

1 **The impact of aphantasia on mental healthcare experiences: Quantitative results**

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21 **Abstract**

22 Approximately 4% of the population has aphantasia, which is defined as impoverished, or absent,
23 sensory mental imagery. Previous research suggests that people with aphantasia (aphants) may have
24 a higher prevalence of mental health conditions and neurodivergence compared to the general
25 population, but aphantasia presents a special challenge for diagnosis and treatment. Many mental
26 health conditions are currently characterized by imagery-related symptomology (such as sensory
27 flashbacks in post-traumatic stress disorder or negative body image in eating disorders), and the
28 dominant therapeutic treatments rely heavily on imagery techniques. Thus far, little is known about
29 how this impacts mental healthcare experiences in individuals with aphantasia. In the current study,
30 we will use a mixed-methods (questionnaire, interview) approach to comprehensively investigate the
31 effects of aphantasia on seeking diagnoses and treatments for mental illness. Quantitative analyses
32 on the questionnaire data revealed that virtually all psychiatric disorders manifest with a lack of
33 imagery-related symptomology in aphantasia compared to typical imagery controls; aphants report
34 “lack of awareness or understanding of aphantasia” as a common factor in missed- or misdiagnosis by
35 mental health professionals, although the prevalence of missed and misdiagnoses are no different
36 from typical imagery controls; and aphants are very likely to report that therapies involving mental
37 imagery, especially visual imagery in CBT, are ineffective in their mental health treatment compared
38 to controls. A detailed summary of the quantitative results follows.

39

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

41 Visual mental imagery is the ability to simulate visual sensory information in the “mind’s eye”.
42 Individual differences in visual imagery vividness have been long known (Kosslyn et al., 1984; Marks,
43 1973; Pearson & Kosslyn, 2015; Reeder, 2017), but “imagery extremes” have only recently entered
44 the scientific conversation (Zeman et al., 2020), sparked by popular media surrounding *aphantasia*:
45 impoverished or absent visual mental imagery¹ (Zeman et al., 2015). Aphantasia has mainly gone
46 under the scientific radar, although Faw (1997) discussed individual differences in mental imagery
47 abilities, including “wakeful non-imagery”, and Pylyshyn (1973) argued for decades that mental
48 sensory representations can be conceptual. Nevertheless, with the advent of the term *aphantasia*
49 came a new wave of public interest in the phenomenon (Zimmer, 2015). It is now thought that
50 approximately 4% of the population has aphantasia (Dance et al., 2022).

51 Aphantasia is not a neuropsychological disorder, as people with aphantasia (referred to as
52 *aphants*) use compensatory strategies to overcome mental imagery challenges; as a result, they may
53 live fulfilling lives, most never knowing their internal representations of the world are different from
54 anyone else’s (Zeman et al., 2015). For example, many cognitive tasks that are thought to require
55 mental imagery can just as effectively be performed without imagery, such as visuo-spatial working
56 memory (Keogh et al., 2021), mental rotation (Pounder et al., 2021), and face recognition (Milton et
57 al., 2020). It is thought that aphants gravitate toward more mathematical or scientific fields than
58 artistic careers (Zeman et al., 2020), but there are many highly successful aphants in creative fields
59 who can, for example, use technically unconventional strategies to produce visual art (MacKisack et
60 al., 2020). About half of individuals with aphantasia may experience an absence of imagery in all
61 sensory modalities, with a further 30% reporting an absence of imagery in at least one other modality
62 (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.

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

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

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

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

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

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

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

125 While CBT is the recommended course of treatment for most mental health conditions (Pilling
126 et al., 2011), other talking-based therapeutic approaches, including counselling and psychotherapy,
127 are prevalent among mental health professionals for treating a variety of conditions (Barkowski et al.,
128 2020; van Bronswijk et al., 2019). Among other forms of psychotherapy and psychoanalysis, visual
129 imagery remains a popular technique, and is considered powerful and effective among clinicians
130 (Curtis, 2016; Pile et al., 2021; Skottnik & Linden, 2019). As such, some individuals select therapeutic
131 approaches that may not have their roots in CBT but which also incorporate elements of visual imagery
132 (such as positive imagery; Holmes et al., 2006). This collectively suggests that any therapy an individual
133 selects for their mental health will likely involve visual imagery to some extent, and it is important to
134 investigate how this impacts treatment effectiveness for individuals with aphantasia. It is also
135 important to note that individual differences in mental imagery vividness, generally, have not yet been
136 documented as a factor in treatment outcomes, despite early suggestions of its potential role in the
137 success of imagery-based therapies (Crits-Christoph & Singer, 1981). In the current study, we will

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

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

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

- 154 1. Psychiatric disorders will manifest with a lack of imagery-related symptomology in
155 aphantasia (e.g., sensory flashbacks in PTSD; intrusive imagery in body dysmorphic disorder)
156 compared to a typical imagery control group;
- 157 2. Aphants will report a perceived “lack of awareness or understanding of aphantasia” as a
158 common factor in mis-assessment, missed diagnosis, or misdiagnosis by mental health
159 professionals²;

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.

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

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

166

167 **Methods**

168 All materials, code, and anonymized quantitative data will be made publicly available on the Open
169 Science Framework (OSF; <https://osf.io/uamcp/>). Anonymized interview transcripts will be made
170 publicly available provided explicit consent is given by the interviewee. Stage 1 materials will be made
171 available on OSF no later than at Stage 1 acceptance, along with the Stage 1 preprint on *PsyArXiv*.
172 Stage 2 data and code will be made available no later than at Stage 2 acceptance, along with the Stage
173 2 preprint on *PsyArXiv*.

174

175 *Recruitment*

176 In collaboration with the Aphantasia Network, we will disseminate the details of this study to over
177 16,000 aphants in their newsletter. We will also disseminate the study to over 92,000 subscribers on
178 *r/aphantasia* on the forum website, Reddit, and to readers of *The Conversation* (where the senior
179 author previously collected responses from approximately 2500 aphants and 5000 imagers).
180 According to a sample size calculation (see *Sample size justification*), we aim to recruit 4248 aphants
181 to fill out the questionnaire, to ensure at least 7-8 interviews per target group. To obtain the largest
182 sample and because one of our hypotheses pertains to potential misdiagnosis, we will recruit both

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

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

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

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

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

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

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

214

215 *Exclusion and inclusion criteria*

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

226 To avoid potentially activating memories of trauma, we will not ask participants whether their
227 aphantasia is acquired or congenital. We acknowledge that there is a distinction between the two:
228 congenital aphantasia is the lifelong absence of mental imagery (Zeman et al., 2015), and acquired
229 aphantasia is the loss of mental imagery due to neurological or psychological trauma (Zeman et al.,
230 2010). We do not deem this distinction relevant to the current study, and will include participants as
231 long as they believe they were experiencing aphantasia at the time they sought mental healthcare.

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

237 Imagery who respond on the questionnaire (respond negatively to Q1 and rate their average
238 visual imagery vividness as >3 on the PSI-Q) will be excluded from taking part in the interview, but we
239 will use their quantitative data from the questionnaire, as they can serve as a control group for
240 aphants. Individuals who respond negatively on Q1 but indicate that their visual imagery vividness is
241 <4 on the PSI-Q will be excluded from analysis due to inconsistency in responses.

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

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

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

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

267

268 *Sample size justification*

269 In a previous study, 24% of aphants (64/267) reported a history of mental illness (Dawes et al., 2020).
270 According to the UK Adult Psychiatric Morbidity Survey 2014 (McManus et al., 2016, p.86), 39% of
271 adults with a mental health condition ultimately seek treatment³; 6% of those use CBT. Using these
272 estimates, we calculated our sample size as follows:

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

$$275 \quad n = \left(1 - (1 - p)^{\frac{1}{NP}}\right) \times \left(N - \frac{NP-1}{2}\right)$$

276 where P is the expected prevalence in the population, N is the population size (estimated as number
277 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.

