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Aphantasia within the framework of neurodivergence: Some preliminary data and the curse of the confidence gap

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ABSTRACT

Aphantasia is a neurocognitive phenomenon affecting voluntary visual imagery, such that it is either entirely absent, or markedly impaired. Using both the social and medical models of disability, this article discusses the extent to which aphantasia can be understood as a disorder or just a form of neutral neurodivergence, given that imagery plays a central role in thinking and memory for most other people. Preliminary school performance data are presented, showing that low imagery does not necessarily complicate life, especially given compensatory strategies and low societal barriers. In addition, we discuss the consequences of labelling aphantasia a disorder with regard to self- and public stigma, and we provide further data regarding a confidence gap, by which aphantasics perceive themselves as performing worse than they objectively do. We conclude that aphantasia should be understood as neutral neurodivergence and that labelling it a disorder is not only wrong, but potentially harmful.

1. Introduction

The term ‘neuro(logical) diversity’ was first coined within the 1990s by an online community of autistics and other people with neurological conditions to describe human cognitive variation (Dekker, 2023). It describes ‘the idea that people experience and interact with the world around them in many different ways’ and that ‘there is no one right way of thinking, learning, and behaving, and differences are not viewed as deficits’ (Baumer & Frueh, 2021, para. 1). The term ‘neurodiversity’ is often used in the context of Autism Spectrum Conditions, Attention Deficit Hyperactivity Disorder and symbolic dysfunctions such as Dyslexia, Dyscalculia and Dyspraxia (Clouder et al., 2020), which are often described as *neurodivergent* conditions, that is, they ‘diverge significantly from the dominant societal standards of ‘normal’’ (Walker, 2014, para. 26). Some of these conditions have been linked to weaknesses in abilities, for example, in reading (Dyslexia) or arithmetic (Dyscalculia). However, neurodivergent differences should not be seen as inherent deficits per se, not least since some forms of neurodivergence lead to unique strengths. For instance, autism is associated with benefits in attention-to-detail, ability to concentrate on a single topic, or effective systemizing (Wheelwright et al., 2006). Similarly,

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synaesthesia, where everyday stimuli trigger unusual multi-layered sensations or experiences (Simner, 2019; Simner & Hubbard, 2013), is a form of neurodivergence often associated with strengths in the fields of memory, creativity and learning (e.g., Smees et al., 2019).

Here we discuss neurodiversity and neurodivergence in the context of aphantasia, an individual difference concerning the ability to generate visual mental images in the mind's eye.[1] People with aphantasia report either no (waking) imagery at all, or imagery that is notably impaired. The 'gold standard' self-report measure for aphantasia is the *Vividness of Visual Imagery Questionnaire* (VVIQ; Marks, 1973, 1995) in which participants rate the degree to which their visual thinking is picture-like. In one item, for example, participants are required to imagine the appearance of the sea on a warm summer's day. People with aphantasia respond with the lowest two response-scale options, indicating they have either no picture-like image at all, or one that is only 'vague and dim' (e.g., Keogh & Pearson, 2018; Zeman et al., 2015). Importantly, people with aphantasia tend to have intact visual knowledge (i.e., they know what the sea looks like) but this knowledge is not expressed in the mind as a mental picture. Also important is that people show excellent metacognition about their own imagery abilities, and so self-report measures such as the VVIQ correlate well with objective behavioural validations (e.g., Keogh & Pearson, 2018; Pearson et al., 2011). Large-scale screening studies now show that 3.9% of the population has aphantasia (Dance et al., 2022), making it a minority. However, Simner (2021) points out that the population of aphantasics world-wide is close to the entire population of the United States, and that over 15,000 people with aphantasia are born each day. Viewed in this way, we can see that aphantasia, although a minority, is not insignificant.

