Autistic Traits and Atypical Eating Behaviours in the General Adult Population – Investigating the Modulatory Role of Rigid, Repetitive Behaviours and Sensory Processing and their Gender Differences.

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Abstract

Background and aim. Individuals with autistic traits have been shown to demonstrate various atypical eating behaviours. Rigid and repetitive behaviours (RRBs) and sensory processing differences have been postulated to play a potential role on this relationship. The aim of this study is to investigate the presence of autistic traits and their effect on atypical eating behaviours in a general, adult population. The potential modulatory role of these RRBs and sensory processing on this relationship is investigated along with potential gender differences. *Method.* 138 participants including 98 women and 25 men completed an online questionnaire assessing autistic traits, atypical eating behaviours, RRBs and sensory processing. *Results.* A simple linear regression demonstrated a significant positive effect of autistic traits on atypical eating behaviours. Multiple regression analyses showed no moderation effect of RRBs on the relationship between autistic traits and atypical eating behaviours in the total sample or in men and women separately. A moderation effect of sensory processing on this relationship was found in the total sample and in women but not in men. *Conclusions.* Autistic traits are present in an adult, general population and show a possible effect on atypical eating behaviours. Sensory processing difficulties could play a role in the presentation of atypical eating behaviours in individuals with autistic traits. Gender differences were investigated but need to be researched further due to a small male sample, however sensory processing difficulties seem to play a larger role in the effect of autistic traits on atypical eating behaviours in women than men.

Keywords: autistic traits, atypical eating behaviours, RRBs, sensory processing, adult general population.

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Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that involves deficits in social functioning and the presence of restricted and repetitive patterns of behaviours (American Psychiatric Association [APA], 2013). These features have been shown to affect multiple aspects of an individual's life, one of these being eating behaviours (Tanner et al., 2015). Atypical eating patterns are prominent in this population, with food selectivity and hypersensitivity to food textures being the most notable, followed by other atypical behaviours such as brand-based refusal and the ingestion of non-edible foods known as pica (Zickgraf & Mayes, 2019). Results from a meta-analysis found that children with ASD are about five times more likely to exhibit problematic eating behaviours than children without ASD (Mayes & Zickgraf, 2019).

While a consistent finding in research in regards to children with ASD, research investigating eating problems in adults with ASD has been scarce (Kuschner et al., 2017). While limited, studies have demonstrated the presence of food selectivity and sensory hypersensitivity (Kuschner et al., 2015) along with other atypical eating behaviours such as eating rituals and brand selectivity in adults with ASD (Spek et al., 2019). Feeding problems in children with ASD have been shown to interfere with appropriate food consumption and lead to a severe risk in nutritional deficiencies due to an insufficient intake of protein and calcium (Sharp et al., 2013). Given these consequences in children, it is important to investigate the presence and impact of these atypical eating behaviours in adults further.

When continuing research into characteristics of the ASD clinical population it is important to consider the dimensional view of the disorder. It has been suggested that ASD and its traits should be viewed on a spectrum encompassing both the general and clinical population (Carton & Smith, 2014). This approach has led to the inclusion of individuals from the general population in ASD research (Dell'Osso et al., 2017). A recent meta-analysis demonstrated a consistent positive relationship between atypical eating behaviours and various social and cognitive deficits involved in ASD in a sub-clinical population encompassing a wide age range involving both children and adults (Christensen et al., 2019). Further investigation of this association in a sub-clinical population should be considered in order to understand its presentation and impact across the spectrum.

Despite the prevalence of these atypical eating behaviours in individuals with autistic traits, little is known of the underlying processes. It has been hypothesised that restricted and repetitive behaviours (RRBs) typical of individuals with ASD may play an important role (Vissoker et al., 2019; Zickgraf & Mayes, 2019). Features of these behaviours involve an insistence on sameness, inflexible adherence to routines and restricted interests (APA, 2013). These characteristics are reflected in the eating behaviours seen in individuals with ASD such as a strong preference for limited amounts of food, specific presentations and preparations of food and confined variety in texture, temperature and mealtime rules (Diolordi et al., 2014). This positive relationship between RRBs and feeding problems has been demonstrated in a sample of children

with ASD (Johnson et al., 2014) and aspects of this autistic trait have been positively linked with pathological eating behaviours in an adult non-clinical sample (Carton & Smith, 2014). These findings highlight the need for more research focusing on the impact of RRBs on atypical eating behaviours in adult individuals along the ASD continuum.