278 100,000⁴), and p is the confidence level (95%). To obtain 14 responses from individuals who have been
279 evaluated for, or diagnosed with, a mental health condition ($24\% \times 39\% = 9.36\%$), this would require
280 a minimum sample size of 31 (chance of detecting 1 or more) $\times 14 = 434$. To ensure 8 participants have
281 tried CBT ($9.36\% \times 6\% = .5616\%$), this would require a minimum sample size of 531 (chance of
282 detecting 1 or more) $\times 8 = 4248$. Therefore, we estimate that we will require 4248 aphant respondents
283 on our survey to achieve our target sample size for the interviews.

284 For interviewing, we determined target sample sizes based on a quantitative power analysis,
285 an information power model specific to qualitative interview studies, and “rules of thumb” from
286 previous literature. First, as an initial quantitative measure, we calculated the sample size required to
287 find a difference between general population efficacy of CBT (approximately 50% across a variety of
288 mental health disorders; Hofmann et al., 2012) and the hypothesized efficacy of CBT among aphants
289 (0-10%). For this, we conducted a power analysis using the online calculator ClinCalc
290 (<https://clincalc.com/stats/samplesize.aspx>), with a dichotomous primary endpoint (CBT was
291 effective: Yes or No), power set at 90%, beta at 0.1, and alpha at 0.05. The result of this test suggests
292 a sample size of 4-12 is required. It should be noted that quantitative approaches are not ideal for
293 qualitative sample size justification, but are worth considering in combination with the other two
294 approaches described below.

295 Next, we calculated the required sample size based on an information power model (Malterud
296 et al., 2016). Information power models take into account 5 dimensions that may contribute to a
297 decrease or increase in estimated required sample size for qualitative interview studies: aim (narrow,
298 broad), specificity (dense, sparse), theory (applied, none), dialogue (strong, weak), and analysis (case,
299 cross-case). A narrow, dense, applied, strong case study will require the fewest participants ($N=1$ in
300 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.

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

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

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

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

331

332 *Stopping rule*

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

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

350

351 *Procedure*

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

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

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

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

385

386 ***Planned analyses***

387 *Quantitative*

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

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

402 *Hypothesis 1*

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

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

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

425 auditory, tactile, body, emotional, and other groups; and split responses into “Yes” (Significantly,
426 Somewhat, A little bit) and “No” (Not at all) for 2 (aphantasia, imagery) x 2 (yes, no) Bayesian
427 Contingency Tables tests. If there are at least 5 responses per cell, we will also perform a series of 2 x
428 4 (“Significantly”, “Somewhat”, “A little bit”, “Not at all”) Bayesian Contingency Tables tests. Within
429 the aphantasia group, we will perform tests with responses split into visual versus “other sensory”
430 (auditory, tactile, body, other), and sensory (visual, auditory, tactile, body, other) versus non-sensory
431 (emotional) imagery. These tests will address how aphants’ experience of their mental health
432 condition is affected by visual, other sensory, and non-sensory imagery, and which form of intrusive
433 imagery is most prevalent. Finally, we will perform the same tests in the control group, then enter
434 these results as our expected counts in Bayesian Multinomial tests comparing the aphantasia group
435 to the control group. This will tell us whether aphants’ experience of their mental health condition is
436 affected differently by imagery intrusions compared to imagers.

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

447 *Hypothesis 2*

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

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

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

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

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

483 *Hypothesis 3*

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

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

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

507

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

514

515 *Qualitative: Thematic analysis*

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

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

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

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

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

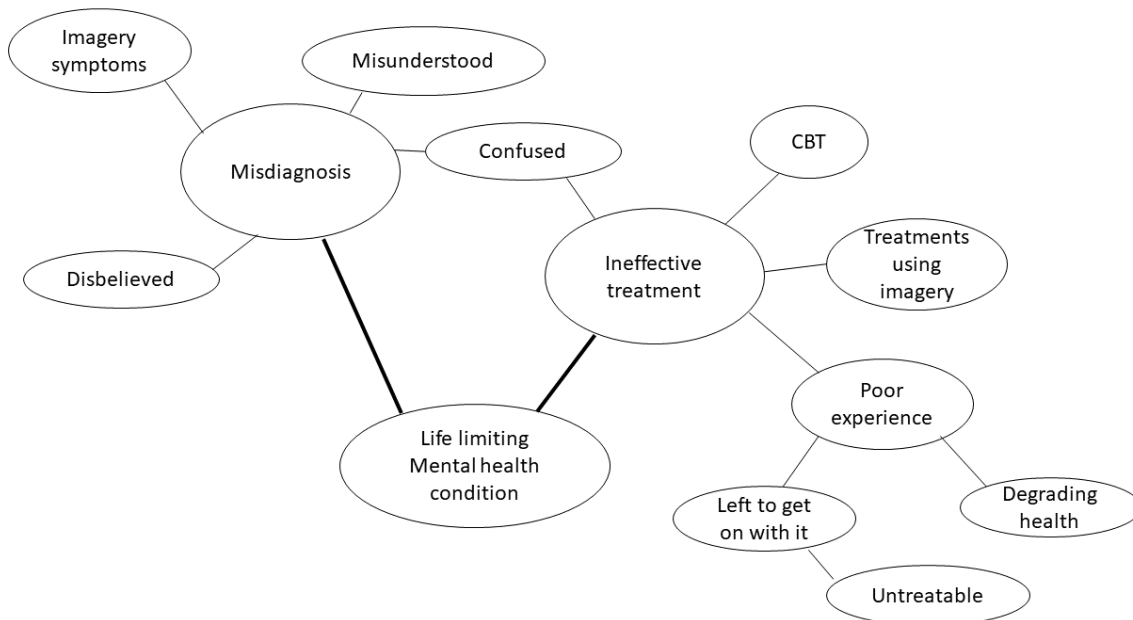
548 particular features in the data. Our three hypotheses will be used as inclusion criteria for interview:
549 that is, we will recruit individuals who indicated that they believe their aphantasia affected their ability
550 to receive adequate assessment, diagnosis, and/or treatment; that clinician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

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

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

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

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



587 Figure 1. *Thematic map of the hypotheses.*

588

589 ***Interpretative plan***

590 *Quantitative*

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

598 $BF_{10} > 10$ = strong evidence for a difference between groups

599 $3 < BF_{10} < 10$ = moderate evidence for a difference between groups

600 $1 < BF_{10} < 3$ = weak evidence for a difference between groups

601 $BF_{01} > 10$ = strong evidence for no difference between groups

602 $3 < BF_{01} < 10$ = moderate evidence for no difference between groups

603 $1 < BF_{01} < 3$ = weak evidence for no difference between groups

604

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

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

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

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

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

662

663 *Qualitative*

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

669

670 ***Reality checks***

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

680

681 ***Results***

682 *Quantitative*

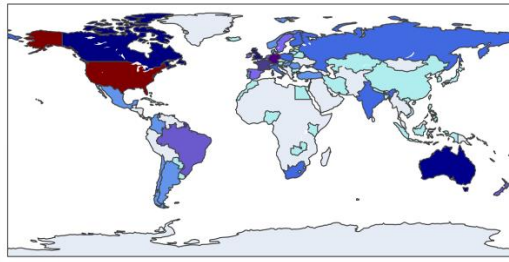
683 For the quantitative survey, we first pre-processed the data for exclusions (see *Exclusion and inclusion*
684 *criteria*), then calculate descriptive statistics on demographic data and questionnaire responses. Data
685 analysis was performed in JASP (JASP Team & others, 2019). Bayesian Contingency Tables tests and
686 Multinomial tests were performed on count data.