Given that aphantasia is a distinct neuropsychological variation, it reflects the biological fact of neurodiversity, i.e., 'the diversity of human minds, the infinite variation in neurocognitive functioning within our species' (Walker, 2014, para. 8). But is aphantasia a disorder or just a form of neutral neurodivergence? On this point there has been notable discrepancy in the literature, with some researchers framing aphantasia as simply an 'intriguing variation in human experience' (Zeman et al., 2020, p. 18), while others go as far as to define aphantasia as a 'mental illness' (Yang, 2022, p. 1037), although there is no data suggesting a pathological origin. In fact, many of the conditions described above are often thought of as non-pathological interindividual differences rather than disorders. The aim of this statement paper is therefore to present an argued view of aphantasia not only as a form of neurodivergence, but to oppose the idea that aphantasia is necessarily a disorder or impairment (see also Monzel, Vetterlein, et al., 2022). To this end, we consider below a set of objective standards by which aphantasia might be evaluated.

2. The social model of disability

Scotland's National Autism Implementation Team created a model to illustrate different aspects of neurodiversity (Shah et al., 2022). They argued that *neurotypicality* is the typical statistical range of a specific *neurocognitive function*[2] as depicted in Fig. 1. In the case of aphantasia, this would be the ability to create mental imagery. From this perspective, a *neurotypical* person is an individual that falls within statistical societal norms of this specific neurocognitive function and a *neurodivergent* person falls outside of these norms, that is, scores a predefined distance below average or above average on that particular cognitive function. A *neurodevelopmental disorder,* on the other hand, is present when the deviation from societal norms is so extreme that significant functional impairments occur, which, for example, makes it difficult to participate in social life. This, however, does not mean that a disorder cannot also be considered a form of neurodivergence. The risk for functional impairment increases the more extreme the deviation from the societal norms, in part because the deviation makes interacting with the environment all the more difficult. For instance, Dyslexia would not qualify as a problem at all, if a society did not rely so much on the written word. This view is in line with the social model of disability (Shakespeare, 2006), which suggests that disabilities are the consequence of the interaction between societal barriers and individual differences. Indeed, this school of thought suggests that extreme mental imagery (either side of the mean) would only qualify as a disorder if the societal barriers were high enough to provoke *functional impairments* in daily living. Decreased or increased imagery alone, however, would not be sufficient for a classification of a disorder.

Under this depiction above, one would indeed consider aphantasia as neurodivergence, but should it also be considered a neurodevelopmental disorder? In most cases, aphantasia is certainly neurodevelopmental (although some acquired cases do exist; e.g., Knowles et al., 2021) but does it have the qualities we associate with disorders? To answer this, it is necessary to examine the extent of functional impairment seen in aphantasia. A lack of mental imagery does not seem sufficient, in and of itself, to give rise to any great amount of functional impairment. Indeed, in the majority of cases, aphantasics simply do not know they are missing an ability that most other people possess, and when they do find out, only one third of them feel any considerable amount of personal distress (Monzel, Vetterlein, et al., 2022). However, previous research has identified certain correlates of aphantasia that might be seen as functional impairments. For example, aphantasics experience less detailed autobiographical memory (Dawes et al., 2022; Milton et al., 2021; Zeman et al., 2020) and lower emotional reactivity to verbally presented stimuli (Monzel, Keidel, et al., 2023; Wicken et al., 2021). Nonetheless, they also possess traits that give them distinct advantages, being, for example, potentially protected from the trait of sensory hyper-sensitivity (i.e., they may be significantly less overwhelmed or distressed by sensory events, such as bright lights, powerful smells or loud noises; Dance, Ward, et al., 2021). In some ways, the biggest barrier to aphantasics might actually be a lack of

[1] Aphantasia was originally defined in the visual sense, but can also co-occur with poor imagery in other senses (e.g., poor olfactory imagery). For a discussion of terminology relating to these other senses, see Lambert and Sibley, 2022; Monzel et al., 2022a, 2022b and Simner and Dance, 2022.

[2] Shah et al.'s (2022) model includes only neurocognitive functions. However, the original coiner of the term 'neurodivergent' included differences in all neurological structures and functions in the conception of neurodivergence, e.g., epilepsy, cluster headaches, and chiari malformation (Asasumasu, 2023).