Another speculation has been the role of sensory hyper- and hypo-reactivity in the development of problematic eating behaviours in ASD (Nadon et al., 2011). The majority of children with ASD display atypical processing of sensory information, particularly tactile, olfactory and visual/auditory input (Diolordi et al., 2014; Nadon et al., 2011). Given the multi-sensory experience of feeding behaviours, these abnormalities have been postulated to lead to the development of sensory preferences seen in the selective eating of neutral foods in texture, taste and colour seen in ASD individuals (Nadon et al., 2011; Zickgraf & Mayes, 2019). Problems with taste, tactile and smell sensitivity have been shown to be correlated with more selective eating in children with and without ASD (Nadon et al., 2011; Zucker et al., 2015). While sensory processing problems have been shown to be related to a number of autistic traits in clinical and non-clinical adult populations, their impact on eating behaviours remains unexamined (Mayer, 2017).

Evidence comparing the role of RRBs and sensory processing difficulties on the presentation of atypical eating behaviours in individuals with autistic traits is limited and inconsistent. One comparison study found RRBs to be the only significant predictor of eating disturbances when comparing them to the impact of sensory processing (Bitsika & Sharpley, 2018) while another demonstrated the contrary (Suarez et al., 2014). However, as both studies were conducted with a sample of children with ASD, the results are difficult to generalise, emphasising the importance of broadening the scope to include non-clinical population and adults. A possible reason for this discrepancy is in the demographics of the samples investigated as one sample consisted of a female-only sample (Suarez et al., 2014) whereas the other had a majority of male participants (Bitsika & Sharpley, 2018). This suggests a possible gender effect on the impact of these separate factors on eating behaviours.

Research of gender differences in the ASD population is complicated by the presence of a large gender discrepancy in the disorder (Lai et al., 2015). ASD is diagnosed four times more frequently in boys than girls suggested to be due to an existent sex variation worsened by an insensitivity to the female-specific presentation of the disorder (Hiller et al., 2014). In terms of eating behaviours, only one study has investigated the differences between ASD men and women (Spek et al., 2019). The results showed that women and not men demonstrated evidence of abnormal sensory processing towards eating, however RRBs were not assessed. This result supports the general finding that women with ASD are shown to have more sensory processing difficulties than men (Dell'Osso et al., 2017). In contrary, RRBs have been shown to be more prominent in males than females in the ASD population (Ratto et al., 2018). These general trends seem to contradict the findings by Bitsika & Sharpley (2018) and Suarez et al., (2014) where RRBs were the significant predictor of eating behaviours in a female sample and sensory processing the more significant predictor in a male dominated sample. From these, conclusions on gender differences in the role of RRBs and sensory processing on eating behaviours can only be

speculated due the gender-biased samples. In the general population, sex differences have not been investigated regarding associations between atypical eating behaviours and autistic traits (Christensen et al., 2019). The need to expand research on gender differences is clear in order to broaden the knowledge on the gender-specific presentation of these autistic traits across individuals.

The aim of the study was to investigate the relationship between autistic traits and atypical eating behaviours in the general population. In addition, the role RRBs and sensory processing may play on this relationship in the population and in men and women separately was explored.

Hypothesis 1

Autistic traits will demonstrate a significant positive effect on atypical eating behaviours. Past research has demonstrated this relationship to be present in both clinical and non-clinical individuals.

Hypothesis 2

RRBs and sensory processing will moderate the relationship between autistic traits and atypical eating behaviours. Both factors have been shown to be related to the amount of atypical eating behaviours found in individuals with autistic traits and given inconsistencies in their comparative roles, both are hypothesised to play a significant moderating role.

A moderation effect conceptually defines a moderator as having an effect on the strength of the relationship established between two variables (Wu & Zumbo, 2008). In our studies case, RRBs and sensory processing will show a significant effect on the strength of the effect of number of autistic traits on the presence of atypical eating behaviours.

Hypothesis 3

RRBs will be the only significant moderator on the relationship between autistic traits and atypical eating behaviours in men and sensory processing difficulties will be the only significant moderator in women. Past research has clearly demonstrated this tendency in individuals with autistic traits broadly while its focus in eating behaviours has been limited and conflicting, leading to the mentioned hypothesis.

Methods

Participants

The initial sample consisted of 205 participants, responses were excluded if the participants completed less than 90% of the survey ($N = 52$) and if survey-completion took less than 15 minutes ($N = 15$); almost half the time the survey should have taken to complete. The final sample consisted of 98 females (71.0%), 25 males (18.1%), 2 identifying as other (1.4%) and 13 unidentified participants due to a technical error (9.4%). Participants were aged 18-66 years old, with a mean age of 27.25 years (SD =11.71) (See Table 1). Participants were compensated with course credit at Utrecht University or by entering a raffle for €50. The study was approved by the Ethics Review Board of the Faculty of Social & Behavioural Sciences at Utrecht University, Utrecht.

