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Investigation of the Relationship Between Orientation Discrimination Thresholds, Autistic, and Schizotypal Personality Traits

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Abstract: Imbalances in cortical excitation and inhibition (E-I) have been implicated in both autism spectrum conditions (ASC) and schizophrenia spectrum conditions (SSC). However, most studies investigate these clinical conditions independently, possibly due to the difficulty of obtaining comorbid clinical populations. As such, the current study investigated the relationship between performance in the orientation discrimination task “ODT” as a potential proxy for E-I balance and the autistic (as assessed by Autism Spectrum Quotient “AQ”) and schizotypal personality traits (as assessed by Schizotypal Personality Questionnaire-Brief “SPQ-BR”) in the general population. 87 healthy adult volunteers participated in the study. We found that high autistic personality traits are associated with enhanced performance in the oblique condition of ODT. In contrast, high schizotypal personality traits are associated with poor performance in the vertical condition of ODT. Such associations support the suggested disruption of cortical E-I balance in ASC and SSC.

Keywords: Excitation inhibition balance, Orientation Discrimination Task, Autistic personality traits, Schizotypal personality traits, Visual Perception.

Introduction

The role of Excitation-Inhibition (E-I) balance in sensory processing has been har-nessed through the use of psychophysical tasks (Edden et al., 2009; Freyberg et al., 2015; Robertson et al., 2013; Snijders et al., 2013; Trakoshis et al., 2020; Yoon et al., 2010), see (Dickinson, Jones, et al., 2016). An advantage of psychophysical tasks is that the E-I balance differences inferred from them must be of ‘functional relevance’. Indeed, one commonly used psycho-physical task for this purpose is the visual-Orientation Discrimination Task (ODT) (Dickinson, Bruyns-Haylett, et al., 2016; Dickinson et al., 2014; Shaw et al., 2019), given its well-known association with inhibitory mechanisms (Edden et al., 2009). A vast range of animal (Katzner et al., 2011; Leventhal et al., 2003; Sillito, 1975; Xia et al., 2013) and human research (Edden et al., 2009; Kurcyus et al., 2018) supports the vital role of cortical inhibition on orientation selectivity tuning and perceptual judgment of stimuli’s orientations due to their associations with GABA, the main inhibitory transmitter. For instance, animal research showed that orientation selectivity tuning reduced following the application of GABA antagonist (Katzner et al., 2011; Sillito, 1975) but increased following the application of GABA agonist (Leventhal et al., 2003; Xia et al., 2013). Similarly, enhanced visual orientation discrimination skills in humans are linked to higher GABA concentration levels in the visual cortex (Edden et al., 2009; Kurcyus et al., 2018). Together, these findings suggest that performance in ODT may provide a useful, al-beit indirect, indicator of cortical E-I balance in the visual cortex.

ODT traditionally uses two different conditions, namely cardinal and oblique conditions. In the cardinal condition, participants judge orientation deviation from vertical or horizontal reference stimuli (i.e., 0/90 degrees). In the oblique condition, however, participants judge orientation deviation from oblique reference stimuli (i.e., 45/135 degrees). It is widely recognised that performance in the cardinal condition is superior to that in the oblique condition (Dickinson et al., 2015; Dickinson et al., 2014; Edden

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et al., 2009; Orban et al., 1984; Vogels and Orban, 1985), possibly due to the larger number of cortical cells tuned to cardinally orientated objects compared to obliquely oriented ones (Hubel and Wiesel, 1968; Mansfield, 1974; Mansfield, 1974). This neural orientation selectivity has been proposed to explain the well-known 'oblique effect', which refers to performance deficiency in judging obliquely oriented stimuli compared to cardinally oriented ones (Appelle, 1972).