687 *Demographics*

688 At the time of completion of the interviews, we had received 4,005 responses on the online
689 survey (demographics, PSI-Q, and mental-healthcare questionnaire). 934 did not respond to any
690 mental healthcare questions, and were excluded. A further 6 were excluded who reported that they
691 did not have aphantasia, but had average PSI-Q visual scores ≤ 3 . A further 251 were excluded for
692 reporting that they had aphantasia, but had average PSI-Q visual scores > 3 . 2,815 participants
693 contributed to the final sample (total aphantasia $N = 2405$; total control $N = 410$). Demographic data
694 can be found in Fig.1.

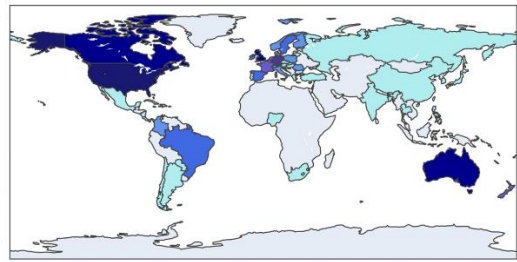
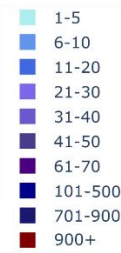
695 Fig.1.

nationality

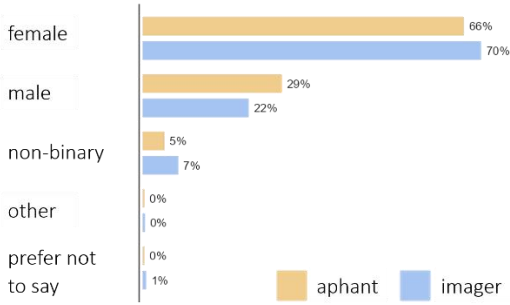


country mental healthcare sought

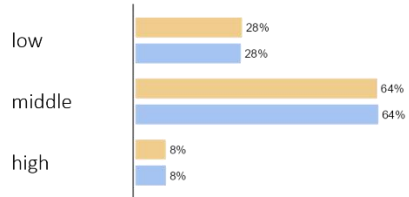
frequency



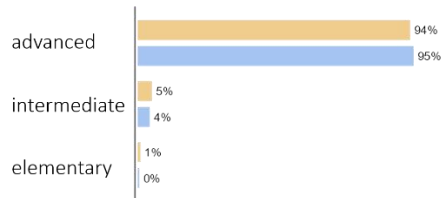
gender



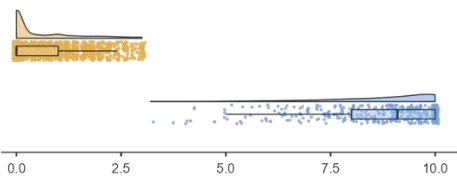
SES



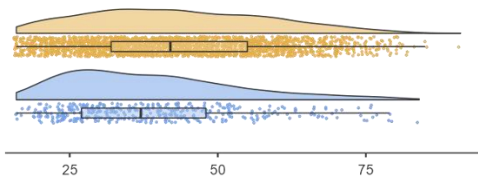
English proficiency



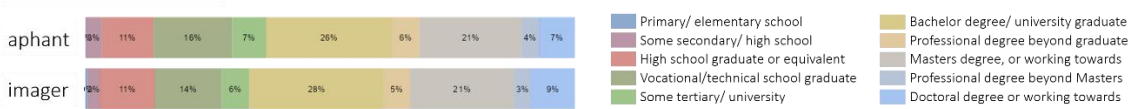
visual mental imagery vividness (PSI-Q visual)



age in years



education



696

697

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To summarize, we did not specifically seek to match aphantasia and typical imagery control samples as we recruited indiscriminately from our online resources, but our demographic distributions are quite similar between the two. Bayesian contingency tables tests revealed no evidence for a difference in the distributions of reported gender ($BF_{10Poisson} = 0.00154$, $N = 2807$), English proficiency ($BF_{10Poisson} = 8.94e-4$, $N = 2801$), or socioeconomic status ($BF_{10Poisson} = 0.00396$, $N = 2569$). A Bayesian Mann-Whitney U test conducted on the age distributions of the two groups revealed moderate

704 evidence for a difference ($BF_{10} = 9.01$, $W = 535580$), with the aphantasia sample being slightly older
705 (Median age = 42 years, standard deviation (SD) = 15.2, $N = 2321$) than the typical imagery controls
706 (Median age = 37 years, SD = 14.4, $N = 392$). We then coded highest level of education attained on a
707 1-10 scale, from 'primary school' to 'doctorate', and conducted a Bayesian Mann-Whitney U test on
708 the difference in median level of education between the two groups. This revealed no evidence for a
709 difference ($BF_{10} = 0.209$, $W = 474530$), with median education for both groups being at the level of
710 Bachelor's degree.

711 We have included the distribution of PSI-Q visual scores reported for each group (note that
712 some participants were excluded from each group so there could be no overlap in scores). This shows
713 that most aphants (whose PSI-Q visual scores could range from 0-3) had a median visual imagery
714 vividness rating of 0, with 75% of scores including ratings up to 2.5. Imagers (whose PSI-Q visual scores
715 could range from 3-10), had a median visual imagery vividness rating of 9.10, with a high number of
716 individuals also concentrating around scores of 10, and 75% of scores including ratings down to 5.

717

718 *Mental health condition prevalence*

719 Next, in terms of the general lifetime prevalence of different mental health conditions
720 reported, we conducted 2 (aphant, control) x 2 (X disorder yes, no) Bayesian contingency tables tests.
721 There was no difference in prevalence between the two groups for Generalized Anxiety Disorder
722 (GAD; $BF_{10Poisson} = 0.139$, $N = 2813$), social anxiety ($BF_{10Poisson} = 0.109$, $N = 2814$), Autism Spectrum
723 Conditions (ASC; $BF_{10Poisson} = 0.0584$, $N = 2813$), Post-Traumatic Stress Disorder (PTSD; $BF_{10Poisson} =$
724 0.810 , $N = 2814$), depression ($BF_{10Poisson} = 0.110$, $N = 2813$), Eating Disorder (ED; $BF_{10Poisson} = 0.0425$, N
725 $= 2813$), body dysmorphic disorder ($BF_{10Poisson} = 0.0724$, $N = 2813$), Schizophrenia Spectrum Disorders
726 ($BF_{10Poisson} = 0.0143$, $N = 2813$), Dissociative Identity Disorder (DID; $BF_{10Poisson} = 0.0210$, $N = 2813$), or
727 Borderline Personality Disorder (BPD; $BF_{10Poisson} = 0.0286$, $N = 2813$). There was also no difference in
728 the prevalence of having any number of other disorders not covered in our list (Other; $BF_{10Poisson} =$

729 0.413, $N = 2813$). The most common write-in disorder for both groups was Attention Deficit
730 (Hyperactivity) Disorder (ADD/ADHD), with 76% of aphants and 81% of imagers who responded
731 'Other' including it in their response.

732 We did find strong evidence for a difference in the prevalence of Obsessive Compulsive
733 Disorder (OCD; $BF_{10\text{Poisson}} = 59.4$, $N = 2813$) between the two groups, with a higher incidence of OCD
734 among the typical imagery controls (OCD yes = 13.5%) compared to aphants (OCD yes = 7.5%). We
735 also found moderate evidence for a difference in the prevalence of Bipolar Disorder ($BF_{10\text{Poisson}} = 7.49$,
736 $N = 2813$), with a higher incidence among typical imagery controls (Bipolar yes = 8.6%) compared to
737 aphants (4.4%).

