social diversion. However, only social communication difficulties were negatively associated with avoidant-oriented coping using social diversion. Autistic traits reflecting social difficulties and RSMB were positively associated with an inclination to use coping styles focused on emotions, and negatively with a tendency to cope by using task-oriented coping. In the instance of the positive correlation between these subtypes of autistic traits and emotion-oriented coping, it can be hypothesised that coping using emotion will decrease the probability of being able to engage in more adaptive forms of coping such as seeking help from others or being able to analyse the presenting problem in a logical manner. For example, being angry, blaming oneself or ruminating has been found to predict worse problem-solving abilities and performance on a range of cognitive and reasoning tasks (Jung et al., 2014; Owens & Derakshan, 2013). The association between autistic traits and emotion-oriented coping is supportive of Pinsula et al. (2015), who found total AQ score to be positively associated with emotion-oriented coping. It is also notable that

the current study reported RSMB but not IS behaviours to be independently and positively associated with emotion-oriented coping. It could be suggested that RSMB is used as a means of coping with emotional arousal (Groden et al., 1994).

In contrast to Pinsula et al. (2015), the present study reported a negative direct effect between RSMB and social communication difficulties with task-oriented coping. However, no association occurred between IS and task-oriented coping. This finding may imply that people with higher levels of specific autistic traits are less likely to rely on coping methods that include problem-solving and planning. This finding is supportive of Rosbrook and Whittingham (2010), who found a negative relationship between problem-solving abilities and autistic traits. The relationship between these constructs may be explained by reduced cognitive flexibility, which is found in ASD (D'Cruz et al., 2013; Lopez, Lincoln, Ozonoff, & Lai, 2005). Cognitive flexibility is considered the ability to switch between different ideas and tasks. Task-oriented coping involves taking direct action to overcome the stressful situation, but if one is absorbed in the stressful situation it may be difficult to disengage, or to consider a range of solutions to select an optimal strategy. For instance, such an activity may be difficult to do if a person is engaging in RSMB that may prevent them from being able to switch between different tasks and focus on something different.

The connection between autistic traits and avoidance coping through social diversion is not surprising and is consistent with Pinsula et al. (2015), who also found higher expressions of autistic traits were negatively associated with social diversion coping. The current study showed that it was RSMB that reflected a negative

association with social diversion coping. However, IS behaviours were unrelated to social diversion when controlling for all autistic traits. This finding suggests that the endorsement of RSMB may lead individuals to avoid seeking social contact in times of stress. One potential explanation could be that such behaviours elicit negative feedback from others, therefore such individuals are less likely to seek out social contact in stressful situations (Gillott & Standen, 2007; Goodwin, Groden, Velicer, & Diller, 2007).

When examining the mediating role of coping style on the relationship between autistic traits and anxiety, the results support a mediation for certain coping styles and traits but not others. In line with the initial hypothesis, emotion-oriented coping mediated the relationship for social communication difficulties and RSMB with both cognitive and somatic anxiety. That is, higher autistic traits lead to an increased use of emotion-oriented coping, which contributes to higher levels of anxiety. Individuals who engage in an emotion-oriented coping style likely experience difficulties that reduce the ability of responding adaptively to stressful situations, as they are more likely to use self-blame and self-criticism, which will lead to anxiety (Smith, Saklofske, Keefer, & Tremblay, 2016). However, emotion-oriented coping style did not mediate the relationship between IS behaviours for either cognitive or somatic anxiety symptoms. One explanation could be that IS behaviour is in itself a type of avoidant-coping style and is, therefore, unaffected by other coping styles. For example, it has been argued that IS behaviour is a way of controlling the environment as a means to manage anxiety (Russell, Frost, & Ingersoll, 2019). During this process, an individual with IS

behaviours is more likely to focus on their environment as opposed to activate other coping styles in times of stress.

Finally, turning to the mediating role of task-orienting coping, such a coping style mediated the relationship between social communication difficulties and RSMB with cognitive, but not somatic, anxiety. This suggests that these autistic traits predicted worse task-oriented coping, which leads individuals to experience the cognitive symptoms of anxiety. However, such interactions are unrelated to somatic symptoms of anxiety. This finding illustrates that somatic and cognitive symptoms of anxiety may have different antecedents. For example, several studies demonstrate that individuals with autistic traits have difficulty controlling their worries and negative thoughts, despite fewer physiological symptoms of anxiety (Helverschou & Martinsen, 2011; Russell & Sofronoff, 2005; Weisbrot et al., 2005). It could be that higher autistic traits and reduced task-oriented coping may relate to cognitive symptoms of anxiety but not somatic symptoms of anxiety, which may only become apparent if one is engaging in a more emotion-oriented way of coping. Again, IS behaviours were unrelated to anxiety when task-oriented coping was included in the model. This observation further supports the idea that IS behaviours may be a form of coping in itself.

4.1 Clinical implications

The present study has several important clinical implications. Firstly, the current study highlights how the presentation of specific autistic traits combined with

explicit coping styles may inflate anxiety-based symptoms. Consequently, this finding proposes that interventions shaped around recognising and amending less adaptive coping may be useful for decreasing anxiety symptoms. Psychological interventions are often one of the first line of interventions for people who experience symptoms of anxiety (Otte, 2011). Indeed, existing research (Sizoo & Kuiper, 2017; Spain, Sin, Chalder, Murphy, & Happe, 2015) has underlined the importance and efficacy of adapting psychological interventions such as Cognitive Behavioural Therapy for people with ASD. Notably, Cooper, Loades and Russell (2018) have emphasised that clinicians must be alert and self-assured in adapting their interventions in line with the needs of people with ASD. For example, task-oriented coping leads to better outcomes, but it can be speculated that social communication difficulties make autistic people less able to engage in task-oriented coping. The data suggests that, if we can increase task-oriented coping in ASD, we should see a reduction in cognitive anxiety. One way to increase such a style of coping can involve the clinician assessing the existing degree of task-oriented coping and identify any barriers that prevent such coping being activated. This may encourage the clinician and client to collaboratively find ways that can strengthen their skills to proactively use task-oriented coping in times of distress. In terms of psychological interventions, the challenge may stem from encouraging individuals to recognise when they are engaging in less adaptive strategies to cope. One way to address this could be to provide psychoeducation around task-oriented coping. This could be achieved through investing education around coping styles during the initial sessions of a psychological intervention. Furthermore, behavioural

experiments could be designed which highlight the advantages of adopting a task-oriented style of coping.

Furthermore, emotion-oriented coping exacerbates both cognitive and somatic anxiety symptoms, which suggests that targeting emotion-oriented coping may lead to a reduction in a worsening of cognitive and somatic anxiety. This may be achieved by encouraging self-monitoring of emotions and adapting existing emotion regulation skills for individuals with social and communication difficulties.

The findings are valuable for providing further support and psychoeducation to parents of children with ASD, who can provide support for helping individuals respond to stressful situations. As a result, clinicians and researchers should be mindful of assessing specific symptom domains and note their implications as opposed to focusing on a single diagnosis.

4.2 Limitations of the study

Several limitations of the current study should be noted. There is a significant gender bias of female to male participants. Consequently, further analysis should aim to recruit a more representative sample and investigate sex differences. In addition, all the measures in the study were dependent on self-report. This meant that there may have been a bias towards more socially desirable responses such as a drive for task-oriented as opposed to emotion-oriented coping. In spite of this, given the study was conducted online and anonymously, it is unlikely that participants would be motivated

to complete the questionnaires in a socially desirable manner. It should also be noted that individuals with high degrees of social communication difficulties are less likely to be concerned with how they are perceived by others. In other words, individuals with such traits may be less concerned with the type of coping style they engage in. Notwithstanding, future research should consider both self-report and behavioural measures of coping. For example, tasks could be used to examine whether perceived coping style maps on to actual behaviour by providing participants with a stress-induced task (e.g. giving a brief presentation). Finally, another caveat to acknowledge is the potential item overlap between emotion-based coping items on the CISS and cognitive anxiety items on the STICA. For example, an item on the STICA is presented as "My worries are hard to control" whereas an item on the CISS: Emotion is presented as "Feel anxious about not being able to cope". It could be argued that these items are phemenologically similar which may have inflated the relationship between cognitive symptoms of anxiety and emotion-based coping. Future research should consider teasing out any items that overlap with the two questionnaires.

4.3 Conclusion

The study highlights the importance of considering the impact of coping styles on the experience of cognitive and somatic anxiety in people with high levels of autistic traits. The data provide an evidence base that targeting coping styles may be a fruitful way of reducing anxiety in this population.

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Critical Reflection and Evaluation of Paper 1 and Paper 2

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Introduction to Paper 3

The current paper sets out to critically appraise both the research process and research methodology that were used throughout the production of the Systematic Review (Paper 1) and the Empirical research study (Paper 2).