Several studies have shown ODT performance differences in individuals with autism spectrum conditions (ASC) and schizophrenia spectrum conditions (SSC) compared to neurotypical (NT) individuals (Dickinson, Bruyns-Haylett, et al., 2016; Shaw et al., 2019). For instance, compared to NT individuals, those with ASC have been reported to have enhanced performance in oblique orientation discrimination (as indicated by lower OD thresholds) (Dickinson, Bruyns-Haylett, et al., 2016). However, the same enhancement was absent for the vertical condition of ODT, possibly due to the ceiling effect (Garin, 2014a), as vertical OD thresholds are about one-fifth of the oblique OD thresholds (Edden et al., 2009). Additionally, compared to NT individuals, individuals with SSC have been reported to have poorer performance in ODT (as indicated by higher OD thresholds) in vertical and oblique ODT conditions (Shaw et al., 2019). Both enhanced and impaired performance in ODT has been suggested to reflect cortical E-I imbalance (Dickinson, Bruyns-Haylett, et al., 2016; Shaw et al., 2019). However, given the practical difficulty in obtaining both comorbid and non-comorbid samples for the same investigation, most studies have not investigated E-I balance in ASC and SSC simultaneously (Dickinson, Bruyns-Haylett, et al., 2016; Shaw et al., 2019). This difficulty can initially be overcome by measuring the traits associated with each condition in the general population (Del Giudice et al., 2010; Del Giudice et al., 2014; Ford et al., 2018; Hurst et al., 2006).

Indeed, in addition to ODT studies in clinical samples with ASC, studies with subclinical traits of ASC (as measured by Autism Spectrum Quotient "AQ") have reported that higher autistic personality traits in NT individuals are associated with enhanced ODT performance in the oblique condition compared to those with low autistic personality traits (Dickinson et al., 2015; Dickinson et al., 2014). These findings have been suggested to indicate increased cortical inhibition in the visual cortex of individuals with high autistic personality traits compared to those with low autistic personality traits (Dickinson et al., 2015; Dickinson et al., 2014). This suggestion has also been supported by neurophysiological measures, as individuals with higher autistic personality traits have higher peak gamma frequency than individuals with low autistic personality traits (Dickinson et al., 2015), given that variations in peak gamma frequency have been associated with levels of GABA concentrations in the visual cortex (Edden et al., 2009). Notwithstanding, such an association between peak gamma frequency and GABA concentration levels in the visual cortex was not replicated in a more recent study (Cousijn et al., 2014), possibly as a consequence of methodological differences related to sample size and the techniques used in measuring GABA (i.e., type of MRS sequence) (Kujala et al., 2015).

Although previous studies have investigated the relationship between ODT performance and autistic personality traits (Dickinson et al., 2015; Dickinson et al., 2014), we are unaware of any study that has assessed ODT performance in relation to schizotypal personality traits. Given the differences between ASC and SSC clinical groups (i.e., enhanced and impaired, respectively) compared to NT control groups, we may expect poor ODT performance in individuals with higher schizotypal personality traits. However, there is a link between autistic and schizotypal personality traits (Dinsdale et al., 2013; Ford et al., 2017; Ford and Crewther, 2014; Nenadić et al., 2021; Russell-Smith et al., 2011); see (Zhou et al., 2019). Thus, we may expect a similar enhanced ODT performance of individuals with high autistic personality traits in those with higher schizotypal personality traits.

The current study aimed to investigate the relationship between performance in ODT and both autistic and schizotypal personality traits in one sample, helping to disentangle these two possibilities. Ultimately, investigating the relationship between ODT and both autistic and schizotypal traits may provide a deeper understanding of the neural mechanisms underlying subclinical autistic and schizotypal traits, given the suggestion that ASC and SSC are two opposites on the same spectrum (Abu-Akel et al., 2018; Ford et al., 2017; Nenadić et al., 2021; Russell-Smith et al., 2010).

Materials and Methods

Participants

Eighty seven healthy volunteers from the University of Sheffield with normal or corrected to normal vision participated in the study. Twenty - eight were first-year Psychology students and received credits for participation. The rest (N=59) were recruited from the students and staff-volunteering email list of

the University of Sheffield and received a £7 Amazon voucher for participation in the study. Participants provided (written) informed consent before taking part. The study received full ethical approval from the Department of Psychology University of Sheffield ethics committee.

Orientation Discrimination Task

We used an orientation discrimination task (ODT) initially developed by (Edden et al., 2009) and had previously been used to measure orientation discrimination in several studies (Bin Dawood et al., 2020; Dickinson, Bruyns-Haylett, et al., 2016; Dickinson et al., 2015; Dickinson et al., 2014). The ODT measures orientation discrimination thresholds using a two-alternative forced-choice adaptive staircase procedure (Leek, 2001; Treutwein, 1995) and was programmed in MATLAB (The MathWorks Inc., Natick, MA, 2000) with PsychToolbox (Brainard, 1997).