Procedure

Participants were recruited through an online survey on Qualtrics (https://www.qualtrics.com). Respondents were granted access through a hyperlink advertised via social media platforms and posted on an online credit platform for Psychology students called Sona Systems (https://uu.sona-systems.com). The survey provided the participants with an information letter and consent form where consent had to be granted in order to. The option to contact the experimenters for questions and request to be contacted regarding the outcomes of the study was given to the respondents. The study was advertised as looking at "Personality characteristics and eating habits" so as to blind the participants towards the autistic trait aspect of the study.

Measures

Autism Spectrum Quotient (AQ)

The AQ (Baron-Cohen et al., 2001) is a self-reported questionnaire that is used to measure sub-clinical autistic traits in the general population. The questionnaire consists of 50 statements rated on a 4-point Likert scale from 1 = "Definitely agree" to 4 = "Definitely Agree". While the original version of the questionnaire (Baron-Cohen et al., 2001) has been divided into two "agree" and "disagree" scales, the Dutch version of the AQ still uses the 4-point Likert scale (Hoekstra et al., 2008). Reverse scoring was performed on 24 of the items (Hoekstra et al., 2008). The 50 statements can be separated into five subscales: Attention to detail, Social skills, Attention Switching, Communication, and Imagination (Baron-Cohen et al., 2001). The total score on all 50 items was calculated, resulting in a minimum score of 50 and a maximum score of 200; with a cut-off score of above 145 being in the ASD-range (Hoekstra et al., 2008). The AQ and the Dutch AQ have both been demonstrated to be valid and reliable instruments in demonstrating individual differences in autistic traits in a general

population (Baron-Cohen et al., 2001; Hoekstra et al., 2008); in this study the questionnaire showed excellent reliability with a Cronbach's alpha value of 0.95 (George & Mallery, 2003).

Swedish Eating Assessment for Autism Spectrum Disorders (SWEAA)

The SWEAA (Karlsson et al., 2013) is a self-reported questionnaire designed to measure the presence of specific eating problems found in ASD. It consists of 60 items divided into eight subscales and 2 single items with additional demographic and medical background items. The eight subscales and single items include perception, motor control, purchase of food, eating behaviour, mealtime surroundings, social situation at mealtime, other behaviours associated with disturbed eating, hunger/satiety, pica and simultaneous capacity. These 60 items are rated on a 5-point Likert-scale from 1 = "never correct" to 5 = "always correct". Ten items on the scale were reverse-score and a total score for all 60 Likert-items was calculated ranging from 60 – 300. The questionnaire has been shown to measure the presence of these eating behaviours in both ASD and neurotypical populations effectively (Karjalainen et al., 2019). Spek et al (2019) developed the Dutch version of the SWEAA demonstrating a good reliability, our study demonstrated an excellent reliability with a Cronbach's alpha value of 0.95 (George & Mallery, 2003).

Adult Repetitive Behaviours Questionnaire-2 (RBQ-2A)

The RBQ-2A (Barrett et al., 2015) is a self-reported questionnaire designed to measure the autistic trait of RRBs in adults. The questionnaire consists of 20 items scored on 5 different 3-point Likert scales: 1 = "Never or rarely" to 3 = "15 or more times daily" (items 1-5); 1 = "Never or rarely" to 3 = "Marked or notable" (items 6-12); 1 = "Never or rarely" to 3 = "Marked or notable (occasionally affects others)" (items 13-16); 1 = "Never or rarely" to 3 = "Marked or notable (will tolerate changes when necessary)" (items 17-19); and 1 = "A range of different and flexible self-chosen activities" to 3= "Almost always choose from a restricted range of repetitive activities" (item 20). The questionnaire consists of two subscales labelled Repetitive Motor Behaviour and Insistence of Sameness. For this study, a mean total score ranging between 1-3 was calculated (Barrett et al., 2015). While the RBQ-2A is relatively new it has been shown to be reliable and valid in measuring the presence of RRBs in neurotypical and ASD populations (Barrett et al., 2018). The Dutch version of the questionnaire was developed for this study using a forward and back-translation with a good reliability of Cronbach's alpha value 0.88 (George & Mallery, 2003).

