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ORIGINAL PAPER

The Role of Dispositional Mindfulness in the Impact of Repetitive Negative Thinking on Anxiety and Depression in People with Different Autistic-Like Traits

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Abstract

Objectives Available data suggest that inflexible allocation of attention in people on the autism spectrum can lead to anxiety and depression symptoms, through the increase of repetitive negative thinking (worry and rumination). In the present study, we used dispositional mindfulness as a proxy to attention flexibility and tested its role in the influence of repetitive negative thinking on affective symptoms (anxiety and depression) in people with different autistic-like traits.

Method Path analysis was used to test the direct and indirect effects of different autistic-like traits, dispositional mindfulness, worry and rumination on anxiety-related concerns and depression symptoms in a sample ($n = 209$) of neurotypical adults.

Results Autistic-like traits implying poor attention switching and communication abilities were linked to higher dispositional mindfulness, increased repetitive thinking, and stronger affective symptoms through largely shared pathways. Autistic-like traits implying strong attention-to-detail bypassed dispositional mindfulness in the pathways linking increased repetitive negative thinking and stronger affective symptoms.

Conclusions The present findings indicate that dispositional mindfulness can play a protective role against the impact of worry and rumination on affective symptoms in some people but not in others, depending on different autistic-like traits.

Preregistration This study was not pre-registered.

Keywords Mindfulness · Autistic-like traits · Attention switching · Repetitive negative thinking · Worry · Rumination

Mindfulness, whether dispositional or practice-related, is associated to lower anxiety and depression symptoms (Cash & Whittingham, 2010; Desrosiers et al., 2013; Freudenthaler et al., 2017; Hofmann et al., 2010; Miller et al., 1995). Several datasets converge in suggesting that mindfulness produces its positive effects on anxiety and depression by counteracting the mediating influence of dysfunctional emotion regulation strategies, such as worry and rumination (Baiano et al., 2020; Desrosiers et al., 2013; Parmentier et al., 2019; Raes & Williams, 2010; van der Velden et al., 2015) that characterise the so-called repetitive negative thinking (McEvoy et al., 2010; Treynor et al., 2003; Watkins, 2008). Indeed, the capacity to orient attention to the present moment implied in mindfulness is antithetical to the strong focus on the past and the focus on future threats characterising rumination and worry, respectively (Desrosiers et al., 2013; Verplanken & Fisher, 2014).

Anxiety and depression are prevalent throughout the lifespan in individuals on the autism spectrum and impact on functional adaptation (Lai et al., 2019; Mayes et al., 2011; Simonoff et al., 2008). Indeed, comorbidity between autism and anxiety disorders has been observed in about 40-70% of individuals (Salazar et al., 2015; Simonoff et al., 2008; van Steensel et al., 2011) with a rate substantially higher than that in the general population (Costello et al., 2005). Also, autistic individuals may experience depression across their lifetime up to 4 times more than individuals in the general population (Mazefsky et al., 2010; Mayes et al., 2011).

Burrows et al. (2017) developed a neurofunctional model according to which inflexible allocation of attention in people on the autism spectrum can lead to dysfunctional

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emotional responses, such as anxiety and depression symptoms, through the increase of repetitive negative thinking (worry and rumination). On the contrary, if allocation of attention is flexible, the possibility to get stuck in negative self-referential maladaptive cognitions is reduced, in turn reducing the possibility to develop anxiety and depression symptoms (Fig. 1).

According to Burrows et al. (2017), applications of their neurofunctional model could be helpful to improve existing intervention approaches for autistic people who are verbally fluent and capable of self-reporting on their cognitions. In a review on mindfulness in people on the autism spectrum, Cachia et al. (2016) found that, in adults with high-functioning autism, mindfulness training can reduce anxiety, depression and rumination. Reviewed data also led the authors to suggest that rumination is a potentially mediating factor in depression and anxiety symptoms (de Bruin et al., 2014; Kiep et al., 2015; Spek et al., 2013), but the few available studies call for further research.

Non-clinical people with high autistic-like traits (Baron-Cohen et al., 2001) are more likely to develop affective symptoms as well. Indeed, university students and older adults with a higher degree of autistic-like traits can show more anxiety and depression symptoms with respect to people with lower degree of autistic-like traits (Dickter et al., 2018; Freeth et al., 2013; Kanne et al., 2009; Scherff et al., 2014; Wainer et al., 2013; Wallace et al., 2016). Furthermore, an association exists between autistic-like traits and severity of anxiety and depression symptoms (Pine et al., 2008; van Steensel et al., 2013), with an increasing rate of the symptoms throughout childhood and adolescence (Rai et al., 2018). Notably, adolescents with a higher degree of autistic-like traits and a diagnosis of anxiety disorder may respond less to classical cognitive-behavioural interventions when compared with adolescents with clinical anxiety and a lower degree of autistic-like traits (Puleo & Kendall, 2011; Settipani & Kendall, 2013).