In each trial of ODT, two circular black and white gratings (diameter 4°; spatial frequency three cycles/degree; contrast 99 %; mean luminance 83 cd/m²) were sequentially presented for 350 ms with fixation of 500 ms between these two gratings, (Figure 1). The first presented grating is regarded as the reference grating, whereas the second presented grating is regarded as the target grating. Based on the orientation of the reference grating, the ODT comprised vertical and oblique conditions. In the vertical condition, the reference grating was orientated at 0°. In the oblique condition, however, the reference grating was orientated at 45°. Each condition has two staircases based on the target grating's rotation direction (clockwise, anti-clockwise). The staircases implemented one-up three-down procedures, converging on 79% accuracy (Leek, 2001). For each staircase, the target grating was initially presented 5 degrees away from the reference grating with an initial step size of 1 degree, decreasing 75% after each reversal.

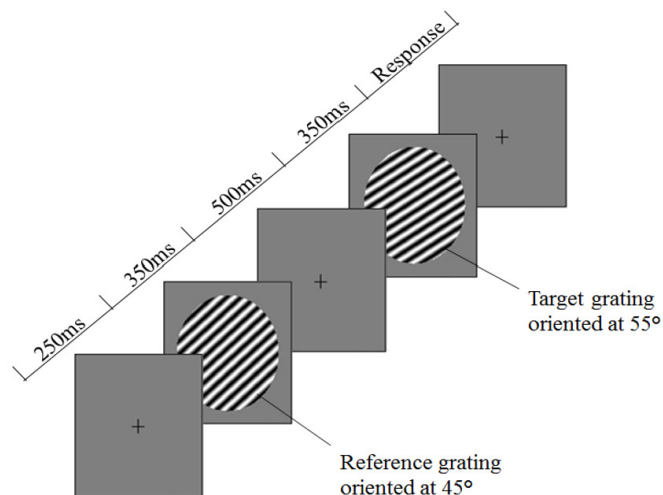


Figure 1. Schematic diagram of the orientation discrimination task. This figure is reprinted with permission from (Dickinson et al., 2014).

Participants were asked to sit comfortably on a chair 57 cm away from the monitor in a dimly lit room. A black circular aperture covered the monitor to eliminate any external orientation cues provided by the monitor edges. Participants were asked to judge whether the target grating had been tilted clockwise or anti-clockwise compared to the reference grating using the right and left arrow keys. Participants started with a practice run of 10 trials for each of the four staircases. Participants then completed the experimental run consisting of 140 trials for each staircase. The task finished when each staircase had reached eight reversals and would be terminated if 140 trials were hit for each staircase.

To calculate OD thresholds, we used the final six reversals from each staircase after discarding the initial two reversals as practice trials. The thresholds of vertical and oblique conditions were calculated separately by averaging each condition's right (clockwise) and left (anti-clockwise) staircases.

Questionnaires

To assess autistic and schizotypal personality traits, we used the Autism Spectrum Quotient (AQ) (Baron-Cohen et al., 2001) and the Schizotypal Personality Questionnaire-Brief Revised (SPQ-BR) (Cohen et al., 2010). Both AQ and SPQ-BR scales were administered online using Qualtrics (<https://www.qualtrics.com>).

Autism Spectrum Quotient (AQ)

The Autism Spectrum Quotient (AQ) is a 50-item self-report Quotient for measuring autistic personality traits in the general population (Baron-Cohen et al., 2001). The items are scored on a 4-point Likert scale with response options ranging from 'definitely agree' to 'definitely disagree'. The responses are collapsed into a dichotomous scoring scheme as responses with an endorsement of autistic personality traits are scored 1 while the opposite responses are scored 0. The five AQ subscales assess imagination, attention to detail, communication, attention switching, and social skills subscales. The total score of AQ ranges from 0-50 for the complete inventory, with a higher score indicative of a higher level of autistic personality traits.

Schizotypal Personality Questionnaire-Brief Revised

The Schizotypal Personality Questionnaire-Brief Revised (SPQ-BR) is a 32-item self-report questionnaire for measuring schizotypal personality traits (Cohen et al., 2010). The items are scored on a 5-point Likert scale with response options ranging from 'strongly disagree' to 'strongly agree'. The SPQ-BR consists of positive (i.e., "Cognitive-Perceptual"), negative (i.e., "Interpersonal"), and disorganised (i.e., "Disorganized") subscales, with a total score ranging from 0 to 128 for the complete inventory whereby a higher score is indicative of a higher level of schizotypal traits.