Dutch Glasgow Sensory Questionnaire (GSQ-NL)

The GSQ-NL (Kuiper et al., 2019) is a Dutch version of the Glasgow Sensory Questionnaire (GSQ) measuring affective and behavioural responses to sensory stimuli (Kuiper et al., 2019). It consists of 42 self-reported questions scored on a 5-point Likert scale ranging from 0 = "Never" to 4 = "Always". There are six items representing each modality (visual, auditory, gustatory, olfactory, tactile, vestibular and proprioception), half measuring hypersensitivity and half measuring hyposensitivity. A total score will be calculated ranging from 0-168. The GSQ-NL has been shown to have good

psychometric properties (Kuiper et al., 2019); it was found to have an excellent reliability in this study with a Cronbach's alpha value of 0.90 (George & Mallery, 2003).

Data Analysis

The data was analysed using SPSS Statistics (version 25) software. All assumptions were checked for the simple linear regression and multiple regression analyses. Outliers were maintained in the analyses after running the analyses without the outlier data and finding no difference in significance along with very small differences in confidence intervals (Laerd Statistics, 2015). Violations of homoscedasticity and normality assumptions in the moderation analyses were fixed by performing an inverse transformation of the dependent variable of atypical eating behaviours (Pallant, 2016). Significance levels were set at $p < .05$.

In order to investigate the effect of autistic traits on atypical eating behaviours (H1) a simple linear regression was performed. With total scores on the AQ measuring autistic traits as the independent variable and total scores on the SWEAA measuring atypical eating behaviours as the dependent variable.

To investigate the moderation effects of RRBs and sensory processing on the relationship between autistic traits and atypical eating behaviours (H2), two multiple regression analyses were performed. Prior to the analysis, the independent variable (autistic traits) and two moderator variables (RRBs measured by total RBQ-2A mean scores and sensory processing measured by total GSQ-NL scores) were centred so as to reduce the risk of multicollinearity (Wu & Zumbo, 2008). To determine whether rigid and repetitive behaviours moderate the influence of autistic traits on eating behaviours, an interaction term was computed between the independent variables of autistic traits and RRBs. This interaction term was entered into the multiple regression model with atypical eating behaviours as the dependent variable. Evidence of moderation was assessed by determining whether there was a significant change in the multiple regression models when the interaction variable was added. Whether the second model explained a significantly larger proportion of the variance in the eating behaviours than the first model determined whether RRBs are a significant moderator. This analysis was repeated replacing sensory processing as the moderator so as to investigate whether sensory processing has a moderating effect on the relationship between autistic traits and atypical eating behaviours.

Gender differences in whether RRBs and sensory processing moderate the effect of autistic traits on atypical eating behaviours were also investigated through a multiple regression analyses (H2). The two previously mentioned multiple regression analyses were both repeated in the male participants and female participants separately.

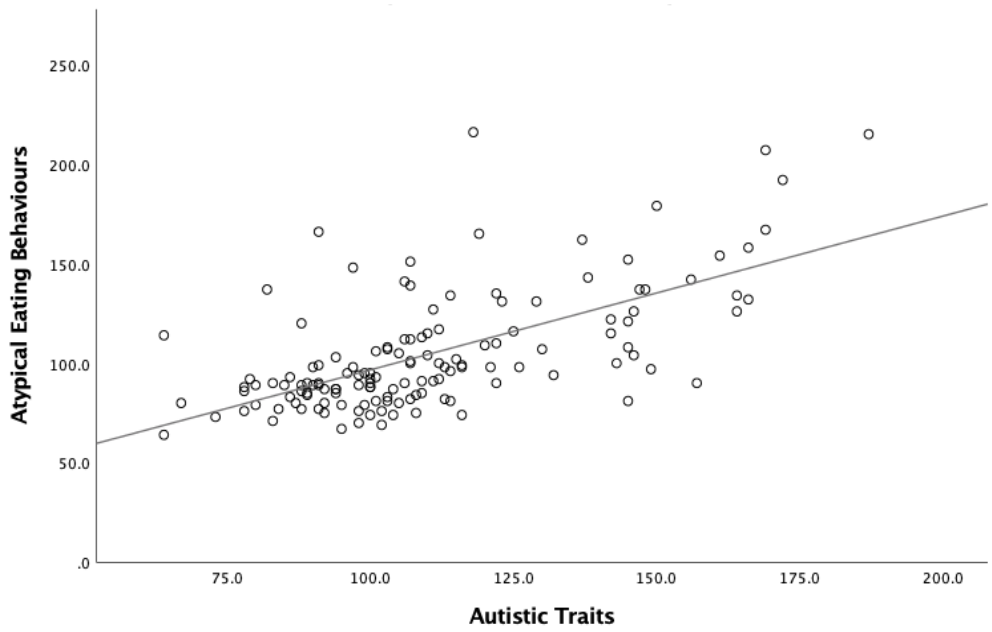
Results

Hypothesis 1: There is a Positive Effect of Autistic Traits on Atypical Eating Behaviours

The results from the simple linear regression indicated that autistic traits significantly predicted atypical eating behaviours $\beta = .64$, $t(136) = 9.68$, $p < .001$, demonstrating a positive relationship (see Figure 1). Autistic traits explained a significant proportion of the variance in atypical eating behaviours $R^2 = .40$, $F(1, 136) = 93.76$, $p < .001$. Therefore, approximately 40% of the variance of atypical eating behaviours can be explained by autistic traits, a large effect size according to (Cohen, 1977). Therefore, our hypothesis on the positive effect of autistic traits on atypical eating behaviours was confirmed.