In order to clarify that both papers are critically reviewed in equal measure, this paper will be divided into two key sections. The first section will focus on the systematic review, whilst the second section will focus on the empirical research study. Whilst reflecting on the research process, the current paper will consider the following: strengths and weaknesses of the paper; advantages and disadvantages of the methodological approach; limitations of the line of enquiry as a whole; specific implications for theory and suggestions for further research; and finally, specific implications for clinical practice, policy and/or service development.

Personal Context

I was clear that I wanted to explore issues in Autism Spectrum Disorder (ASD) as I find the field both fascinating and intellectually stimulating. My previous background before

starting the doctorate in clinical psychology was working as a Mental Health Worker in a Later Life Liaison Psychiatry Service. My research experience before taking this post had consisted of completing a PhD in cognitive psychology, specifically focusing on the relationship between Schizophrenia Spectrum Disorders (SSD) and reasoning and decision-making processes. Although I have been fortunate to have acquired such research experience, I often felt that the research I carried out was more theoretical and, although it had indirect clinical implications, it could not translate to clinical practice unless further research was conducted. One of the skills I wanted to cultivate during my clinical training was to conduct research whereby I could make meaningful contributions to the evidence base that guides clinical practice. As a trainee clinical psychologist, I felt I was in an optimal position to pursue this endeavour. I also felt that, by completing such a project, I would be adhering to the British Psychological Society (2019) expectations which encourage all trainees to undertake novel research autonomously. Finally, it was advantageous that my clinical training at South Wales is attached to the Welsh Autism Research Centre (WARC), which carries out high-quality research within the field of autism. I was particularly enthused by one of the mission statements of the research centre, that is, "To create positive change for individuals and families affected with autism by; advancing scientific research in areas of risk factors, early identification, diagnosis, cognitive development and intervention." I have often felt that the collaboration of academic and clinical psychology is paramount in order for research to evolve; thus, I was keen to work jointly alongside an established research team in the field of ASD.

One project on ASD was available at the Research Fair. However, this project discussed a newly developed self-report questionnaire to assess Restrictive and Repetitive Behaviours and Interests (RRB) in adults, one of the first of its kind. The supervisor described how any research undertaken that looked at how this measure relates to constructs associated with ASD would be innovating. I felt inspired by this revelation and started to generate ideas with the supervisor about how such a project could be linked with clinical psychology. Scoping the literature on ASD and mental health revealed that suicide, chronic psychiatric diagnoses and poor quality of life remained disproportionately prevalent in people with ASD compared to typically developing populations (Dell'Osso et al., 2019; Kato et al., 2013; Mayes et al., 2013; Smith, Ollendick, & White, 2019). Notably, anxiety symptoms were reported to be a strong moderator and mediator between suicidal ideation and worsening of overall quality of life. Such findings encouraged me to develop a research question that would foster an understanding of the potential pathways that lead to anxiety symptoms (Paper 2). I was also keen to conduct a Systematic Review that would explore the links between autistic traits and anxiety.

Paper I – The associations between Restricted and Repetitive Behaviours and Interests (RRB) and Anxious Symptomology: A Systematic Review

Background of Systematic Review

Despite a growing interest in the association between Restrictive and Repetitive Behaviours and Interests (RRB) and anxiety among clinicians and researchers, there has yet to be a published a comprehensive review which evaluates the methodology quality of the association between these two constructs. As far as I am aware, this is the first time that such an investigation has been carried out; therefore, a rationale for writing this paper was its novelty.

Earlier systematic reviews had looked at the relationship between anxiety and ASD (White et al., 2009; Van Steensel, Bögels & Perrin, 2011). However, these studies had predominantly focused on prevalence rates of anxiety in ASD. Only one previous systematic review by Spain et al. (2018) was identified, which looked exclusively at social anxiety in ASD. Spain et al. concluded that there was limited evidence to suggest that RRB was associated with social anxiety. However, Spain et al. search terms were not sensitive enough to include key variants of RRB (e.g. Insistence of Sameness). I felt that conducting a systematic review including unequivocal search terms to capture the broad range of RRB would be a valuable contribution to the field. I was surprised that many systematic reviews that looked at anxiety and ASD symptoms had actively excluded studies whereby the sample of participants did not have a formal diagnosis of ASD. In line with existing views on ASD, I was aware that ASD resided on a continuum that graded from clinical levels of ASD to subclinical traits of ASD. Considering this, I felt that a major limitation in all reviews was that they did not adopt a dimensional approach to ASD.

Search Strategy

In reviewing a decade-worth of research on RRB, Leekam, Prior, & Uljarevic (2011) report that there is a limited consensus among professionals regarding a specific definition of RRB. In fact, previous research (Joseph, Thurm, Farmer, & Shumway, 2013; Honey, Rodgers, & McConachie, 2012) emphasises that there is disagreement to the structure of RRB. Consequently, it is challenging for researchers and clinicians to measure such behaviours in both clinical and research settings. Starting the systematic review several months early allowed me to conduct an initial scoping review that allowed the key concepts and key words associated with RRB to be identified. This process also allowed me to read seminal papers on RRB and how they have been viewed and conceptualised overtime (e.g. Evans, 1997).

The current paper positioned itself in line with contemporary research findings that strongly support a two-factor structure of RRB, which classifies RRB into Insistence on Sameness (IS) and Repetitive sensory motor (RSMB) behaviours (Bishop et al., 2013; Mooney et al., 2009; Richler et al., 2010; Szatmari et al., 2006). Support from both supervisors and the library service ensured the search terms were comprehensive enough to identify all the relevant articles related to the review. A major strength of the present review was that the literature search strategy included a broad range of search terms that have been associated with RRB. Furthermore, to enhance sensitivity of the search, specialist autism journals were searched electronically for any articles that the key database searches may have missed.

Turning to the search terms relating to anxiety, a particular strength of the search strategy was that no restrictions on specific types of anxiety were enforced. This meant that papers exploring a specific type of anxiety were not excluded or missed when sifting through the papers. For example, “anxi*” was used as opposed to “Anxi* AND Disorder”; this allowed for a range of papers that had included anxiety, anxiety disorders, anxious, etc., to be identified.

One limitation of the search strategy was that, due to the large number of studies available for review, only studies published in peer-reviewed journals were included. It was beyond the scope of the paper to examine unpublished studies and the “grey literature”. As a result, the given methodological approach may result in a bias, since studies are less likely to publish if no relationship between RRB and anxiety is reported. Finally, the review included only quantitative research; qualitative studies were excluded. Although qualitative research does not generally establish whether one variable can influence another, qualitative research can provide detailed understandings on the intricate associations of interest. However, given the difficulties primary caregivers may have in demarcating anxiety symptoms from RRB, it would have been difficult to draw any conclusive inferences from qualitative studies.

Quality Appraisal

The Effective Public Health Practice Project Quality Assessment Tool (EPHPP; Jackson & Waters, 2005) was the appraisal tool selected, as it appeared to be the most appropriate given the wide heterogeneity of the studies employed. In addition, Lundh

and Lundh and Gøtzsche (2008) highlight that many quality appraisal tools exist, with some tools tailored to address specific types of studies (e.g. intervention studies). The EPHPP is the most suitable choice as it had demonstrated high inter-rater reliability and is able to assess a wide range of domains associated with research studies. Furthermore, there is some evidence that found the EPHPP to be more reliable compared to other tools such as the Cochrane Collaboration Risk of Bias Tool (Armijo-Olivo et al., 2012). Nonetheless, it should be acknowledged that there is no consensus for a specific approach to appraise the quality of studies within a systematic review (Popay et al., 2006).

The EPHPP was adapted so that it would be suitable to assess the included studies. One component of the EPHPP relied on "Study Design"; however, only epidemiological and randomised controlled trials can obtain a moderate or strong rating in this domain. Given that many of the studies had cross-sectional designs due to the aims of their investigation (e.g. associations/mediation), they received weaker ratings that affected their global score. This meant that many of the studies had poor methodological quality. In addition, removing the domains that were not relevant to the study (e.g. blinding) may have put the studies at a disadvantage in terms of being able to achieve a better global quality rating. Upon reflection, it may have been useful to replace those domains with domains that assess the quality of the cross-sectional design. However, this may have diluted the effectiveness of the EPHPP. It should also be noted that the EPHPP framework is based on studies achieving a certain number of "weak" ratings in order to be considered weak in overall quality. Beyond the study

design, many studies did not control for confounding variables and exhibited selection biases. Thus, even customising the domains assessed would still have resulted in those studies being considered to have weak or moderate global quality.

A particular challenge of appraising the studies was the context in which the methodological appraisal of the studies took place. Notably, although the paper was written for publication in a peer-reviewed journal, it was also part of a doctoral thesis to obtain the Doctorate degree in Clinical Psychology, which required the paper to be conducted by only one researcher and imposed time limitations. This is a particular challenge, as Gopalakrishnan and Ganeshkumar (2013) have highlighted that high-quality systematic reviews require great care to find and appraise all relevant studies, which is time intensive. However, both supervisors had an extensive knowledge in ASD and were familiar with many of the papers included in the review. This allowed the researcher to verify their interpretation of the quality of the studies.