Autistic traits exist across the general population on a continuously distributed spectrum, with clinical autism representing the extreme end of the distribution (Baron-Cohen et al., 2001; Grove et al., 2013; Hurst et al., 2007; Lundstrom et al., 2012; Robinson et al., 2011; Ronald & Hoekstra, 2011; Warrier et al., 2019). In recent decades cognitive and neuroscientific research has witnessed a remarkable increase in the number of studies investigating nonclinical adults differing in their degree of autistic-like traits to shed light on the mechanisms underlying the autism spectrum conditions (e.g., Hoekstra et al., 2008; Landry & Chouinard, 2016; Palmer et al., 2015). The advantages of studying neurotypical participants with high autistic-like traits in the context of autism research comprise the relative ease of participant recruitment, enabling larger samples, and the possibility to easily control for potential confounds, such as differences in the intelligence quotient (Landry & Chouinard, 2016). Furthermore, consistent with the variability observed in the clinical diagnosis of autism, evidence suggests the existence of different autistic-like trait profiles in the general population (e.g., Palmer et al., 2015). These traits can be grouped in distinctive dimensions, such as social and non-social ones, that can be differently correlated with each other and associated with different individuals' characteristics (e.g., Hoekstra et al., 2008). Therefore, investigating the manifestation of autistic-like traits in the general population can be particularly relevant to understand the contribution of different autistic dimensions to the cognitive, emotional and behavioral features of people on the spectrum (Landry & Chouinard, 2016).

The present research fits into this framework by testing the behavioral adaptation of the neurofunctional model developed by Burrows et al. (2017; see Fig. 1) in neurotypicals with autistic-like traits. In detail, we measured autistic-like traits by a well-validated self-report scale, the Autism Spectrum Quotient (Baron-Cohen et al., 2001), which provide specific subscales, each tapping into different traits: social skill, attention switching, attention-to-detail, communication, and imagination. Among these traits, the one relating to poor attention switching was of particular interest here. Importantly, since mindfulness implies a flexible orientation of attention (Bishop et al., 2004; Malinowski, 2013; Tang et al., 2015), reducing the possibility of getting stuck in past or future self-related cognitions (Desrosiers et al., 2013; Verplanken & Fisher, 2014), we decided to use dispositional mindfulness as a proxy to attention flexibility (e.g., Moore & Malinowski,

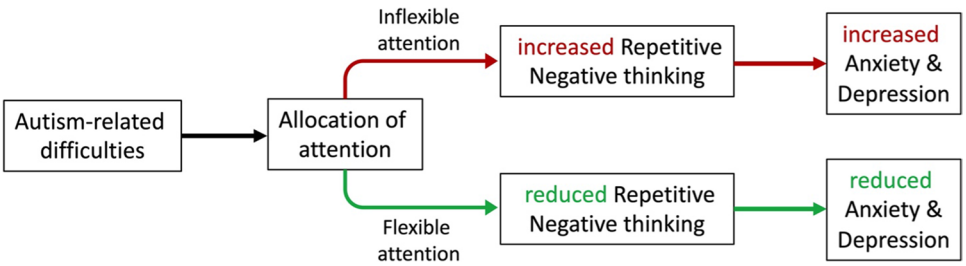

Fig. 1 Illustration of the behavioral adaptation of the Burrows et al. (2017) neurofunctional model

2009; Sørensen et al., 2018). Dispositional mindfulness was measured by the Mindful Attention Awareness Scale (Brown & Ryan, 2003), following studies relating higher scores on this scale to better performance on attentional control tasks and attentional-related neurofunctional activations (Aguerre et al., 2021; Ainsworth et al., 2013; Chang et al., 2018; Zhuang et al., 2017). Individuals' proneness to worry and rumination was assessed by widely used and well-validated measures (Meyer et al., 1990; Treynor et al., 2003), as well as anxiety (Taylor et al., 2007) and depression symptoms (Beck et al., 1996). Since sex differences have been reported in depression, anxiety, and repetitive negative thinking (Gater et al., 1998; Hoyer et al., 2002; Johnson & Whisman, 2013), also participants' sex was considered here.

The present study represents, to the best of our knowledge, the first attempt to test the neurofunctional model by Burrows et al. (2017) from a behavioral point of view. Therefore, we made specific predictions only by relying on the model itself. We expected that the autistic-like traits most implying ineffective attention switching were associated to lower dispositional mindfulness, in turn relating to increased repetitive negative thinking that was associated with stronger anxiety and depression symptoms. No specific expectations can be formulated on the possible involvement of autistic-like traits other than attention switching in the pathways linking dispositional mindfulness, repetitive negative thinking, and affective symptoms. However, as recalled above, accumulating data are revealing dissociations between different autistic-like traits. Attention switching measured by the Autism Spectrum Quotient pertains to social autistic-like traits, together with all the other subscales except for attention-to-detail representing alone the non-social dimension of the autistic-like traits (Hoekstra et al., 2008). Social and non-social traits in people on the autism spectrum have been recently found to dissociate behaviourally, genetically, and in their relationships with affective symptoms (e.g., Baiano et al., 2022; Conson et al., 2022; Palmer et al., 2015; Warrier et al., 2019). Therefore, although no clear-cut predictions can be put forward, we could hypothesise differences between pathways linking social and non-social (attention-to-detail) autistic-like traits with the other factors of the model we tested here.

Method

Participants

A sample of 215 psychology students (females: $n = 123$; males: $n = 92$) was recruited through electronic and printed advertisements on notice boards at various sites of the Psychology Departments of different universities in the Campania region (Italy). Participation in the research did not include monetary or non-monetary compensation.

