The impact of aphantasia on mental healthcare experiences

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Abstract

Approximately 4% of the population has aphantasia, which is defined as impoverished, or absent, sensory mental imagery. Previous research suggests that people with aphantasia (aphants) may have a higher prevalence of mental health conditions and neurodivergence compared to the general population, but aphantasia presents a special challenge for diagnosis and treatment. Many mental health conditions are currently characterized by imagery-related symptomology (such as sensory flashbacks in post-traumatic stress disorder or negative body image in eating disorders), and the dominant therapeutic treatments rely heavily on imagery techniques. Thus far, little is known about how this impacts mental healthcare experiences in individuals with aphantasia. In the current study, we will use a mixed-methods (questionnaire, interview) approach to comprehensively investigate the effects of aphantasia on seeking diagnoses and treatments for mental illness. We will use quantitative analyses on questionnaire data and thematic analysis on interview data to explore three hypotheses: psychiatric disorders will manifest with a lack of imagery-related symptomology in aphantasia compared to typical imagery controls; aphants will report "lack of awareness or understanding of aphantasia" as a common factor in missed- or misdiagnosis by mental health professionals; and aphants will be more likely to report that therapies involving mental imagery are ineffective in their mental health treatment compared to controls. This study will elucidate the immediate issues and experiences of individuals seeking mental healthcare with aphantasia, and lay the foundation for improvements to psychiatric evaluation, diagnosis, and treatment.

Keywords: mental health; mental imagery; aphantasia; cognitive behavioral therapy; registered report

Visual mental imagery is the ability to simulate visual sensory information in the "mind's eye". Individual differences in visual imagery vividness have been long known (Kosslyn et al., 1984; Marks, 1973; Pearson & Kosslyn, 2015; Reeder, 2017), but "imagery extremes" have only recently entered the scientific conversation (Zeman et al., 2020), sparked by popular media surrounding *aphantasia*: impoverished or absent visual mental imagery[1] (Zeman et al., 2015). Aphantasia has mainly gone under the scientific radar, although Faw (1997) discussed individual differences in mental imagery abilities, including "wakeful non-imagers", and Pylyshyn (1973) argued for decades that mental sensory representations can be conceptual. Nevertheless, with the advent of the term *aphantasia* came a new wave of public interest in the phenomenon (Zimmer, 2015). It is now thought that approximately 4% of the population has aphantasia (Dance et al., 2022).

Aphantasia is not a neuropsychological disorder, as people with aphantasia (referred to as *aphants*) use compensatory strategies to overcome mental imagery challenges; as a result, they may live fulfilling lives, most never knowing their internal representations of the world are different from anyone else's (Zeman et al., 2015). For example, many cognitive tasks that are thought to require mental imagery can just as effectively be performed without imagery, such as visuo-spatial working memory (Keogh et al., 2021), mental rotation (Pounder et al., 2021), and face recognition (Milton et al., 2020). It is thought that aphants gravitate toward more mathematical or scientific fields than artistic careers (Zeman et al., 2020), but there are many highly successful aphants in creative fields who can, for example, use technically unconventional strategies to produce visual art (MacKisack et al., 2020). About half of individuals with aphantasia may experience an absence of imagery in all sensory modalities, with a further 30% reporting an absence of imagery in at least one other modality (Zeman et al., 2020).

[1] There has been some recent debate concerning whether the definition of aphantasia should include all sensory modalities (see Monzel et al., 2022). We use the term aphantasia to denote a lack of *visual* imagery, specifically, but acknowledge that other sensory modalities are likely affected.

The most striking difference between aphants and people with imagery (called *imagers*) is in their self reports of their internal worlds. Recall of autobiographical memories and atemporal or future imagination are impoverished in aphantasia (Dawes et al., 2020; Milton et al., 2020). Specifically, aphants describe hypothetical atemporal and near-future scenarios in less detail, have a lower sense of presence in an imagined scene, and less salient imagination of scenes compared to imagers; aphants also recall fewer details and have less vivid memories of recent and remote autobiographical events. Some people (mistakenly) interpret a reduced ability to remember personal memories, such as a marriage or birth of a child, as "not caring as much", which can lead to negative feelings about having aphantasia and can negatively impact relationships (Zeman et al., 2020).

A critical problem that bears further scrutiny is the combination of aphantasia and mental health challenges. Individuals struggling with their mental health require prompt diagnosis and empathetic early intervention to achieve the best outcome (Arikian & Gorman, 2001), but both of these needs present potential difficulties due to differences between aphants and imagers. Unhelpful or destructive mental imagery is considered a core symptom of various psychiatric disorders, such as Obsessive Compulsive Disorder (OCD; Moritz, Claussen, et al., 2014), Post-Traumatic Stress Disorder (PTSD) and other anxiety disorders (Hirsch & Holmes, 2007), eating and body dysmorphic disorders (Kadriu et al., 2019), depression (Moritz, Hörmann, et al., 2014; Weßlau et al., 2015), schizophrenia (Benson & Park, 2013; Brébion et al., 2008; Ji et al., 2019; Maróthi & Kéri, 2018), and bipolar disorder (Di Simplicio et al., 2016), among many others. In addition to the overt mental imagery present in those conditions, a lack of mental imagery is a symptom of both dementia (Ji et al., 2019) and prosopagnosia (Grüter et al., 2009). Having aphantasia may increase the potential for misdiagnosis, as many medical and clinical professionals remain unaware of aphantasia as part of the spectrum of imagery within a healthy population. For example, professionals unaware of aphantasia may find it challenging to diagnose conditions such as OCD or PTSD due to a reported absence of intrusive imagery, or they may misdiagnose conditions such as dementia, for which the absence of imagery is a symptom.

Already, the connection between PTSD and intrusive mental imagery has led some scientists to speculate that aphants may be less prone to develop PTSD following a traumatic event (Pearson et al., 2015; Wicken et al., 2021). While aphants may present similar symptoms to a typical imagery control group in the diagnostic profile of PTSD (Dawes et al., 2020), closer scrutiny reveals that there is a difference in intrusive imagery and mood/cognition, with strong evidence that aphants report more negative mood and cognition, and less intrusive imagery, compared to controls. Reduced intrusive images for aphants compared to controls from simulated traumatic scenarios has also been found in a recent empirical study (Keogh et al., 2023). This lack of intrusive imagery – a key defining feature of PTSD (DSM-V) as opposed to mood disorders and depression (DSM-V) – may lead referring practitioners, such as General Practitioners, to refer for an assessment of depression rather than PTSD, potentially delaying diagnosis or increasing the risk of missed or misdiagnosis. It is therefore likely that aphants can suffer from any disorder that a person with imagery can, but may lack imagery-related symptoms; in fact, recent studies have proposed that neurodivergences may be *more* prevalent in aphantasia than in the general population (Dance et al., 2021; Milton et al., 2020). However, no solution has been proposed to mental health professionals in diagnosing and treating aphants with mental health conditions.