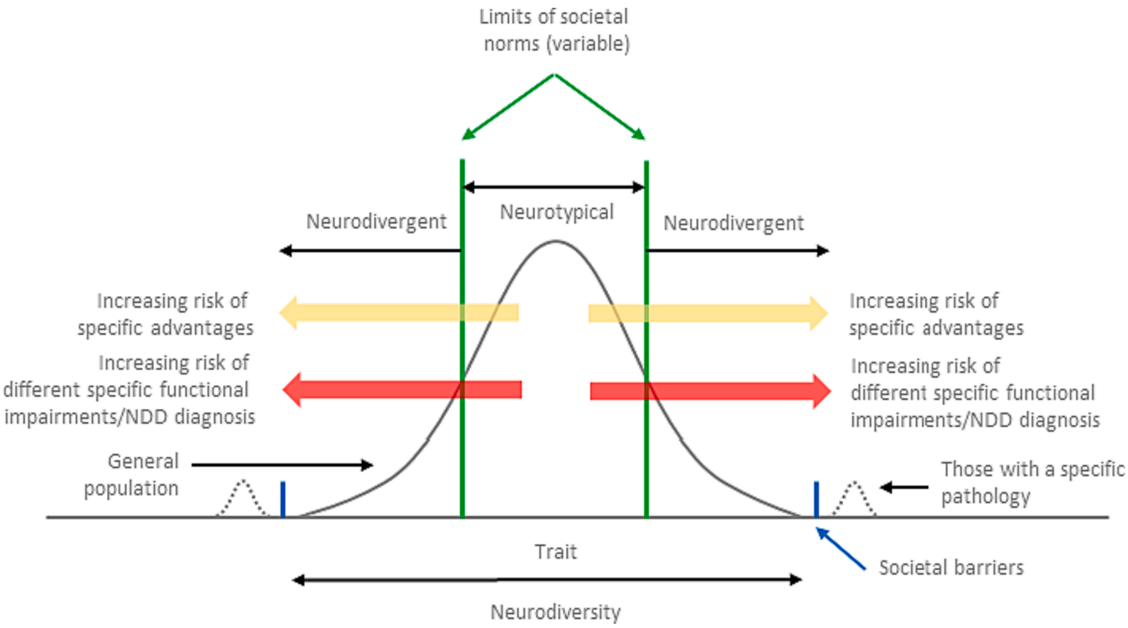

Fig. 1. Replica of Shah et al.'s (2022) model of neurodiversity. *Note.* Distributed under the terms of the Creative Commons Attribution licence (https://creativecommons.org/licenses/by/4.0/) in Shah et al. (2022). Societal barriers were added in blue.

understanding from others.

Given its low prevalence (Dance et al., 2022), society may not be attuned to the experiences of people with aphantasia, making societal barriers potentially high. Hillary (2020), for example, goes as far as to refer to 'cross-cultural communication' when people with and without aphantasia communicate together (see also Fox-Muraton, 2021). They provide several examples where people with mental imagery assume an absence of imagery equates to an absence of visual knowledge (which is almost never the case), and that simple tasks of thinking cannot be performed if imagery is not used. On the contrary, tasks historically associated with imagery (e.g., mental rotation) are easily performed by people with aphantasia relying on visual knowledge alone, and there are often no objective performance differences (e.g., Pounder et al., 2018). This is because people with aphantasia simply use alternative strategies to solve the same tasks without mental imagery, using their intact and sometimes superior abilities (e.g., in spatial processing; Keogh et al., 2021), which is also mirrored in different neural network activity (Logie et al., 2011). After all, this might also be one reason why there is no evidence to date for disadvantages for aphantasics in everyday life, for example at school or work (although this issue has not been extensively explored yet). Table 1 presents our own data showing correlations between vividness of visual imagery and school grades in different school subjects at different class levels. For this, we asked 115 participants (mean age = 22.93, $SD = 11.61$; 43.5% female, 53.9% male, 2.6% non-binary) to provide their current or past school certificates to assess associations between school performance and imagery ability. There is moderate ($BF_{01} > 3$) to strong ($BF_{01} > 5$) evidence for the null hypothesis that school performance in most subjects is not associated with visual imagery vividness. As suggested above, one reason may be the various different strategies for thinking, which might translate into multiple ways to learn (other than using imagery), as well as class-level or school-level factors (e.g., influence of teachers; school environment) which may conceivably overwrite any marginal influence of mental imagery (cf. Hattie, 2008).