To be included in the study, each participant had to meet the following inclusion criteria: (1) lack of any neurological or neurodevelopmental condition; (2) lack of any history of psychiatric difficulties; (3) Autism Spectrum Quotient scores below the clinical cut-off of 32 (Baron-Cohen et al., 2001; Ruta et al., 2012). Two hundred nine individuals (females: $n = 119$; males: $n = 90$; mean age = 23.96; $SD = 2.54$; range = 18-31) met the criteria and were included in the study.

Measures

Autistic-like Traits

Autistic-like traits were assessed by means of the Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001; Ruta et al., 2012). The AQ can be used in both clinical and non-clinical settings to measure the number of autistic-like traits an individual possesses across five domains: social skill, attention switching, attention-to-detail, communication, and imagination. Here, participants were administered the full 50-item AQ (Baron- Cohen et al., 2001). The results were scored according to Baron-Cohen et al. (2001) criteria. Thus, a total AQ score and further five scores for the corresponding five domains were obtained, with higher scores indicating: poor social skill; poor attention-switching/strong focus of attention; exceptional attention to detail; poor communication; poor imagination skills. In the present study, Cronbach α were: 0.78, 95% CI [0.74 - 0.82], for the total score; 0.63, 95% CI [0.55 - 0.70], for the social skill subscale; 0.63, 95% CI [0.55 - 0.70], for the attention switching subscale; 0.68, 95% CI [0.61 - 0.74], for the attention-to-detail subscale; 0.59, 95% CI [0.50 - 0.66], for the communication subscale; and 0.51, and 95% CI [0.41 - 0.61] for the imagination subscale. Thus, overall reliability was acceptable.

Dispositional Mindfulness

Mindfulness was evaluated through the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003; Rabitti et al., 2013). The MAAS measures the individual differences in daily mindful states considered as the dispositional ability to pay attention to what is occurring in the present moment. Thus, the scale mainly deals with attention and awareness components of mindfulness rather than with mindfulness-related attributes, such as acceptance, trust, empathy, and gratitude. The scale comprises 15 items, with a total mean score ranging from 0 to 6. In the present study, a total score evaluating the ability to pay attention to the present moment was computed, showing a Cronbach α of 0.83, 95% CI [0.79 - 0.86], indicating an adequate reliability.

Rumination

Rumination was assessed by means of the 10-item Ruminative Response Scale (RRS-10; Palmieri et al., 2007; Treynor et al., 2003), derived from the original 22-item RRS (Nolen-Hoeksema & Morrow, 1991) with the depression factor being removed. The 2 main factors provided by the scale are: (1) Reflection, assessing the degree to which individuals engage in cognitive problem-solving to improve their mood; (2) Brooding, assessing the degree to which individuals passively focus on the reasons for their distress. Each subscale is composed of 5 items, with scores ranging from 4 to 20. In the present study, the Cronbach α were 0.77, 95% CI [0.72 - 0.82], for the Reflection subscale, and 0.81, 95% CI [0.77 - 0.85], for the Brooding subscale, showing an adequate internal consistency.

Worry

Worry was evaluated through the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990; Morani et al., 1999). The PSWQ measures worry as a trait measure since it refers to the personal propensity of worrying irrespective of the situations. The items do not relate to the content of the individual's concerns but refer to critical aspects of the tendency of worrying, such as the intensity, excessiveness, and uncontrollability of the process. The scale is composed of 16 items and the total score ranges from 16 to 80, with higher scores implying higher levels of worry. In the present study, a total score was computed showing a Cronbach α of 0.92, 95% CI [0.91 - 0.94], thus indicating a good reliability.

Anxiety Sensitivity

Anxiety sensitivity was evaluated by means of the Anxiety Sensitivity Index-3 (ASI-3; Petrocchi et al., 2014; Taylor et al., 2007), a self-report scale assessing different types of concerns about possible negative consequences of anxiety symptoms. In detail, the scale evaluates three main kinds of anxiety-related concerns: physical concerns, corresponding to the fear of somatic anxiety symptoms believed to lead to a catastrophic physical issue; social concerns, relating to the belief that a public exhibition of anxiety symptoms will result in public ridicule and ostracism; cognitive concerns, corresponding to the fear of the mental correlates of anxiety symptoms, and considered as signals of a mental disorder. The scale includes 18 items and a total score ranging from 0 to 72, with higher scores indicating higher anxiety sensitivity levels. In the present study, a total score was computed. The Cronbach α was 0.92, 95% CI [0.90 - 0.93], showing a good internal consistency reliability.

Depression

Depressive symptoms were evaluated by means of the Beck Depression Inventory-II (BDI-II, Beck et al., 1996; Sica & Ghisi, 2007), one of the most widely used and well-validated psychometric tests for the assessment of depression severity. BDI-II is composed by 21 items investigating depressive symptoms, as sense of failure, guilt, social withdrawal, insomnia, or weight loss. The total score ranges from 0 to 63, with higher scores reflecting higher levels of depression. In the present study, the total score was computed and the Cronbach α was 0.91, 95% CI [0.90 - 0.93], showing a good reliability.

Procedure

The protocol was administered entirely online. After filling out a personal data form (including information on sex, age, native language, and on possible presence of the conditions incompatible with the participation in the study), the respondents underwent the self-report measures.

The administration order of the scales was balanced across participants. The assessment was performed through a specific online platform (Google Forms, Google Inc., MountainView, CA, USA).