Exclusion Criteria

Three exclusion criteria were applied. One criterion was failing to reach six staircase reversals in any condition of ODT. Another criterion was having OD thresholds with more than two standard deviations (SD) away from the average (mean). The last criterion was failing to complete the survey. Data from 16 participants were excluded. Two participants failed to reach six staircase reversals in any ODT condition. Also, the OD thresholds of six participants in any condition of ODT were more than 2 SD away from the average. Additionally, eight participants did not complete the online survey, Tables 1 and 2.

Table 1. Illustrates the demographic information of 71 participants (46 female, 25 male) whose data were included in the analyses after applying the exclusion criteria stated earlier.

Variable	Mean	Standard Deviation
Age	22.42	4.82
Vertical Orientation Discrimination Threshold (in degrees)	1.76	1.06
Oblique Orientation Discrimination Threshold (in degrees)	7.80	2.38
Autism Spectrum Quotient (AQ) Score	18.83	6.78
Schizotypal Personality Questionnaire-Brief Revised (SPQ-BR) Score	85.11	16.21

Table 2. Illustrates each participant's demographic information after applying the exclusion criteria stated earlier

No.	Sex	Age	AQ Score	SPQ Score	Vertical OD Thresholds (°)	Oblique OD Thresholds (°)
1	F	26	28	103	0.95	7.01
2	F	36	28	127	3.80	11.63
3	F	24	27	77	0.94	4.45
4	F	18	26	92	0.80	5.66
5	F	20	26	85	2.28	8.69
6	F	24	26	98	1.81	3.89
7	F	28	26	72	0.64	6.97
8	F	21	26	106	1.80	6.89
9	F	26	25	97	2.29	6.71
10	F	18	24	112	2.82	8.61
11	F	22	24	93	1.95	7.77
12	F	29	24	93	2.62	9.63
13	F	25	23	112	3.95	7.37
14	F	22	22	66	4.03	13.26
15	F	19	21	105	2.29	7.75
16	F	19	21	80	2.34	9.71
17	F	34	21	76	3.00	7.05
18	F	25	21	81	2.40	6.05
19	F	23	20	87	3.14	10.7
20	F	20	19	92	1.48	5.96
21	F	21	18	96	4.36	8.65
22	F	20	17	106	4.46	9.61
23	F	20	16	86	1.90	10.31
24	F	18	16	103	1.82	8.15
25	F	18	16	74	1.27	10.93
26	F	28	16	56	1.37	11.71
27	F	19	16	63	2.04	8.28
28	F	37	16	84	0.53	4.69
29	F	19	16	65	0.89	6.09
30	F	18	15	90	1.35	13.52
31	F	27	15	77	1.12	5.33
32	F	27	15	75	0.93	7.29
33	F	18	14	73	0.91	9.00
34	F	18	13	100	1.13	9.48
35	F	19	13	79	1.02	5.27
36	F	21	13	88	1.61	8.81
37	F	23	13	86	0.50	6.84
38	F	18	12	92	3.93	7.32
39	F	18	12	65	1.78	8.97
40	F	18	10	88	2.48	7.14
41	F	23	10	69	2.03	8.48
42	F	26	10	65	0.58	4.55

43	F	18	8	73	2.43	13.00
44	F	33	8	104	2.53	9.88
45	F	19	7	56	1.72	10.21
46	F	18	7	77	2.04	10.50
47	M	18	37	106	1.77	6.13
48	M	19	36	115	2.93	10.25
49	M	27	32	66	0.90	4.97
50	M	19	29	96	0.55	4.40
51	M	20	29	95	0.60	4.20
52	M	31	26	101	0.90	3.25
53	M	20	24	58	1.41	7.21
54	M	19	24	103	1.02	6.47
55	M	19	22	94	0.82	8.48
56	M	32	21	57	1.57	9.07
57	M	19	21	86	0.98	3.93
58	M	28	20	101	1.27	6.69
59	M	26	19	94	1.10	8.29
60	M	20	18	91	1.33	7.84
61	M	20	18	95	0.96	6.69
62	M	20	18	71	1.29	5.20
63	M	19	17	81	1.92	9.39
64	M	22	17	79	4.91	11.3
65	M	22	15	80	0.65	4.46
66	M	18	14	99	1.50	8.28
67	M	21	14	71	0.86	7.75
68	M	22	14	71	1.33	8.77
69	M	30	14	61	0.67	6.93
70	M	21	12	64	0.98	9.14
71	M	19	6	64	0.78	4.01

Results

Data from 71 participants (46 female, 25 male; mean age 22.42; SD= 4.82; age range = 18–37) were used to examine the relationship between ODT performance, autistic personality traits, and schizotypal personality traits. The mean threshold of the vertical condition of ODT was 1.76° with a standard deviation of 1.06°, while the mean threshold of the oblique condition of ODT was 7.80° with a standard deviation of 2.38°. Paired sample t-test analysis showed a statistically significant difference between vertical and oblique ODT performance ($t(70) = -24.88$, $p < .0001$), Figure 2.