However, there are three domains where neurocognitive differences for aphantasia are reliably found: in memory, emotional reactivity, and face recognition. But is this sufficient for a label of 'disorder'? For memory, the largest deficits are in autobiographical memory recall (Dawes et al., 2022; Milton et al., 2021; Zeman et al., 2020), while differences in everyday memory (Monzel et al., 2021; Monzel, Vetterlein, et al., 2022) and working memory (Pounder et al., 2022) are relatively small or non-existent. For lower emotional reactivity, there is some evidence of this in reading (i.e., reading frightful or empathy-triggering material; Monzel et al., 2023; Wicken et al., 2021) but not when watching similar material visually. This suggests no emotional deficit per se, but rather, that poor imagery limits 'emotional amplification' (see Holmes et al., 2008). However, these differences are far less impactful than, say, face recognition deficits in prosopagnosia (for face recognition data in aphantasics, see Dance et al., 2023; Monzel, Vetterlein, et al., 2023). As such, they may rise to the level of functional impairments only rarely.[3]

Given the discussion above, Monzel, Vetterlein, et al. (2022) suggest taking an individualized approach, by medicalising only on a case-by-case basis, for any aphantasic whose poor imagery means they suffer greatly, or where educational or healthcare support

[3] In this paragraph, we mainly discussed systematic differences reported in scientific literature. For a more individual approach to the internal experiences of aphantasics, we recommend Kendle (2017).

Table 1
Correlations between vividness of visual imagery and school grades in different subjects and grade levels in a general population sample ($N = 115$).

	3rd grade			5th grade			7th grade			9th grade			11th grade		
	r	*p*	BF_{01}	r	*p*	BF_{01}	r	*p*	BF_{01}	r	*p*	BF_{01}	r	*p*	BF_{01}
Religious Education	–0.196	0.106	2.88	0.084	0.450	8.69	0.092	0.428	8.10	0.127	0.412	6.08	–0.040	0.832	7.03
German	0.070	0.500	9.84	–0.145	0.168	4.73	–0.252	0.018	0.72	–0.062	0.651	8.54	–0.123	0.462	6.05
Foreign Languages	–0.177	0.249	4.40	–0.052	0.623	10.72	–0.094	0.387	8.14	0.061	0.719	7.33	–0.094	0.387	8.14
Mathematics	0.139	0.181	5.04	0.224	0.032	1.22	0.190	0.078	2.53	0.228	0.094	2.35	0.321	0.053	1.22
Natural Sciences	0.072	0.607	8.22	–0.047	0.665	10.71	0.073	0.506	9.43	0.069	0.617	8.35	0.211	0.217	3.62
Humanities	–0.086	0.658	6.32	–0.022	0.835	11.76	–0.098	0.368	7.90	–0.256	0.062	1.66	0.140	0.407	5.56
Music	0.046	0.716	9.68	–0.183	0.089	2.81	–0.001	0.996	10.10	–0.008	0.960	8.01	–0.037	0.889	5.39
Arts	0.084	0.478	8.51	0.213	0.047	1.66	–0.035	0.760	10.90	0.048	0.750	8.25	–0.122	0.569	5.43
Physical Education	–0.080	0.472	8.93	–0.168	0.110	3.41	–0.305	0.004	0.19	–0.076	0.583	8.07	–0.106	0.543	6.34

Note. Reported *p*-values are not corrected for multiple comparisons. After Bonferroni correction, not a single correlation is significant.

would be warranted. They further suggest that the very discovery of aphantasia itself (i.e., the realisation that one's internal world is dramatically different to others) might sometimes argue for the diagnosis of a temporary adjustment disorder (e.g., due to a sense of otherness). This would be in line with the model by Shah et al. (2022) who propose that only people on the neurodevelopmental spectrum *showing specific functional impairments* should be treated as having a neurodevelopmental disorder. Therefore, functional impairments themselves, either statistically associated with aphantasia or otherwise co-occurring but statistically unrelated, should be diagnosed *aside from* aphantasia (e.g., visual agnosia) rather than pathologizing aphantasia itself. This is especially important since many neurodivergent individuals fall under multiple categories of neurodivergence (e.g. Russell & Pavelka, 2013) and impairments might be attributable to the co-occurring conditions rather than to aphantasia itself (see: Associations between aphantasia and autism). Finally, although Shah et al.'s (2022) model suggests that neurodivergence does increase the risk for specific functional impairments, it also suggests it increases the risk for advantages. We saw above that people with aphantasia may be protected from sensory hypersensitivities, and we might also consider that it is protective to experience lower emotional distress when confronted with frightful passages or, potentially, memories (Monzel et al., 2023; Wicken et al., 2021). In both these ways, aphantasia may be somewhat protective against mental health conditions, and a similar argument has been made about mental health conditions directly linked to intrusive imagery (such as post-traumatic stress disorder; Dawes et al., 2020; Keogh et al., 2023).

