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'A storm of post-it notes': Experiences of perceptual capacity in autism and ADHD

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Abstract

Lab-based tasks suggest autistic people have increased perceptual capacity (i.e. process more information at any one time) compared to non-autistic people. Here, we explored whether this increase is reflected in autistic people's day-to-day perceptual experiences and, when compared to those with ADHD/neurotypical people, whether commonalities/divergences in these experiences can illuminate differences between neurotypes. UK-based adults (108 autistic, 40 with ADHD, 79 autistic with ADHD, 85 neurotypical) completed an online survey about experiences of attention and distraction. Responses were analysed using thematic analysis. We found that participants of all neurotypes experienced periods of intense focus. Neurodivergent participants reported experiencing a barrage of information; autistic participants found this overwhelming, whereas those with ADHD referred to overload. This finding may reflect increased perceptual capacity for autistic people (adding ecological validity to previous findings regarding increased autistic perceptual capacity) vs. difficulties maintaining attentional priorities for those with ADHD. While differences between neurodivergent and neurotypical people were evident, discrepancies between experiences of neurodivergent groups were more subtle, suggesting that increased perceptual capacity may extend beyond autism. Consequently, perceptual capacity offers a useful framework to promote better understanding of one's own perceptual experiences, and to guide strategies to ameliorate any challenges encountered.

Keywords

Attention, distractibility, focus, autism, ADHD, perception, perceptual capacity

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Lay summary

Autistic people can process more information than non-autistic people, leading to benefits (superior perceptual skills) and challenges (sensory sensitivities). We do not know whether this increased processing is specific to autistic people, or shared by other neurodivergent people. Here, we examined how autistic people, people with ADHD and neurotypical people process information. We used an online questionnaire to ask participants about their experiences of paying attention to interesting and uninteresting tasks, and situations when they were distracted by external information (e.g. something in the physical environment) or internal information (e.g. thoughts). Participants from all the groups experienced times when they could focus intensely. They also all discussed workarounds that helped them pay

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attention. Many neurodivergent participants (and a small number of neurotypical people) spoke about a feeling that they had to process too much information. Autistic participants described this as being overwhelming, whereas those with ADHD described it as an overload. This difference might be because autistic people have increased perceptual capacity (so they take in more information) while people with ADHD are experiencing difficulties in selecting what they want to pay attention to (i.e. excluding distractions). Participants who experienced increased processing felt that it had both benefits and challenges: facilitating creativity but also leading to anxiety and overstimulation. The similarities and differences in the experiences of the participants (autistic, non-autistic, with and without ADHD) can help us create better ways to support education, employment and daily perceptual experiences for all people.

The way we experience the world around us shapes every aspect of our daily lives. Here, we examine how individual differences in these perceptual experiences can offer insight into challenges and successes of neurodivergent people; specifically those who are autistic or have Attention Deficit Hyperactivity Disorder (ADHD). Throughout this paper, we will use the identity-first language espoused and defended by the autistic community and autistic advocates within Anglophone countries. We acknowledge, however, that there is no one way to describe autism and so individuals may elect other ways of doing so (Botha et al., 2021; Kenny et al., 2015). In contrast to the identity-first language of autism, we use 'with' ADHD. There is some discussion amongst those with ADHD that the name itself, being inherently medical and referring to both 'disorder' and 'deficit' cannot be adopted in the same manner that 'autistic' can be used outside of a medical or deficit focused model (Person First vs. Identity First Language with ADHD, 2021). We have also chosen to move from the common parlance of 'neurotypical' to the term 'Predominant Neurotype' (with the contraction PNT; Beardon, 2016, p. 14). We feel this serves to accurately, but non-judgmentally, note the unequal dynamic between a majority perceptual frame and minority groupings.

A growing body of work demonstrates that autistic people have an increased perceptual capacity, meaning they process more information from their surroundings compared to non-autistic individuals (O'Riordan et al., 2001; Remington et al., 2012; Remington & Fairnie, 2017). Using Lavie's Load Theory (Lavie, 2005) to assess selective attention, an increased capacity has been observed for autistic people in both visual and auditory domains (Remington et al., 2012; Remington & Fairnie, 2017) and across the lifespan (Swettenham et al., 2014). This superiority has been suggested to impact the way in which autistic people experience and navigate the environment on a daily basis (Remington & Fairnie, 2017), and may contribute to both advantages and challenges in daily living. For example, in situations of high perceptual load (where there is a lot of potentially task relevant information in the environment) having additional capacity can allow more efficient information processing, and will result in better task performance (Remington et al., 2012). Conversely, in situations of low perceptual load, where task demands do not fill an individual's perceptual capacity, having additional capacity would result in the processing of task-irrelevant information and, consequently, increased susceptibility to distraction (Remington et al., 2009). Differences in increased perceptual capacity, and the corresponding processing of environmental stimuli, may also explain variation in sensory sensitivities (Brinkert & Remington, 2020; Robertson & Simmons, 2013). Indeed, sensory processing differences are experienced by more than 90% of autistic people throughout their lives (Crane et al., 2009; Leekam et al., 2007).

We (and others) have reframed the increased distractibility and sensory sensitivities that autistic people may experience, in terms of superior capacity rather than a failure of attentional control (Bayliss & Kritikos, 2011; Remington & Fairnie, 2017). This reframing allows suggestions to be made regarding the best approach to maximise task performance and ameliorate any challenges experienced. The optimal approach can sometimes seem counterintuitive: for someone with increased capacity, adding information into the task (rather than simplifying it) can help minimise distraction (Remington et al., 2019).

The value of Load Theory as a framework to understand, and support, individual differences in perceptual processing extends beyond autism. It may help, for example, those who have Attention Deficit Hyperactivity Disorder (ADHD) - another neurodevelopmental diagnosis that is characterised by aspects of unique sensory processing.

Indeed we already know that there is co-occurrence between autism and ADHD; pooled analysis of 63 studies estimates that 38% of autistic people have ADHD and 40% of those with ADHD are autistic (Rong et al., 2021). This high level of co-occurrence might mean that there are similar increases in perceptual capacity for people with ADHD. Alternatively, unique characteristics of attention, focus and distractibility may characterise people who have ADHD and are not autistic. Clarifying which of these possibilities holds true may offer insight for autistic people and those with ADHD, and crucially, inform effective ways to support any challenges experienced due to differences in perceptual capacity.