738

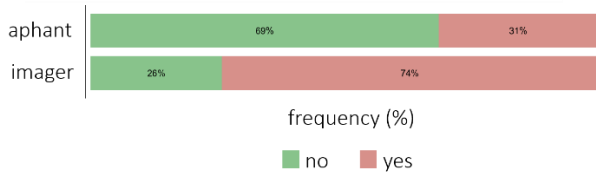
739 ***Hypothesis 1: Psychiatric disorders will manifest with a lack of imagery-related symptomology in***
740 ***aphantasia***

741 ***Supported: Yes***

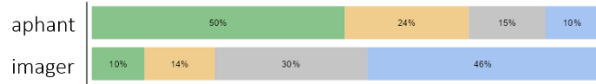
742 To address Hypothesis 1, we first present descriptive statistics for answers to Q7 (I have had intrusive
743 sensory experiences (for example: flashbacks, unpleasant imagery, hallucinations) because of my
744 mental health condition Yes/No) and Q8 (If you answered yes to the last question, what kind of
745 experience affected you? Visual, Auditory, Tactile, Body, Emotional: Significantly—Somewhat—A little
746 bit—Not at all). Due to an oversight, 'Other' responses were not collected for this question:
747 nevertheless, as we did not have any hypotheses around 'Other' intrusions, we did not deem this to
748 be a critical oversight. The descriptive statistics are graphically summarized in Fig.2.

749 Fig.2.

lifetime prevalence of intrusions (any kind)



visual



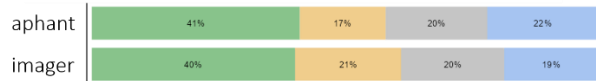
auditory



tactile



bodily sensation



emotional



frequency (%)
 no a little bit somewhat significantly

750

751

752 *Lower lifetime prevalence of intrusions in aphants compared to imagers*

753 First, individuals were excluded who reported that they did not believe they had a mental
 754 health condition, since we were only interested in mental-health-related intrusions. This left us with
 755 1363 aphants and 236 imagers who responded to Q7. To determine whether there was a difference
 756 in the lifetime prevalence of intrusive sensory experiences in aphantasia versus a typical imagery
 757 control group, we conducted a 2 (aphantasia, imagery) x 2 (any intrusions yes, no) Bayesian
 758 Contingency Tables test. This revealed extremely strong evidence for a difference ($BF_{10Poisson} =$
 759 $1.28e+32, N = 1599$), in that typical imagery controls reported a higher prevalence of intrusions as part
 760 of their mental health condition (74%) compared to individuals with aphantasia (31%).

761

762 *Anxiety & panic disorders and depression: Higher prevalence of intrusions in imagers than aphants; no*
763 *more prevalent than in other disorders*

764 We then performed the same analysis within different classes of disorders, starting with
765 anxiety and panic disorders. Individuals were included who reported GAD, social anxiety, and Panic
766 Disorder (included from 'Other' write-in responses). This created a sub-sample of 921 aphants and
767 165 controls. We found extremely strong evidence that controls are more likely to experience
768 intrusions compared to aphants ($BF_{10\text{Poisson}} = 3.12e+26$, $N = 1086$). The general prevalence of intrusions
769 was not significantly different between our total sample and the sub-sample of those with anxiety and
770 panic disorders (χ^2 goodness of fit = 1.16, $p = 0.282$). We then analyzed the sub-sample who reported
771 depression, which included 1006 aphants and 164 controls. This again revealed extremely strong
772 evidence for a difference in the proportion of intrusions experienced ($BF_{10\text{Poisson}} = 1.11e+22$, $N = 1170$),
773 and this was also no different from expected proportions obtained from the total sample (χ^2 goodness
774 of fit = 0.353, $p = 0.552$).

775

776 *PTSD and other trauma disorders: Higher prevalence of intrusions in imagers than aphants; higher than*
777 *in other disorders*

778 We then performed the same tests for a sub-sample who reported either PTSD or other
779 symptoms of trauma for which they sought mental healthcare; this led to a sub-sample of 408 aphants
780 and 86 controls. This test revealed extremely strong evidence for a difference in intrusion prevalence
781 between the two groups ($BF_{10\text{Poisson}} = 4.60e+9$, $N = 494$), with aphants being much less likely to report
782 intrusions of any kind. A higher proportion of individuals reported intrusions as part of their PTSD
783 compared to the total sample (χ^2 goodness of fit = 130, $p < 0.001$): specifically, there was nearly a

784 perfect flip in the proportion of yes-to-no intrusion responses, with 63% of the PTSD sample reporting
785 intrusions, compared to 37.7% across all conditions.

786

787 *Personality disorders: Higher prevalence of intrusions in imagers than aphants; higher than in other*
788 *disorders*

789 Next, we analyzed the sub-sample with personality disorders, including OCD, DID, and BPD,
790 along with those who responded with another personality disorder under 'Other': these included
791 Avoidant Personality Disorder/Sociopathy, Depersonalization Disorder, Schizoid Personality Disorder,
792 Schizoaffective Personality Disorder, and Schizotypal Personality Disorder. This resulted in a sub-
793 sample of 239 aphants and 57 controls. There was again extremely strong evidence for a difference in
794 the proportion of intrusions between the two groups ($BF_{10Poisson} = 106070$, $N = 296$). Individuals with
795 personality disorders generally showed a higher proportion of intrusions than observed in the total
796 sample (χ^2 goodness of fit = 45.7, $p < 0.001$).

797

798 *Schizophrenia spectrum disorders and psychosis: N/A*

799 We wished to analyze intrusions in Schizophrenia Spectrum Disorders and Psychosis (written
800 under 'Other' disorders), but there were too few individuals to submit to Contingency Tables Tests
801 (aphant $N = 16$, control $N = 3$). We instead report numerically that all three controls and 13/16 aphants
802 experienced intrusions as part of their disorder.

803

804 *Eating and body dysmorphic disorders: N/A*

805 For ED and Body Dysmorphic Disorders, there were also not enough responses per cell to
806 conduct Contingency Tables Tests; however 83/178 (46.63%) aphants and 27/31 (87.10%) controls

807 experienced intrusions as part of ED, and 52/100 (52%) of aphants and 22/23 (95.65%) controls
808 experienced intrusions as part of a body dysmorphic disorder.

809

810 *Aphants only: Higher prevalence of intrusions for trauma-related, personality, and eating disorders*
811 *compared to other disorders; not higher in anxiety & panic disorders or depression*

812 We then performed 2 (answer to Q7: yes, no) x 2 (Disorder: yes, no) Bayesian Contingency
813 Tables tests within the aphantasia group only, to determine whether intrusive symptoms are
814 prevalent in certain disorders and not others. Intrusions were more prevalent if individuals had PTSD
815 ($BF_{10Poisson} = 6.39e+35$, $N = 1363$), BPD ($BF_{10Poisson} = 10439$, $N = 1363$), ED ($BF_{10Poisson} = 3018$, $N = 1363$),
816 OCD ($BF_{10Poisson} = 49.5$, $N = 1363$), DID ($BF_{10Poisson} = 301$, $N = 1363$), or Bipolar Disorder ($BF_{10Poisson} = 152$,
817 $N = 1363$), compared to individuals who did not have each of those disorders. Intrusions were not
818 more prevalent in GAD, social anxiety, or depression (all $BF_{10S} < 1$).