Figure 1

Simple linear regression results between autistic traits and atypical eating behaviours.



Hypothesis 2: RRBs and Sensory Processing will both Moderate the Relationship between Autistic Traits and Atypical Eating Behaviours.

To examine the moderating effect of RRBs on the effect of autistic traits on atypical eating behaviours, a multiple regression analysis was performed. The addition of the interaction term only explained an increase in total variation of atypical eating behaviours of 0.7% ($\Delta R^2 = .007$) which was not statistically significant $R^2 = .56$, $F(1, 134) = 2.20$, $p = .14$). Therefore, the results do not show RRBs to have a significant moderating effect on the relationship between autistic traits and atypical eating behaviours. See Table 3 for regression coefficients.

The moderating effect of sensory processing on the relationship between autistic traits and atypical eating behaviours was investigated through a multiple regression analysis. The change in the model was shown to be significant demonstrated by an increase in total variation in atypical eating behaviours explained of 1.8% ($\Delta R^2 = .018$), which was statistically significant $R^2 = .70$, $F(1, 134) = 7.74$, $p = .006$. Therefore, sensory processing was shown to be a significant moderator of the relationship between autistic traits and atypical eating behaviours. See Table 4 for regression coefficients.

Our hypothesis was partly confirmed with sensory processing but not RRBs demonstrating a moderating relationship on the effect of autistic traits on atypical eating behaviours.

Hypothesis 3: RRBs are the only Significant Moderator in Men and Sensory Processing the only Significant Moderator in Women.

The moderation effect of RRBs and sensory processing on the relationship between autistic traits and atypical eating behaviours was investigated in women. RRBs did not show a significant moderator effect on atypical eating behaviours in women, only explaining an increase in total variation of 0.3% ($\Delta R^2 = .003$), which was not statistically significant ($R^2 = .57$, $F(1, 94) = 0.72$, $p = .40$). See Table 5 for regression coefficients. Sensory processing demonstrated a significant moderator effect by an increase in variation explained of 1.4% ($\Delta R^2 = .014$), which was statistically significant ($R^2 = .68$, $F(1, 94) = 4.05$, $p = .047$). See Table 6 for regression coefficients. Our hypothesis was confirmed as only sensory processing and not RRBs demonstrated a significant moderator effect on the relationship between autistic traits and atypical eating behaviours in women.

In the men, RRBs did not show a moderator effect with only an increase in total variation of atypical eating behaviours of 4.4% ($\Delta R^2 = .044$) explained, which was not statistically significant ($R^2 = .58$, $F(1, 21) = 2.16$, $p = .16$). See Table 7 for regression coefficients. Sensory processing only explained an increase in total variation of atypical eating behaviours of 0.5% in men ($\Delta R^2 = .005$) which was not statistically significant ($R^2 = .70$, $F(1, 21) = 0.32$, $p = .58$). See Table 8 for regression coefficients. Therefore, the hypothesis was only partly confirmed, with neither RRBs and sensory processing demonstrating a significant moderator effect on the relationship between autistic traits and atypical eating behaviours in men.

Discussion

Autistic Traits and Atypical Eating Behaviours

The current study aimed to expand the previous research investigating the relationship between autistic traits and atypical eating behaviours. The results found that there was a significant effect of autistic traits on the presence of atypical eating behaviours within a general population. This relationship has been demonstrated extensively in the past but has mainly focused on children with ASD (Kuschner et al., 2017); very little research has looked at the presence of these eating

behaviours in adults with ASD (Spek et al., 2019) and fewer in terms of their relationship with autistic traits in the general population (Christensen et al., 2019). This result therefore not only confirms previous findings but expands the scope so as to include both adults and the general population. Given the negative impact of these atypical eating behaviours on the nutritional intake of children (Sharp et al., 2013) and these findings that these behaviours extend into adulthood, the necessity to continue involving adults in further research and treatment development is highlighted. The results also demonstrated a range of scores on the AQ (see Table 2) involving high scores close to and above the possible ASD diagnosis cut-off score of 145 proposed by Hoekstra et al. (2008). Therefore demonstrating the presence of autistic traits in a general population and encouraging the view of these traits on a dimensional scale (Carton & Smith, 2014).