Previous research has shown that sensory differences are experienced by people with ADHD in a number of domains (see Fuermaier et al., 2018 for a review). These include, for example, more sensitive hearing with less tolerance of auditory discomfort (Lucker et al., 1996); heightened sensitivity to bitterness (Weiland et al., 2011); increased odour sensitivity unless medicated, though without any significant difference in odour discrimination (Romanos et al., 2008); significantly decreased cold pain tolerance (Treister et al., 2015); and a propensity to tactile defensiveness in girls with ADHD (Bröring et al., 2008). A small number of studies have directly considered the issue of perceptual capacity for people with ADHD. Some showed no difference in performance on visual load-based tasks (children with and without ADHD, Huang-Pollock et al., 2005). Others showed increased distractor processing under low levels of load (adults with ADHD compared to those without), but similarly reduced distractor processing for those with and without ADHD under conditions of increased perceptual load (Forster et al., 2014). This is unlike the superior information processing autistic people demonstrate (compared to non-autistic people) under high levels of perceptual load (Remington et al., 2012).

A similar contrast may be seen when considering experiences of hyperfocus. Being deeply immersed in a task has been discussed with respect to autism since the first documented case reports of autistic people. Historically this was framed in negative terms, with an emphasis on reduced cognitive flexibility (Isomura et al., 2015), and considered to be maladaptive (Lovaas, 1971). Subsequently, research literature began to consider the benefits of autistic attentional experiences (Russell et al., 2019), for example, increased creativity and frequent periods of "flow" where focus is "automatic, effortless, yet highly focused" (Csikszentmihalyi, 2013).

More recently, studies have aimed to assess equivalent attentional skills in people with ADHD. This work suggests that certain attentional strengths may distinguish between autistic individuals and those with ADHD. For example, compared to children with ADHD, autistic children were found to be more likely to sustain attention on an activity, and engage in tasks requiring sustained mental effort (Dupuis et al., 2022). Likewise, adults with ADHD were no more likely to experience hyperfocus than those without ADHD. They were, in fact, less likely to report hyperfocus in educational and social settings than those without ADHD (Groen et al., 2020), despite suggestions in the media that ADHD is characterised by increased focus in certain situations (ADDitude Editors, 2022; Nerenberg, 2016). The contrast suggests that the increased distraction experienced by people with ADHD may not be consequences of increased perceptual capacity (as it appears to be for autistic people) but instead may be due to differences in cognitive control (Forster et al., 2014).

There is no consensus, however, regarding this issue. Other studies have found that hyperfocus is one of the self-reported positive aspects of ADHD (Mahdi et al., 2017; Schippers et al., 2022), that there are higher levels of hyperfocus for those with ADHD (e.g. see Hupfeld et al., 2019), or that there are fine-grained distinctions between 'hyperfocus' and 'flow' (similar phenomena but the latter being viewed through a more positive lens). When such a distinction is drawn, increased experience of hyperfocus, but reduced experience of flow was seen for those with ADHD (Grotewiel et al., 2022). This distinction may, however, be an artefact of the measures used: Grotewiel and colleagues examined hyperfocus using the Adult Hyperfocus Questionnaire (designed based on existing literature about ADHD and input from interviews with people with ADHD) but measured flow using a modified version of the Dispositional Flow Scale-2 Long (not specific to ADHD). As such, the perceptual load framework may be useful to understand subtle variations in attention for a broad range of neurodivergent people.

To date, studies of perceptual capacity have almost exclusively employed tightly controlled experimental paradigms to assess selective attention and determine an individual's capacity in lab-based environments. To our knowledge, the first-hand experiences of individual differences in perceptual capacity remain unexplored. We assert that it is important to understand how performance on lab-based tasks maps onto experiences of daily life, and that areas of commonality and divergence in first-hand experiences can also further illuminate differences between neurotypes. Preliminary evidence for the link between perceptual capacity size and first-hand experiences can be found from a small number of studies that have examined the relationship between perceptual capacity in the PNT, as determined by lab-based experimental tasks, and self-report questionnaires that measure cognitive skills by asking about certain aspects of daily life (but do not consider qualitative experience). For example, high scores on the Cognitive Failures Questionnaire (a self-report measure of distractibility) correlated with individuals' level of distractibility under low perceptual load (Forster & Lavie, 2007). Similarly, there was a significant association between levels of auditory perceptual capacity and scores on the Sensory Perception Quotient (SPQ), a self-report measure of sensory sensitivity (Brinkert & Remington, 2020).

Autobiographical reports by autistic authors also echo a sense of increased perceptual capacity. The autistic professor Temple Grandin, for example, has explained how she feels her 'ears are like microphones picking up all sounds with equal intensity' (Grandin, 1995, p. 64). For those with ADHD, a sense of superior processing, albeit with accompanying challenges, is echoed by Edward Hallowell, a medical doctor and psychologist with ADHD. He has famously likened ADHD to having "the power of a Ferrari engine but with bicycle-strength brakes" (Hallowell & Ratey, 2021, p. xvii).

In the present study, we extend the existing literature on perceptual capacity by using a qualitative approach to explore the first-hand perceptual experiences of the Predominant NeuroType (PNT), those who are autistic and/or have ADHD. In doing so, we aim to understand whether there are differences in the lived experiences of these groups, to examine the specificity of increased perceptual capacity, and reflect on the impact that individual differences in this capacity might have on daily life.

Methods

Participants

Participants were adults (over 18 years of age), living in the UK, recruited via existing contacts, UK advocacy groups, and UK-based social media. Of the 324 people who responded to at least one question in the survey, 108 reported a diagnosis or identified as autistic, 79 reported a diagnosis or identified as autistic adults with ADHD, 40 reported a diagnosis or identified as having ADHD and 97 participants identified as PNT. There were 12 respondents who were neither autistic nor had ADHD, but reported one or more alternative neurodevelopmental diagnosis (dyslexia: 3, dyspraxia: 4 synaesthesia: 4; aphantasia: 1, dyscalculia: 1). There were too few participants to create separate groups for each of these diagnoses, therefore, in line with our a priori study aims, these participants were excluded in order to allow comparison between the PNT and those who are autistic/have ADHD. This resulted in a total of 85 PNT participants. Given the known overlap in neurodevelopmental condition (Hollocks et al., 2019; Rong et al., 2021), we did not exclude participants in the target neurodivergent groups who disclosed additional diagnoses (see Table 1). Exclusions in this group would create a sense of artificiality that would undermine the ecological validity of the current study.