819

820 *Higher prevalence of intrusions in imagers compared to aphants for all analyzable disorders*

821 Finally, we performed the same series of 2 x 2 tests within the control group, and input their
822 observed intrusions as expected values in a χ^2 goodness-of-fit test (this was mistakenly referred to as
823 a Multinomial Test in the methods), to determine whether intrusions occur with different proportions
824 across different disorders in aphants compared to typical imagery controls. The control group,
825 compared to aphants, experienced significantly more intrusions in all analyzable disorders (see **Table**
826 **1**). There were not enough observations for an analysis of DID or BPD, though 5/5 (100%) controls
827 with DID and 9/10 (90%) controls with BPD experienced intrusions, compared to 60.9% and 56.6% of
828 aphants with DID and BPD, respectively.

829

830 **Table 1.** A summary of the χ^2 goodness of fit tests performed, comparing the proportion of individuals
 831 who experience intrusions as part of their disorder, split by disorder and imagery group.

| <i>Disorder</i> | <i>Percentage with intrusive experiences</i> | | χ^2 <i>goodness of fit</i> | <i>p</i> |
|------------------|--|----------------|---------------------------------|----------|
| | <i>Imagers</i> | <i>Aphants</i> | | |
| GAD | 79.2 | 32.5 | 148 | <0.001 |
| Social anxiety | 82.2 | 35.1 | 71.1 | <0.001 |
| OCD | 85.7 | 45.3 | 27.7 | <0.001 |
| PTSD | 92.9 | 43.0 | 86.5 | <0.001 |
| Depression | 73.8 | 33.5 | 119 | <0.001 |
| ED | 87.1 | 46.6 | 71.1 | <0.001 |
| Bipolar Disorder | 93.1 | 50.5 | 21.1 | <0.001 |

832

833

834 *Prevalence of auditory, tactile, body, and emotional intrusions are no different between aphants and*
 835 *imagers; only visual intrusions are more prevalent in imagers*

836 To determine if there are differences in the prevalence of different types of intrusions within
 837 our aphantasia versus control sample, we then split answers to Q8 into visual, auditory, tactile, body,
 838 and emotional intrusions; and split responses into “Yes” (Significantly, Somewhat, A little bit) and “No”
 839 (Not at all) for 2 (aphantasia, imagery) x 2 (yes, no) Bayesian Contingency Tables tests. Note that these
 840 analyses only include individuals who reported having experienced intrusions of some kind
 841 (responded positively to Q7). This analysis revealed extremely strong evidence for a difference in
 842 visual intrusion prevalence between aphants and controls ($BF_{10Poisson} = 1.08e+19$, $N = 594$), whereas
 843 we found no evidence for a difference in auditory ($BF_{10Poisson} = 0.537$, $N = 589$), tactile ($BF_{10Poisson} =$
 844 0.297 , $N = 592$), bodily sensations ($BF_{10Poisson} = 0.187$, $N = 591$), or emotional intrusions ($BF_{10Poisson} =$
 845 0.0916 , $N = 598$). The analysis of emotional intrusions even passed the threshold of strong evidence
 846 for *no* difference in prevalence between groups ($BF_{01Poisson} = 10.9$).

847

848 *Virtually all aphants who reported intrusions experienced emotional intrusions; prevalence of auditory*
 849 *intrusions higher than visual in aphantasia*

850 Within the aphantasia group only, we then performed 2 (visual versus “other modality”) x 4
851 (“Significantly”, “Somewhat”, “A little bit”, “Not at all”) Bayesian Contingency Tables tests to
852 investigate the difference in visual versus other sensory intrusion reports. We found extremely strong
853 evidence for a difference between visual and auditory intrusions ($BF_{10\text{Poisson}} = 459$, $N = 418$), but no
854 evidence for a difference in reports of visual versus body ($BF_{10\text{Poisson}} = 0.0190$, $N = 418$) or visual versus
855 touch intrusions ($BF_{10\text{Poisson}} = 0.0398$, $N = 419$). Next, still within the aphantasia group only, we
856 performed 2 (sensory versus non-sensory) x 4 (“Significantly”, “Somewhat”, “A little bit”, “Not at all”)
857 Bayesian Contingency Tables tests, to investigate the difference between emotional (non-sensory)
858 versus sensory intrusion reports. These tests revealed several cells with fewer than 5 responses:
859 specifically, there were not enough responses for ‘No, not at all’ or ‘A little bit’ for emotional intrusions
860 (i.e., nearly all participants experienced emotional intrusions at least somewhat or significantly), so
861 we could not analyze these contingency tables.

862

863 *Visual versus other-modality intrusions in imagery versus aphantasia: N/A*

864 Finally, we performed the same tests (visual versus “other modality” intrusions) in the control
865 group, to then enter these results as our expected counts comparing the aphantasia group to the
866 control group. However, we were unable to perform these tests because there were not at least 5
867 cells in which imagers responded ‘No, not at all’ or ‘A little bit’ for visual intrusions (i.e., nearly all
868 imagers experienced visual intrusions at least somewhat or significantly).

869

870 *Higher prevalence of intrusions in diagnosed compared to undiagnosed aphants*

871 We conducted a Bayesian contingency tables test within the aphant group who believed they
872 had a mental health condition of some kind, on the proportion of individuals who experienced
873 intrusions as part of their disorder, split by diagnosis status: diagnosed, and did not have trouble

874 receiving a diagnosis; diagnosed, but had trouble receiving a diagnosis in the past; or never diagnosed.
875 This revealed extremely strong evidence for a difference in the prevalence of reported intrusions
876 ($BF_{10\text{Poisson}} = 80.3$, $N = 1363$), with the lowest prevalence of intrusions (22.6%) among undiagnosed
877 individuals, compared to those who did not have trouble receiving a diagnosis (28.6%) and those who
878 were currently diagnosed but had trouble receiving a diagnosis in the past (39.4%). To investigate
879 whether removing individuals who had never received a diagnosis changed the difference in the
880 prevalence of intrusions between aphants and imagers, we then removed the group that had never
881 been diagnosed and re-ran the Bayesian contingency tables test on the prevalence of intrusions
882 between aphants and imagers. This test still revealed extremely strong evidence for a difference
883 between aphants and imagers ($BF_{10\text{Poisson}} = 1.27e+29$, $N = 1498$), with more imagers still experiencing
884 intrusions than aphants (70.8% compared to 29.2%, respectively). We therefore deemed that
885 although individuals with different diagnosis statuses experienced different prevalences of intrusions,
886 this difference did not affect the main finding that aphants are much less likely to experience
887 intrusions compared to imagers.

888

889 *Higher prevalence of intrusions in hypophantasia compared to aphantasia*

890 We conducted a Bayesian contingency tables test within the aphant group who believed they had a
891 mental health condition of some kind, on the proportion of individuals who experienced intrusions as
892 part of their disorder, split by whether the individual reported complete aphantasia (PSI-Q visual rating
893 = 0) or hypophantasia (PSI-Q visual rating between 1-3). This revealed extremely strong evidence for
894 a difference in intrusion prevalence ($BF_{10\text{Poisson}} = 49992$, $N = 1363$), with hypophants being more likely
895 to experience intrusions compared to aphants (41.9% compared to 27.4%, respectively). We therefore
896 re-ran the Bayesian contingency tables test on the difference in intrusion prevalence between aphants
897 and imagers with complete aphants removed, to determine whether the main finding was still intact.
898 This revealed extremely strong evidence for a difference in intrusion prevalence between imagers and

899 hypophants ($BF_{10Poisson} = 7.23e+12$, $N = 613$), with imagers being still more likely to experience
900 intrusions compared to hypophants (74.2% versus 41.9%, respectively). This suggests that even
901 though there is a difference in intrusions experienced by aphants and hypophants, both are much less
902 likely than imagers to experience intrusions as part of their disorder. The imagery group difference in
903 intrusion prevalence was still intact after further removing the data of undiagnosed individuals
904 ($BF_{10Poisson} = 9.76e+11$, $N = 574$), thus suggesting a robust effect of mental imagery ability on the
905 prevalence of intrusions.