Data Analyses

Preliminary descriptive analyses were performed to assess missing values and variables distributions. Univariate distributions of observed variables were evaluated for normality (Tabachnick & Fidell, 1996). Then, a path analysis was conducted to test the relationships between autistic-like traits, dispositional mindfulness, worry and rumination, and to test the direct and indirect effects (mediated by dispositional mindfulness, worry and rumination) of autistic-like traits on anxiety and depression symptoms.

Path analysis is a structural equation modelling (SEM) technique which assesses theoretical relations among multiple variables (Kline, 2011). Although this statistical approach is not directly informative of the causal inference of the data, it permits studying the relationships between different variables based on the hypotheses of the type of links and the direction of the links between the studied variables. Indeed, the path analysis is a multivariate data analysis technique developed to decompose the observed covariance in the data by assigning to each variable the specific amount of explained variance. In particular, this analysis allows defining a complex model of the relationships between the variables identifying a possible pattern of relationships and testing, through the fit statistics, the goodness of fit of the formulated theoretical model. Like any other statistical technique, it is the researcher that hypothesizes (based

on the theoretical framework) the relationships between the variables distinguishing between independent (exogenous) and dependent (endogenous) variables. The goodness of fit statistics, therefore, allows verifying the correctness of the model or to compare different models among them. Once the best fitting model has been established, it is possible to investigate the link between the variables by distinguishing between direct effects and indirect, or mediated, effects, allowing to clarify how the considered variables relate to each other, i.e., to verify the internal validity of the study/model (Kline, 2011).

Here, a theoretical model was assumed in which autistic-like traits (social skill, attention switching, attention-to-detail, communication, and imagination) and sex were considered as exogenous variables (independent variables), whereas dispositional mindfulness, worry, rumination, anxiety sensitivity and depressive symptoms were considered as endogenous variables (dependent variables). Following the assumed theoretical model, to identify which paths to include in the basic model, a bivariate correlation analysis was conducted. More in detail, the correlation analysis was conducted solely with the purpose to identify which paths to include in the basic model; in other terms, Pearson's correlation coefficients (zero-order correlations) between variables were to be considered as exploratory and data-driven analysis allowing to define the basic model. Thus, the basic model included all paths between those variables that showed a significant association based on the correlation analysis (with p-value < 0.05). Once the basic model was established, the first analysis was performed to estimate the path coefficients (partial regression coefficients) through the maximum likelihood method and to check the fit to the model. Moreover, to find possible significant path coefficients ($p < 0.05$) to add that were not initially detected by the zero-order correlations, modification indexes (*MI*; Kline, 2011) of the tested model were also considered. Therefore, the model with all the relevant paths was used as the reference model. Then, the non-significant paths (partial regression coefficients with p value > 0.05) were removed one by one, monitoring any changes in *MI*. This allowed us to identify the most parsimonious model in line with the assumed theoretical model, which was considered as the pruned model. Finally, the pruned model was compared with the reference model to assess whether the more parsimonious one did not produce a significant reduction in the fit. Path coefficients were estimated with LISREL 8.71 software (Jöreskog & Sörbom, 2004) and the maximum likelihood method. The following fit indices were used: Maximum Likelihood ($ML\chi^2$) goodness-of-fit test statistics, in combination with Root Mean Square Error of Approximation index (*RMSEA*); Normed Fit Index (*NFI*); Comparative Fit Index (*CFI*); Goodness-of-Fit statistic (*GFI*); and the ratio $ML\chi^2/df$ (Cheung & Rensvold 2002; Kline 2011). The following values indicated good fitting models: $p > 0.05$ for $ML\chi^2$ test; values ≤ 0.06 for *RMSEA*; values ≥ 0.95 for *NFI*; values > 0.90 for *CFI*; values ≥ 0.95 for GFI; values < 3 for ratio $ML\chi^2/df$. Moreover, the difference in χ^2 statistics ($ML\chi^2_{diff}$) and *CFI* values (CFI_{diff}; Cheung & Rensvold, 2002; Kline, 2011) were used to test relative fit of nested models (Putnick & Bornstein, 2016). Additional information criteria, including the Akaike information criterion (*AIC*; Akaike, 1974) and its adjusted forms, the consistent *AIC* (*CAIC*; Bozdogan, 1987), and the Expected Cross Validation Index (*ECVI*; Browne & Cudeck, 1993) were also considered, with smallest values indicating the best fitting model.

Results

Preliminary descriptive analyses showed no missing values or significant violations of normality assumption (Table 1). Correlation analyses were performed to assess bivariate relations between variables (Table 2). All the significant zero-order correlations (all $p < 0.05$) were considered in defining the paths of the basic model (Fig. S1, Supplementary materials).