The Modulatory Role of Sensory Processing and RRBs

Abnormal sensory processing and RRBs have both been highlighted as potentially playing a role in the development of atypical eating behaviours present in individuals with ASD traits (Spek et al., 2019). As commented on in the introduction, this speculation is based on the documented presence of RRBs and sensory processing differences in individuals with autistic traits along with their characteristics being similar to those found in these atypical eating behaviours (Nadon et al., 2011; Vissoker et al., 2019). Our study investigated the moderating effect of these two features on the relationship between autistic traits and atypical eating behaviours typically found in individuals with ASD and it was found that only sensory processing and not RRBs played a modulatory role. In other words, only sensory processing had a significant impact on the strength of the influence of autistic traits on atypical eating behaviours. These findings have a large contribution to research due to previous investigations comparing the role of RRBs and sensory processing on atypical eating behaviours being restricted to two conflicting studies with an only focus on children with ASD (Bitsika & Sharpley, 2018; Suarez et al., 2014). Our results are in line with Suarez et al (2014) who demonstrated that sensory processing was the only significant predictor of atypical eating behaviours and not RRBs. However, Bitsika & Sharpley (2018) concluded the contrary emphasising the importance of the effect of RRBs over sensory processing. An explanation for these differences may be the use of a questionnaire specifically investigating RRBs in both this study and Suarez et al's (2014) rather than a sub-scale of a measure of autistic traits used in Bitsika & Sharpley's (2018). However, comparisons among these three studies should be cautious given this specific investigation being the only one performed in adults of the general population and as such difficult to draw conclusions based on similarities. For now, it is an important contribution towards future research and stipulates that sensory processing may play a more important role in the development of these problematic eating behaviours in individuals with autistic traits than RRBs.

Gender Differences

Another possible explanation for the difference in findings between Suarez et al (2014) and Bitsika & Sharpley (2018), was the the gender bias in their samples; Suarez et al having demonstrated their findings in a male-dominated sample and Bitsika & Sharpley in a female-only ASD sample. These conflicted with general findings in the ASD population where women have been shown to have more sensory difficulties than men and men to show more restricted and repetitive behaviours (Dell'Osso et al., 2017; Ratto et al., 2018). The lack of comparison of the roles of sensory processing and RRBs towards eating behaviours in a gender-representative sample of the populations of individuals with autistic traits led to the investigation of gender differences in this study. Our results found sensory processing having a significant impact on the effect of autistic traits on atypical eating behaviours in women while RRBs did not and that neither RRBs nor sensory processing had a significant modulatory effect in men. Our results in men did not show the expected prominent role of RRBs over sensory processing, it is important to take into account the small male sample size of 25 that discourages drawing conclusions from these results. However, the findings in women supports previous research demonstrating these sensory processing difficulties as prominent features in women with autistic features and having a stronger impact than RRBs, in this case, on atypical eating behaviours. The presence of significant results in our female sample is a sizeable contribution to current research in the ASD population that is generally focused on the presentation of these autistic traits and their impact prominently in men.

Strengths and Limitations

The main strength of this study is in its aim to broaden the scope of previous research in eating behaviours in individuals with autistic traits. Our results demonstrated the presence of these atypical eating behaviours along a spectrum of autistic traits in adults widening the previous intense focus on individuals of the ASD population and particularly children (Kuschner et al., 2017). The use of questionnaires addressing specific features of sensory processing and RRBs and investigating their impact on eating behaviours has never been addressed in such a population and encourages future research to further assess their impact so as to potentially direct future treatment. The results from the multi-sensory assessment of sensory processing in this study allows encourage the perspective of eating behaviours and their difficulties as involving a multi-sensory experience that goes beyond a prominently gustatory approach (Nadon et al., 2011). While the use of self-reported questionnaires is not ideal due to the possibility of certain response biases (Demetriou et al., 2015), the use of these in the study avoids the previous limitations of prominently children-focused research which mainly involved parent-reported questionnaires that could lead to under or over reporting (Martins et al., 2008).

A major limitation of the study was that the results did not follow a normal distribution. This could be due to the decision to maintain outliers in the analyses; however the outliers were shown not to affect the significance of the results after repeating the analyses and were deemed suitable to retain (Pallant, 2016). The violation of normality was fixed by a transformation of the dependent variable which should be taken into account when interpreting the results (Pallant, 2016).