Participants in all groups were predominantly female and of White ethnicity. As reported in Table 1, a number of participants in each group reported a mental health condition (e.g. anxiety, depression, etc.). A Fisher's Exact Test indicated that the prevalence of mental health conditions varied by neurotype ($p = <.001$). Specifically, PNT were significantly less likely than any other group to report a mental health condition (all $p < .001$) and autistic participants with ADHD were significantly more likely to report a mental health condition than those in the autistic neurotype ($p = .002$) or ADHD neurotype groups ($p = .01$). Some participants in the neurodivergent groups reported an additional Specific Learning Difficulty (SpLD). Fisher's Exact Tests indicated that the prevalence of SpLD varied between the three neurodivergent groups ($p < .001$). The number of those reporting a SpLD in the ADHD group was lower than for the autistic ($p = .004$) and autistic with ADHD groups ($p < .001$). A one way ANOVA indicated that the groups differed in age ($F (3, 307) = 5.809$, $p < .001$; $\eta 2 = .054$). Post-hoc Bonferroni tests revealed that participants in the ADHD group were slightly younger than those in the other groups (all $p < .001$). There were no other significant differences between the groups (see Table 1 for full participant demographic information).

Measures

This study used a bespoke set of questions on perceptual experiences, which formed part of a wider project on neurodiverse attentional behaviour (Superior Perceptual Capacity in Autism: Investigating Universality, Specificity and Practical Applications for Learning, n.d.). The survey was co-designed by an autistic researcher with ADHD from the research team, with input from neurodiverse consultants via 1:1 cognitive interviews (Willis, 2004) and a consultation group. Questions were refined through iterative negotiation within a neurodiverse research team. The survey was then trialled with a diverse group of seven consultants. Both groups of consultants included autistic people, those with ADHD, the PNT, those with English as a second language, and members of the BAME and LGBTQ+ communities. Interviews with consultants were held and the survey was honed with exemplars developed from their suggestions. The survey sought to bridge cognitive science terminology with an accessible yet robust wording that addressed long standing neurodiverse community conversations around focus, perceptual capacity and distractibility. Great care was taken to ensure access from a representative sample by ensuring scaffolding that would permit wide access in a heterogeneous cohort. For example, vague terms were avoided and simplicity was sought (Dillman, 2007; Lietz, 2010). The negotiation of double empathy problems (the possibility of bi-directional misunderstandings between neurotypes, Milton, 2014) within a neurodiverse research team enabled the development of a cohort-sensitive research tool.

The survey was presented online via Qualtrics (Qualtrics XM, Provo, UT) and first asked participants for demographic information that included age, gender identity, ethnicity, formal and self-diagnoses. Next, in order to characterise our sample and allow comparison to other literature, participants were asked to complete standardised measures to quantify their level of autistic and ADHD traits. These included the Adult ADHD Self-Report Scale (ASRS; Kessler et al., 2005) and the Ritvo Autism and Asperger Diagnostic Scale-14 (RAADS-14; Eriksson et al., 2013). See Table 1 for group means on these measures.

Following this, closed-ended and open-ended questions were presented that asked about 1) experiences of extended focus on an interesting subject or task; 2) experiences of attempting to focus on subjects or tasks that were perceived to be uninteresting; 3) experiences of external distraction and 4) experiences of internal distraction. To maximise accessibility of the open-ended question set for

Table 1. Demographic information by participant group.

	Autistic (n = 108)	ADHD (n = 40)	Autistic with ADHD (n = 79)	Predominant Neurotype (n = 85)	Differences between groups
Mean age (years)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	
	42.7 (15.1)	31.9 (11.9)	40.4 (13.6)	40.4 (13.9)	One way ANOVA: F (3, 307) = 5.809, p < .001; $\eta^2 = .054$ Post-hoc Bonferroni tests: ADHD < PNT (p = .010) ADHD < autistic (p < .001) ADHD < AuADHD p = .012) No other significant differences (p > .99)
Age group (years)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
18 to 24	10 (9.3)	13 (32.5)	10 (12.7)	8 (9.4)	See above, statistics conducted on mean ages.
25 to 34	30 (27.7)	15 (37.5)	22 (27.8)	27 (32.0)	
35 to 44	19 (19.4)	7 (17.5)	17 (21.5)	22 (25.9)	
45 to 54	21 (16.9)	3 (7.5)	13 (16.5)	13 (15.3)	
55 to 64	20 (18.5)	1 (2.5)	13 (16.5)	10 (11.8)	
65 to 74	6 (5.5)	1 (2.5)	3 (3.8)	4 (4.7)	
75+	2 (1.8)	-	-	1 (1.2)	
Did not disclose	-	-	1 (1.3)	-	
Gender	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Male	32 (29.6)	11 (27.5)	21 (26.5)	29 (34.1)	Fisher's Exact Test No significant difference (p = .065)
Female	67 (62.0)	25 (62.5)	47 (59.5)	54 (63.5)	
Non-Binary	5 (4.6)	4 (10.0)	8 (10.1)	-	
Other[a]	3 (2.7)	-	3 (3.8)	-	
Did not disclose	1 (0.9)	-	-	2 (2.4)	
Ethnic Background	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Any White background	103 (95.4)	35 (87.5)	65 (82.3)	76 (89.4)	Fisher's Exact Test No significant difference (p = .062)
Any other background[b]	5 (4.6)	5 (12.5)	13 (16.5)	8 (9.4)	

(continued)

Table 1. Continued.