906

907 *Reality check – Prevalence of intrusions in individuals who provided contact information only: Group*
908 *difference remains intact*

909 We conducted a Bayesian contingency tables test to determine whether individuals who
910 provided contact information for interview would report a different pattern of responses compared
911 to those who did not. We filtered out individuals who did not provide contact information and re-ran
912 the test for a difference in the prevalence of intrusions between aphants and imagers. This test
913 revealed extremely strong evidence for a difference ($BF_{10Poisson} = 2.65e+24$, $N = 1275$), with imagers
914 consistently showing a higher prevalence of intrusions compared to aphants (75.8% compared to
915 31.1%, respectively).

916

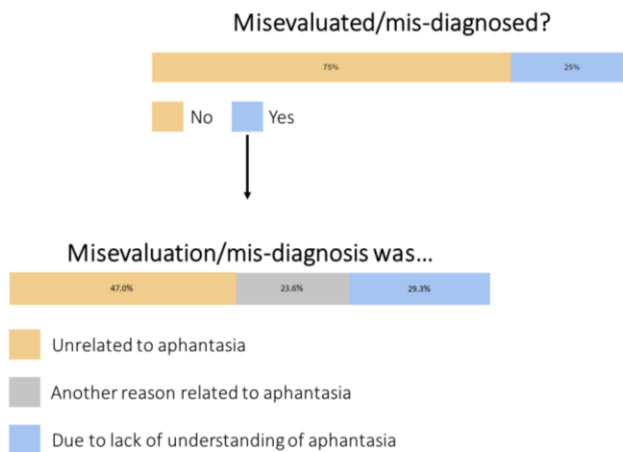
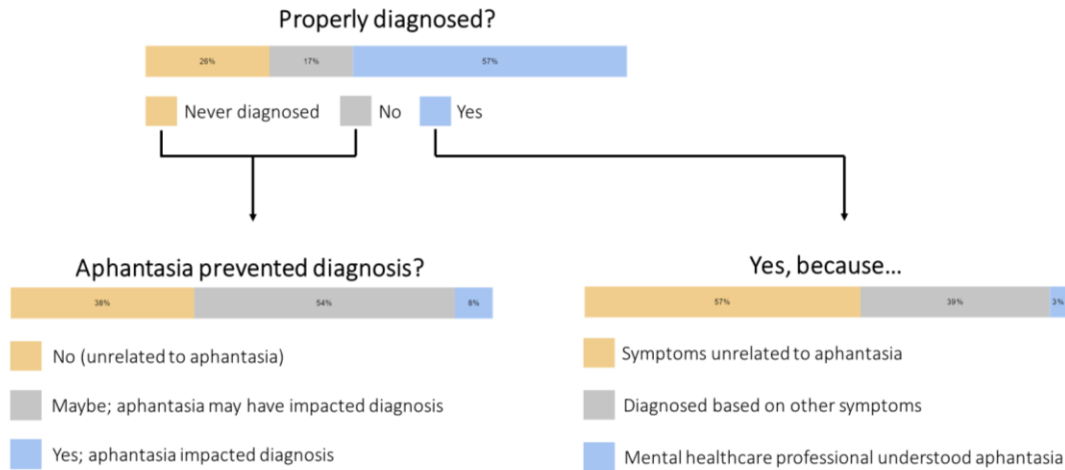
917 ***Hypothesis 2: Aphants will report a perceived “lack of awareness or understanding of aphantasia”***
918 ***as a common factor in mis-evaluation, missed diagnosis, or misdiagnosis by mental health***
919 ***professionals***

920 ***Supported: Yes***

921 To address Hypothesis 2, we first present descriptive statistics from the aphantasia sample for answers
922 to Q6 (Do you think that aphantasia prevented you from being diagnosed in any way?: a. I believe my

923 aphantasia impacted my diagnosis; b. I did not know I had aphantasia at the time, but looking back I
924 believe it may have impacted the diagnosis; c. my issues were unrelated to aphantasia, or I do not
925 have aphantasia), Q9. (Do you believe you were properly diagnosed?), Q10. (If you answered “Yes” to
926 the last question, do you believe you received a diagnosis you agree with because: a) my mental
927 healthcare professional was aware of, and understood, aphantasia; b) my mental health care
928 professional did not understand aphantasia but was able to diagnose me because of other symptoms;
929 c) my condition is unrelated to aphantasia, or I do not have aphantasia), Q11. (Do you believe you
930 have been mis-evaluated and/or mis-diagnosed?), and Q12. (If you answered “Yes” to the last
931 question, do you believe your mis-evaluation/misdiagnosis was: a) because the person assessing me
932 did not understand my aphantasia; b) because of another reason related to aphantasia; c) unrelated
933 to aphantasia, or I do not have aphantasia). The descriptive statistics are graphically summarized in
934 **Figure 3.**

935 **Fig.3**



936

937

To summarize, 57% of aphants who believed they had a mental health condition of some kind
 938 believed they had been properly diagnosed compared to 17% who believed they had not been
 939 properly diagnosed, and 26% who had never received a diagnosis. Among the 57% who felt they were
 940 currently accurately diagnosed, 57% believed their aphantasia was unrelated to their mental health
 941 condition, 39% believed their mental health professional was able to diagnose them based on
 942 symptoms unrelated to aphantasia, and 3% believed they received an accurate diagnosis because their
 943 mental health professional knew about aphantasia and understood how to treat individuals with
 944 aphantasia.

945

Among the 43% of aphants who reported a mental health condition of some kind but believed
 946 they had not been properly diagnosed or had never been diagnosed, 38% believed aphantasia was

947 unrelated to their inability to receive a correct diagnosis. 54% had not known they had aphantasia at
948 the time of diagnosis, but in retrospect, believed that aphantasia may have been related to their
949 inability to receive an accurate diagnosis. 8% knew their aphantasia had contributed to their inability
950 to receive an accurate diagnosis.

951 25% of aphants evaluated for a mental health condition believed they had been misevaluated
952 or mis-diagnosed at some point in their mental healthcare journey. This group included individuals
953 with and without a diagnosis; among those with a diagnosis, this included not only individuals who
954 agreed with their current diagnosis, but also individuals who had had trouble receiving a diagnosis in
955 the past, and also those who did not agree with their current diagnosis. 47% of these individuals
956 believed their misevaluation or misdiagnosis was unrelated to having aphantasia. 29.3% of individuals
957 believed their misevaluation or misdiagnosis was due to a lack of understanding of aphantasia,
958 whereas 23.6% believed their misevaluation or misdiagnosis was related to aphantasia in some other
959 way.

960

961 *No group differences in the prevalence of misevaluations/mis-diagnoses in imagery and aphantasia*

962 We first performed a series of Bayesian contingency tables tests comparing our typical
963 imagery control sample to our aphantasia sample to check whether the rate of missed and mis-
964 diagnoses are similar. First, there was a similar proportion of aphants and imagers who felt they were
965 properly diagnosed, not properly diagnosed, or were undiagnosed at the time of testing ($BF_{10Poisson} =$
966 0.0111 , $N = 2137$). In fact, we found extremely strong evidence for *no* difference between these groups
967 ($BF_{01Poisson} = 89.9$). Aphants and imagers also reported a similar level of misevaluations and mis-
968 diagnoses ($BF_{10Poisson} = 0.0930$, $N = 2022$), and we found strong evidence for no difference between
969 groups ($BF_{01Poisson} = 10.8$). Finally, we found no evidence for a difference in diagnosis status between
970 the two groups (i.e., diagnosed, and had no trouble receiving a diagnosis; diagnosed, but had trouble

971 receiving a diagnosis in the past; never diagnosed with a mental health condition; $BF_{10\text{Poisson}} = 0.902$, N
972 = 1666). However, the null result was only supported by anecdotal evidence ($BF_{01\text{Poisson}} = 1.11$).