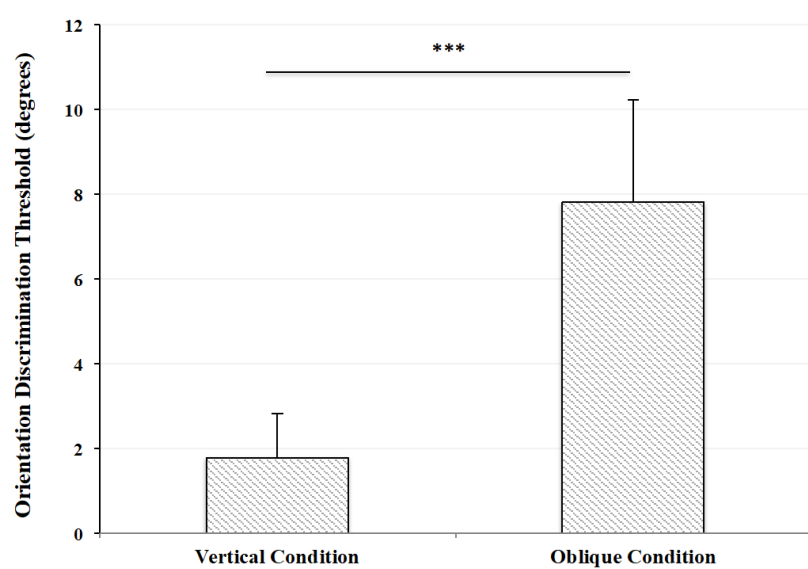


Figure 2. Mean orientation discrimination thresholds for the vertical and oblique conditions of the orientation discrimination task. Error bars represent standard deviation. *** $p < 0.0001$.

AQ scores ranged from 6 to 37 (mean=18.83, SD=6.78), and SBQ-BR scores ranged from 56 to 127 (Mean=85.11, SD=16.21). The internal consistency analysis of both AQ and SPQ-BR scales revealed high reliability, with Cronbach's alpha of .80 for AQ and .85 for SPQ-BR.

To examine the relationship between performance in ODT, autistic personality traits, and schizotypal personality traits, a Pearson correlation analysis was performed using the following variables: vertical OD thresholds, oblique OD thresholds, AQ scores, and SPQ-BR scores.

We found a statistically significant positive correlation between vertical OD thresholds and SPQ-BR scores, ($r = .304$, $n = 71$, $p = .010$). Higher vertical OD thresholds (worse task performance) correlated with higher SPQ-BR scores, (Figure 3(a)). Also, we found a statistically significant negative correlation between oblique OD thresholds and AQ scores, ($r = -.241$, $n = 71$, $p = .043$). Lower oblique OD thresholds (better task performance) correlated with higher AQ scores, (Figure 3(b)). However, we found no significant correlation between vertical OD thresholds and AQ scores ($r = .052$, $n = 71$, $p = .33$), nor was it between oblique OD thresholds and SPQ-BR scores ($r = -.036$, $n = 71$, $p = .77$).