The challenge of diagnosis is further compounded by the treatment protocols for these mental health conditions. The most common psychotherapeutic intervention as recommended by a large evidence base (Pilling et al., 2011), is Cognitive Behavioral Therapy (CBT). CBT is a short-term therapeutic intervention that is designed to catalogue and challenge negative thoughts and behaviors and encourage positive experiences and patterns, primarily delivered through a semi-structured program detailed in manuals for practitioners (Becker et al., 2013).

While CBT claims to be a functional approach, and should have no overt connection to imagery, an examination of the manuals reveals a recurring reliance on imagery-based approaches (Hofmann et al., 2012). One exercise involves practicing how to respond appropriately to different

situations, and requires “imagin[ing] a scene as if it were a photograph”, followed by “imagin[ing] the action starting as if it were a movie” (p. 60, Munoz & Miranda, 2000). The techniques around making fun of problematic thoughts are often centered around visual imagery, for example, imagining anger as smoke coming out of someone’s ears or visualizing situations whereby the negative thoughts are personified and ridiculed (Munoz & Miranda, 2000).

When examining negative thoughts and exposure scenarios for anxiety, practitioners are encouraged to elicit scripts with detailed visual imagery (Simos & Hofmann, 2013). More recent literature on CBT includes recommendations for increasing the use of visualization techniques for pain management (Kutsuzawa et al., 2022). Visualization techniques are particularly noted in CBT approaches for children and young people (Stallard, 2020). Taken together, it is clear that mental imagery techniques, especially those involving visual imagery, are pervasive within CBT.

While CBT is the recommended course of treatment for most mental health conditions (Pilling et al., 2011), other talking-based therapeutic approaches, including counselling and psychotherapy, are prevalent among mental health professionals for treating a variety of conditions (Barkowski et al., 2020; van Bronswijk et al., 2019). Among other forms of psychotherapy and psychoanalysis, visual imagery remains a popular technique, and is considered powerful and effective among clinicians (Curtis, 2016; Pile et al., 2021; Skottnik & Linden, 2019). As such, some individuals select therapeutic approaches that may not have their roots in CBT but which also incorporate elements of visual imagery (such as positive imagery; Holmes et al., 2006). This collectively suggests that any therapy an individual selects for their mental health will likely involve visual imagery to some extent, and it is important to investigate how this impacts treatment effectiveness for individuals with aphantasia. It is also important to note that individual differences in mental imagery vividness, generally, have not yet been documented as a factor in treatment outcomes, despite early suggestions of its potential role in the success of imagery-based therapies (Crits-Christoph & Singer, 1981). In the current study, we will

recruit individuals with aphantasia, as well as those with abilities across the mental imagery spectrum, to investigate the role of mental imagery in mental health treatment.

There is already evidence that aphants and imagers experience mental health conditions differently; for example, aphants experience symptoms of PTSD with greater emphasis on mood and cognition, with fewer intrusive experiences (Dawes et al., 2020). However, thus far, there has been no scientific investigation of how different psychiatric disorders manifest in aphants. Importantly, widespread ignorance of aphantasia among medical and clinical professionals likely leads to missed and mis-diagnoses. Even if aphants with a mental health condition receive a correct diagnosis, the dominant therapeutic interventions used to treat these disorders are likely ineffective, or even harmful, for them. Combined errors in diagnosis and treatment may compound the problem, due to the intersectionality of these two factors. Misdiagnosis, followed by ineffective or harmful treatment, can lead to worse mental health outcomes, such as a reduction in self efficacy left by feelings of being "abnormal" or "untreatable". These factors may also contribute to a delay in diagnosis or early termination of treatment.

We propose a mixed methods, questionnaire- and interview-based study to investigate three currently speculative hypotheses:

1. Psychiatric disorders will manifest with a lack of imagery-related symptomology in aphantasia (e.g., sensory flashbacks in PTSD; intrusive imagery in body dysmorphic disorder) compared to a typical imagery control group;

2. Aphants will report a perceived "lack of awareness or understanding of aphantasia" as a common factor in mis-assessment, missed diagnosis, or misdiagnosis by mental health professionals[2];

[2] Professionals' perceived level of understanding of aphantasia, and how it influences their healthcare practices, is beyond the scope of the current study, but will be an important investigation for future studies.

3. Aphants will be more likely to report that imagery-related psychotherapies (specifically CBT) are ineffective in their mental health treatment compared to a typical imagery control group.

Questionnaires and follow-up interviews will be used to address each of these three hypotheses. The end goal of this research is to gain an understanding of the outstanding issues related to the impact of aphantasia on the quality and effectiveness of mental healthcare.

Methods

All materials, code, and anonymized quantitative data will be made publicly available on the Open Science Framework (OSF; https://osf.io/uamcp/). Anonymized interview transcripts will be made publicly available provided explicit consent is given by the interviewee. Stage 1 materials will be made available on OSF no later than at Stage 1 acceptance, along with the Stage 1 preprint on *PsyArXiv*. Stage 2 data and code will be made available no later than at Stage 2 acceptance, along with the Stage 2 preprint on *PsyArXiv*.

Recruitment

In collaboration with the Aphantasia Network, we will disseminate the details of this study to over 16,000 aphants in their newsletter. We will also disseminate the study to over 92,000 subscribers on *r/aphantasia* on the forum website, Reddit, and to readers of *The Conversation* (where the senior author previously collected responses from approximately 2500 aphants and 5000 imagers). According to a sample size calculation (see *Sample size justification*), we aim to recruit 4248 aphants to fill out the questionnaire, to ensure at least 7-8 interviews per target group. To obtain the largest sample and because one of our hypotheses pertains to potential misdiagnosis, we will recruit both

individuals who suspect they may have a disorder (but are currently undiagnosed) and those who are clinically diagnosed with a mental health condition.