Data Synthesis

The wide heterogeneity of the studies included in the review implied that a meta-analysis was not appropriate. For that reason, a narrative synthesis was conducted which involved describing and contrasting the main findings from the included studies and examining their methodological strengths and weaknesses (Centre for Reviews and Dissemination 2009). A narrative analysis is often considered the default choice when the data is quantitative, but the characteristics of the studies included in the review do not allow statistical analysis to be carried out (Campell et al., 2018).

Several authors (Higgins et al., 2016; Valentine et al., 2017) have suggested that a limitation of using a narrative synthesis is the absence of transparency that may result in a bias in the synthesis. Taken these views into consideration, the current author attempted to be mindful of the way the discussion and narrative of results was structured by referring to guidance by Popay et al. (2006) on how to conduct a narrative synthesis within a systematic review. Further to this, full drafts of the systematic review were sent to supervisors in order to verify that the review was being transparent; the supervisors were helpful in being able to identify any forms of biases emerging throughout the synthesis. Indeed, Boland et al. (2017) has highlighted how any data synthesis needs to take into consideration the expertise of the research team in addition to the research aims.

One limitation of the synthesis was that, because of the word constraint, it was not possible to attempt to discuss the wider conceptual questions such as why certain types of anxiety may be associated with specific factors of RRB. In addition, the paper did not present detailed information about RRB and anxiety measures utilised, the general constructs that assessed the number of items in each measure, and the method of administration. This type of information may have allowed further insight concerning why the relationship with certain domains of RRB occurred with anxiety and not others. However, this was not included as it deterred focus away from the main aim of the paper, which was to examine the quality of the papers that investigated the relationship between RRB and anxiety.

Implications of Findings

The review shed further light on the relationship between subtypes of RRB and anxiety. In particular, the findings added further support to the premise that IS behaviours and RSMB have differential relationships with anxiety. The review highlights that increased RRB is associated with increased levels of anxiety. A particular strength of the review is that it highlights the inconsistencies among the different papers that explain why some subtypes of behaviour are more strongly associated with anxiety. In addition, the review underlines how future research can move forward when considering the associations between RRB and anxiety (e.g. using multi-informant approaches, anxiety measures tailored for ASD, etc.). This is consistent with the notion that Systematic Reviews are valuable for advancing research and identifying limitations in existing research.

In terms of broader clinical implications, the data suggest researchers and clinicians should consider the role of anxiety when understanding and treating RRBs. Specifically, high endorsement of items that reflect RRB should be used to identify individuals who are at risk of anxiety. However, the findings also suggest that, when assessing RRB, multi-informant measures should be used.

Paper 2 – Autistic traits and Anxiety: The mediating role of coping style

Background of research and decision to investigate the research topic

Conducting the systematic review (Paper 1) enabled the researcher to develop a strong understanding of the relation between anxiety and ASD. However, there was a dearth in research that highlighted the underlying mechanisms that precipitated and perpetuated anxiety. Coping styles have been reported to be a key predictor of stress and are often considered a good indicator and predictor of whether someone is likely to develop mental health symptoms (Campbell-Sills, Cohan, & Stein, 2006; Schnider, Elhai, & Gray, 2007). Surprisingly, Pinsula et al. (2015) were the only authors to have examined autistic traits, coping style and quality of life. Pinsula et al. findings were fruitful and highlighted that coping styles mediated the relationship between autistic traits and worsening quality of life. However, no measures of anxiety or mental health were integrated into the study.

The link between autistic traits, coping style and anxiety was, therefore, considered a worthwhile research pursuit. Notably, there were several limitations to Pinsula et al.'s (2015) study that I aspired to address. Finally, as a trainee clinical psychologist, I felt that many psychological interventions are often driven to build resilience in clients in addition to helping them develop more adaptive forms of coping. Thus, understanding the link between coping styles and anxiety would strengthen the researcher's ability to understand how specific coping styles related to worsening or a prevention in symptoms of anxiety.

Sample of interest

The design of the study adhered to a dimensional model of ASD. That is, ASD traits (e.g. social skills, communication difficulties, restrictive and repetitive behaviours, etc.) are considered to reside on a continuum ranging from typicality to disorder across the general population (Constantino & Todd, 2003; Ronald & Hoekstra, 2011; Skuse et al., 2005). It has been proposed that understanding these traits leads to a stronger understanding of the mechanisms underlying ASD (Wainer, Ingersoll, & Hopwood, 2011). Potential explanations could be that having a formal diagnostic label of 'autistic' could impact on how someone perceives themselves and how others perceive them, which may have a distinct effect on the relationship with anxiety and coping styles; in other words, an environmental effect of having a diagnostic label may occur. However, the researcher is aware it would be impossible to interpret whether any differences were due to a fundamental difference in the category of people who are autistic, or the indirect effects of having a diagnosis. Notwithstanding, there was a strong rationale to recruit a general population as opposed to focusing specifically on a clinical sample. Recruiting participants from a general population sample would likely lead to identifying individuals with clinical levels of ASD traits, milder variants of ASD traits, and individuals with low levels of individual traits.

Recruitment campaign and administration of online measures

Given the dimensional view of ASD, it was important to recruit a diverse range of participants from the general population. Indeed, major criticisms of psychological research have highlighted that psychology students, and students in general, tend to make up a large majority of samples of data. Consequently, such research findings can be problematic when generalising to the wider populations (Hanel & Vione, 2016).

In light of this limitation, the recruitment strategy in the current study drew on a wide pool of resources in order to research participants from a diverse range of backgrounds and occupations. The strategies employed were to advertise through multiple social media channels (Facebook, Twitter, Yammer) in addition to advertising through the WARC. In order for recruitment to be successful, questions from the public that were posted about the research study in forums or in Facebook "comments" were responded to where possible by the researcher. This behaviour was consistent with Moloney et al.'s (2009) research findings, which implied that online recruitment campaigns are likely to be more successful if the researcher develops rapport and discussion with interested participants.

Recruitment campaigns that use online methods have some limitations that were reflected upon during the recruitment phase of the study. Firstly, online studies can attract an increased amount of "data noise". Specifically, the environment in which the questionnaires are completed is not controlled and will likely vary from participant to participant. Consequently, it is unclear how the questionnaires were completed or whether there were any distractions during the completion of the questionnaires (e.g.

online gaming, chatting, etc.). Secondly, there is a likelihood of participants completing the study multiple times. This limitation is particularly pertinent when a prize draw is involved. Thirdly, Dandurand et al. (2008) found that the dropout rate of online studies (i.e. participants who discontinue the study before the end by closing the web browser) can be as high as 80%. As a result, the number of participants who access the study may not be an accurate representation of participants who complete the study. Finally, the absence of the researcher being present when participants complete the study means participants cannot ask for clarity of questions. Many of these limitations have been discussed in several earlier research papers (Bargh & McKenna, 2004, Birnbaum, 2004). Taking these concerns into consideration, the researcher developed strategies to address each of these issues, which are outlined below.

Regarding the increased data noise, extensive data screening was used to identify any patterns in the data that indicated questionnaires were not completed accurately. For example, participants who completed all questionnaires within five minutes or less were excluded from the study, as that was considered unrealistic. An inspection of box blots looked for extreme scoring on all of the questionnaires. Internet Protocol addresses (IP) were logged via Qualtrics, which would prevent a participant from submitting multiple responses within a set period. Fourthly, given Dandurand et al.'s (2008) findings, when the study was monitored from participant numbers the author was aware that people accessing the study (n = 300+) did not necessarily reflect the number of participants who completed all questionnaires. Thus, the researcher was mindful of not closing the study prematurely. Qualtrics also recorded the longitude and

latitude of IP addresses of computers, which allowed me to determine whether participants were completing the questionnaires outside the UK (i.e. likely being completed by 'bots' or spammers). Finally, the electronic information and consent sheet were re-drafted several times and discussed within the supervisory team. This verified that the study was clear and was communicated to participants in an accessible manner.

Beyond the limitations of online recruitment, there are notable advantages: increased sampling pool, which indicates better statistical power; increased accessibility beyond university populations; time efficient; greater anonymity; and less socially desirable responses.

Ethical Approval

The proposed research project was submitted for ethical review to the Cardiff University School of Psychology Research Ethics Committee. As no data would be collected involving clinical participants, an application to the NHS National Research Ethics Service (NRES) was not necessary.