	Autistic (n = 108)	ADHD (n = 40)	Autistic with ADHD (n = 79)	Predominant Neurotype (n = 85)	Differences between groups
Did not disclose	-	-	1 (1.7)	1 (1.2)	
Specific Learning Difficulty	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Any	48 (44.4)	7 (17.5)	41 (51.8)	N/A	Fisher's Exact Test Significant difference between groups ($p < .001$) ADHD < AuADHD ($p < .001$) ADHD < autistic ($p = .004$) Autistic = AuADHD ($p = .374$)
Dyslexia	15 (13.8)	3 (7.5)	20 (25.3)		
Dyspraxia	25 (23.1)	4 (10.0)	27 (34.2)		
Dyscalculia	-	1 (2.5)	1 (1.3)		
Synaesthesia	12 (11.1)	2 (5.0)	10 (12.7)		
Auditory Processing Disorder	1 (0.9)	-	4 (5.1)		
Irlen's Syndrome	1 (0.9)	1 (2.5)	1 (1.3)		
Other[c]	1 (0.9)	-	-		
Neurological Condition	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Any	3 (2.8)	2 (5.0)	7 (8.7)	N/A	Fisher's Exact Test No Significant difference between ND groups $p = .164$
Epilepsy	2 (1.9)	1 (2.5)	2 (2.5)		
Tourette's Syndrome/ Tic Disorder	1 (0.9)	1 (2.5)	3 (3.8)		
MS/ other demyelinating disease	1 (0.9)	-	3 (7.5)		
Other[d]	-	-	1 (2.5)		
Mental Health Condition	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Any	85 (78.7)	31 (77.5)	75 (94.9)	36 (42.4)	Fisher's Exact Test Significant difference between groups ($p < .001$) PNT < all other groups ($p < .001$). AuADHD > autistic ($p = .002$) and ADHD ($p = .01$) neurotype groups. Autistic = ADHD ($p < .99$)
Mood Disorder	55 (50.9)	20 (50.0)	52 (65.8)	15 (17.6)	
Anxiety	71 (65.7)	25 (62.5)	65 (82.3)	28 (32.9)	
Eating Disorder	8 (7.4)	2 (5.0)	16 (20.3)	4 (4.7)	
PTSD	13 (12.0)	4 (10.0)	17 (21.5)	3 (3.5)	
Psychotic disorder	2 (1.9)	2 (5.0)	1 (1.3)	-	

(continued)

Table 1. Continued.

	Autistic (n = 108)	ADHD (n = 40)	Autistic with ADHD (n = 79)	Predominant Neurotype (n = 85)	Differences between groups
OCD	5 (4.6)	5 (20.0)	6 (7.6)	3 (3.5)	
EUPD	3 (2.8)	-	3 (3.8)	1 (1.2)	
PMDD	2 (1.9)	1 (2.5)	-	1 (1.2)	
Phobia	1 (0.9)	-	1 (1.3)	-	
Trait Measures	**Mean (SD) n = 108**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	
Adult ADHD Self-Report Scale (ASRS)[e]	12.3 (5.0)	13.9 (5.2)	15.5 (4.8)	9.68 (4.6)	One-way ANOVA: $F(3, 308) = 20.361$, $p < .001$, $\eta^2 = .165$ Bonferroni Post-hoc comparisons: PNT < other groups (all $p < .002$). AuADHD > autistic ($p < .001$) ADHD = AuADHD ($p = .545$) ADHD = autistic ($p = .489$)
Ritvo Autism and Asperger Diagnostic Scale-14 (RAADS-14)[f]	26.8 (12.9)	22.8 (13.3)	29.9 (11.2)	15.9 (8.85)	One-way ANOVA: $F(3, 308) = 18.545$, $p < .001$, $\eta^2 = .153$ Bonferroni Post-hoc comparisons: PNT < all other groups ($p < .032$). AuADHD > ADHD ($p < .032$) Autistic = AuADHD ($p = .737$) Autistic = ADHD ($p = .534$)

Note. For Specific Learning Difficulty (SpLD), Neurological conditions and Mental Health conditions participants could report multiple conditions. Therefore n (%) may be greater than the column n and a total percentage greater than 100.

[a]Other genders included: “Trans Masculine”, “autogender”, “agender”, “atypical woman” and personal descriptions of not connecting with any specific description of gender.

[b]Non-White backgrounds- South-East Asian, Asian, Black and dual heritage backgrounds.

[c]Prosopagnosia.

[d]Unspecified pain disorder.

[e]Six items rated on five-point scale from ‘never’ to ‘very often’. Maximum score of 72. Higher scores reflect greater level of ADHD traits. Scores of 14 or greater are considered an indicator of ADHD (Kessler et al., 2005).

[f]14 items rated ‘True now and when I was young’, ‘true only now’, ‘true only when I was younger than 16’ or ‘never true’. Higher scores reflecting higher autistic traits. Scores of 14 or greater are considered a positive screen indicating further clinical assessment. A median score of 32 for autistic adults and 15 for ADHD was found when assessing the validity of this measure (Eriksson et al., 2013).

neurodivergent participants (see Maras et al., 2021), we included examples (created collaboratively with neurodivergent consultants of what we considered to be positive and negative aspects of these four concepts. As mentioned above, these questions were part of a larger survey aimed at addressing various facets of the universality and specificity of superior perceptual capacity in autism. The present study considers participants’ open-ended text responses to questions regarding their perceptual experiences (see Supplementary Materials for a copy of the questions posed). Closed questions on similar topics were also presented, and form the basis of a separate study that aims to quantify the attentional differences between neurotypes (Poole et al., 2022).

All procedures were approved by the UCL Institute of Education Ethics Committee and participants provided informed consent in advance of taking part, supported through co-designed explanatory images and videos (Irvine et al., 2023).

Qualitative analysis

Reflexive thematic analysis (TA) was used to analyse the large dataset of novel text responses (Braun & Clarke, 2022). We chose an inductive approach which was data driven and allowed us to explore new perspectives within a developing area of research.

The coding was led by two neurodivergent researchers (FE and BI), which avoided themes being constrained by pre-existing normative assumptions (Milton, 2013). One is autistic with ADHD and Tourette's and one is an aphant (no internal visual imagery). We followed Braun and Clarke's six steps for reflexive thematic analysis (Braun & Clarke, 2022). FE and BI familiarised themselves with the data and shared first insights. BI led on the creation of codes and coded the entire dataset, informed by discussion with FE who independently coded randomised subsets of the data. FE and BI held regular meetings in order to generate an initial set of themes. To avoid bias in coding that might result from knowing participants' diagnostic status, the coders were kept intentionally unaware of respondents' neurotypes until the first negotiation of shared definitions of codes and themes. Subsequent discussions with authors DP and AR (both PNT) led to further refinement of themes and subthemes. All authors reviewed, refined and approved the final set of themes. Once final themes had been established, we examined whether each theme/subtheme was present for each neurotype group. The themes revealed a number of similarities and discrepancies between neurotype groups. We have not, however, taken a quantitative approach to the qualitative data. Rather than counting the frequency of codes, we have chosen instead to 'embrace partiality, and refuse to nail down a final, absolute analysis' (Braun & Clarke, 2022, p. 142). Where distinctions are drawn, these are based on a clear discrepancy between the responses of the neurotype groups (e.g. themes that were exclusively [or almost exclusively] found for individual groups).