We will distribute the Plymouth Sensory Imagery Questionnaire (PSI-Q; Andrade et al., 2014) to measure self-assessed imagery vividness in seven modalities: visual, auditory, tactile, olfactory, gustatory, bodily sensations, and emotional imagery. This will be delivered along with a brief mental healthcare questionnaire (see *Supplementary Materials: Appendix A*) on the Aphantasia Network, *r/aphantasia*, and via a popular media article (in *The Conversation*) to achieve our target sample size. For individuals who are hesitant to document their mental healthcare experiences in a questionnaire, they will have the option to e-mail the researchers directly if they believe they meet inclusion criteria and are open to an interview. If we are still unable to recruit 8 aphants who can comment on the efficacy of CBT using these methods (see *Stopping rule*), we will further recruit participants through providers of CBT-based mental health support.

The PSI-Q will be used to identify different mental imagery abilities, particularly aphantasia. The mental healthcare questionnaire will be analyzed quantitatively, in addition to being used as a tool to recruit participants into three interview groups:

1. aphants experiencing mental health symptoms that impact their quality of life who have either not been diagnosed or feel they have been misdiagnosed, due to a perceived lack of understanding of aphantasia by mental health professionals (target N=7, see *Sample size justification* below)

2. aphants who have been clinically evaluated and diagnosed with a mental health condition, but believe they have received ineffective treatment, potentially due to having aphantasia (target N=7)

3. aphants who have been clinically evaluated and diagnosed with a mental health condition, and believe they have received effective treatment (target N=7)

Of the final two groups (*N*=14), we will require 8 to have tried CBT, regardless of the distribution (i.e., whether they believe CBT worked for them or not). Ideally, we would like 4 from each group, but do not want to exclude the possibility that CBT may work better than expected (and therefore receive more CBT participants from group 3), or not at all (and therefore receive all CBT participants from group 2). For this, an information power approach (Malterud et al., 2016, also see *Sample size justification)* will be appropriate in determining the number of participants needed. See *Supplementary Materials: Appendix B* for details of the interview questions tailored for each group.

Exclusion and inclusion criteria

Individuals across the mental imagery spectrum will be included in the questionnaire, so that we may compare aphants to a typical imagery control group during quantitative analysis. The questionnaire will also be used as a screening tool for inclusion in the interview, since we will only interview aphants. Q1 requires participants to indicate whether they have aphantasia or not. If participants respond positively to Q1, we will check this against their responses on the visual section of the PSI-Q (a 0-10 rating of mental imagery vividness for five visualized items). The average rating across the five items must be <4 (consistent with previous research: Königsmark et al., 2021; Reeder, 2022) for inclusion in the aphantasia group. Any individual who reports having aphantasia with a score >3, or who reports not having aphantasia with a score <4, will have their data excluded from analysis, due to inconsistency in responses.

To avoid potentially activating memories of trauma, we will not ask participants whether their aphantasia is acquired or congenital. We acknowledge that there is a distinction between the two: congenital aphantasia is the lifelong absence of mental imagery (Zeman et al., 2015), and acquired aphantasia is the loss of mental imagery due to neurological or psychological trauma (Zeman et al., 2010). We do not deem this distinction relevant to the current study, and will include participants as long as they believe they were experiencing aphantasia at the time they sought mental healthcare.

As an additional measure, we will analyze the data separately for individuals who do and do not provide their email address to be contacted for interview (based on the assumption that participants interested in an interview will be less likely to fabricate having aphantasia). If there is strong evidence for a difference in questionnaire responses based on this data-splitting procedure, we will present the results of these data separately, but not exclude data based on this difference.

Imagers who respond on the questionnaire (respond negatively to Q1 and rate their average visual imagery vividness as >3 on the PSI-Q) will be excluded from taking part in the interview, but we will use their quantitative data from the questionnaire, as they can serve as a control group for aphants. Individuals who respond negatively on Q1 but indicate that their visual imagery vividness is <4 on the PSI-Q will be excluded from analysis due to inconsistency in responses.

We will exclude participants from analysis based on further inconsistent questionnaire responses: for example, if they answer "Yes" to both a. (I have never been diagnosed with a mental health condition) and c. (I now have a diagnosis, and did not have trouble receiving a diagnosis) of Q5. This will exclude participants who do not read the questions carefully or do not comprehend the questions.

We have exceptionally narrow inclusion criteria for our three interview groups, to ensure we can collect the relevant data. At the beginning of the interview, we will make sure that all participants have aphantasia by asking them a few questions about their mental imagery experience compared to the wider imagery spectrum (~5-minutes; see *Supplementary Materials: Appendix B*). This assessment can also be used to further categorize individuals into "complete aphantasia" (no mind's eye) or "hypophantasia" (dim or vague mind's eye). Should it be revealed that the participant does not have aphantasia or hypophantasia, they will be thanked for their time and the interview will be terminated.

If participants pass the aphantasia check, their responses on the questionnaire that led to interview group inclusion will then be verbally confirmed prior to interview. That is, to be considered for interview group 1, participants must respond that they have had trouble receiving a diagnosis (Q5)

and believe it is related to their aphantasia (a or b on Q6), or respond that they believe they have been mis-evaluated or mis-diagnosed (Q11). To be considered for group 2, participants must respond that they have been evaluated for a mental health condition (Q4) but believe they have received ineffective treatment for it (Q14). To be considered for group 3, participants must respond that they have been evaluated for a mental health condition (Q4) and have received adequate treatment for it (Q13), which included some form of therapy (Q17, Q18, Q21). Those who answer positively on Q21 (related to CBT) will receive priority for interview. If this check reveals inconsistencies in questionnaire responses, we will clarify these with participants prior to interview. If a participant no longer meets inclusion criteria following clarification of responses, the participant will be thanked for their time and the interview will be terminated.

Sample size justification

In a previous study, 24% of aphants (64/267) reported a history of mental illness (Dawes et al., 2020). According to the UK Adult Psychiatric Morbidity Survey 2014 (McManus et al., 2016, p.86), 39% of adults with a mental health condition ultimately seek treatment[3]; 6% of those use CBT. Using these estimates, we calculated our sample size as follows:

The required sample size to find the prevalence of X in a population (Duncan & Humphry, n.d.) can be calculated using the following formula:

$$n = \left(1 - (1-p)^{\frac{1}{NP}}\right) \text{x} \left(N - \frac{NP-1}{2}\right)$$

where P is the expected prevalence in the population, N is the population size (estimated as number of aphants on *Reddit*, the *Aphantasia Network*, and *The Conversation* readership = approximately

[3] These estimates are even higher in the US (Substance Abuse and Mental Health Services Administration, 2020, p.5). We predict the majority of our sample will come from the US and UK as in previous large-scale questionnaire studies of mental imagery (Reeder, 2022), but we chose to use the smaller number in our calculations for a more conservative estimate.