Rationale of Measures

Autistic Traits

The researcher opted to use the Autism Quotient (AQ; Baron-Cohen et al., 2001) as it remains the measure of choice for assessing a range of autistic traits in adults without

an intellectual disability. Although other measures do exist such as the Social Responsiveness Scale (Constantino et al., 2003), it is the AQ that has remained consistent over time (Wheelwright et al., 2006) and culture (Ruta et al., 2012; Wakabayashi et al., 2006), and is designed for self-report administration. However, the AQ in isolation is not an adequate measure that captures the full range of behaviours (Kloosterman et al., 2011; Lau et al., 2013). Thus, the Adult Repetitive Behaviours Questionnaire-2 (RBQ-2A; Barrett et al., 2015; Barrett et al., 2018) was employed.

The RBQ-2A and AQ were felt to adequately capture the full range of autistic traits. Importantly, the RBQ-2A was designed for adults without an intellectual disability and was a self-report measure. However, there is a limitation that needs to be acknowledged. Notably, due to the overlap between RRB items in the RBQ-2A and items on the AQ, the decision was made to sum the two subscales from the AQ (Social Skills and Communication) which led to a 'Social Communication' subscale being created. This meant that the remaining subscales, namely Imagination, Attention to detail, and Task Switching, were excluded from analysis. Notwithstanding, inspection of the items on the Attention Switching subscale revealed items such as: "In a social group, I can easily keep track of several different people's conversations" and "I often notice small sounds when others do not" and "I tend to notice details that others do not". Collectively, it could be argued that these items reflect social communication and should have been included in the newly computed Social Communication scale. This was a notable concern for the researcher and was discussed thoroughly with the supervisory team. During these discussions, it was decided that the original labels of the subscales for the AQ were

referring to the perceived core issue, i.e. switching between conversation is a difficulty with attention switching rather than a difficulty with conversations (such as items loading on the communication factor). Consequently, computing a social communications scale from the AQ subscales 'Social Skills' and 'Communication' was considered to have good face validity.

Coping Style Measure

The Coping Inventory for Stressful Situations (CISS; Endler & Parker, 1990, 1999) was selected as it has been evaluated extensively and found to have excellent psychometric properties across a broad range of participant samples and cultural contexts (Greene et al., 2013; Rafnsson et al., 2006). Furthermore, the CISS is scored on a five-point Likert scale from 1 to 5, which allows for a more sensitive measure of coping style. This is particularly pertinent as many individuals will likely use all different coping styles at different times (e.g. emotion-oriented coping when stressed at work and task-oriented when stressed at home). Thus, using a Likert scale allows the participant to relate to which style of coping they have a bias towards using overall.

One limitation of the CISS was the wording of some of the items. Items reflecting emotion-oriented coping tended to reflect negative personality characteristics (e.g. 'Get angry', 'Blame others', 'Take it out on others' etc.). Therefore, there was a high probability that such a coping style would have been under-reported due to social desirability. However, given the study was online the enhancement of anonymity likely encouraged participants to be more transparent about their coping style.

Anxiety measures

In line with the previous discussions, the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA; Grös, Antony, Simms, & McCabe, 2007) was selected due to its strong psychometric properties and ease of administration (Roberts, Hart and Eastwood, 2016). Further to this, the STICSA examines individual symptoms of anxiety as opposed to focusing on a specific type of anxiety disorder. The researcher felt that this measure was particularly appropriate given anxiety symptoms are considered transdiagnostic and relate to many different types of disorders (Martin et al., 2018). In other words, exploring the pathways between autistic traits and general symptoms of anxiety will be more valuable than focusing on specific anxiety-based diagnoses.

Rationale of Data Analysis

As discussed, online recruitment methods have many advantageous over lab-based studies. However, due to the reduced control the researcher has over the data, it is imperative that data screening and cleaning is conducted thoroughly. Given the number of confounding factors that may have impacted on the data gathered, multiple discussions were had with the supervisory team. These discussions were fruitful as they allowed me to consider how best to assess the data that I had collected. These consultations instilled confidence in the data I had acquired. However, at times the process was frustrating as the initial sample size when down dramatically when certain

cases were omitted for violating a rule (i.e. spending less than five minutes completing questionnaires).

Preliminary data analysis using visual inspection of box plots and associated statistics indicated that the data for most of the variables were distributed normally. However, for some of the variables, the data looked a little bit skewed. Initially, I considered transforming the data, but discussion with my supervisor led to the agreed understanding that the data were not a misrepresentation of the data and that transformation was not to be the most effective way to manage skewed data (Bakker & Wicherts, 2014).

Mediation analysis was selected, as it was the most suitable analysis for the research question(s) under investigation. Correlational analysis in isolation would have been insufficient to develop an understanding between the pathways between coping styles, autistic traits and anxiety symptoms. As outlined by MacKinnon (2008), mediation analysis is an ideal way to test mechanisms based on theory. Further to this, bootstrapping methods were widely recommended (Bakker & Wicherts, 2014; Wright, London & Field, 2011).

Implications for findings

The study supports the notion that subtypes of autistic traits, when combined with a specific coping style, may serve as risk factor for developing heightened levels of anxious symptomology. Greater attention should be paid to detect high-risk individuals as a first step to prevent the onset and the chronic course of anxiety disorder. A better

recognition of autistic traits and coping styles in clinical settings may allow for more effective therapeutic strategies to be carried out.

It is important for further research to extend the findings of this study by verifying the results within the ASD population. This would further inform interventions to reduce anxious symptoms within the ASD population. These preliminary results suggest that such efforts would be best focused upon encouraging individuals to identify their coping style and assess the effectiveness that their coping style has. Finally, the findings highlight how different types of autistic traits may serve different functions, thus prospective studies looking at autistic traits should assess and analyse social and non-social measures separately.

Limitations of empirical paper

One of the major limitations of the current study was reliance on the self-report questionnaire to assess a person's coping style. Although the questionnaire had high validity and reliability, a self-report questionnaire on coping style alone may not necessarily reflect how someone responds in a stressful situation. Future research should consider inducing stressful situations in a controlled and ethically approved way which would allow for researchers to assess a participant's coping style from both a behavioural and cognitive perspective. For example, physiological observations could be used to assess level of stress (e.g. cortisol sample, blood pressure, etc.), in addition to a self-report questionnaire.

Another limitation of the study was that the current analyses looked at symptom scores of anxiety but did not focus on those with scores in the clinical range, as assessed by standardised clinical interview. Although higher scores indicated worsening anxiety symptoms, it was not possible to deduce to what extent these symptoms impacted on daily functioning.

A caveat of mediation analysis outlined by Judd & Kenny (1981) was that psychological behaviours are likely to have a variety of causes, so it is often unrealistic to claim that a single mediator (i.e. coping style) can completely explain the autistic traits to anxiety relation. However, given the wide range of literature on coping with stress and mental health problems (Phillips et al., 2007; Burton, Chaneb, & Meeks, 2007; Lavoie, 2013), it is reasonable to speculate that coping style plays a significant role with anxiety.

Dissemination of findings

One of the greatest criticisms of psychological research, particularly master's and doctoral dissertations, is that the findings are rarely fed back to society or the public. In order to avoid this, the findings will be disseminated in the following ways:

- Findings published in a peer-reviewed journal
- Findings presented to the Welsh Autism Research Centre (WARC)

- Findings presented to online forums for parents and carers of individuals with ASD.

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Appendix A - Guidelines for Journal Submission

MANUSCRIPT PREPARATION & SUBMISSION

Use of word processing software

Files must be saved in the native format of the word processor and the text should be in 10-point Arial font, single-column format, double spaced, with standard 1 inch page margins (2.54 cm). Please keep the layout of the text as simple as possible, as most formatting codes will be replaced on processing the article. In particular, do not use the options to justify text or hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. Note that source files of figures and text graphics will be required whether or not you embed them in the text. See also the section on Electronic artwork below for details on preparing figures and graphics.

Language (usage and editing services)

Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel they require support in editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's WebShop (http://webshop.elsevier.com/languageediting/).

In relation to terminology, we prefer authors to refrain from using the terms 'low-functioning' or 'high-functioning' to describe individuals with ASD who either have additional intellectual or language impairments or not (see Kenny et al., 2015; http://aut.sagepub.com/content/early/2015/06/10/1362361315588200.abstract). Instead authors should consider whether it may be appropriate to provide details about their participants in terms of the severity specifiers of the DSM-5 (American Psychiatric Association, 2013).

Types of Articles

Research in Autism Spectrum Disorders publishes the following types of manuscripts:
Brief reports: Papers of no more than 2,500 words that report an original piece of research of limited scope and/or that serves as proof-of principle for larger-scale studies.
Regular Articles: Papers of up to 6,000 words that report a substantive piece of research that makes a significant contribution and has clear implications for practice.Manuscripts reporting the results of randomized trials or interventions must demonstrate adherence to the CONSORT guidelines (http://www.consort-statement.org/) and include the relevant flow diagram and completed checklist.
Reviews: Papers of up to 10,000 words that provide a comprehensive overview of a significant area of research. Quantitative (e.g., meta-analyses) and qualitative reviews are welcome as long as they go beyond a mere description of the available literature and synthesise new knowledge with clear implications for future directions and practice.For systematic reviews and meta-analyses, authors must demonstrate adherence to the PRISMA guidelines (www.prisma-statement.org) and include the relevant flow diagram and checklist.
Commentaries: We welcome brief commentaries of no more than 1,000 words that offer new insights on papers published in RASD or elsewhere. Commentaries on government policy and/or items in the media are also welcome.