973

974 *Aphantasia-related factors are believed to contribute to inaccurate and missed diagnoses, specifically*
975 *a lack of understanding of aphantasia by mental healthcare professionals*

976 We then performed a series of Bayesian Contingency Tables tests within our aphantasia
977 sample, collapsed across disorders. The analyses detailed below target proportions of accurate
978 diagnoses, missed diagnoses, mis-diagnoses, and misevaluations thought to be related or unrelated
979 to aphantasia.

980 To determine whether there was a different proportion of missed- or mis-diagnoses related
981 to aphantasia compared to accurate diagnoses, we first performed a 2 (accurately diagnosed,
982 missed/misdiagnosed) x 2 (related to aphantasia, unrelated to aphantasia) test within our aphantasia
983 sample. This revealed strong evidence that individuals who believed they were accurately diagnosed
984 felt they were able to receive a diagnosis based on factors unrelated to aphantasia, whereas people
985 who believed they were misdiagnosed or had not been diagnosed indicated aphantasia-related factors
986 as a barrier ($BF_{10\text{Poisson}} = 8.43\text{e}+68$, $N = 1390$).

987 We then repeated the analysis, but removed individuals who reported that their missed-/mis-
988 diagnosis was related to aphantasia in some other way, rather than due to a specific lack of
989 understanding of aphantasia by their mental healthcare professional. This again revealed extremely
990 strong evidence for a difference ($BF_{10\text{Poisson}} = 1.69\text{e}+43$, $N = 1294$), in that individuals were likely to
991 attribute an accurate diagnosis to factors unrelated to aphantasia, whereas they were likely to
992 attribute an inaccurate or missed diagnosis to factors related to aphantasia, specifically a lack of
993 understanding of aphantasia.

994

995 *Misdiagnoses more likely attributed to aphantasia-related factors compared to missed diagnoses; a*
996 *lack of understanding of aphantasia is a significant factor in this difference*

997 To determine whether missed or misdiagnoses are differently thought to be due to
998 misunderstandings about aphantasia, we conducted a 2 (missed diagnosis, misdiagnosed) x 2 (due to
999 aphantasia, not due to aphantasia) test. This revealed extremely strong evidence for a difference
1000 ($BF_{10\text{Poisson}} = 3.43e+30$, $N = 565$), in that 57.7% of individuals who felt they were misdiagnosed
1001 attributed their misdiagnosis to aphantasia-related factors, whereas only 7.4% of undiagnosed
1002 individuals who felt they had a mental health condition attributed their lack of a diagnosis to
1003 aphantasia-related factors. This difference remained when only a lack of understanding of aphantasia
1004 was analyzed as the aphantasia-related factor ($BF_{10\text{Poisson}} = 2.62e+22$, $N = 474$).

1005

1006 *Accurate diagnoses that benefited from an understanding of aphantasia by mental healthcare*
1007 *professionals: PTSD*

1008 To find out whether an understanding of aphantasia benefited the accurate diagnosis of
1009 specific disorders, we performed Bayesian Contingency Tables tests on whether aphants were
1010 diagnosed with a certain disorder or not, with responses split by whether individuals believed their
1011 diagnosis benefited from an understanding of aphantasia; whether they could be diagnosed based on
1012 other symptoms; or whether their condition was unrelated to aphantasia. This revealed that the
1013 accurate diagnosis of PTSD benefited from an understanding of aphantasia, and individuals diagnosed
1014 with PTSD were also less likely to say that their condition was unrelated to aphantasia, compared to
1015 other disorders ($BF_{10\text{Poisson}} = 180$, $N = 1031$). The diagnosis of no other specific disorders showed a
1016 benefit over others from an understanding of aphantasia.

1017

1018 *Missed- or mis- diagnoses that were exacerbated by a lack of understanding of aphantasia by mental*
1019 *healthcare professionals: PTSD (anecdotally) for missed diagnoses only*

1020 We then performed a series of Bayesian Contingency Tables tests for different mental health
1021 conditions to determine whether a lack of understanding of aphantasia seemed to contribute more
1022 to misdiagnoses in specific conditions compared to others. These tests revealed no evidence that any
1023 mental health condition over another was more affected by this factor (all $BF_{10\text{Poisson}} < 1.0$). The same
1024 tests performed for missed diagnoses (i.e., in individuals who believed they had a mental health
1025 condition and had sought mental healthcare, but currently remained undiagnosed), revealed
1026 anecdotal evidence that individuals believed their PTSD remained undiagnosed due to aphantasia-
1027 related factors ($BF_{10\text{Poisson}} = 1.26$, $N = 60$). Specifically, 9/15 individuals who believed they had PTSD but
1028 had never been diagnosed with PTSD believed this may have been due to aphantasia-related factors.

1029

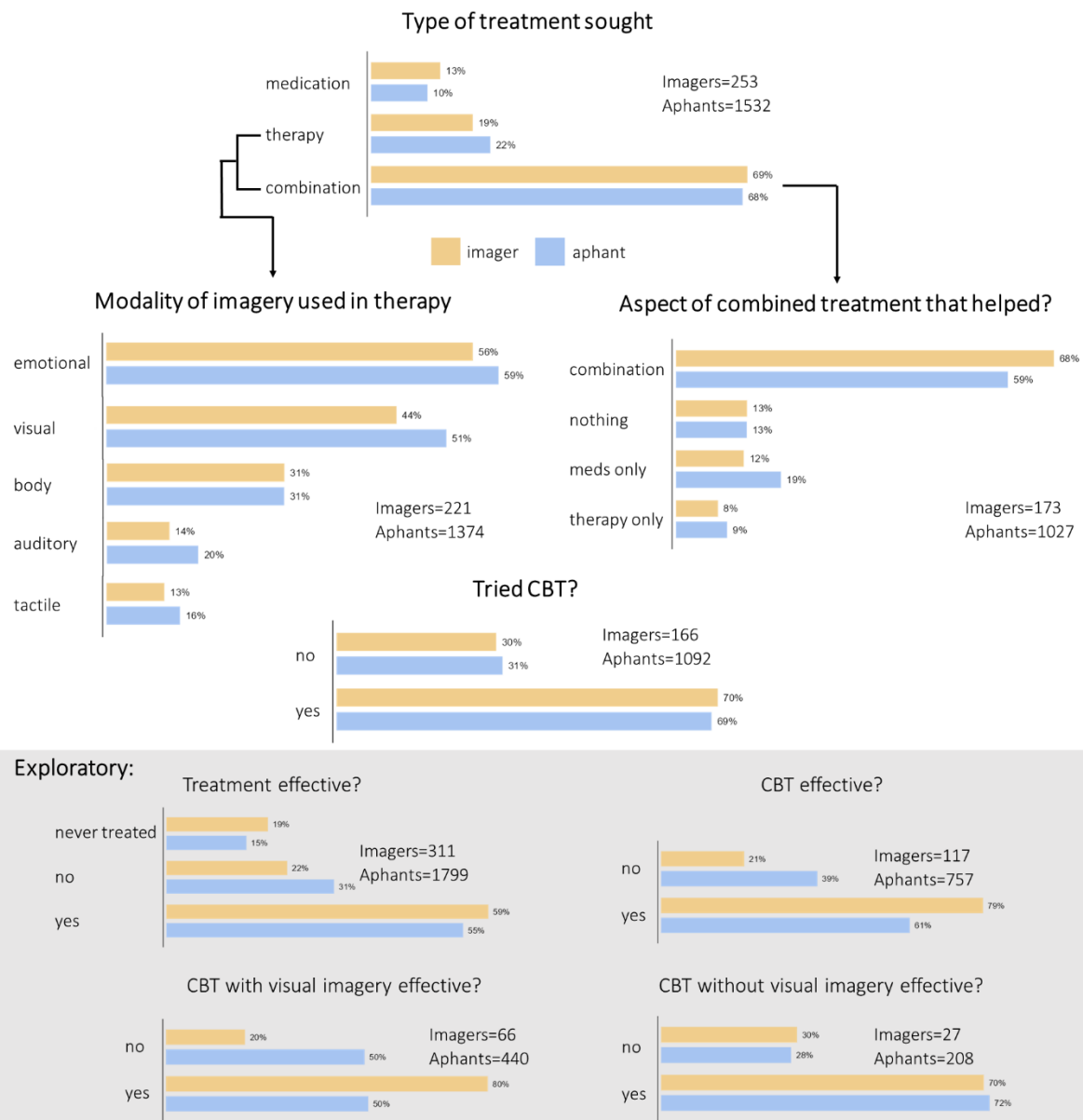
1030 ***Hypothesis 3: Aphants will report that imagery-related therapies (specifically CBT) are ineffective in***
1031 ***their mental health treatment***