100,000[4]), and p is the confidence level (95%). To obtain 14 responses from individuals who have been evaluated for, or diagnosed with, a mental health condition (24% x 39% = 9.36%), this would require a minimum sample size of 31 (chance of detecting 1 or more) x 14 = 434. To ensure 8 participants have tried CBT (9.36% x 6% = .5616%), this would require a minimum sample size of 531 (chance of detecting 1 or more) x 8 = 4248. Therefore, we estimate that we will require 4248 aphant respondents on our survey to achieve our target sample size for the interviews.

For interviewing, we determined target sample sizes based on a quantitative power analysis, an information power model specific to qualitative interview studies, and "rules of thumb" from previous literature. First, as an initial quantitative measure, we calculated the sample size required to find a difference between general population efficacy of CBT (approximately 50% across a variety of mental health disorders; Hofmann et al., 2012) and the hypothesized efficacy of CBT among aphants (0-10%). For this, we conducted a power analysis using the online calculator ClinCalc (https://clincalc.com/stats/samplesize.aspx), with a dichotomous primary endpoint (CBT was effective: Yes or No), power set at 90%, beta at 0.1, and alpha at 0.05. The result of this test suggests a sample size of 4-12 is required. It should be noted that quantitative approaches are not ideal for qualitative sample size justification, but are worth considering in combination with the other two approaches described below.

Next, we calculated the required sample size based on an information power model (Malterud et al., 2016). Information power models take into account 5 dimensions that may contribute to a decrease or increase in estimated required sample size for qualitative interview studies: aim (narrow, broad), specificity (dense, sparse), theory (applied, none), dialogue (strong, weak), and analysis (case, cross-case). A narrow, dense, applied, strong case study will require the fewest participants (*N*=1 in the optimal scenario).

[4] The calculated sample size from this equation does not depend directly on population size, and the minimum sample size requirement does not change over a population size of 1000.

The current study has a narrow aim (the phenomenon being measured is therapy efficacy in aphants with mental health conditions); dense specificity (the participants in our study are targeted for their specific experiences and characteristics); applied theory (we use an evidence-based theory from aphantasia research and general population studies of CBT to motivate our predictions); moderate-strength dialogue (one author has a background in interviewing people with aphantasia, and two have a background in mental health); and a cross-case analysis (we wish to include individuals with different mental healthcare experiences for a variety of disorders). Based on these factors, we estimate that a sample size of 6-10 should provide sufficient information power for descriptions of different mental healthcare experiences, although the precise number will be updated continuously throughout the process of data collection.

Finally, according to rules of thumb, we can estimate an appropriate sample size based on various factors. First, we will take individual participant interviews to understand individuals' lived experiences using an interpretative approach: thematic analysis (TA). According to a recent systematic review of 200 qualitative studies (Bartholomew et al., 2021), sample sizes can be extremely diverse across studies (*N*=1-308), but "higher quality" studies require lower sample sizes around or below the average sample size for the particular type of study. For interpretative studies (like ours), the average sample size was 11.61, with a minimum sample size of 5. Pre-identifying the data collection and analysis method significantly predicted higher quality. Furthermore, individual participant interviews were found to contribute the highest quality data compared to other data collection methods, such as focus groups. Finally, our chosen research methodology is congruent with our research questions, our philosophical perspective, our proposed representation and analysis of data, and the proposed methods used to collect the data – all factors that contribute to high quality data. These factors indicate that we should glean sufficient power for our study with 5-12 interviews.

The triangulation of these three methods suggests a minimum sample of 4-6, although information power suggests updating these numbers throughout the data collection process. We

therefore estimate that we will need to recruit at least 7 participants for each interview group (with 8 in the CBT sub-group) to ensure sufficient power in our analyses, although these numbers may change as we gather data. The estimated maximum sample is between 10-12. To allow for flexibility, we therefore leave open the possibility of doubling our estimated number of participants (to 42) if necessary.

Stopping rule

We will stop recruitment for the questionnaire once we have reached our target sample size for each interview group. During TA, we may need to recruit additional participants, and broadly estimate up to 42 total participants (double the estimated required sample size for each group, to allow for flexibility in the TA). If we do not reach our target interview sample after six months of active recruitment, we will seek to recruit participants via providers of CBT-based mental health support who can screen clients for aphantasia or aphantasia symptomology. Participants recruited in this way will be qualified for inclusion using the methods described above. When individuals discover they have aphantasia, there is a risk of confusion and misunderstanding about the condition; participants who did not know they had aphantasia prior to study recruitment will therefore be signposted to resources on the Aphantasia Network.

Only participants that pass both the aphantasia check and the group inclusion check (see *Exclusion and inclusion criteria*) will continue with the interview. We will continue to recruit participants for the interview until the target sample per group has been reached. We will send out interview requests to the first 7 who meet each group's inclusion criteria. If participants do not schedule their interview within two weeks, or if participants are excluded during interview for the above-stated reasons, we will work our way down the list of participants who meet the inclusion criteria until our target sample is reached.

351

352 *Procedure*

353 Prior to the survey, participants will read a Participant Information Sheet, providing details of the
354 research and open data policy, and contact information of the researchers, ethics board, and external
355 help lines. They will then provide written, informed consent to participate in the survey. If participants
356 opt to e-mail the researchers directly for interview, the researchers will send these forms via e-mail
357 before the scheduled meeting date. Participants will then optionally enter demographic data (age,
358 gender, country of residence, country where mental health services were sought, English language
359 level, level of education, socioeconomic status, ethnic background). The PSI-Q will precede the mental
360 healthcare survey, and will take approximately 5 minutes to complete. Participants will provide a 0-
361 10 rating of the vividness of seven modalities of imagery (visual, auditory, gustatory, olfactory, tactile,
362 bodily sensations, emotional), with five items per modality, for a total of 35 ratings. The mental
363 healthcare survey will take approximately 10 minutes to fill out and consists of 23 questions regarding
364 mental healthcare experiences (evaluation, diagnosis, and treatment; see *Supplementary Materials:*
365 *Appendix A*). The survey will end with a debrief form and contact information to request withdrawal
366 of personal information (email) within two weeks of completing the survey.