NOTE: Word limits do not include the title page, abstract, figure legends, tables and reference list.

Submission

Our online submission system guides authors stepwise through the submission process. The system converts article files to a single PDF file used in the peer–review process. Editable files (e.g., Word, LaTeX) are required to typeset your article for final publication. All correspondence, including notification of the Editor's decision and requests for revision, is sent by e–mail.

Elsevier accepts electronic supplementary material such as supporting applications, high resolution images, background datasets, sound clips and more. These will be published online alongside the electronic version of your article in Elsevier Web products, including ScienceDirect: http://www.sciencedirect.com. For further information, please visit our artwork instruction pages at https://www.elsevier.com/artworkinstructions

To increase the transparency of editorial information within the framework of single/ double blind peer review , RASD displays the number of unique reviewer reports received in the first round of review with each published article. This policy will be in place for original research articles submitted from 1 January 2016 that are accepted for publication.

Manuscript Format

All manuscripts must include a Title, Abstract and Highlights on separate pages, followed by the main manuscript text. The main manuscript text of brief reports, regular articles and quantitative reviews should include subsections carrying the headings Introduction, Methods, Results, Discussion & Implications. Reviews may deviate from this structure but must include a methods section that provides details on how the relevant literature was searched. The structure of commentaries is at the discretion of authors.

Essential Title Page Information

Title:Titles must be concise and informative and should have no more than 20 words. Titles are often used in information–retrieval systems. Avoid abbreviations and formulae where possible.
Author names and affiliations: Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. Present the author's affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lowercase superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e–mail address of each author.
Corresponding author: Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. **Ensure that the e–mail address is given and that contact details are kept up to date by the corresponding author**.
Present/permanent address: If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main affiliation address. Superscript Arabic numerals are used for such footnotes.

Abstract & Keywords

The abstract page must include a structured abstract of no more than 250 words that includes the following subsections:
Background: A brief summary of the research question and rationale for the study.
Method: A concise description of the methods employed to test the stated hypotheses, including details of the participants where relevant.
Results: A brief description of the main findings.
Conclusions: This section must include a clear statement about the implications of the findings for practice.

Immediately after the abstract, a maximum of 6 keywords should be provided, avoiding general and plural terms and multiple concepts (for example, avoid 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible (e.g., ADOS, ASD, etc). These keywords will be used for indexing purposes.

Graphical Abstract

Graphical abstracts are optional but encouraged to draw more attention to the online

article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Please provide an image with a minimum of 531 X 1328 pixels (h X w) or proportionally more. The image should be readable at a size of 5 X13 cm using a regular screen resolution of 96 dpi. Preferred file types include TIFF, EPS, PDF or MS Office files. See https://www.elsevier.com/graphicalabstracts for examples. Authors can make use of Elsevier's Illustration and Enhancement service to ensure the best presentation of their images.
http://webshop.elsevier.com/illustrationservices/

Introduction

The introduction should develop a clear rationale for the presented work on the basis of a concise overview of the relevant literature. Detailed literature reviews should be avoided.

Methods

This section will typically include sub–headings for a description of the Participants, Materials & Design, Procedures and Analysis. However, alternative sub–headings may be used to suit particular research approaches (e.g., case–studies, meta–analyses, imaging studies etc.)

The participants section should provide demographic information (age, sex, ethnicity, socio–economic status, etc.), and include details on where and how participants were recruited and how relevant clinical diagnoses were verified. Additional clinical information (e.g., intellectual functioning, co–morbidities, use of medication etc.) is desired and may be necessary for some research designs. Sample sizes should be justified by suitable power calculations although it is appreciated that it is not always feasible to obtain desired numbers of participants.

The materials, design and procedures must be described in sufficient detail for the work to be replicable. Authors must also include a statement confirming that the work was carried out in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Declaration of Helsinki as revised in 2000. In this context confirmation should also be given that participant or guardian informed consent was obtained where appropriate.

The analysis section should provide details of the statistical methods used including information on the significance thresholds and the methods used to correct for multiple comparisons where necessary. Information on inter–rater reliability and any data filtering / transformation that was applied should also be included here.

Results

The results should be set out transparently and in full and should conform to the formatting style of the American Psychological Association (http://www.apastyle.org/).

Effect sizes must be reported for all significant and non–significant effects, and sufficient descriptive statistics must be provided for the effect size calculations to be replicated.

Tables

Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. The formatting of tables should conform to APA guidelines (http://www.apastyle.org/).

Appendix B – Quality Appraisal Tool

Quality Assessment Tool for Quantitative Studies Dictionary

The purpose of this dictionary is to describe items in the tool thereby assisting raters to score study quality. Due to under-reporting or lack of clarity in the primary study, raters will need to make judgements about the extent that bias may be present. When making judgements about each component, raters should form their opinion based upon information contained in the study rather than making inferences about what the authors intended. Mixed methods studies can be quality assessed using this tool with the quantitative component of the study.

A) SELECTION BIAS

(Q1) Participants are more likely to be representative of the target population if they are randomly selected from a comprehensive list of individuals in the target population (score very likely). They may not be representative if they are referred from a source (e.g. clinic) in a systematic manner (score somewhat likely) or self-referred (score not likely).

(Q2) Refers to the % of subjects in the control and intervention groups that agreed to participate in the study before they were assigned to intervention or control groups.

B) STUDY DESIGN

In this section, raters assess the likelihood of bias due to the allocation process in an experimental study. For observational studies, raters assess the extent that assessments of exposure and outcome are likely to be independent. Generally, the type of design is a good indicator of the extent of bias. In stronger designs, an equivalent control group is present and the allocation process is such that the investigators are unable to predict the sequence.

Randomized Controlled Trial (RCT)

An experimental design where investigators randomly allocate eligible people to an intervention or control group. A rater should describe a study as an RCT if the randomization sequence allows each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. If the investigators do not describe the allocation process and only use the words 'random' or 'randomly', the study is described as a controlled clinical trial.

See below for more details.

Was the study described as randomized?

Score YES, if the authors used words such as random allocation, randomly assigned, and

random assignment. Score NO, if no mention of randomization is made.

Was the method of randomization described?

Score YES, if the authors describe any method used to generate a random allocation sequence.

Score NO, if the authors do not describe the allocation method or describe methods of allocation such as alternation, case record numbers, dates of birth, day of the week, and any allocation procedure that is entirely transparent before assignment, such as an open list of random numbers of assignments.

If NO is scored, then the study is a controlled clinical trial.

Was the method appropriate?

Score YES, if the randomization sequence allowed each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. Examples of appropriate approaches include assignment of subjects by a central office unaware of subject characteristics, or sequentially numbered, sealed, opaque envelopes.

Score NO, if the randomization sequence is open to the individuals responsible for recruiting and allocating participants or providing the intervention, since those individuals can influence the allocation process, either knowingly or unknowingly.

If NO is scored, then the study is a controlled clinical trial.

Controlled Clinical Trial (CCT)

An experimental study design where the method of allocating study subjects to intervention or control groups is open to individuals responsible for recruiting subjects or providing the intervention. The method of allocation is transparent before assignment, e.g. an open list of random numbers or allocation by date of birth, etc.

Cohort analytic (two group pre and post)

An observational study design where groups are assembled according to whether or not exposure to the intervention has occurred. Exposure to the intervention is not under the control of the investigators. Study groups might be non-equivalent or not comparable on some feature that affects outcome.

Case control study

A retrospective study design where the investigators gather 'cases' of people who already have the outcome of interest and 'controls' who do not. Both groups are then questioned or their records examined about whether they received the intervention exposure of interest.

Cohort (one group pre + post (before and after)

The same group is pretested, given an intervention, and tested immediately after the intervention. The intervention group, by means of the pretest, act as their own control group.

Interrupted time series

A study that uses observations at multiple time points before and after an intervention (the 'interruption'). The design attempts to detect whether the intervention has had an effect significantly greater than any underlying trend over time. Exclusion: Studies that do not have a clearly defined point in time when the intervention occurred and at least three data points before and three after the intervention

Other:

One time surveys or interviews

C) CONFOUNDERS

By definition, a confounder is a variable that is associated with the intervention or exposure and causally related to the outcome of interest. Even in a robust study design, groups may not be balanced with respect to important variables prior to the intervention. The authors should indicate if confounders were controlled in the design (by stratification or matching) or in the analysis. If the allocation to intervention and control groups is randomized, the authors must report that the groups were balanced at baseline with respect to confounders (either in the text or a table).