Positionality

As a team of autistic, ADHD, otherwise neurodivergent and PNT researchers, we exemplify and investigate neurodiversity via our varied yet complementary approaches. Before coding began, FE and BI prepared bracketing statements to aid recognising and setting aside our own preconceptions (Tufford & Newman, 2012). These statements were made by considering a set of questions that asked authors to contemplate their existing links with the topic and/or participant groups. Bringing these values/assumptions into view, allowed us to proactively consider how they might impact analysis, and monitor this on an ongoing basis. All authors endorse a 'social model plus'; a social model of disability that rails against the disabling of societal frames, but which continues to acknowledge the embodied disablement of being neurodivergent (Shakespeare, 2013). Our work is about ensuring that the burden for change is placed upon institutions and cultures; changing the things that can be changed. As a research group, we view attention through multi-faceted and non-mutually exclusive models (e.g. Amso & Scerif, 2015), but here we build on the framework of load theory (Lavie, 2005) because it has previously helped to capture empirically strengths in autistic attention and perception (Remington et al., 2012).

Results

Five main themes and 14 sub-themes were identified from the data (see Figure 1 for thematic map, and Supplementary Materials for a table of example quotes). Data from all participants are considered together below, but individual quotes are identified by participant ID and group in order to show the spread of responses. Any overlap and/or divergence of themes across the groups is stated within the text. In the case of overlap, only one quote is included within the text to illustrate each point, but equivalent quotes from the other neurotype group(s) sharing the theme are listed in Table 2.

Intense focus

Participants in all groups spoke about their experiences of intense focus. A key aspect of this was a sense of being in a *flow state*, where an individual was able to focus solely on the task in hand without disruption from distractors. This experience varied between neurotype groups, where PNT participants reported a state in which they were still able to recognise other needs (e.g. hunger) but could choose to set these aside in order to continue their engagement with the task. For neurodivergent participants, the language of flow/hyperfocus aligned with narratives in which the self - and its needs - were no longer grasped: 'I can focus on things to the total exclusion of self care. I have terrible issues with hunger and thirst, partly because I don't feel the sensations of them until my body is what I refer to as "screaming at me"' [Aut169]. For many, this was an extremely positive sensation: 'I'm totally unaware of anything around me … it will sound like a contradiction, but it's invigorating and relaxing and calming all at once' [Aut184]. Others identified the experience in which 'the once enjoyable activity becomes a compulsion' [AuADHD269]. Participants explained that there can be a physical and relational toll. This toll is innately wrapped in the interplaying of relationships with needs, time, and others. Where, in the case of a more neurodivergent flow/hyperfocus, the absorbed self cannot grasp itself easily so as to deal with hunger, thirst, exhaustion, the next imposed demand, or a graceful interaction with an interrupting partner, friend or colleague who were "almost invisible" a moment before [AuADHD221]. This sits alongside three core worries expressed by our respondents: becoming lost in focus, the fear - and real pain - of the disorientation of exiting flow/hyperfocus, and the looming potential that

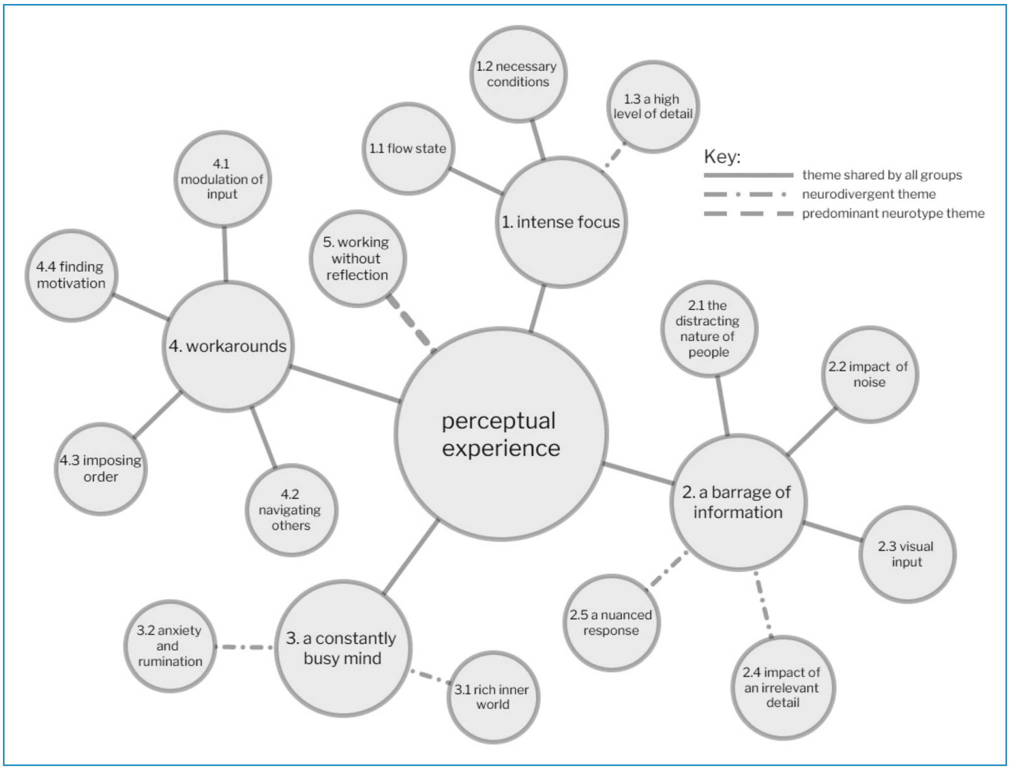

Figure 1. Map of themes and sub-themes. Line style indicates when themes are shared/unique to a particular participant group.

the ‘happy place’ may be lost should it slip away [ADHD102].

Despite these worries, there was an overwhelming sense that flow and hyperfocus were deeply valued as a state in which so much more could be experienced. As such, participants spoke about *necessary conditions* for flow/hyperfocus to occur, and it is no surprise that levels of frustration were voiced - from all groups alike - around the struggles to ‘consciously make’ flow or hyperfocus happen [AuADHD051, PNT074, ADHD162]. There were slight differences between the neurotype groups in this regard, with autistic participants reporting a spontaneous entry into the flow state when conditions permit it, compared to a more effortful approach by those with ADHD.