367 Prior to the interview, participants will receive an interview-specific Participant Information
368 Sheet and consent form. Additionally, if they are being interviewed about their CBT experience, they
369 will receive a short schematic of the most commonly used CBT tools (see *Supplementary Materials:*
370 *Appendix C*) and to indicate those they have experience with, which will help steer the interview
371 questions concerning CBT. Here, they will also be asked whether they would like to opt-in to have
372 their anonymized interview transcript made available in a public repository. Understanding of the
373 study, ethical information, and consent will be reconfirmed during the interview.

374 Interviews will take place online via Microsoft Teams (Microsoft, 2018) meeting, and
375 participants will be asked to turn off their video prior to audio recording. Audio of interviews will be

auto-transcribed via Otter (Otter.ai, 2016) speech-to-text, to assist with initial transcription. Interviews will last approximately one hour but may be longer or shorter depending on the amount of information the participant is willing to share. Interviewers will first reconfirm consent verbally, and then proceed to verbal validation of the participant's imagery classification and interview group membership lasting approximately 10 minutes. This will be followed by the core interview questions (approximately 50 minutes; see *Supplementary Materials: Appendix B*). All participants who pass the initial checks will receive £12 (1.5 hours of participation) via PayPal in the currency of their country. Participants will be informed that the interview may take around 1 hour, but they may take as much or as little time as they are comfortable with. Following the interview, participants will be sent copies of the debrief form and contact information to request withdrawal of their data within two weeks.

Planned analyses

Quantitative

For the quantitative survey, we will first pre-process the data for exclusions (see *Exclusion and inclusion criteria*), then calculate descriptive statistics on demographic data and questionnaire responses. Data analysis will be performed in JASP, where applicable (JASP Team & others, 2019), and supplemented with Python, if necessary (Scipy; Virtanen et al., 2020). Contingency Tables tests and Multinomial tests will be performed on count data. We will calculate Bayes Factors where applicable, to evaluate the strength of evidence for the different hypotheses. To increase power, we will include data both from individuals who have been diagnosed with a disorder, and those who have sought mental health evaluation for a disorder but have not been diagnosed. We will also include data from individuals with complete aphantasia and hypophantasia (dim or vague imagery). We will additionally conduct analyses on these groups separately (complete aphantasia = 0/10 and hypophantasia = an average of 1-3/10 on the PSI-Q visual scale) if there are at least 5 individuals in each cell for Contingency Tables tests. For analyses that include a typical imagery control group, this group will be

401 defined as individuals who respond negatively to Q1 on the mental healthcare questionnaire, *and*
402 score an average >3 on the PSI-Q visual scale.

403 *Hypothesis 1*

404 To address Hypothesis 1 (Psychiatric disorders will manifest with a lack of imagery-related
405 symptomology in aphantasia), we will first present descriptive statistics for answers to Q7 (I have had
406 intrusive sensory experiences (for example: flashbacks, unpleasant imagery, hallucinations) because
407 of my mental health condition Yes/No) and Q8 (If you answered yes to the last question, what kind of
408 experience affected you? Visual, Auditory, Tactile, Body, Emotional, Other: Significantly—
409 Somewhat—A little bit—Not at all). These will be split by answers to Q20 (The mental health
410 condition(s) I have/may have) where possible. If there are at least 5 individuals who have answered
411 "Yes" to Q7, we will perform the analyses detailed below. If we do not find at least 5 individuals out
412 of our sample who report intrusive sensory experiences, further analyses will be unnecessary.

413 To determine whether there are differences in the lifetime prevalence of intrusive images in
414 aphantasia versus a typical imagery control group, we will conduct 2 (aphantasia, imagery) x 2 (yes,
415 no) Bayesian Contingency Tables tests. In a meta-analysis by Brewin et al. (2010), the authors reported
416 lifetime prevalence of intrusive images across various anxiety disorders, depression, PTSD, eating and
417 body perception disorders, and psychotic disorders. In anxiety neurosis and panic disorders, there are
418 much higher reports of intrusive imagery when anxious or during panic (90-100%) compared to "any
419 time in the last three weeks" (32-37%; Brewin et al., 2010), suggesting that intrusive images are tied
420 to illness-related episodes. We therefore predict the most extreme differences by comparing
421 aphantasia and control responses concerning lifetime prevalence. We will conduct analyses within
422 specific disorders (e.g., PTSD) and classes of disorders (e.g., anxiety and panic disorders) where
423 possible.

424 To determine if there are differences in the prevalence of visual versus other imagery
425 experiences within our aphantasia versus control sample, we will split answers to Q8 into visual,

auditory, tactile, body, emotional, and other groups; and split responses into "Yes" (Significantly, Somewhat, A little bit) and "No" (Not at all) for 2 (aphantasia, imagery) x 2 (yes, no) Bayesian Contingency Tables tests. If there are at least 5 responses per cell, we will also perform a series of 2 x 4 ("Significantly", "Somewhat", "A little bit", "Not at all") Bayesian Contingency Tables tests. Within the aphantasia group, we will perform tests with responses split into visual versus "other sensory" (auditory, tactile, body, other), and sensory (visual, auditory, tactile, body, other) versus non-sensory (emotional) imagery. These tests will address how aphants' experience of their mental health condition is affected by visual, other sensory, and non-sensory imagery, and which form of intrusive imagery is most prevalent. Finally, we will perform the same tests in the control group, then enter these results as our expected counts in Bayesian Multinomial tests comparing the aphantasia group to the control group. This will tell us whether aphants' experience of their mental health condition is affected differently by imagery intrusions compared to imagers.

To determine if there are differences in the prevalence of any imagery-related symptomology in different disorders between the aphantasia and control sample, we will conduct Bayesian Contingency Tables tests on answers to Q7 (I have had intrusive experiences because of my mental health condition), in a 2 (aphantasia, imagery) x 2 (yes, no) test for each disorder, separately. Disorders must have at least 5 responses in each cell (yes, no) to be tested. We will then perform a 2 (answer to Q7: yes, no) x *N* (Disorder: yes, no) Bayesian Contingency Tables test within the aphantasia group, to determine whether imagery symptoms are more prevalent in certain disorders. We will perform a final Bayesian Multinomial test with responses from the control group input as expected values, to determine whether imagery-related symptomology occurs differently across disorders in aphants compared to typical imagery controls.