D) BLINDING

(Q1) Assessors should be described as blinded to which participants were in the control and intervention groups. The purpose of blinding the outcome assessors (who might also be the care providers) is to protect against detection bias.

(Q2) Study participants should not be aware of (i.e. blinded to) the research question. The purpose of blinding the participants is to protect against reporting bias.

E) DATA COLLECTION METHODS

Tools for primary outcome measures must be described as reliable and valid. If 'face' validity or 'content' validity has been demonstrated, this is acceptable. Some sources from which data may be collected are described below:

Self reported data includes data that is collected from participants in the study (e.g. completing a questionnaire, survey, answering questions during an interview, etc.).

Assessment/Screening includes objective data that is retrieved by the researchers. (e.g. observations by investigators).

Medical Records/Vital Statistics refers to the types of formal records used for the extraction of the data.

Reliability and validity can be reported in the study or in a separate study. For example, some standard assessment tools have known reliability and validity.

F) WITHDRAWALS AND DROP-OUTS

Score **YES** if the authors describe BOTH the numbers and reasons for withdrawals and drop-outs.

Score **NO** if either the numbers or reasons for withdrawals and drop-outs are not reported.

Score **NOT APPLICABLE** if the study was a one-time interview or survey where there was not follow-up data reported.

The percentage of participants completing the study refers to the % of subjects remaining in the study at the final data collection period in all groups (i.e. control and intervention groups).

G) INTERVENTION INTEGRITY

The number of participants receiving the intended intervention should be noted (consider both frequency and intensity). For example, the authors may have reported that at least 80 percent of the participants received the complete intervention. The authors should describe a method of measuring if the intervention was provided to all participants the same way. As well, the authors should indicate if subjects received an unintended intervention that may have influenced the outcomes. For example, co-intervention occurs when the study group receives an additional intervention (other than that intended). In this case, it is possible that the effect of the intervention may be over-estimated. Contamination refers to situations where the control group accidentally receives the study intervention. This could result in an under-estimation of the impact of the intervention.

H) ANALYSIS APPROPRIATE TO QUESTION

Was the quantitative analysis appropriate to the research question being asked?

An intention-to-treat analysis is one in which all the participants in a trial are analyzed according to the intervention to which they were allocated, whether they received it or not. Intention-to-treat analyses are favoured in assessments of effectiveness as they mirror the noncompliance and treatment changes that are likely to occur when the intervention is used in practice, and because of the risk of attrition bias when participants are excluded from the analysis.

Component Ratings of Study:

For each of the six components A – F, use the following descriptions as a roadmap.

A) SELECTION BIAS

Good: The selected individuals are very likely to be representative of the target population (Q1 is 1) **and** there is greater than 80% participation (Q2 is 1).

Fair: The selected individuals are at least somewhat likely to be representative of the target population (Q1 is 1 or 2); **and** there is 60 - 79% participation (Q2 is 2). 'Moderate' may also be assigned if Q1 is 1 or 2 and Q2 is 5 (can't tell).

Poor: The selected individuals are not likely to be representative of the target population (Q1 is 3); **or** there is less than 60% participation (Q2 is 3) **or** selection is not described (Q1 is 4); and the level of participation is not described (Q2 is 5).

B) DESIGN

Good: will be assigned to those articles that described RCTs and CCTs.

Fair: will be assigned to those that described a cohort analytic study, a case control study, a cohort design, or an interrupted time series.

Weak: will be assigned to those that used any other method or did not state the method used.

C) CONFOUNDERS

Good: will be assigned to those articles that controlled for at least 80% of relevant confounders (Q1 is 2); **or** (Q2 is 1).

Fair: will be given to those studies that controlled for 60 – 79% of relevant confounders (Q1 is 1) **and** (Q2 is 2).

Poor: will be assigned when less than 60% of relevant confounders were controlled (Q1 is 1) **and** (Q2 is 3) **or** control of confounders was not described (Q1 is 3) **and** (Q2 is 4).

D) BLINDING

Good: The outcome assessor is not aware of the intervention status of participants (Q1 is 2); **and t**he study participants are not aware of the research question (Q2 is 2).

Fair: The outcome assessor is not aware of the intervention status of participants (Q1 is 2); **or** the study participants are not aware of the research question (Q2 is 2).

Poor: The outcome assessor is aware of the intervention status of participants (Q1 is 1); **and** the study participants are aware of the research question (Q2 is 1); **or b**linding is not described (Q1 is 3 and Q2 is 3).

E) DATA COLLECTION METHODS

Good: The data collection tools have been shown to be valid (Q1 is 1); **and** the data collection tools have been shown to be reliable (Q2 is 1).

Fair: The data collection tools have been shown to be valid (Q1 is 1); **and** the data collection tools have not been shown to be reliable (Q2 is 2) **or** reliability is not described (Q2 is 3).

Poor: The data collection tools have not been shown to be valid (Q1 is 2) **or** both reliability and validity described (Q1 is 3 and Q2 is 3)

F) WITHDRAWALS AND DROP-OUTS - a rating of:

Good: will be assigned when the follow-up rate is 80% or greater (Q1 is 1 and Q2 is 1).

Fair: will be assigned when the follow-up rate is 60 – 79% (Q2 is 2) **OR** Q1 is 4 or Q2 is 5.

Poor: will be assigned when a follow-up rate is less than 60% (Q2 is 3) or if the withdrawals and drop-outs were not described (Q1 is No or Q2 is 4).

Not Applicable: if Q1 is 4 or Q2 is 5.

Appendix C – Ethical Approval for Paper 2

Dear Marcus,

The Ethics Committee has considered the amendment to your PG project proposal: The relationship between autism traits, coping style and anxiety (EC.18.02.13.5237A).

The amendment has been approved.

Please note that if any changes are made to the above project then you must notify the Ethics Committee.

Best wishes,
Mark Jones

School of Psychology Research Ethics Committee

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Appendix D – Information and Consent Sheet for Study

Investigating autistic traits, coping style and anxiety

You are invited to take part in a questionnaire study investigating autistic traits, coping style and anxiety in the general population.

Anxiety is a feeling of worry, nervousness or unease about something with an uncertain outcome and is experienced by everyone to different intensities. However, there is a growing body of evidence that certain individual differences affect the extent to which a person experiences anxiety.

Autistic traits, which include difficulties with social communication and a preference for repetitive behaviours and interests, are seen in the general population and are associated with heightened levels of anxiety. Another factor that is associated with anxiety is an individual's coping style. A coping style refers to the specific strategies, both behavioural and psychological, that people employ to tolerate, reduce, or minimise stressful events.

We are interested in investigating the associations between autistic traits, coping style and anxiety within the general population. Developing an understanding of these relationships could potentially allow both clinicians and researchers to develop effective psychological interventions that can be used to help an individual manage and reduce their anxiety.

This is a general population investigation and we are interested in people with both high and low levels of different traits and behaviours. The questionnaires will be used to measure levels of behaviour and are not diagnostic. Your responses are collected anonymously, therefore individual feedback cannot be provided.

What will I have to do?

This study will take approximately 35 minutes and requires you to complete four online questionnaires that all participants will be asked to complete. These include: Coping Inventory for Stressful Situations (CISS), which measures how a person copes when presented with difficult or stressful situations; the Autism-Spectrum Quotient (AQ), which measures autistic traits; the Adult Repetitive Behaviour Questionnaire (RBQ-2A), which measures restricted and repetitive behaviours; and the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA), which measures anxiety across two time points (right now and in general). You will also be asked to provide information on your gender, age and previous or current mental health diagnoses. You can leave a question blank if you do not want to answer.

Who can take part?

The study is open to adults who are UK residents. Participation in this study is entirely voluntary and participants are free to withdraw from taking part at any time.

Compensation for taking part?

Participants who complete the study will be able to provide their e-mail address to take part in a prize draw to win one of four £50 Amazon vouchers. Winners of the vouchers will be selected at random and contacted in September 2018.

Email addresses will be held in compliance with GDPR regulations. Cardiff University is the data controller and Matt Cooper is the data protection officer (inforequest@cardiff.ac.uk). Email addresses will be held securely and separately from the research information you provide and only Dr Marcus Lewton will have access. The list of

email addresses will be destroyed once the winners have been contacted.

What will happen to my data?

All study data are held anonymously, which means they cannot be traced back to you, and will only be used for research purposes. As the data are anonymous you cannot withdraw your responses after you have submitted your answers. However, you can withdraw at any time during your participation by closing the browser window.

Thank you for reading this information. If you would like more information regarding the study or have any questions, please contact Marcus Lewton, Catherine Jones or Sarah Barrett. If you have any further queries or would like to make a complaint, please contact the School of Psychology Ethics Committee.

Contact Information:

Marcus Lewton
LewtonM@cardiff.ac.uk

Dr Sarah Barrett
Barrettsl2@cardiff.ac.uk

Dr Catherine Jones
JonesCR10@cardiff.ac.uk

Secretary of the Ethics Committee
psychethics@cardiff.ac.uk

Appendix E – Autism Quotient (AQ)

The Adult Autism Spectrum Quotient (AQ)

Ages 16+

SPECIMEN, FOR RESEARCH USE ONLY.