Neurodivergent participants in particular also spoke about the object of their intense focus. Specifically, that they paid attention to a *high level of detail* in the world around them: ‘I notice everything all of the time and find much of it interesting or informative’ [ADHD349]. There was pride voiced by neurodivergent groups in the noticing of these details: I don’t consider noticing details as a distraction, it gives me a lot of power and speed and consider it a good trait [ADHD102]. However, whilst autistic people were more likely to talk about the value of the details themselves, those with ADHD were more likely to frame it in wider terms of ‘missing the big picture’ and ‘seeing things others miss’. Furthermore, there was subtle interplay in the autistic with ADHD group, who talked about the details themselves, but appeared less likely than both the autistic group and the ADHD group to report thinking on how this detail related to the whole, or to the perceptual frame of others. Overall, a detail-focussed approach was credited for success in art and analysis, though it came with an acknowledgement that the stacking up of details could contribute to feelings of being overwhelmed or overloaded as observation overtakes processing.

A barrage of information

The sense of overload formed the second key theme in the data: that many participants (predominantly neurodivergent, but not exclusively so) felt they were experiencing ‘a constant barrage of thoughts and sensations [that] interfere with absolutely everything.’ [ADHD357]. As noted above, the additional information was also valued, which was reflected in responses that conceptualised distraction in seemingly paradoxical ways: distractors ‘interfere’ and are avoided as ‘it comes with at a cost’ yet are ‘welcomed’ for breaking patterns of negative thought [ADHD357, Aut184, PNT022]. Within the present sample three predominant sources of distraction were identified. First, all groups spoke about the *distracting nature of people*. Autistic participants, including those with ADHD, mentioned how the barrage of social noise resulted in simultaneously processing multiple conversations that led to an ‘overlapping babble’ [Aut205] which hindered comprehension. Second, all neurotype groups shared experiences of the *impact of noise*: ‘I function better in silence and random unnecessary noises trigger me’ [PNT032]. Lastly, all groups spoke about times when aspects of *visual input* were challenging; ‘bright lights are distracting, flashing lights are overwhelming (Christmas I’m looking at you)’ [Aut183].

In addition to weathering the barrage of people and noise, most participants with ADHD, and many from all other groups spoke about the disproportionate *impact of an irrelevant detail*. There was a common experience of becoming distracted by, and focusing on, something that was deemed minor or irrelevant, and the resulting worry that this was slowing down productivity: becoming ‘overwhelmed by micro-distractions a lot of the time. Traffic, birds, neighbours, cars, weather. Everything, really’ [ADHD352] or ‘I’d find myself fixated on someone’s tie or the little dust particles… Meeting about meetings should be illegal’ [Aut262]. Whilst this narrative tended to be framed in terms of the workplace, and the economic worries and pressures that entails, there were also those who spoke to how this sensitivity ‘stops me from relaxing and working on things that I actually want to do’ [AuADHD051].

A further source of distraction that participants mentioned, was a person’s attentional priorities. It is of note that both the PNT group and people with ADHD appeared to report more issues with this type of distraction than the autistic and autistic with ADHD groups. That is to say, autistic people were less likely to talk about being distracted by the feeling that they should be doing something else. Rather, the constant pull of a to-do list or a mobile phone was evident only for our ADHD and PNT groups.

Interestingly, there was *a nuanced response* to this barrage of stimuli where the language used varied by neurotype. Autistic participants spoke about feeling ‘overwhelmed by sensory input’ [Aut183], whereas those with ADHD reported ‘sensory overload and overstimulation’ [ADHD102]. This was not limited to external information, but also extended to internal thought processes where participants discussed ‘having too many things to think about at the same time’ [PNT071].

A constantly busy mind

Whilst not confined solely to our neurodivergent respondents, the motif of a constantly busy mind was a common theme for participants with ADHD: a constant ‘“storm of post-it notes” in my mind’ (AutADHD212). As was the case with many phenomena described by our participants, neurodivergent people spoke of this lively internal monologue as both a help and a hindrance: ‘I have a rich, busy, inner world that is either bringing me joy or causing me to be anxious’ [Aut291].

On the positive side, neurodivergent participants felt that the *rich inner world* allowed for enhanced creativity in which one can ‘flit from concept to concept and join them together in new and different ways’ [AuADHD212]. Conversely, *anxiety and rumination* were also experienced: ‘The internal monologue in my head constantly churning away for fear of not exercising my brain enough’ [Aut230]. For some neurodivergent respondents there was a sense that this constant churn was the domain of ‘my brain’ rather than of the self. ‘My brain’ being the one that ‘shuts down’, cannot ‘cooperate’, ‘finds any excuse’, goes ‘on strike’, or is the one ‘trying to sabotage’ me [ADHD162, AuADHD162, AutADHD156, Aut184, Aut215 respectively].

Workarounds

To address the experiences detailed above, people spoke about their attentional strategies and workarounds. These were broadly focussed on modifying the external environment, or the task at hand.

Participants spoke about *modulation of the input* whereby they made efforts to smooth the external environment in order to facilitate focus: ‘when I have to concentrate hard I’ll turn [podcasts and TV] off.. but doing multiple things at once can help as long as I remember each one of them and loud music helps when doing more menial or simple tasks’ [ADHD010]. In some cases this involved attenuation of sensory stimuli, to ‘decrease information coming in’ [Aut300] and in others the addition of information to fill capacity with ‘always something on in the background’ [ADHD004] so as to ‘filter out annoying sounds’ [PNT014]. This was felt to allow participants to gain control of their surroundings, e.g. to ‘smooth it out’ [PNT081], to remove ‘visual clutter’ [ADHD353], to avoid places with ‘contradictory, unwanted or superfluous information’ or by having ‘time where all apps and notifications are blocked off’ [AuADHD066]. This extended to the social realm, with participants explaining their tactics for *navigating others*. This can be by explicit requests: ‘Sometimes I have the confidence to say “Sorry, I totally zoned out there”’ [Aut215]. Or, through careful planning, ensuring that ‘interruptions from other people [are] solely on my own terms’ [Aut236]. Alongside modification of environment and others, participants reported *imposing order* on the task they were approaching. This included, for example, breaking down a task into its component parts, using alarms to stay on track or developing schedules and routines ‘for intense bursts of focus and for remembering to take breaks’ [Aut227].