Hypothesis 2

To address Hypothesis 2 (Aphants will report a perceived "lack of awareness or understanding of aphantasia" as a common factor in mis-evaluation, missed diagnosis, or misdiagnosis by mental health

professionals), we will first present descriptive statistics from the aphantasia sample for answers to Q6 (Do you think that aphantasia prevented you from being diagnosed in any way?: a. I believe my aphantasia impacted my diagnosis; b. I did not know I had aphantasia at the time, but looking back I believe it may have impacted the diagnosis; c. my issues were unrelated to aphantasia, or I do not have aphantasia), Q9. (Do you believe you were properly diagnosed?), Q10. (If you answered "Yes" to the last question, do you believe you received a diagnosis you agree with because: a) my mental healthcare professional was aware of, and understood, aphantasia; b) my mental health care professional did not understand aphantasia but was able to diagnose me because of other symptoms; c) my condition is unrelated to aphantasia, or I do not have aphantasia), Q11. (Do you believe you have been mis-evaluated and/or mis-diagnosed?), and Q12. (If you answered "Yes" to the last question, do you believed your mis-evaluation/misdiagnosis was: a) because the person assessing me did not understand my aphantasia; b) unrelated to aphantasia, or I do not have aphantasia).

We will then perform a series of Bayesian Contingency Tables tests within our aphantasia sample, collapsed across disorders, provided there are at least 5 data points per cell. As a reference, misdiagnosis is, generally, extremely common among anxiety and mood disorders: from 65.9 – 97.8%; and missed diagnoses range from approximately 50 – 99%, depending on the condition (Vermani et al., 2011). We will expect roughly these ratios among our aphantasia sample, as well, but we will perform an additional Bayesian Multinomial test using results from our typical imagery control sample as expected values to check whether the rate of missed and mis-diagnoses are similar. The analyses detailed below will target proportions of accurate, missed, and mis-diagnoses thought to be related or unrelated to aphantasia.

To determine whether there is a different proportion of missed- or mis-diagnoses related to aphantasia compared to accurate diagnoses, we will first perform a 2 (accurately diagnosed, missed/misdiagnosed) x 2 (related to aphantasia, unrelated to aphantasia) test within our aphantasia sample. To determine whether missed or misdiagnoses are differently thought to be due to

misunderstandings about aphantasia, we will conduct a 2 (missed, misdiagnosed) x 2 (due to aphantasia, not due to aphantasia) test. To find out whether accurate, missed or misdiagnoses related to aphantasia are more prevalent in certain disorders, we will then perform three Bayesian Contingency Tables tests (one each for accurate, missed, and mis-diagnoses) with each disorder (with at least 5 values per cell) as a separate group, split by whether individuals believed their diagnosis was related to aphantasia or not (i.e., three *N* x 2 tests). If there are differences between disorders, we will conduct post-hoc comparisons between pairs of disorders. Because these tests require individuals to have aphantasia, we cannot compare the results of these tests to a control sample.

Hypothesis 3

To address Hypothesis 3 (Aphants will report that imagery-related therapies (specifically CBT) are ineffective in their mental health treatment), we will first present descriptive statistics for answers to Q17 (I only tried therapy and it a. helped, b. didn't help), Q18 (I tried a combination of prescribed medication and therapy, and they a. helped in combination, b. only medication helped, c. only therapy helped, d. nothing helped), Q19 (The type of therapy I tried included visual imagery exercises), Q20 (The type of therapy I tried included other types of mental imagery), and Q21 (The type of therapy I tried was cognitive behavioral therapy – CBT). The responses on Q19-21 will be split by whether participants reported therapy was effective or not, either in combination with pharmaceutical intervention or on its own, where applicable. These descriptive statistics will be reported for the aphantasia and typical imagery control group, separately.

To determine whether there is a difference in effectiveness between therapy that included imagery techniques versus non-imagery techniques among our aphantasia group, we will conduct four Bayesian Contingency Tables tests, collapsed across all mental health conditions, provided there are at least 5 data points per cell: a 2 (imagery-based, not imagery-based) x 2 (effective, ineffective) test for a general effect of imagery-based therapies; a 2 (CBT, other psychotherapy) x 2 (effective, ineffective) test for CBT effectiveness versus other forms of therapy; a 2 (visual imagery-based, other

imagery-based) x 2 (effective, ineffective) test to find out whether therapies that use other modalities of imagery (e.g., auditory, tactile, body, emotional) are more effective than visual imagery therapies; and a 2 (CBT with imagery, CBT without imagery) x 2 (effective, ineffective) test to determine whether CBT is judged more effective if imagery techniques were not used. Finally, we will perform the same tests in the control group, then enter these results as our expected counts in Bayesian Multinomial tests comparing the aphantasia group to the control group. This will tell us whether there is a difference in imagery versus non-imagery-based therapy effectiveness between aphants and imagers.

Based on our prevalence calculations, it is unlikely that we will be able to carry out Contingency Tables tests for conditions that look at the effectiveness of CBT (e.g., CBT with imagery versus CBT without imagery). For these cases, we will be able to address Hypothesis 3 with our thematic analysis, described below. For all analyses that can be performed with at least 5 data points per cell, we will additionally perform all above stated analyses within each mental health condition separately, where feasible.

Qualitative: Thematic analysis

For the interviews, we will conduct a thematic analysis (TA) to extract themes from the different interview groups. TA is a flexible method for detecting meaningful patterns, or themes, in acquired data. According to Braun & Clarke (2012), we should pre-determine whether the data will be collected using an inductive or theory-driven approach, an experiential or critical orientation, and an essentialist or constructionist theoretical framework. It is important to note that we will stay open to the possibility of adapting our pre-determined approach to best fit the data we get, and there is always an element of both deductive and inductive methodology in TA. Therefore, the following is a guide we

will start with, but is by no means a plan to which we must strictly adhere, should the data lead us in another direction. For this reason, our TA remains exploratory (Braun et al., 2022).

For the current study, it is most appropriate to use a deductive, theory-driven approach, as our hypotheses are motivated and steered by previous research findings. We will take an experiential orientation to the data, as it is important to understand the needs of individuals with the lived experience of mental illness, and we do not presume to know what those needs are. For example, we hypothesize that clinical ignorance about aphantasia negatively impacts patient satisfaction with mental healthcare, but *how* this impact manifests can only be gleaned from learning about people's lived experiences. Finally, we will take a constructionist theoretical perspective. This means we will not only focus on recurring patterns in interviews (which could include those that are unanticipated and not directly related to our hypotheses), but also concentrate on patterns we deem meaningful for our study, which are those that address the three hypotheses (Byrne, 2022). Throughout the TA (particularly at the end of Phase 1 and 4), we will use member checking (Birt et al., 2016), which entails verifying with interviewees whether they agree with our transcriptions and interpretations of their words, allowing them to make amendments as necessary.