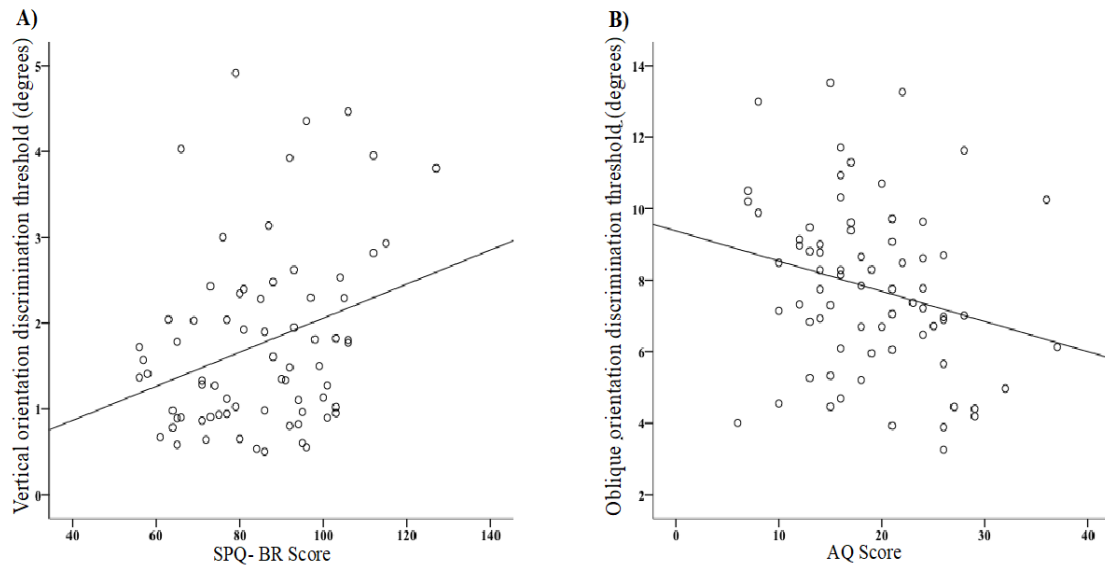


Figure 3. (a) A correlation between vertical orientation discrimination thresholds and SPQ-BR scores ($r = .304$, $n=71$, $p=.010$), and (b) A correlation between oblique orientation discrimination thresholds and AQ scores ($r = -.241$, $n=71$, $p=.043$).

Additionally, the result showed that AQ scores positively correlated with SPQ-BR scores ($r = .455$, $n=71$, $p < .0001$), (Figure 4).

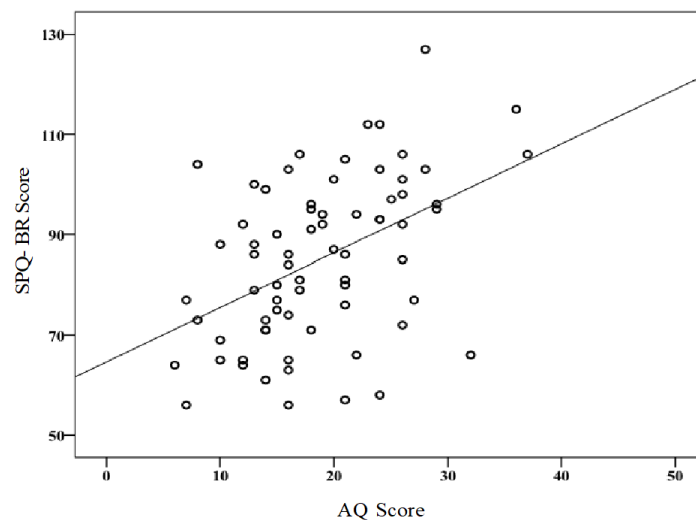


Figure 4. A correlation between AQ scores and SPQ-BR scores ($r = .455$, $n=71$, $p < .0001$).

Furthermore, two partial correlation analyses were performed, given the correlational relationship between AQ and SPQ-BR.

The first partial correlation analysis was to assess the relationship between vertical OD thresholds and SPQ-BR scores while controlling for AQ scores. The result revealed a statistically significant positive correlation between vertical OD thresholds and SPQ-BR scores when the AQ scores were controlled for ($r = .316$, $n=71$, $p=.008$).

The second partial correlation analysis assessed the relationship between oblique OD thresholds and AQ scores while controlling for the SPQ-BR scores. The result revealed a statistically negative correlation between oblique OD thresholds and AQ scores when the SPQ-BR scores were controlled for ($r = -.253$, $n=71$, $p=.035$).

In addition, to confirm that the associations between OD thresholds and scores in personality traits were not driven by other possible factors such as age, which has been linked to cortical E-I balance in previous studies (Abuleil, McCulloch and Thompson, 2019; King et al., 2020; Petit et al., 2021; Pitchaiuthu

et al., 2017), further correlation analyses were performed. The results indicated no statistically significant correlation between age and both OD thresholds and personality traits, with p-values greater than .05, Table 3. A possible explanation for the insignificant associations between age and other variables may be due to the narrow range of age (18- 37 years).