For full details, please see:

S. Baron-Cohen, S. Wheelwright, R. Skinner, J. Martin and E. Clubley, (2001)
The Autism Spectrum Quotient (AQ) : Evidence from Asperger Syndrome/High Functioning Autism, Males and Females, Scientists and Mathematicians
Journal of Autism and Developmental Disorders 31:5-17

Name:..... Sex:.....

Date of birth:..... Today's Date.....

How to fill out the questionnaire

Below are a list of statements. Please read each statement very carefully and rate how strongly you agree or disagree with it by circling your answer.

DO NOT MISS ANY STATEMENT OUT.

1. I prefer to do things with others rather than on my own.	definitely agree	slightly agree	slightly disagree	definitely disagree
2. I prefer to do things the same way over and over again.	definitely agree	slightly agree	slightly disagree	definitely disagree
3. If I try to imagine something, I find it very easy to create a picture in my mind.	definitely agree	slightly agree	slightly disagree	definitely disagree
4. I frequently get so strongly absorbed in one thing that I lose sight of other things.	definitely agree	slightly agree	slightly disagree	definitely disagree
5. I often notice small sounds when others do not.	definitely agree	slightly agree	slightly disagree	definitely disagree
6. I usually notice car number plates or similar strings of information.	definitely agree	slightly agree	slightly disagree	definitely disagree
7. Other people frequently tell me that what I've said is impolite, even though I think it is polite.	definitely agree	slightly agree	slightly disagree	definitely disagree
8. When I'm reading a story, I can easily imagine what the characters might look like.	definitely agree	slightly agree	slightly disagree	definitely disagree
9. I am fascinated by dates.	definitely agree	slightly agree	slightly disagree	definitely disagree
10. In a social group, I can easily keep track of several different people's conversations.	definitely agree	slightly agree	slightly disagree	definitely disagree
11. I find social situations easy.	definitely agree	slightly agree	slightly disagree	definitely disagree
12. I tend to notice details that others do not.	definitely agree	slightly agree	slightly disagree	definitely disagree
13. I would rather go to a library than a party.	definitely agree	slightly agree	slightly disagree	definitely disagree
14. I find making up stories easy.	definitely agree	slightly agree	slightly disagree	definitely disagree
15. I find myself drawn more strongly to people than to things.	definitely agree	slightly agree	slightly disagree	definitely disagree
16. I tend to have very strong interests which I get upset about if I can't pursue.	definitely agree	slightly agree	slightly disagree	definitely disagree
17. I enjoy social chit-chat.	definitely agree	slightly agree	slightly disagree	definitely disagree
18. When I talk, it isn't always easy for others to get a word in edgeways.	definitely agree	slightly agree	slightly disagree	definitely disagree
19. I am fascinated by numbers.	definitely agree	slightly agree	slightly disagree	definitely disagree

20. When I'm reading a story, I find it difficult to work out the characters' intentions.	definitely agree	slightly agree	slightly disagree	definitely disagree
21. I don't particularly enjoy reading fiction.	definitely agree	slightly agree	slightly disagree	definitely disagree
22. I find it hard to make new friends.	definitely agree	slightly agree	slightly disagree	definitely disagree
23. I notice patterns in things all the time.	definitely agree	slightly agree	slightly disagree	definitely disagree
24. I would rather go to the theatre than a museum.	definitely agree	slightly agree	slightly disagree	definitely disagree
25. It does not upset me if my daily routine is disturbed.	definitely agree	slightly agree	slightly disagree	definitely disagree
26. I frequently find that I don't know how to keep a conversation going.	definitely agree	slightly agree	slightly disagree	definitely disagree
27. I find it easy to "read between the lines" when someone is talking to me.	definitely agree	slightly agree	slightly disagree	definitely disagree
28. I usually concentrate more on the whole picture, rather than the small details.	definitely agree	slightly agree	slightly disagree	definitely disagree
29. I am not very good at remembering phone numbers.	definitely agree	slightly agree	slightly disagree	definitely disagree
30. I don't usually notice small changes in a situation, or a person's appearance.	definitely agree	slightly agree	slightly disagree	definitely disagree
31. I know how to tell if someone listening to me is getting bored.	definitely agree	slightly agree	slightly disagree	definitely disagree
32. I find it easy to do more than one thing at once.	definitely agree	slightly agree	slightly disagree	definitely disagree
33. When I talk on the phone, I'm not sure when it's my turn to speak.	definitely agree	slightly agree	slightly disagree	definitely disagree
34. I enjoy doing things spontaneously.	definitely agree	slightly agree	slightly disagree	definitely disagree
35. I am often the last to understand the point of a joke.	definitely agree	slightly agree	slightly disagree	definitely disagree
36. I find it easy to work out what someone is thinking or feeling just by looking at their face.	definitely agree	slightly agree	slightly disagree	definitely disagree
37. If there is an interruption, I can switch back to what I was doing very quickly.	definitely agree	slightly agree	slightly disagree	definitely disagree
38. I am good at social chit-chat.	definitely agree	slightly agree	slightly disagree	definitely disagree
39. People often tell me that I keep going on and on about the same thing.	definitely agree	slightly agree	slightly disagree	definitely disagree

40. When I was young, I used to enjoy playing games involving pretending with other children.	definitely agree	slightly agree	slightly disagree	definitely disagree
41. I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).	definitely agree	slightly agree	slightly disagree	definitely disagree
42. I find it difficult to imagine what it would be like to be someone else.	definitely agree	slightly agree	slightly disagree	definitely disagree
43. I like to plan any activities I participate in carefully.	definitely agree	slightly agree	slightly disagree	definitely disagree
44. I enjoy social occasions.	definitely agree	slightly agree	slightly disagree	definitely disagree
45. I find it difficult to work out people's intentions.	definitely agree	slightly agree	slightly disagree	definitely disagree
46. New situations make me anxious.	definitely agree	slightly agree	slightly disagree	definitely disagree
47. I enjoy meeting new people.	definitely agree	slightly agree	slightly disagree	definitely disagree
48. I am a good diplomat.	definitely agree	slightly agree	slightly disagree	definitely disagree
49. I am not very good at remembering people's date of birth.	definitely agree	slightly agree	slightly disagree	definitely disagree
50. I find it very easy to play games with children that involve pretending.	definitely agree	slightly agree	slightly disagree	definitely disagree

Developed by:
The Autism Research Centre
University of Cambridge

Appendix F – The Adult Repetitive Behaviour Questionnaire (RBQ-2A)

The Adult Repetitive Behaviour Questionnaire-2 (RBQ-2A)[1]

1. Do you like to arrange items in rows or patterns?

☐ Never or rarely

☐ One or more times daily

☐ 15 or more times daily

☐ 30 or more times daily

2. Do you repetitively fiddle with items? (e.g. spin, twiddle, bang, tap, twist, or flick anything repeatedly?

☐ Never or rarely

☐ One or more times daily

☐ 15 or more times daily

☐ 30 or more times daily

3. Do you spin yourself around and around?

☐ Never or rarely

☐ One or more times daily

☐ 15 or more times daily

☐ 30 or more times daily

4. Do you rock backwards and forwards, or side to side, either when sitting or when standing?

☐ Never or rarely

☐ One or more times daily

☐ 15 or more times daily

☐ 30 or more times daily

5. Do you pace or move around repetitively? (e.g. walk to and fro across a room, or around the same path in the garden?)

☐ Never or rarely

☐ One or more times daily

☐ 15 or more times daily

☐ 30 or more times daily

6. Do you make repetitive hand and/or finger movements? (e.g. flap, wave, or flick your hands or fingers repetitively?

☐ Never or rarely

☐ One or more times daily

☐ 15 or more times daily

☐ 30 or more times daily

7. Do you have a fascination with specific objects? (e.g. trains, road signs or other things?)

☐ Never or rarely

☐ Mild or occasional

☐ Marked or notable

8. Do you like to look at objects from particular or unusual angles?

☐ Never or rarely

☐ Mild or occasional

☐ Marked or notable

9. Do you have a special interest in the smell of people or objects?

☐ Never or rarely

☐ Mild or occasional

☐ Marked or notable

10. Do you have a special interest in the feel of different surfaces?

☐ Never or rarely

☐ Mild or occasional

☐ Marked or notable

11. Do you have any special objects you like to carry around?

☐ Never or rarely

☐ Mild or occasional

☐ Marked or notable

12. Do you collect or hoard items of any sort?

☐ Never or rarely

☐ Mild or occasional

☐ Marked or notable

13. Do you insist on things at home remaining the same? (e.g. furniture staying in the same place, things being kept in certain places, or arranged in certain ways?)