Lastly, participants highlighted the crucial role of *finding motivation* in order to engage with a task. This often involved adding a reward, or tricking themselves into starting; ‘if I’m working on an essay I’ll almost pretend that I’m just going to have a casual flick through my research and that can usually help kick off an intense focus session' [ADHD070]. Societal norms, and the judgement of others also offered a route to motivation, with participants explaining how they sometimes worked in view of others with the 'quiet hum of others working' [PNT043] in order to live up to perceived expectations which - in extreme forms - is 'leveraging my social anxiety against my inability to focus' [AuADHD152].

The responses within the current study generated a huge amount of rich data on this question of workarounds (approximately one third of all data). Though all were encompassed by the four overarching subthemes outlined above, there were a great deal of fine-grained divisions that may shed additional light on the nuanced relationship between perceptual experiences and neurotype. This is beyond the scope of the present paper, and future analyses will consider this in more depth. Anecdotally, however, it was noted that the depth, number and complexity of the strategies varied by neurotype. While PNT participants discussed a generic approach, those with ADHD and - to an even greater extent - autistic participants shared a large number of sophisticated and elaborate workarounds for different situations.

Working without reflection

As outlined above, many participants spoke in depth about their attentional abilities, the strategies they employ to maximise performance, and the challenges they experience in various settings. There were also a number of PNT participants, however, who used relatively simple reflective statements that suggest an absence of any prior need for introspection in this area: 'crack on' or 'just knuckle down' [PNT061, PNT097].

Discussion

The present study highlights the first-hand perceptual experiences of autistic people, the PNT, and those who have ADHD. Using open-ended questions, and qualitative analysis, we explored the commonalities and differences between these experiences within a perceptual capacity framework. All groups shared experiences of intense focus, situations when they felt bombarded by the external environment and inner thoughts, and strategies to overcome perceptual challenges. Differences within these experiences appeared most pronounced between the PNT and the neurodivergent groups, and centred on the volume of information processing (both internal and external) and the impact of detail in the environment. In some cases, more subtle differences emerged between the autistic and ADHD groups, while autistic participants with ADHD did not seem to show a unique perceptual profile. For example, all themes and subthemes were represented in the AuADHD group, and in some cases, the pattern of responses appeared similar to the autistic group while for other topics the responses were more similar to the ADHD group. Future quantitative research could allow a more fine-grained comparison between these groups.

Irrespective of neurotype, participants spoke in positive terms about experiencing periods of intense focus, or flow state. PNT participants were more likely to report a continuing awareness of their external environment and internal needs. Conversely, neurodivergent participants often shared how this state involved total immersion, unaffected by any other sensations. This finding seems to be in keeping with Hupfeld et al.'s (2019) assertion that there is a distinct 'deep flow' experience, associated with reduced sense of time, difficulty switching tasks or attending to personal needs. The positive yet all-encompassing nature of this experience was also evident in recent work highlighting autistic people's experience of task immersion (Rapaport et al., 2023). Similarly, Grotewiel et al. (2022) highlighted how - when in flow/hyperfocus - participants with ADHD experienced a greater sense of transformational time, and lower levels of control and concentration, than those without ADHD. In this existing literature, the authors appear to be making a distinction between the positive 'flow state' and the negative, maladaptive 'hyperfocus' - the latter being more associated with neurodivergent experiences (Grotewiel et al., 2022). Interestingly, in stark contrast to these value judgements, our participants viewed hyperfocus as a positive sensation. As such, we suggest that the term 'intense focus' is more appropriate, and helps to avoid normative assumptions regarding attentional experiences.

A second issue raised predominantly by participants in the neurodivergent groups, was a sense of being bombarded by information: both from the external environment and one's own internal thoughts. There were fine-grained group differences in these experiences. For example, participants with ADHD, but not autistic participants, particularly reported challenges with internal distraction and the difficulty of being preoccupied by detail they deemed irrelevant.

A double edged sword

The experiences that our neurodivergent participants shared gave insight into a multifaceted, complex relationship with their increased information processing. On the one hand, intense focus and increased attentional processing were valued. They were seen to lead to a rich inner world that facilitated creativity. Neurodivergent participants also spoke about noticing a high level of detail that PNT individuals may have missed. This maps onto research that links ADHD (Hoogman et al., 2020) and autistic traits with enhanced innovation (e.g. Best et al., 2015; Pennisi et al., 2021). With respect to the latter, we welcome this additional momentum away from the incorrect stereotype that autistic people lack imagination and creativity (Bury et al., 2019;

Russell et al., 2019). For the neurodivergent participants in the present study, these areas of superior attention to nuance and detail also came at a cost. In the three neurodivergent groups, creativity was often reported alongside anxiety and rumination, and many participants felt overwhelmed or overloaded by information in the external environment.

Specificity of increased capacity

The commonalities and differences highlighted in the present data offer insights into the impact of increased perceptual capacity on daily life, and preliminary evidence for the specificity of this increased capacity for autistic people.

The feeling reported by autistic participants and/or those with ADHD of processing a large amount of information is in keeping with the experimental findings of increased interference from distractors on lab-based experimental tasks (Brinkert & Remington, 2020; Remington et al., 2012). The nuanced response to this increased processing by the various neurotype groups further indicates subtle differences in the route of this distraction. Autistic participants spoke about feeling overwhelmed by sensory input, perhaps reflecting the automaticity of the increased perceptual processing. Indeed, Load Theory asserts that one's full perceptual capacity must be assigned to information processing (either internal or external stimuli) at any given time. If there is insufficient external task-relevant information to fill capacity, then the remainder will spill over to distracting or irrelevant information or thoughts (Lavie, 2005). Interestingly, this sense of overarousal was accompanied by the observation that autistic participants reported less distraction from mental to-do lists or the urge to check phone notifications (distractions that both the PNT participants and those with ADHD experienced more frequently).