TA will follow 6 phases, as described in Braun & Clarke (2006). In Phase 1, interviews will be audio-recorded, then transcribed verbatim. The researchers will listen to every interview: one to perform the initial transcription, and the other to validate the accuracy of the transcription. The researchers will then independently immerse themselves in the data and makes notes on potential patterns of interest prior to a deeper analysis. We will use peer debriefing and investigator triangulation here to ensure a high amount of information sharing throughout the process and improve credibility (Nowell et al., 2017).

In Phase 2, data will be coded for both semantic and latent content, meaning that we will focus on both specific language used in the interviews and potential implied meanings, as they may both come through in the data. Our coding technique will be exploratory, and our aim is to identify

549 particular features in the data. Our three hypotheses will be used as inclusion criteria for interview:
550 that is, we will recruit individuals who indicated that they believe their aphantasia affected their ability
551 to receive adequate assessment, diagnosis, and/or treatment; that clinician ignorance of aphantasia
552 interfered with their mental health assessment, diagnosis, and/or treatment; that CBT was not an
553 effective psychotherapeutic treatment for them; or that CBT was an effective treatment for them.
554 Once we have obtained our groups, we will explore more deeply how individuals have come to these
555 feelings. For example, to summarize some of the discussion points for interview (the full list can be
556 found in Appendix A): 1) Given that the individual believes their aphantasia affected their ability to
557 seek mental healthcare, *in what ways* do they believe the process was affected? *Which* symptoms
558 do/did they experience that caused them to seek mental healthcare? 2) Given that the individual
559 expresses clinician ignorance of aphantasia as a factor in their mis-evaluation/misdiagnosis, *in what*
560 *ways* do they feel this occurred? *What* made them feel this way?; 3) Given that the individual feels
561 that CBT was ineffective for them, *what aspects* of CBT do they feel were ineffective? 4) Given that
562 the individual feels that CBT was effective for them, *what aspects* of CBT do they feel were effective?
563 We can therefore aim to focus coding on these points; however, if unexpected, but meaningful
564 patterns occur at this stage, we will follow them up with exploratory analyses and coding. Therefore,
565 no potential themes will be ignored.

566 In Phase 3, we will sort codes into broader themes and sub-themes. Our hypotheses allow us
567 to speculate on possible themes that may emerge. When answering the question: “Can you please
568 elaborate on the point that you believe aphantasia affected your ability to receive a(n appropriate)
569 diagnosis?”, we expect themes to emerge around imagery-related and imagery-unrelated
570 symptomology (Hypothesis 1). To address Hypothesis 2, there are known factors that contribute to
571 the perceived success of therapy, such as therapeutic empathy. Therapeutic empathy requires
572 understanding, communication of that understanding to the patient, and acting on that shared
573 understanding in a therapeutic way (Howick et al., 2018). Because Hypothesis 2 is that there will be a
574 lack of clinician understanding of aphantasia, we suspect “good therapeutic empathy” and “poor

therapeutic empathy" will be important themes. For Hypothesis 3, participants who have tried CBT will be asked the question: "What do you think about CBT as a treatment for you?". Here we would expect themes of negative and positive CBT experiences.

Phase 4 requires reviewing and refining themes. Together, the researchers will work reflexively and collaboratively (Byrne, 2022), using peer debriefing to discuss identified themes; review the codes associated with each theme; and discard, add, and change themes as necessary. We will keep reflexive diaries to account for some of the researcher bias inherent in the analysis process. We will all agree on the final thematic map and its representation of the data, and check that each hypothesis has been addressed. Phase 5 requires defining the scope of each theme, determining whether themes are sufficiently distinct from one another, and giving them each a clear, appropriate name. In Phase 6, we will report the final analysis, which will address each hypothesis.

A thematic map will be produced as part of the coding process. An example thematic map of our hypothesis is shown in Figure 1.

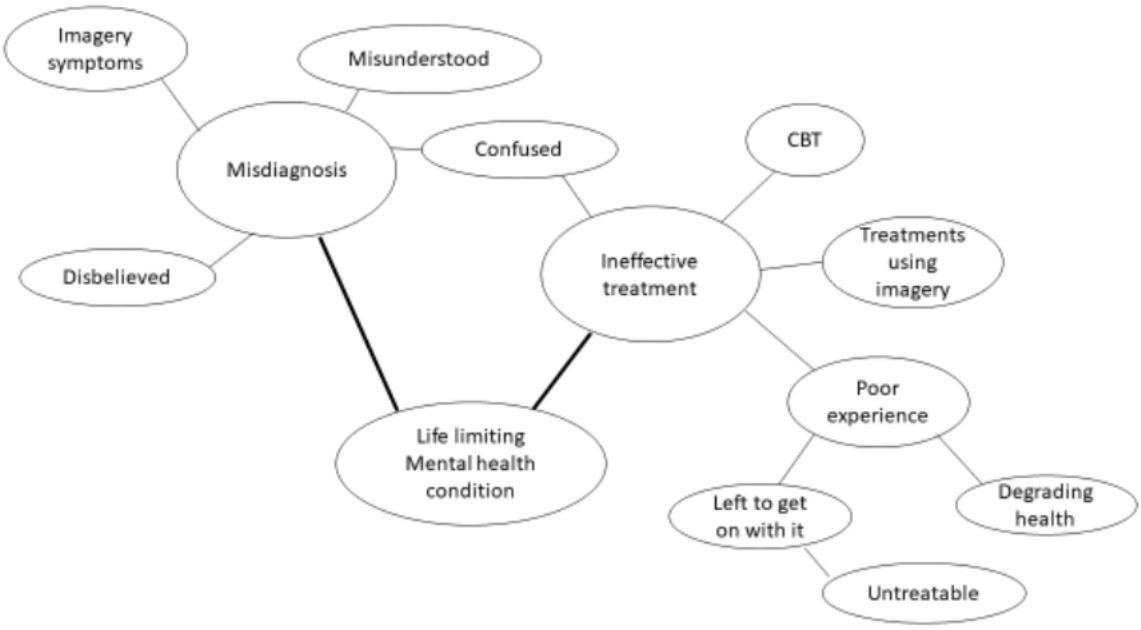

Figure 1. *Thematic map of the hypotheses.*

Interpretative plan

Quantitative

We will conduct Bayesian analyses in JASP (JASP Team & others, 2019), with the prior concentration set to the default of 1, and all tests two-sided. We will use the default prior concentration of 1 because we do not want to make any assumptions about how our distributions deviate from a null distribution; nevertheless, we will repeat all tests with prior concentrations set between 1-10, which will allow us to test a range of weakly informative priors, and we will report whether the direction of the results changes across these values. For all analyses that include Bayes Factors (BF), the strength of evidence for the different hypotheses is defined as follows:

$BF_{10}>10$ = strong evidence for a difference between groups

$3<BF_{10}<10$ = moderate evidence for a difference between groups

$1<BF_{10}<3$ = weak evidence for a difference between groups

$BF_{01}>10$ = strong evidence for no difference between groups

$3<BF_{01}<10$ = moderate evidence for no difference between groups

$1<BF_{01}<3$ = weak evidence for no difference between groups

We clearly state below which groups we expect to show differences, which we do not, and in which direction this difference is expected to take. Bayes Factors provide relative evidence for two competing hypotheses; strong evidence ($BF_{10}>10$ for a difference between groups; $BF_{01}>10$ for no difference between groups) will be taken as confirming or disconfirming evidence depending on the hypothesis. Moderate or weak evidence in either direction will be reported as inconclusive. If we do not have hypotheses about the direction or difference between groups, these are listed as exploratory.

For Hypothesis 1 (Psychiatric disorders will manifest with a lack of imagery-related symptomology in aphantasia), confirming evidence would include: fewer than five total "Yes" responses on Q7 of the questionnaire (I have had intrusive sensory experiences (for example: flashbacks, unpleasant imagery, hallucinations) because of my mental health condition Yes/No) within the aphantasia sample, combined with more than 5 total "Yes" responses on the same question within the typical imagery control group; a lower lifetime prevalence of imagery-related symptomology in aphantasia versus a typical imagery control group; and/or a lower prevalence of visual intrusive imagery compared to other sensory and non-sensory imagery. Disconfirming evidence would include a higher lifetime prevalence of imagery symptomology in aphantasia compared to control, or a higher prevalence of visual intrusive imagery compared to other forms of imagery. Strong evidence for no difference in any of these tests will also be taken as disconfirming. We do not have a hypothesis as to whether imagery-related symptomology is stronger in some disorders compared to others, so these planned analyses and post-hoc contrasts will be exploratory. We do not have a hypothesis concerning potential differences due to group splits (diagnosed versus undiagnosed, aphantasia versus hypophantasia), so these analyses will also be exploratory.

For Hypothesis 2 (Aphants will report "lack of awareness or understanding of aphantasia" as a common factor in mis-evaluation, missed diagnosis, or misdiagnosis by mental health professionals), confirming evidence would be: more than five total "Yes" responses to item a. (because the person evaluating me did not understand my aphantasia) on Q12 of the questionnaire combined with fewer than five total "Yes" responses to item b. (unrelated to aphantasia); or a higher likelihood that aphants will attribute missed/mis-diagnosis to aphantasia-related factors compared to those that received an accurate diagnosis. On the same analysis, if we find that accurate diagnoses are more likely to be related to aphantasia than missed/misdiagnoses, or that missed/misdiagnoses are more likely to be unrelated to aphantasia compared to accurate diagnoses, this would be taken as disconfirming evidence. Strong evidence for no difference in any of these tests will also be taken as disconfirming evidence. For the analysis comparing missed versus misdiagnoses, we predict that these are similarly

affected by misunderstandings of aphantasia; we therefore predict to find strong evidence for no difference on this test. Finally, we do not have specific hypotheses concerning whether a certain disorder is more prone to misdiagnosis due to a misunderstanding of aphantasia compared to others; these analyses are therefore exploratory. We do not have a hypothesis concerning potential differences due to an aphantasia versus hypophantasia group split, so this analysis will also be exploratory.

For Hypothesis 3 (Aphants will report that imagery-related therapies (specifically CBT) are ineffective in their mental health treatment), confirming evidence includes: fewer than five total responses of "No" on Q14 of the questionnaire (If you answered no to the last question, do you believe treatment was ineffective because you have aphantasia?), combined with more than five total "Yes" responses; a greater ineffectiveness of imagery-based therapies compared to non-imagery therapies; a greater ineffectiveness of CBT compared to other forms of psychotherapy; strong evidence that non-visual imagery therapies are more effective than visual imagery therapies; and/or strong evidence that CBT without imagery is more effective than CBT with imagery. Disconfirming evidence would include: fewer than five total "Yes" responses on Q14 of the questionnaire, combined with more than 5 total "No" responses; strong evidence for the opposite effects (e.g., effectiveness where ineffectiveness is expected); or strong evidence for null effects (i.e., no difference in effectiveness between types of therapy). In our tests comparing aphants to typical imagery controls, we also expect that aphants will be more likely to report ineffectiveness of imagery-based therapies compared to control, whereas strong evidence in the opposite direction, or no difference between groups, would be taken as disconfirming evidence. All analyses that can be performed within each mental health condition separately will be considered exploratory. We do not have a hypothesis concerning potential differences due to an aphantasia versus hypophantasia group split, so this analysis will also be exploratory.

Qualitative

We will additionally address all hypotheses with a thematic analysis (TA) of the interviews to obtain a richer, multidimensional dataset. Some questions can only be answered with a qualitative analysis; as previously stated, *how* participants have come to feel satisfied or dissatisfied with mental health services is best captured in a discussion of lived experiences. TA is inherently exploratory in its interpretation. Our interpretative plan is described in Phases 5 and 6 of the planned TA.

Reality checks

Reality checks will be performed both for questionnaire and interview data. These checks are described in the *Exclusion and inclusion criteria*. To summarize, we will first check that participants respond consistently on different questions in the questionnaire (e.g., they indicate that they have aphantasia and score themselves <4 on the PSI-Q visual scale). We will also check responses from individuals who provide an email address compared to those who do not, to find out whether participants interested in an interview will be less likely to fabricate responses. At the beginning of the interview, we will perform a short aphantasia assessment. We will then double check questionnaire responses verbally. If any responses are inconsistent between questionnaire and interview, we will either clarify with the participant (if they still meet inclusion criteria) or terminate the interview.

Conflict of interest statement

The authors declare no conflicts of interest, and no author will receive a financial advantage from the direction of any result in this work.

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