The generalisability of the results to a general population needs to be questioned by the majority of females (71%) in the total sample. Considering sensory processing difficulties were shown to be the only significant moderator in both the total and female-only sample, it is important to interpret the results on the total sample as potentially bias towards females and that RRBs may play a more important role in a more representative sample. Additionally, small number of males in the study made it difficult to successfully assess the impact of these two features on the eating behaviours of men with autistic features and hence properly investigate gender differences.

Conclusions and Future Directions

This study confirms the importance of broadening the scope of ASD research to involve adult general populations particularly in the domain of atypical eating behaviours. Autistic traits were demonstrated to be present in an adult, general population and to have a significant impact on the presence of atypical eating behaviours. Furthermore, the potential role of sensory processing on the presentation of these abnormalities in these individuals and particularly women, is exhibited in our research. Our results highlight the need for future research investigating the extent of the impact of sensory processing on these eating difficulties. While our study demonstrated the necessity to take a multi-sensory approach, it would be important to further investigate the role of each sensory modality separately so as to better understand their individual roles. In addition, both hyper- and hypo-sensitivity issues have been identified in this population, further differentiating these two and their impact on eating behaviours would be essential in order to fully understand the role of sensory processing on these behaviours. Untangling their role in the development and maintenance of these eating behaviours would be beneficial in informing potential future treatment given that previous treatment of atypical eating behaviours has not taken these into account and focused on behavioural approaches (Ledford & Gast, 2006). The limitations in our male sample causes our non-significant results regarding the impact of RRBs on atypical eating behaviours to be considered lightly and demands for further investigation with a larger and more gender-representative sample size to be considered so as to investigate its potential role on eating behaviours in individuals with autistic traits more accurately. This study only begins to investigate gender differences in the role of RRBs and sensory processing on atypical eating behaviours in individuals with autistic trait, a large gap in this domain is still very much present and needs to be investigated further so as to potentially identify gender-specific phenotypes that could guide knowledge and treatment development of these behaviours. In conclusion, the present study is a promising contribution to research regarding atypical eating behaviours in individuals with autistic traits and highlights the areas that need to be expanded so as to lead to a greater understanding of its manifestations and contributing factors across the ASD spectrum population.

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Appendix

Table 1

Participant Characteristics (N=138)

Characteristic	*M*	SD	*n*	%
Age	27.25	11.71		
Gender				
Female			98	71
Male			25	18
Other			2	1
Unidentified			13	9
Years of Education	15.49	3.30	—	
Highest educational level				
Primary			0	0
Pre-secondary vocational			2	1
Senior general secondary			15	11
Pre-university			43	31
University of applied sciences			19	14
Bachelor			28	20
Masters			11	8
Other			20	15
Weight (kg)	68.63	14.68		

Characteristic	*M*	SD	*n*	%
Height (cm)	171.50	18.30		

Table 2

Descriptive statistics for study variables

Variable	Total Sample n = 138			Women n = 98			Men n = 25		
	M	SD	Range	*M*	SD	Range	*M*	SD	Range
AQ	110.51	25.10	64-187	107.78	23.98	64-172	123.36	24.65	86-169
SWEAA	104.77	30.36	64-216	103.88	30.70	67-216	109.76	25.24	69-167
RBQ-2A	1.46	0.34	1-2.95	1.42	0.31	1-2.20	1.57	0.35	1.10-2.45
GSQ-NL	39.64	23.63	2-134	37.57	22.21	2-98	44.44	22.36	18-100

Note. AQ = Autism Quotient; SWEAA = Swedish Eating Assessment for Autism Spectrum Disorders; RBQ-2A = Adult Repetitive Behaviours Questionnaire-2; Dutch Glasgow Sensory Questionnaire.

Table 3

Multiple regression results for atypical eating behaviours predicted by autistic traits, RRBs and their interaction term in total sample (N=138).

Predictors	*B*	95% CI		*SE B*	*ß*	R^2	ΔR^2
		LL	*UL*				
Model 1						.55***	.54***
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-0.24E-5	0.00	0.00	0.00	-.26**		
RRBs	-0.004	0.00	0.00	0.00	-.54***		
Model 2						.56***	.007
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-2.64E-5	0.00	0.00	0.00	-.28**		
RRBs	-0.004	0.00	0.00	0.00	-.59**		
Autistic Traits x RRBs	2.00E-5	0.00	0.00	0.00	.11		

Note. B = unstandardized regression coefficient; CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; *ß* = standardized coefficient; R^2 = explained variance; ΔR^2 = change in explained variance.

*p < .05 **p < .01 ***p < .001.

Table 4

Multiple regression results for atypical eating behaviours predicted by autistic traits, sensory processing and their interaction term in total sample (N=138).