The first path analysis showed a good fit for the basic model considering all the significant correlations between the variables, $ML\chi^2(20) = 10.50$; $p = 0.958$; $ML\chi^2/df = .52$; $RMSEA = 0.00$, 90% CI [0; 0]; $ECVI = 0.67$; $NFI = 0.99$; $CFI = 1$; $GFI = 0.99$; $AIC = 126.50$; $CAIC = 378.35$. The analysis of modification indices (*MI*) did not show any significant path coefficient to add (all $p > 0.05$). Thus, the basic model was equivalent to the reference model. Subsequently, to ensure the parsimony of the model, the not significant paths were pruned one by one: for gamma matrix, paths between AQ social skills (AQ-soc) and dispositional mindfulness (MAAS), brooding (RRS-brood), worry (PSWQ), anxiety (ASI) and depression symptoms (BDI), paths between AQ attention switching (AQ-switch) and reflection (RRS-reflect) and depression (BDI), paths between AQ attention-to-detail (AQ-detail) and anxiety (ASI) and depression symptoms (BDI), paths between AQ communication (AQ-comm) and worry (PSWQ), anxiety (ASI) and depression symptoms (BDI), and path between AQ imagination (AQ-ima) and dispositional mindfulness (MAAS); for beta matrix, paths between dispositional mindfulness (MAAS) and anxiety (ASI), between reflection (RRS-reflect) and depression (BDI), and between brooding (RRS-brood) and anxiety (ASI) (all $p > 0.05$); no loss of significance emerged for phi and psi matrices (all $p < 0.05$) and the *MI* did not show any significant parameters (see Figure S2 in Supplementary materials). Then, the fit of the resulting pruned model was assessed, and results showed that it was good, $ML\chi^2(36) = 25.11$; $p = 0.913$; $ML\chi^2/df = 0.69$; $RMSEA = 0.00$, 90% CI [0; 0.02]; $ECVI = 0.59$;

Table 1 Descriptive analysis of the interest variables

Variables	*M*	*SD*	Min	Max	Skewness	Kurtosis
1. AQ-soc	2.77	2.11	0	10	0.65	0.03
2. AQ-switch	5.10	2.16	0	10	-0.15	-0.48
3. AQ-detail	5.16	2.42	0	10	0.21	-0.60
4. AQ-comm	2.63	1.91	0	8	0.33	-0.76
5. AQ-ima	2.76	1.85	0	9	0.99	0.79
6. MAAS	3.99	0.77	1.66	6	-0.06	-0.25
7. RRS-reflect	10.93	3.54	5	20	0.21	-0.73
8. RRS-brood	11.80	3.80	5	20	0.37	-0.62
9. PSWQ	52.89	13.92	19	80	-0.11	-0.80
10. ASI	21.23	14.97	0	61	0.66	-0.43
11. BDI	15.23	10.76	0	51	0.86	0.55

AQ: Autism Spectrum Quotient; AQ-soc: AQ social skill subscale; AQ-switch: AQ attention switching subscale; AQ-detail: AQ attention-to-detail subscale; AQ-comm: AQ communication subscale; AQ-ima: AQ imagination subscale; MAAS: Mindful Attention Awareness Scale; RRS: Ruminative Response Scale; RRS-reflect: RRS reflective subscale; RRS-brood: RRS brooding subscale; PSWQ: Penn State Worry Questionnaire; ASI: Anxiety Sensitivity Index-3; BDI: Beck Depression Inventory-II

Table 2 Intercorrelations between variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Sex	-											
2. AQ-soc	0.01	-										
3. AQ-switch	-0.05	0.35***	-									
4. AQ-detail	0.16*	-0.04	0.11	-								
5. AQ-comm	-0.05	0.53***	0.49***	-0.01	-							
6. AQ-ima	-0.20**	0.25***	0.26***	-0.00	0.34***	-						
7. MAAS	0.02	-0.24***	-0.49***	-0.03	-0.45***	-0.20**	-					
8. RRS-reflect	0.12	0.06	0.24***	0.23**	0.10	-0.06	-0.36***	-				
9. RRS-brood	0.06	0.23**	0.43***	0.22**	0.37***	0.10	-0.45***	0.58***	-			
10. PSWQ	0.22**	0.25***	0.48***	0.23**	0.33***	0.07	-0.43***	0.48***	0.61***	-		
11. ASI	0.13	0.23**	0.46***	0.26***	0.25***	0.11	-0.39***	0.46***	0.49***	0.60***	-	
12. BDI	0.08	0.19**	0.40***	0.21**	0.32***	0.09	-0.56***	0.45***	0.58***	0.57***	0.55***	-

Sex: participants' sex (dummy coding: males = 0, females = 1); AQ: Autism Spectrum Quotient; AQ-soc: AQ social skill subscale; AQ-switch: AQ attention switching subscale; AQ-detail: AQ attention-to-detail subscale; AQ-comm: AQ communication subscale; AQ-ima: AQ imagination subscale; MAAS: Mindful Attention Awareness Scale; RRS: Ruminative Response Scale; RRS-reflect: RRS reflective subscale; RRS-brood: RRS brooding subscale; PSWQ: Penn State Worry Questionnaire; ASI: Anxiety Sensitivity Index-3; BDI: Beck Depression Inventory-II. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

NFI = 0.98; *CFI* = 1; *GFI* = 0.98; *AIC* = 109.11; *CAIC* = 291.49, and revealed that the more parsimonious model did not produce a significant reduction in the fit, $ML\chi^2_{diff}$ (16) = 14.61, $p = 0.553$;$CFI_{diff} = 0$. Therefore, this latter model was judged as the best fitting one (Fig. 2).