Table 3. illustrates the correlations between age and both OD thresholds and scores in personality traits.

		Vertical OD Thresholds (°)	Oblique OD Thresholds (°)	AQ Scores	SPQ Scores
AGE	Pearson's r	0.003	-0.121	0.142	0.002
	p-value	0.981	0.315	0.236	0.988

Discussion

The current study aimed to replicate previous studies examining the relationship between performance in ODT and autistic personality traits (Dickinson et al., 2015; Dickinson et al., 2014) finding that higher levels of autistic personality traits were associated with lower thresholds in the oblique, but not vertical, condition of ODT. In the same group of participants, we found that schizotypal personality traits were linked to ODT performance in the vertical but not in the oblique condition, partially consistent with the increased OD thresholds that have been found in a clinical sample of participants with SSC (Dickinson et al., 2015; Dickinson et al., 2014), finding that higher levels of autistic traits were associated with lower thresholds in the oblique, but not vertical, condition of ODT. In the same group of participants, we found that schizotypal personality traits were linked to ODT performance in the vertical but not in the oblique condition, partially consistent with the increased thresholds that have been found in a clinical sample of participants with SSC (Shaw et al., 2019). Specifically, individuals with higher schizotypal personality traits showed increased OD thresholds (i.e., worse performance) in the vertical condition. Finally, we found that higher autistic personality traits are associated with higher schizotypal personality traits, consistent with previous findings (Dinsdale et al., 2013; Ford et al., 2017; Ford and Crewther, 2014; Russell-Smith et al., 2011).

As expected based on the hypothesis of increased inhibition in the ASC (Bonnel et al., 2010; Bonnel et al., 2003; Dickinson, Bruyns-Haylett, et al., 2016; Dickinson et al., 2014), we found that high autistic personality traits (indexed by high AQ scores) are associated with enhanced performance in ODT (indexed by low OD thresholds). In line with previous results (Dickinson et al., 2015; Dickinson et al., 2014), this association was condition-specific as it was only observed in the oblique ODT condition. A possible explanation for the lack of a significant relationship between autistic personality traits and OD thresholds in the vertical condition has been attributed to the ceiling effect (Dickinson et al., 2014). Compared to OD thresholds in the oblique condition ($M=7.81^\circ$, $SD=2.42^\circ$), OD thresholds in the vertical condition were very low ($M=1.78^\circ$, $SD=1.05^\circ$), possibly preventing any potential performance differences from being detectable (Garin, 2014a). Similar to this orientation-specific association between performance in ODT and autistic personality traits, Edden et al. (2009) found that GABA concentration level in the visual cortex was only significantly associated with performance in the oblique condition of ODT but not with that of vertical condition, possibly due to ceiling effect. Our finding of an association between high autistic personality traits and enhanced performance in the oblique condition of ODT supports the suggestion of increased cortical inhibition in the visual cortex of individuals with high autistic personality traits (Dickinson et al., 2015; Dickinson et al., 2014).

Consistent with the hypothesis of disrupted E-I balance in the SSC (Abbasi et al., 2023; Anticevic and Lisman, 2017; Lisman, 2012), the current study found an association between high schizotypal personality traits (indexed by higher SPQ-BR score) and poor performance in ODT (indexed by high OD thresholds). However, this association was only statistically significant for the vertical condition of ODT but not for the oblique condition. Such poor performance in the vertical condition of ODT may reflect decreased inhibition in the visual cortex, which has been suggested to be associated with SSC (Goto et al., 2009; Rokem et al., 2011; Yoon et al., 2010; Yoon et al., 2009). For instance, reduced cortical inhibition

is associated with a broader orientation tuning curve of visual cortical neurons of individuals with SSC (Rokem et al., 2011). As such, the lack of observing any significant relationship between high schizotypal personality traits and performance in the oblique condition of ODT might be due to the so-called 'floor effect' (Garin, 2014b). This is because the visual orientation-tuning curve is initially broader for oblique orientations than the vertical ones (Ringach, 1998), possibly limiting any further performance reduction from being detectable.

Additionally, our finding of an association between high schizotypal personality traits and poorer ODT performance is consistent with that of (Shaw et al., 2019) finding that individuals with SSC had poorer ODT performance than NT individuals. However, it should be noted that (Shaw et al., 2019) found that individuals with SSC had higher OD thresholds in both vertical and oblique conditions. Such partial inconsistency could be related to the type of population. For example, while the study of (Shaw et al., 2019) included a sample of clinically diagnosed individuals with SSC, our current study included a sample of NT individuals with subclinical traits.