This may reflect a bias towards bottom-up attentional influences (i.e. being driven by what is present in the environment, rather than by top-down attentional goals influenced by prior experience and interest; Maekawa et al., 2011). The Enhanced Perceptual Functioning account of autism asserts that autistic people experience an altered balance between top-down and bottom-up processing, and that this may explain many of the diagnostic features of autism (Mottron et al., 2006). For example, neuroimaging research suggests that increased influence of bottom-up processes results in the superior performance demonstrated by autistic people on cognitive tasks such as the block design task (Bölte et al., 2008; Silverstein, 1975).

Participants with ADHD echoed the sentiment of increased processing, but framed it slightly differently – reporting a sense of overload rather than overwhelm. This may reflect less of an absolute increase in the amount of information being taken in, but instead, a difficulty maintaining attentional priorities and excluding irrelevant distractors while performing a task. Experimental testing should aim to further explore whether susceptibility to distraction may reflect increased perceptual capacity for autistic people and an attenuation of cognitive control for those with ADHD.

Teasing apart these differences is important as they may require different workarounds for a flourishing life. Avoiding being overloaded requires calm, quiet and solitude, whilst avoiding being overwhelmed requires agency over ensuring surplus sensory capacity is filled well (Lavie, 2005).

The insight that workarounds offer

A large number of practical approaches were outlined by participants in the present dataset. These included techniques to help modify the task at hand (e.g. using schedules, alarms or dividing tasks up into component parts), the external environment (e.g. choosing a calm, quiet setting) or oneself (e.g. bribes to increase motivation). Given the subtle group differences that were evident in the perceptual experiences, we were surprised to see remarkable overlap between the strategies raised by our participant groups.

What was observed, however, was a difference between the texture of PNT responses when compared to the neurodivergent corpus as a whole; in short, the neurodivergent participants wrote far more in this area. We would suggest that the experiences accrued in schools, offices, and even sometimes homes, of being neurodivergent, in which you are not understood creates the momentum for self-reflection, and could explain the volume of text written by the neurodivergent participants. Whilst resilience in the face of systematic barriers permits survival, developing these strategies undoubtedly involves time, effort and energy which instead could - and should - be liberated, by creating more accessible sensory environments.

Limitations

While our findings offer preliminary insight into the everyday experiences of perceptual capacity and how they may vary according to neurotype, there are limitations of the study that should be acknowledged.

Similar to other online research (see Rødgaard et al., 2022; Rubenstein & Furnier, 2021), those who took part in our study tended to be of White ethnic background, particularly the autistic group and ADHD group which each contained over 90% White participants. Not only are these percentages higher than the UK population as a whole (Office for National Statistics, 2022), but a recent study of school children showed that the prevalence of autism was highest for Black pupils in the UK (Roman-Urrestarazu et al., 2021). Further, completing the online survey required a certain level of verbal ability, likely precluding access for those with lower levels of ability.

Although our aim was to compare the experiences of people with different neurotypes, it is likely that our participant groups have a great deal of overlap. In the UK, the adult diagnostic pathways for assessment for Autism Spectrum Disorder and ADHD are not combined, rather these are commissioned separately from each other, and from adult mental health services (secondary care; Male et al., 2020). Therefore, seeking an adult clinical diagnosis of either neurodevelopmental condition is a large endeavour and seeking both diagnoses an even greater challenge (Crane et al., 2018; Lewis, 2017). Additionally, due to the limited (though growing) understanding of neurodivergent traits it is common for individuals, or parents, to be told that a diagnosis already in place (be that ADHD, dyspraxia or a mental health condition) already covers the observed neurodivergent behaviour (diagnostic overshadowing; Rosen et al., 2018) or already gives the individual access to reasonable adjustments. Further, many adults with mental health diagnoses seeking answers about potentially being neurodivergent may face additional barriers to accessing the diagnostic pathway due to being under secondary mental health services (Camm-Crosbie et al., 2019). To mitigate this, we have included participants who self-identify as autistic/having ADHD as well as those who report clinical diagnoses, however, this may still represent an underestimation of co-occurrence of diagnoses.

Furthermore, in addition to reporting neurological conditions, a large number of participants in the present study reported one or more mental health concerns, most commonly anxiety and/or depression. The rates were significantly higher for the neurodivergent groups, compared to the PNT. The possibility remains, therefore, that the variations in perceptual experiences of the participant groups may be underpinned by these mental health differences. Indeed, anxiety disorders - for example - are known to alter one's perceptual framework: those with high anxiety show hypervigilance for threats, and demonstrate altered selective attention even when no threat is present. This has been seen to manifest as increased distraction to irrelevant peripheral stimuli, and increased visual detection in certain situations (Berggren et al., 2015). Given the presence of equivalent levels of mental health condition reports in our autistic group and ADHD group, the nuanced differences in perceptual experiences presented here are not likely to be solely attributable to this. However, future research should aim to separate out the relative contributions of mental health and neurodevelopmental conditions to individual differences in perceptual capacity, and how these differences manifest in daily life.

Finally, the conclusions drawn here are based on self-report measures: both in terms of neurotype and experiences of capacity. This was appropriate, given that the key aim of our research was to highlight these first-hand experiences. Future studies could, however, seek to more explicitly link individual experiences to neurotype and perceptual capacity by using continuous measures of neurological traits and lab-based tests of attentional performance.

Conclusion

Overall, the first-hand experiences presented here tell a story that echoes the findings from lab-based work, giving additional ecological validity to the suggestion that autistic people experience increased perceptual capacity. The findings also begin to consider the specificity of this capacity. While differences between PNT and neurodivergent groups were evident, the more subtle discrepancies between the experiences of autistic people and those with ADHD suggest that increased perceptual capacity may extend beyond autistic people.

Understanding these commonalities, and further elucidating individual differences, is crucial to avoid harmful over-generalisation of support/interventions. As outlined above, the same situation can be experienced very differently, depending on one's perceptual capacity. For someone with increased perceptual capacity, tranquillity could lead to unpleasant rumination, and solitude could become imposed isolation. Instead of creating bland and featureless places, we must create places in which ongoing cycles of engagement and rest can be done well. These will have details to 'rest the eye', not a tyranny of magnolia; 'if I'm facing a blank wall I get distracted by the emptiness of facing nothing' [AutADHD265]. As such, we assert that individual difference in perceptual capacity is a core tenet of perceptual experience, and offers a useful framework to promote better understanding of one's own perceptual experiences, and to guide strategies to ameliorate any challenges encountered.

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Data availability: The data from this study are available from the authors on request. Due to ethical constraints, the full dataset cannot be shared publicly.

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