Results (Fig. 2) showed that depression symptoms (BDI) were directly related to dispositional mindfulness (MAAS), brooding (RRS-brood) and worry (PSWQ), whereas they were indirectly related to sex (Standardized Indirect Effect - *SIE* = 0.07, $p = 0.003$), AQ attention switching (AQ-switch; *SIE* = 0.30, $p < 0.001$), AQ attention-to-detail (AQ-detail; *SIE* = 0.09, $p = 0.001$), AQ communication (AQ-comm; *SIE* = 0.18, $p < 0.001$), and to dispositional mindfulness (MAAS; *SIE* = -0.15, $p < 0.001$). As it regards anxiety sensitivity (ASI), it was directly related to AQ attention switching (AQ-switch), reflection (RRS-reflect) and worry (PSWQ), and indirectly to sex (*SIE* = 0.10, $p < 0.001$), AQ attention switching (AQ-switch; *SIE* = 0.20, $p < 0.001$), AQ attention-to-detail (AQ-detail; *SIE* = 0.10, $p = 0.002$), AQ communication (AQ-comm; *SIE* = 0.05, $p = 0.001$), and to dispositional mindfulness (MAAS; *SIE* = -0.18, $p < 0.001$).

With regard to the exogenous variables: sex was directly related to worry (PSWQ); AQ attention switching (AQ-switch) had a direct relation to dispositional mindfulness (MAAS), brooding (RRS-brood), worry (PSWQ) and to anxiety sensitivity (ASI); AQ attention-to-detail

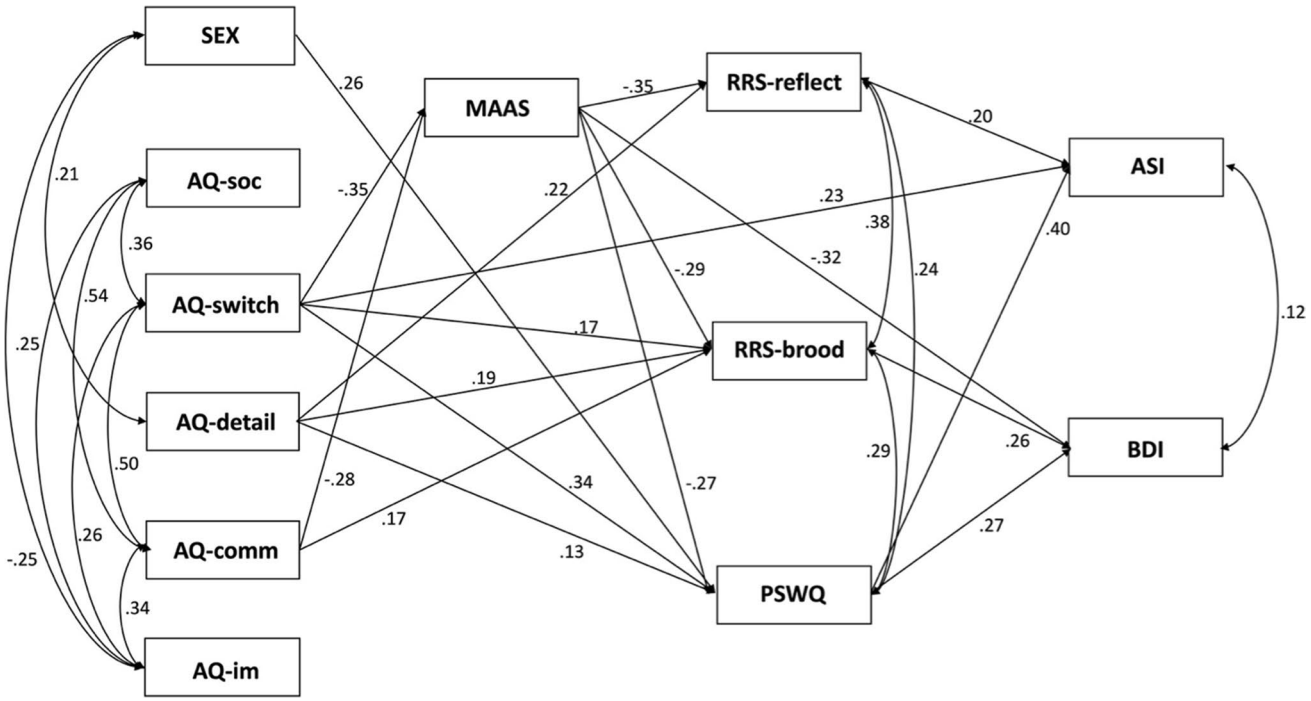

Fig. 2 Path diagram for the best fitting model predicting anxiety sensitivity and depression. Causal paths were represented with arrows (gamma and beta matrices) and non-directional correlations with arcs (phi and psi matrices); lines indicate significant paths (standardized partial regression coefficients with p value < 0.05). Each arrow and line were associated with a standardized coefficient. Sex: participants' sex (dummy coding: males = 0, females = 1); AQ: Autism Spectrum Quotient; AQ-soc: AQ social skill subscale; AQ-switch: AQ attention switching subscale; AQ-detail: AQ attention-to-detail subscale; AQ-comm: AQ communication subscale; AQ-ima: AQ imagination subscale; MAAS: Mindful Attention Awareness Scale; RRS: Ruminative Response Scale; RRS-reflect: RRS reflective subscale; RRS-brood: RRS brooding subscale; PSWQ: Penn State Worry Questionnaire; ASI: Anxiety Sensitivity Index-3; BDI: Beck Depression Inventory-II.