Overall, from reviewing aphantasia in relation to the social model of disability, we first suggest that aphantasia is best understood within the framework of neurodivergence (following Shah et al., 2022) but second, that the traits of aphantasia are rarely problematic enough to diagnose a neurodevelopmental disorder, because they are in most cases not strong enough to encounter societal barriers. In other words, mental imagery deficits might seem extreme to people with intact mental imagery, but the societal barriers are low, life is affected very little, and there are few functional impairments in day-to-day life (see Fig. 2).

3. The medical model of disability

In contrast to the social model of disability, the medical model of disability focuses more on the biological differences between people with and without aphantasia. Previous research has indeed found a number of neurological differences between high imagers and low imagers. For example, Fulford et al. (2018) found that weaker imagers showed increased activation (compared to stronger imagers) across a more widespread set of brain regions during a task that required mental visualization. This included greater activation in early visual cortices. One model has explained this as greater cortical excitability in low imagers (which worsens the signal-to-noise ratio of the mental image; Keogh et al., 2020) while other models suggest *lower* cortical excitability (given its co-occurrence with dampened sensory sensitivity; Dance, Ward, et al., 2021). Fulford et al. (2018) also found that frontal activation was higher in high imagers relative to low imagers (see also Zeman et al., 2010, for acquired aphantasia). In addition, Logie et al. (2011) found differing brain activation between high and low imagers in premotor and motor areas during mental rotation, interpreting these different activations as evidence of different mental strategies. A study by Milton et al. (2020) revealed higher resting state connectivity between the visual occipital network and several prefrontal regions in people with hyperphantasia, relative to people with aphantasia, suggesting better working top-down processes during the generation of mental imagery (cf. Pearson, 2019).

In sum, people with aphantasia clearly show a number of functional neurological differences when compared to their peers. They might also, potentially, show genetic differences (see Zeman et al., 2015, 2020 for an early discussion). But are these biological differences in any way sufficient for us to conclude that aphantasia is a disorder? It would be extremely difficult to make this argument based on biology alone, simply because this would also pathologize all neurological group differences ever described in the neuroscience literature, that is, neurodiversity itself. In summary, although these biological differences exist, and might add to the picture of aphantasia as a form of neurodivergence, we suggest these alone are not indicative for a neurodevelopmental disorder.

4. The neurodiversity paradigm

Last, it should be made explicit that both models described above, that is, the medical model and social model of disability, see neurodivergence as deviation from a 'normal' brain, either solely biologically or in misalignment with societal norms, respectively. However, it can also be questioned whether something like a 'normal' brain really exists. This is done within the neurodiversity paradigm which sees the idea of a 'normal' brain as a "culturally constructed fiction, no more valid […] than the idea that there is one 'normal' or 'right' ethnicity, gender, or culture" (Walker, 2014, para. 19). From this perspective, aphantasia could never be described as a disorder, any more than any other form of neurodivergence that is an 'intrinsic and pervasive factor in an individual's psyche, personality, and fundamental way of relating to the world' (Walker, 2014, para. 29). That being said, this does not, however, imply that autism, ADHD or even aphantasia cannot be disabilities in certain situations. Instead, the neurodiversity movement has a key aim of reducing stigmatizing language as one of many accessibility criteria for neurodivergent individuals. For example, by speaking of autism, rather than Autism Spectrum Disorders (Monk et al., 2022).

5. Associations between aphantasia and autism

Since those who do not agree with the neurodiversity paradigm often describe autism as a disorder (e.g., Lord et al., 2018), we will now consider whether aphantasia might be considered a disorder simply by virtue of its potential comorbidity with autism-related traits. However, we note that from the perspective of the neurodiversity paradigm, associations with autism-related traits alone do not automatically justify a classification as a disorder, since autism would not be considered a disorder in and of itself.