☐ Never or rarely

☐ Mild or occasional (does not affect others)

☐ Marked or notable (occasionally affects others)

☐ Serious or severe (affects others on a regular basis)

14. Do you get upset about minor changes to objects? (e.g. flecks of dirt on your clothes, minor scratches on objects?)

☐ Never or rarely

☐ Mild or occasional (does not affect others)

☐ Marked or notable (occasionally affects others)

☐ Serious or severe (affects others on a regular basis)

15. Do you insist that aspects of daily routine must remain the same?

☐ Never or rarely

☐ Mild or occasional (does not affect others)

☐ Marked or notable (occasionally affects others)

☐ Serious or severe (affects others on a regular basis)

16. Do you insist on doing things in a certain way or re-doing things until they are "just right"?

☐ Never or rarely

☐ Mild or occasional (does not affect others)

☐ Marked or notable (occasionally affects others)

☐ Serious or severe (affects others on a regular basis)

17. Do you play the same music, game or video, or read the same book repeatedly?

☐ Never or rarely

☐ Mild or occasional (not entirely resistant to change or new things)

☐ Marked or notable (will tolerate changes when necessary)

☐ Serious or severe (will not tolerate any changes)

18. Do you insist on wearing the same clothes or refuse to wear new clothes?

☐ Never or rarely

☐ Mild or occasional (not entirely resistant to change or new things)

☐ Marked or notable (will tolerate changes when necessary)

☐ Serious or severe (will not tolerate any changes)

19. Do you insist on eating the same foods, or a very small range of foods, at every meal?

☐ Never or rarely

☐ Mild or occasional (not entirely resistant to change or new things)

☐ Marked or notable (will tolerate changes when necessary)

☐ Serious or severe (will not tolerate any changes)

20. What sort of activity will you choose if you are left to occupy yourself?

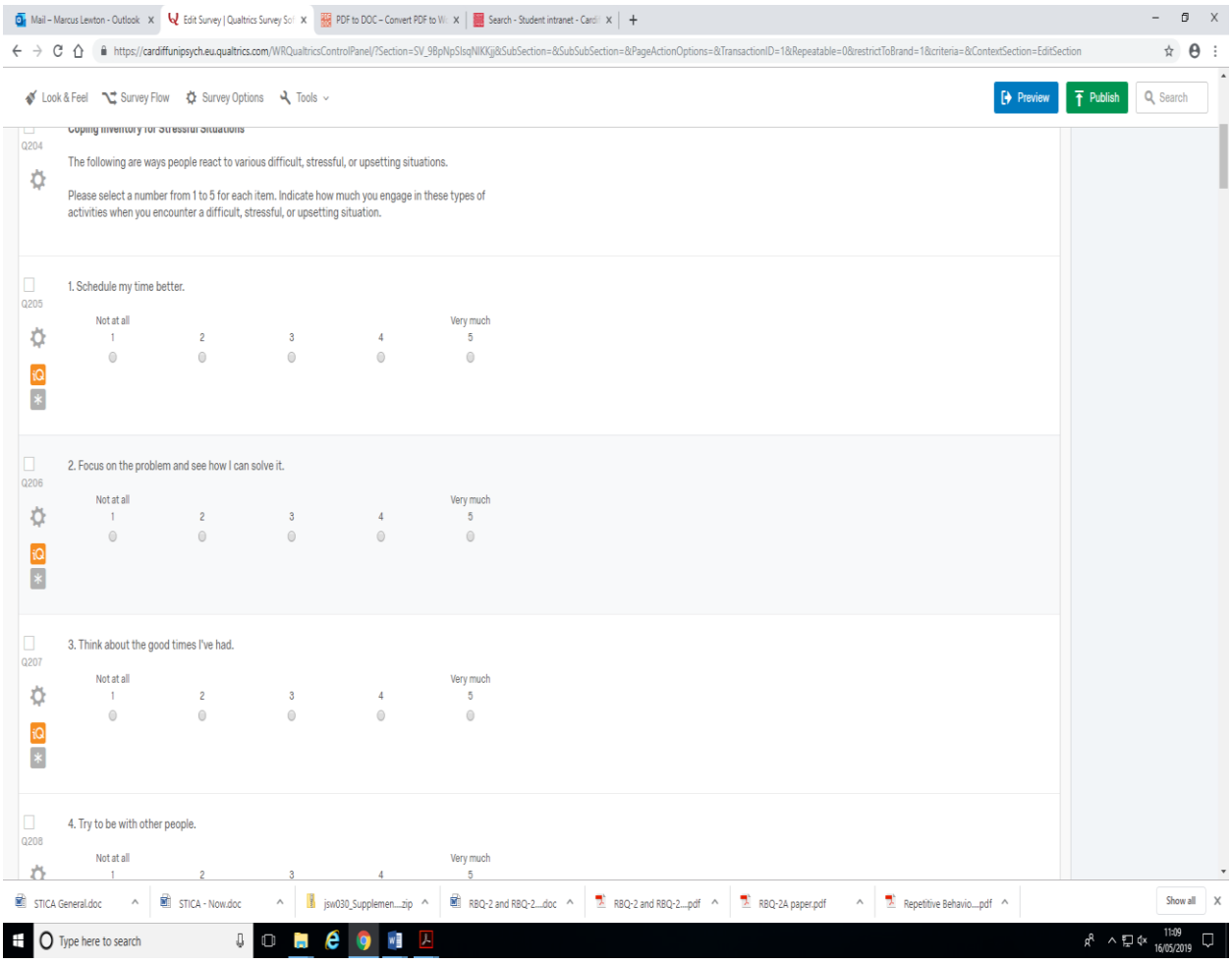
☐ A range of different and flexible self-chosen activities

☐ Some varied and flexible interests but commonly choose the same activities

☐ Almost always choose from a restricted range of repetitive activities © Cardiff University

Appendix G – Coping Inventory for Stressful Situations (CISS)

Due to copyright reasons and having purchased a single study license, the full measure can only be presented in the form of a screen shot.



Appendix H – **State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA)**

STICSA-C
Your Mood at this Moment

Below is a list of sentences that describe how people feel. Beside each sentence are four numbers that say how much the sentence describes your mood right now (e.g., 1= not at all, 4= very much). Please read each sentence carefully and circle the number that best describes **how you feel right now, at this very moment, even if it is not how you usually feel.**

Right now…				
1. My heart beats fast.	1	2	3	4
2. My muscles feel tight.	1	2	3	4
3. I worry a lot (stress out) about my problems.	1	2	3	4
4. I think that others won't like me.	1	2	3	4
5. I have a hard time making up my mind.	1	2	3	4
6. I feel dizzy.	1	2	3	4
7. My muscles feel weak.	1	2	3	4
8. I feel shaky.	1	2	3	4
9. I imagine something bad happening in the future.	1	2	3	4
10. It's hard for me to stop thinking about some things.	1	2	3	4
11. I have trouble remembering things.	1	2	3	4
12. My face feels hot.	1	2	3	4
13. I think that the worst will happen.	1	2	3	4
14. My arms and legs feel stiff.	1	2	3	4
15. My throat feels dry.	1	2	3	4
16. I try to stay busy to keep my mind off upsetting thoughts.	1	2	3	4
17. It's hard for me to concentrate because different thoughts keep popping into my mind.	1	2	3	4
18. My breathing feels fast.	1	2	3	4
19. My worries are hard to control.	1	2	3	4
20. I have butterflies in my stomach.	1	2	3	4

21. My hands feel sweaty.	1	2	3	4

STICSA
General Mood Questionnaire

Below is a list of sentences that describe how people feel. Beside each sentence are four numbers that say how much the sentence is usually true of you (e.g., 1= never, 4= almost always). Please read each sentence carefully and circle the number that best describes **how often, in general, the sentence is true of you.**

In general…

1. My heart beats fast.	1	2	3	4
2. My muscles feel tight.	1	2	3	4
3. I worry a lot (stress out) about my problems.	1	2	3	4
4. I think that others won't like me.	1	2	3	4
5. I have a hard time making up my mind.	1	2	3	4
6. I feel dizzy.	1	2	3	4
7. My muscles feel weak.	1	2	3	4
8. I feel shaky.	1	2	3	4
9. I imagine something bad happening in the future.	1	2	3	4
10. It's hard for me to stop thinking about some things.	1	2	3	4
11. I have trouble remembering things.	1	2	3	4
12. My face feels hot.	1	2	3	4
13. I think that the worst will happen.	1	2	3	4
14. My arms and legs feel stiff.	1	2	3	4
15. My throat feels dry.	1	2	3	4
16. I try to stay busy to keep my mind off upsetting thoughts.	1	2	3	4
17. It's hard for me to concentrate because different thoughts keep popping into my mind.	1	2	3	4
18. My breathing feels fast.	1	2	3	4
19. My worries are hard to control.	1	2	3	4
20. I have butterflies in my stomach.	1	2	3	4
21. My hands feel sweaty.	1	2	3	4