(AQ-detail) was directly related to reflection (RRS-reflect), brooding (RRS-brood) and worry (PSWQ); AQ communication (AQ-comm) had a direct relationship to dispositional mindfulness (MAAS) and brooding (RRS-brood). Also, data showed that reflection (RRS-reflect), brooding (RRS-brood) and worry (PSWQ) were directly related to dispositional mindfulness (MAAS), whereas they were indirectly related (mediated by dispositional mindfulness) to both AQ attention switching (AQ-switch; RRS-reflect: $SIE = 0.12$, $p < 0.001$; RRS-brood: $SIE = 0.10$, $p < 0.001$; PSWQ: $SIE = 0.10$, $p < 0.001$) and AQ communication (AQ-comm; RRS-reflect: $SIE = 0.10$, $p < 0.001$; RRS-brood: $SIE = 0.08$, $p = 0.002$; PSWQ: $SIE = 0.08$, $p = 0.002$). Moreover, data demonstrated that the variables accounted for a relevant percentage of the variance of anxiety (ASI: 43%) and depression (BDI: 48%). Also, they accounted for a considerable proportion of variance of dispositional mindfulness (MAAS: 30%), reflection (RRS-reflect: 18%), brooding (RRS-brood: 31%) and worry (PSWQ: 38%).

Summary of the Results

In synthesis, the main results of the path analysis showed that AQ attention switching and AQ communication were significantly and inversely related to dispositional mindfulness and involved in the pathways linking repetitive negative thinking and affective symptoms. AQ attention-to-detail did not exploit the mediation of dispositional mindfulness to exert its effects on the pathways connecting repetitive negative thinking and affective symptoms.

Discussion

Results showed that dispositional mindfulness mediated the relationships between specific autistic-like traits and affective symptoms through the effect on worry and rumination. These findings provide the first behavioural demonstration of the Burrows et al. (2017) neurofunctional model describing mechanisms underpinning the associations between

autism-related difficulties, repetitive negative thinking and affective symptoms. However, we were also able to provide further details to the model by showing that only specific autistic-like traits, that is attention switching and communication, were associated to dispositional mindfulness, repetitive thinking, and affective symptoms through largely shared pathways. In these cases, dispositional mindfulness could exert a protective role against anxiety and depression through its effect on repetitive negative thinking. Attention-to-detail autistic-like traits bypassed dispositional mindfulness in the pathways linking repetitive negative thinking and affective symptoms.

The inverse association between AQ attention switching and dispositional mindfulness confirmed our main expectation. Indeed, this AQ subscale captures those autistic-like traits most implying a cognitive style relating to inflexible attention allocation, indexed by low dispositional mindfulness, which leaves the individual stuck in negative self-referential thoughts, increasing repetitive negative thinking. This in turn increases the rate of anxiety and depression symptoms. We also found that AQ communication was significantly and inversely related to dispositional mindfulness and involved in the pathways linking repetitive negative thinking and affective symptoms. While this result was not predicted, it is consistent with data on children with autism showing a strong association between autistic-like traits implying communication difficulties and generalized anxiety which is characterised by a high tendency to worry and rumination (Hallett et al., 2012). The nature of this relationship needs to be clarified, since it has been suggested that difficulties in communicating one's own needs, thoughts and feelings may lead to affective symptoms, but also high levels of worry could lead to problems in effective communication, thus implying a possible bi-directional relationship between the two factors (Hallett et al., 2010). Nevertheless, our results are consistent with the idea that strong self-referential cognitions related to communication problems in persons on the autism spectrum (Frith, 2001; Lombardo & Baron-Cohen, 2011), coupled with inflexible allocation of attention, can increase anxiety and depression symptoms through repetitive negative thinking (Burrows et al., 2017).

Interestingly, attention-to-detail was directly related to reflection, brooding, and worry tendencies, and it was indirectly related to both affective symptoms through the mediation of worry and rumination. Attention-to-detail implies a strong focus of attention on details, proneness to repetitive behaviours and adherence to routines (Davis et al., 2017; Hoekstra et al., 2008; Warrier et al., 2019). Such a detail-oriented cognitive style has been related to systemizing, defined as the tendency to analyse, comprehend, and build systems through the implementation of 'if-and-then' logical reasoning, a strength in individuals on the autism spectrum (Baron-Cohen, 2002, 2021). Recent data reported small or even no relationships between systemizing and affective symptoms (Baiano et al., 2022; Warrier et al., 2019), although high systemising tendencies in individuals with higher levels of trait anxiety have been previously observed (Strutt et al., 2014). We can suggest that a detail-oriented cognitive style makes the individual more disposed to analytical problem-solving, a cognitive approach to finding problem solutions that has been placed at the basis of repetitive negative thinking, in particular rumination. Andrews and Thomson (2009) posited that rumination is an analytical process engaging individuals in a problem analysis focused on identification of the causes underpinning their problems and finding optimal solutions. Indeed, people with strong repetitive negative thinking who are relevantly engaged in such a problem-solving approach can outperform non-clinical individuals on different kinds of tasks and situations requiring analytical reasoning (Andrews & Thomson, 2009). On this basis, we suggest that the strong logical reasoning approach of people high in systemizing makes them particularly exposed to repetitive negative thinking, increasing the risk of affective symptoms, through a pathway that does not require poor attentional flexibility. This interpretation is consistent with the fact that, here, we found direct paths from AQ attention-to-detail to both brooding and reflection components of rumination. Since reflection represents the tendency to face problems with an analytic approach (Treynor et al., 2003), the direct link connecting attention-to-detail and reflection may reveal the analytical problem-solving approach shared by people with strong attention-to-detail traits and repetitive negative thinking tendencies.