People with autism experience a range of sensory and developmental differences, for example in attention (e.g., heightened

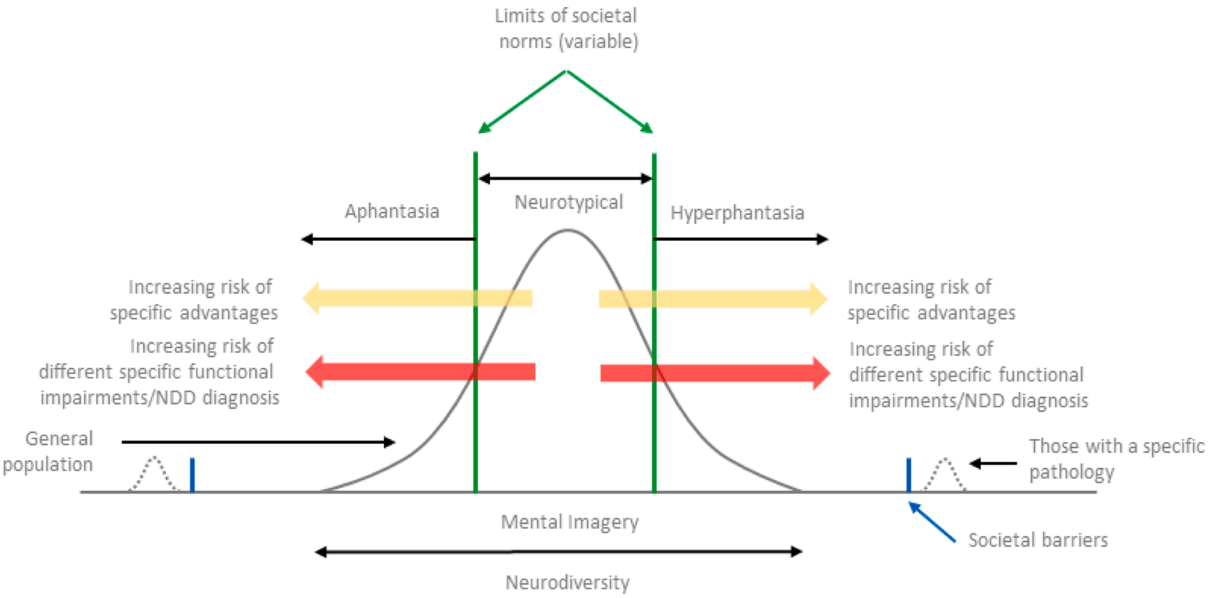

Fig. 2. Application of Shah et al.'s (2022) model of neurodiversity to mental imagery. *Note.* Distributed under the terms of the Creative Commons Attribution licence (https://creativecommons.org/licenses/by/4.0/) in Shah et al. (2022). Societal barriers were added in blue and are far more to the left and right than for other neurodivergent traits than mental imagery