In line with previous studies (Dinsdale et al., 2013; Ford et al., 2017; Ford and Crewther, 2014; Russell-Smith et al., 2011), we also found a significant association between autistic and schizotypal personality traits as high AQ scores are associated with high SPQ-BR scores. This is expected based on previous studies showing an association between ASC and SSC (Burbach and van der Zwaag, 2009; Chisholm et al., 2015; King and Lord, 2011; Pilowsky et al., 2000; Volkmar and Cohen, 1991; Wood, 2017). For instance, a systematic review and meta-analysis study examining the association between ASC and SSC reported a 3.4% to 52% prevalence rate of ASC in individuals with SSC (Chisholm et al., 2015). ASC and SSC have been characterised by defects in social, cognitive, and communication functions (Pilowsky et al., 2000). Also, ASC and SSC have been suggested to share the same pathogenic mechanism (Burbach and van der Zwaag, 2009). Additionally, our finding is consistent with previous studies investigating the relationship between autistic personality traits and schizotypal personality traits (Dinsdale et al., 2013; Ford et al., 2017; Ford and Crewther, 2014; Russell-Smith et al., 2011). For instance, autistic personality traits and schizotypal personality traits of non-clinical participants were found to be positively associated with each other (Dinsdale et al., 2013).

As previously reported (Dinsdale et al., 2013; Ford et al., 2017; Ford and Crewther, 2014; Nenadić et al., 2021; Russell-Smith et al., 2011), AQ scores and SPQ-BR scores were correlated in the current study. Given their association, the question arose as to how AQ scores and SPQ-BR scores could correlate differentially with ODT performance. As is typical, the correlation between AQ scores and SPQ-BR scores is below 1 in the current study ($r=0.455$), allowing the possibility for the scores of these two inventories to independently and differentially correlate with ODT performance. To further investigate this possibility, partial correlations were used to demonstrate that after controlling for AQ scores, the correlation between SPQ-BR scores and vertical OD thresholds ($r=.316$) was similar to the zero-order correlation ($r=.304$). Likewise, after controlling for SPQ-BR, the correlation between AQ scores and oblique OD thresholds ($r=-.253$) was similar to zero-order correlation ($r=-.241$). This suggests that despite their association, AQ scores and SPQ-BR correlate independently and differentially with ODT performance. Indeed, similar findings have been found for global versus local processing (Russell-Smith et al., 2010). Despite the correlation between autistic and schizotypal traits, individuals with high autistic personality traits had an advantage or preference for local versus global processing than those with low autistic personality traits (Russell-Smith et al., 2010). However, individuals with high schizotypal personality traits were found to have an advantage or preference for global versus local processing than those with low schizotypal personality traits (Russell-Smith et al., 2010). Our divergent pattern of findings regarding ODT performance within the same sample is interesting. For instance, while ASC and SSC have been linked to enhanced and impaired ODT performance, respectively (Dickinson, Bruyns-Haylett, et al., 2016; Shaw et al., 2019), we show that these relationships remain present when studying these two types of traits within the same sample. Our findings may contribute unique mechanistic insight regarding E-I disruptions that cannot be inferred when studying autistic and schizotypal samples independently.

Conclusion

The current study extended previous studies examining the relationship between performance in ODT and autistic personality traits by examining schizotypal personality traits in the same sample. Similar to previous studies (Dickinson et al., 2015; Dickinson et al., 2014), we found that higher levels of autistic personality traits are associated with enhanced performance in the oblique condition of ODT. Additionally, we found that high schizotypal personality traits are associated with poorer performance in the vertical

condition of ODT, as expected based on the findings of (Shaw et al., 2019). Finally, we replicated the previously demonstrated relationship between autistic and schizotypal personality traits (Dinsdale et al., 2013; Ford et al., 2017). Future studies should examine such associations in different cultural contexts, given the critical role of culture on cognition and mental health diagnoses (Banerjee, 2012; Kim, 2012; Phillips, 2019).

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Conflict of interests

The authors declare no conflict of interest.

Author Contributions

ABD and MJ planned the experiment. AD developed and provided the software for the ODT. ABD collected and analysed the data. MJ supervised the project. ABD wrote the manuscript, and MJ and AD edited it. All authors reviewed the manuscript and agreed with the content.

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