Predictors	*B*	95% CI		*SE B*	*ß*	R^2	ΔR^2
		LL	*UL*				
Model 1						.68***	.68***
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-1.49E-5	0.00	0.00	0.00	-.16*		
Sensory processing	-7.09E-5	0.00	0.00	0.00	-.71***		
Model 2						.70***	.018**
Constant	0.010	0.01	0.01	0.00			
Autistic traits	-1.92E-5	0.00	0.00	0.00	-.20**		
Sensory processing	-7.73E-5	0.00	0.00	0.00	-.77***		
Autistic traits x sensory processing	4.38E-5	0.00	0.00	0.00	.17**		

Note. B = unstandardized regression coefficient; CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; *ß* = standardized coefficient; R^2 = explained variance; ΔR^2 = change in explained variance.

*p < .05 **p < .01 ***p < .001.

Table 5

Multiple regression results for atypical eating behaviours predicted by autistic traits, RRBs and their interaction term in women (N=98).

Predictors	*B*	95% CI		*SE B*	*ß*	R^2	ΔR^2
		LL	*UL*				
Model 1						. 57***	.57***
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-1.35E-5	0.00	0.00	0.00	-.14		
RRBs	-0.005	-0.01	0.00	0.00	-.65***		
Model 2						.57***	.003
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-1.61E-5	0.00	0.00	0.00	-.16		
RRBs	-0.005	-0.01	0.00	0.00	-.67***		
Autistic Traits x RRBs	1.92E-5	0.00	0.00	0.00	.068		

Note. B = unstandardized regression coefficient; CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; *ß* = standardized coefficient; R^2 = explained variance; ΔR^2 = change in explained variance.

*p < .05 **p < .01 ***p < .001.

Table 6

Multiple regression results for atypical eating behaviours predicted by autistic traits, sensory processing and their interaction term in women (N=98).

Predictors	*B*	95% CI		*SE B*	*ß*	R^2	ΔR^2
		LL	*UL*				
Model 1						.66***	.66***
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-1.13E-5	0.00	0.00	0.00	-.11		
Sensory processing	-7.90E-5	0.00	0.00	0.00	-.74***		
Model 2						.68***	.014*
Constant	0.010	0.01	0.01	0.00			
Autistic traits	-1.72E-5	0.00	0.00	0.00	-.17*		
Sensory processing	-8.28E-5	0.00	0.00	0.00	-.77***		
Autistic traits x sensory processing	4.98E-5	0.00	0.00	0.00	.15*		

Note. B = unstandardized regression coefficient; CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; *ß* = standardized coefficient; R^2 = explained variance; ΔR^2 = change in explained variance.

*p < .05 **p < .01 ***p < .001.

Table 7

Multiple regression results for atypical eating behaviours predicted by autistic traits, RRBs and their interaction term in men (N=25).

Predictors	*B*	95% CI		*SE B*	*ß*	R^2	ΔR^2
		LL	*UL*				
Model 1						.53***	.53***
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-2.82E-5	0.00	0.00	0.00	-.34		
RRBs	-0.003	0.00	0.00	0.00	-.47*		
Model 2						.58***	.044
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-2.10E-5	0.00	0.00	0.00	-.25		
RRBs	-0.001	0.00	0.00	0.00	-.22		
Autistic Traits x RRBs	-5.84E-5	0.00	0.00	0.00	.38		

Note. B = unstandardized regression coefficient; CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; *ß* = standardized coefficient; R^2 = explained variance; ΔR^2 = change in explained variance.

*p < .05 **p < .01 ***p < .001.

Table 8

Multiple regression results for atypical eating behaviours predicted by autistic traits, sensory processing and their interaction term in men (N=25).

Predictors	*B*	95% CI		*SE B*	*ß*	R^2	ΔR^2
		LL	*UL*				
Model 1						.69***	.69***
Constant	0.010	0.01	0.01	0.00			
Autistic Traits	-1.34E-5	0.00	0.00	0.00	-.16		
Sensory processing	-6.52E-5	0.00	0.00	0.00	-.72***		
Model 2						.70***	.005
Constant	0.010	0.01	0.01	0.00			
Autistic traits	-1.27E-5	0.00	0.00	0.00	-.15		
Sensory processing	-5.84E-5	0.00	0.00	0.00	-.65**		
Autistic traits x sensory processing	-2.89E-7	0.00	0.00	0.00	-.11		

Note. B = unstandardized regression coefficient; CI = confidence interval; *LL* = lower limit; *UL* = upper limit; *SE B* = standard error of the coefficient; *ß* = standardized coefficient; R^2 = explained variance; ΔR^2 = change in explained variance.

*p < .05 **p < .01 ***p < .001.