The effect of dispositional mindfulness on worry and rumination we observed here is largely consistent with available evidence (Desrosiers et al. 2013; Parmentier et al., 2019; Raes & Williams, 2010; van der Velden et al., 2015; Verplanken & Fisher, 2014), as well as the direct path connecting sex to worry, reflecting sex differences in repetitive negative thinking, with higher rates of worry and rumination in women than men (Hoyer et al., 2002; Johnson & Whisman, 2013).

Desrosiers et al. (2013) found in a group of adults seeking treatment for anxiety and depression that worry was the only significant mediator of the relationship between mindfulness and anxiety, whereas rumination was the only factor mediating the effect of mindfulness on depression. Also, the presence of these mediators removed the direct effect of mindfulness on anxiety or depression. Parmentier et al. (2019) showed in non-clinical participants that both worry and rumination mediated the effect of mindfulness on depression and anxiety, together with direct effects of mindfulness on both affective symptoms. Consistently, Freudenthaler et al. (2017) reported in the general population that emotion regulation strategies partially mediated the associations of mindfulness with both depression and anxiety symptoms. Our results demonstrated that worry mediated the influence of mindfulness on both anxiety and depression symptoms,

whereas reflection mediated the effect of mindfulness on anxiety while brooding mediated the effect of mindfulness on depression. Furthermore, dispositional mindfulness also showed a direct effect on depression. Together, these data fit the view that distinct and common mechanisms are both involved in the influence of mindfulness on depression and anxiety through the mediation of worry and rumination. However, the specific association, on one side, between worry and anxiety, and, on the other side, between rumination and depression seems not completely supported (Desrosiers et al. 2013).

It has been suggested that brooding relates to negative aspects of self-reflection, while reflection refers to positive aspects implying a purposeful inward seeking to solve problems (Treynor et al., 2003). Notwithstanding this distinction, the adaptive value of reflection remains unclear, since brooding has been consistently related to depression and anxiety disorders but also associations between reflection, depression and anxiety-related disorders have been found, albeit inconsistently (Nolen-Hoeksema et al., 2008; Olatunji et al., 2013; Yang et al., 2021). In a recent study by Yang et al. (2021) significant positive correlations were found between both reflection and brooding and anxiety sensitivity, and reflection specifically mediated the relationship between anxiety-related cognitive concerns and anxiety symptoms. Consistently, we might ascribe the link between reflection and anxiety-sensitivity to the strong tendency of individuals high in reflection to analyse events to solve the problems, in some cases increasing their anxiety-related concerns.

Limitations and Future Research

Two main limitations warrant comment. First, participants in the study were all psychology students, but we were not able to collect information about the specific psychology topic areas. A large literature demonstrates that autistic-like traits are differently distributed across students of diverse academic disciplines. Higher autistic-like traits are found in students reading systems-based disciplines, such as computer science, chemistry, physics, law, neuroscience, experimental and biological psychology, or economics, with respect to students reading non-systemizing degree disciplines, such as literature, drama, counselling psychology and social work (e.g., Baron-Cohen et al., 2021; Conson et al., 2020, 2022). Our recruitment procedure might have impacted on the external validity of the present results thus their generalizability should be verified on samples from a large and controlled variety of academic disciplines. A second limitation of the study could be related to the correlational design we used here. Indeed, although results fitted our predictions based on the Burrows et al. (2017) model, replication is needed possibly by means of experimental designs implementing mindfulness-based interventions and testing the effects on the paths linking repetitive negative thinking, anxiety and depression.

In conclusion, the present results indicate the possibility to distinguish among autistic-like traits differently associated with repetitive negative thinking and affective symptoms, in some cases, through the mediation of dispositional mindfulness, and in some other cases, by bypassing it. Hence, the protective role of dispositional mindfulness against repetitive negative thinking can be pivotal for people with traits implying poor attention switching or communication abilities but not for people with strong attention-to-detail tendencies.

It has been suggested that rumination is a potentially mediating factor in depression and anxiety symptoms in people with clinical autism (de Bruin et al., 2014; Kiep et al., 2015; Spek et al., 2013). Also, in high-functioning autism, mindfulness training can reduce anxiety, depression and rumination (Cachia et., 2016). The present results underscore the need of considering individual differences to better identify people on the autism spectrum who are most suitable to mindfulness interventions. In this respect, our findings can help to shed light on mechanisms through which mindfulness-based intervention could work in clinical autism, thus contributing to refine mindfulness programmes developed for treatment of affective disorders in this population (de Bruin et al., 2014; Kiep et al., 2015; Spek et al., 2013).

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Data Availability Raw data are available on Open Science Framework (https://osf.io/sh24u/?view_only=86040b3f92594d5bbcca724073b6eec7).

Declarations

Ethical Approval All procedures performed in the present study were approved by the Ethics Committee of the Department of Psychology, University of Campania "Luigi Vanvitelli" (Caserta, Italy), and were in accordance with the ethical standards of the 1964 Helsinki declaration.

Consent to Participate Informed consent was obtained in written form by each participant included in the study prior to testing.

Conflict of Interest The authors declare that they have no conflict of interest.

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