attention-to-detail; Baron-Cohen et al., 2009), communication and social skills (e.g., Holt & Yuill, 2014; Hopkins et al., 2022), repetitive behaviour and interests (Zandt et al., 2007), and sensory sensitivities (over- or under-responding to incoming sensory stimuli; Robertson & Simmons, 2015). They also experience difficulties in imagination (American Psychiatric Association, 2013). Dance, Jaquiery, et al. (2021) showed for the first time that people with aphantasia have higher autism-related traits than people with typical imagery. They administered the *The Autism Spectrum Quotient* (AQ; Baron-Cohen et al., 2001), a questionnaire that elicits autism-related traits (e.g., "I frequently find that I don't know how to keep a conversation going"), and found that AQ scores were significantly higher in aphantasics versus imagers. Similar results were found by Milton et al. (2021). Dance, Jaquiery et al. (2021) also found that the aphantasia group was far more likely to contain individuals that surpassed the AQ threshold indicative of a likely autism diagnosis. However, Dance and colleagues further demonstrated that people with aphantasia were different to controls only in two of the five factors measured by the AQ, that is, scoring lower in social skills and imagination. They were no different than imagers in the remaining three scales of communication, attention-to-detail, and attention switching (Dance, Jaquiery, et al., 2021). Dance and colleagues also showed that people with aphantasia had lower sensory sensitivity relative to imagers (Dance, Ward, et al., 2021). Differences in sensory sensitivity also characterize autism (Bogdashina, 2003; Robertson & Simmons, 2015), although these are non-diagnostic autistic traits. On the other hand, the AQ difference in the social skills subscale had only a small effect size. And while the effect size for imagination was large, some portion of these questions were quasi-statements of aphantasia/visual recall (despite the authors' best efforts to avoid this confound). Taken together, these findings suggest that while aphantasia and autism might be linked by specific clusters of traits (i.e., poorer social skills and imagination, differences in sensory sensitivity), they do not share other broader autism-linked deficits (i.e., in communication, attention-to-detail and attention switching). As such, aphantasia does not represent a close companion to autism, and most people with aphantasia do *not* have autism. Hence, it is difficult to rely on a link between aphantasia and autism as a way to categorize the former as a disorder. Overall, however, a justification as a disorder based solely on a link to another condition would be difficult anyway.

6. Aphantasia and 'Werkzeugstörungen'

One final way to conceptualise aphantasia might be to consider a cluster of conditions described in German as 'Werkzeugstörungen'. This term is roughly translated as 'dysfunctions in the use of tools', and includes Dyslexia, Dyscalculia and Dyspraxia (all currently listed in the ICD-10 under the identifier 'R48: Dyslexia and other symbolic dysfunctions, not elsewhere classified'; World Health Organization, 2019). Clearly, any emphasis on 'dysfunction' does not fit within our general thesis above (suggesting aphantasia as a form of neutral neurodivergence, but not a disorder). However, the idea of imagery as a 'mental/cognitive tool' might provide an interesting avenue for future research, because it provides a way to view the impairment as targeted on the tool, not the person (nor any wider functions). Unlike aphantasia, the 'Werkzeugstörungen' of dyslexia, dyscalculia and dyspraxia can lead to major societal barriers, but this is because their tools (i.e., symbolic systems of digits, letters and words) cannot be impaired without significant societal difficulties. In contrast, we suggest that the tool of imagery can be impaired in and of itself, without any great or necessary impairment for the individual.

7. The dangers of mislabelling aphantasia

As reported in the previous sections, the functional impact of aphantasia is rather small. Despite this, many people with aphantasia report less confidence in their abilities, even where objective differences are not found (e.g. Wittmann & Şatırer, 2022). Often, they also report difficulties with some abilities which are thought to be related to mental imagery, such as art making (Monzel, Vetterlein, et al., 2022), although such difficulties are not necessarily given (MacKisack et al., 2022). How can we reconcile this mismatch between self-report and objective data? One suggestion might be that it is caused or magnified by the labelling of aphantasia as a deficit. We suggest that when people with aphantasia are asked how confident they are with their own performance in some tasks, they are at risk of giving lower confidence ratings than their objective performance would actually allow for, as a form of self-stigmatization (Corrigan & Wassel, 2008). For example, Fig. 3 presents data from a visual memory task (Monzel et al., n.d.), illustrating a confidence gap in aphantasia, which might also reflect the belief that they might be performing worse than their peers with imagery. The small objective impact of aphantasia is overestimated by aphantasics themselves, and might therefore have a considerable impact not only on how aphantasia is viewed by science, but also on the self-image of aphantasics. Labelling aphantasia as a 'mental illness' (e.g., Yang, 2022) is likely to enlarge this self-stigmatization and thereby magnify the confidence gap. On the other hand, framing aphantasia simply as a form of neutral neurodivergence might allow us to better consider both advantages and disadvantages. Importantly, using this approach, aphantasia is not defined as an inherent disorder. Instead, we can view aphantasia as a variance in mental experience, and examine or indeed celebrate its unique profile of traits.

8. Final thoughts

In this opinion piece we have made a case for aphantasia within a framework of neurodivergence. This framework promotes aphantasia for its uniqueness as a variance in mental experience and therefore as another beautiful proof for neurodiversity. Moreover, we found no evidence to justify a general conceptualization of aphantasia as a disorder. Instead, we suggest that aphantasia should always be evaluated individually and in the context of consequences and barriers for an individual in society. This approach inherently suggests that changes need not to come from the individual, but from societal barriers themselves. Overall, we advocate that the language used to describe a community should be helpful and appropriate, not only for scientists but for those experiencing it (for a

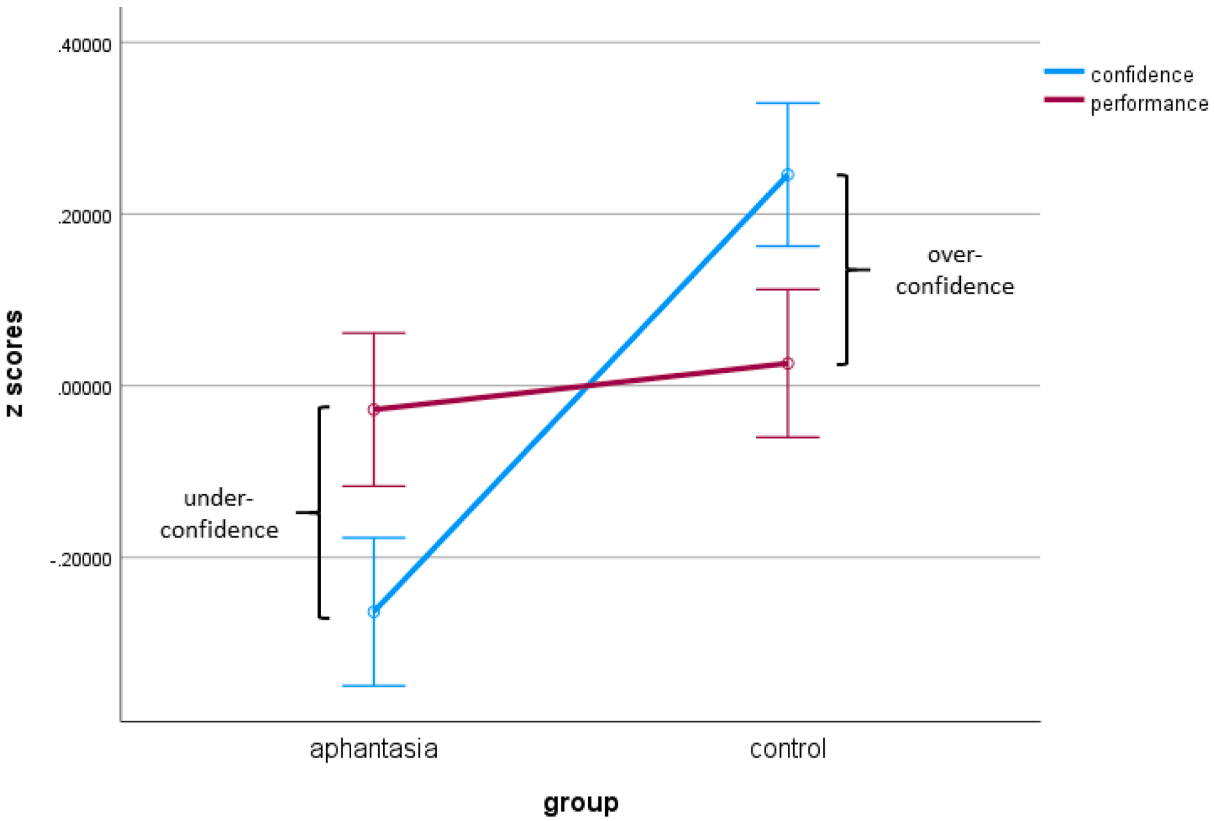

Fig. 3. Illustration of the confidence gap with the data of a visual recognition task (paradigm according to Schooler & Engstler-Schooler, 1990). *Note.* The interaction effect between group and performance/confidence was significant, $F(1, 259) = 9.45$, $p = .002$, $\eta^2 = .035$. Post-hoc tests revealed that aphantasics (n = 126) and controls (n = 135) differed in confidence ($p < .001$), but not in performance ($p = .665$). For analysis, all recognition conditions were collapsed.

personal account of a person affected, see Alyssa, 2017).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Aknowledgements

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