1032 ***Supported: Partially – specifically visual imagery-related techniques, including visual imagery***
1033 ***techniques used in CBT, were less effective than non-visual imagery-related techniques in therapy;***
1034 ***imagery-related therapies could still be effective, especially if visual imagery techniques were not***
1035 ***involved***

1036 To address Hypothesis 3, we first present descriptive statistics for aphants and imagers who had
1037 received treatment for a mental health condition, and provided answers to Q17 (I only tried therapy
1038 and it a. helped, b. didn't help), Q18 (I tried a combination of prescribed medication and therapy, and
1039 they a. helped in combination, b. only medication helped, c. only therapy helped, d. nothing helped),
1040 Q19 (The type of therapy I tried included visual imagery exercises), Q20 (The type of therapy I tried

1041 included other types of mental imagery), and/or Q21 (The type of therapy I tried was cognitive
 1042 behavioral therapy – CBT). The graphical summary of these responses can be found in **Figure 4**.

1043 **Fig.4**



1044

1045 In summary, both aphants and imagers were most likely to have tried a combination of
 1046 medication and therapy in their mental health treatment, followed by only therapy, and then only
 1047 medication. Among individuals who had tried a combination of treatments, both aphants and imagers
 1048 reported that the combination of treatments helped the most, followed by medication only, then
 1049 therapy only, in that order. 13% of both aphants and imagers who tried a combination of treatments

1050 indicated that nothing helped. Among the individuals who had tried therapy either in combination
1051 with medication or on its own, both aphants and imagers reported that emotional imagery was the
1052 most common modality of imagery used in therapeutic exercises, followed by visual, body, auditory,
1053 and tactile imagery, in that order. Finally, more than two thirds of both aphants and imagers whose
1054 treatment included a form of therapy, had tried CBT.

1055 Due to the unexpectedly high number of respondents who had tried CBT (166 imagers and
1056 1092 aphants), we included additional, exploratory descriptive statistics at the bottom of Figure 4. For
1057 aphants and imagers who had tried any form of treatment, there were more individuals from both
1058 groups who indicated that their treatment had been effective rather than ineffective; among those
1059 who had tried CBT, more individuals from both groups reported that CBT was effective compared to
1060 ineffective. If CBT exercises included a visual imagery component, an equal number of aphants
1061 considered it effective versus ineffective, whereas more imagers considered CBT with visual imagery
1062 effective. If individuals took part in CBT without a visual imagery component, more than two thirds of
1063 each group felt that it was effective.

1064

1065 *Among aphants, therapy including mental imagery techniques are considered less effective than*
1066 *therapy including imagery in any modality*

1067 To determine whether there is a difference in effectiveness between therapy that included
1068 imagery techniques versus non-imagery techniques among our aphantasia group, we first conducted
1069 a 2 (imagery, no-imagery) x 2 (effective, ineffective) Bayesian Contingency Tables test among
1070 individuals with aphantasia, collapsed across disorders. This revealed extremely strong evidence for a
1071 difference in the effectiveness of therapy ($BF_{10\text{Poisson}} = 1.06e+6$; $N = 1355$). Specifically, more aphants
1072 felt their treatment was effective if therapy did not include an imagery component, compared to those
1073 whose therapy did include imagery techniques in one or more modalities.

1074

1075 *Among aphants, visual imagery techniques used in therapy are considered less effective than imagery*
1076 *techniques in other modalities*

1077 We then performed a 2 (visual imagery-based, other imagery-based) x 2 (effective, ineffective)
1078 Bayesian Contingency Tables test to find out whether therapies that use other modalities of imagery
1079 (i.e., auditory, tactile, body, emotional) are considered more effective than visual imagery therapies.
1080 Because several individuals reported multiple imagery modalities used in therapy, we first split groups
1081 into those who reported techniques that used any visual imagery (including visual-only and visual-
1082 combined) versus any non-visual imagery modality. This test revealed extremely strong evidence for
1083 a difference in therapy effectiveness ($BF_{10\text{Poisson}} = 7.76e+10$, $N = 1019$), with aphants finding therapy
1084 more effective if imagery techniques were non-visual. We then repeated the test with groups split by
1085 those who used only visual imagery techniques in therapy, versus those that used any non-visual
1086 imagery techniques. This test also revealed extremely strong evidence for a difference in the same
1087 direction ($BF_{10\text{Poisson}} = 225$, $N = 412$).

1088

1089 *Among aphants, CBT is less effective than other forms of therapy*

1090 Next, we conducted a 2 (CBT, other therapy) x 2 (effective, ineffective) test for CBT
1091 effectiveness versus other forms of therapy. This revealed extremely strong evidence for a difference
1092 in effectiveness ($BF_{10\text{Poisson}} = 1963$, $N = 1092$), in that aphants felt their therapy was more effective if it
1093 did not include CBT.

1094

1095 *Among aphants who tried CBT, imagery techniques are considered less effective than non-imagery*
1096 *techniques; visual imagery techniques are considered less effective than non-visual imagery techniques*

1097 We then split the group who reported having tried CBT into those that also tried imagery
 1098 techniques in any modality versus those that did not use imagery techniques as part of their therapy.
 1099 The 2 (CBT with imagery, CBT without imagery) x 2 (effective, ineffective) revealed extremely strong
 1100 evidence for a difference in CBT effectiveness ($BF_{10\text{Poisson}} = 1471, N = 757$), in that CBT was considered
 1101 effective more often if it did not include imagery techniques. Among those that reported using
 1102 imagery techniques of some kind in CBT, non-visual imagery techniques were considered more
 1103 effective than visual imagery techniques ($BF_{10\text{Poisson}} = 1.27e+7, N = 599$).

1104

1105 *Imagery, visual imagery, CBT, CBT and imagery, and CBT and visual imagery techniques less effective*
 1106 *in therapy for aphants compared to imagers*

1107 Finally, we performed the same series of 2 x 2 tests within the control group, and input their
 1108 observed proportions of therapy effectiveness as expected values in a χ^2 goodness-of-fit test (this was
 1109 mistakenly referred to as a Multinomial Test in the methods). The results are summarized in **Table 2.**

1110

1111 **Table 2.** A summary of the χ^2 goodness of fit tests performed, comparing the proportion of individuals
 1112 from the aphant versus imagery group who felt imagery techniques in therapy were effective.

| <i>Technique</i> | <i>Percentage who found it effective</i> | | <i>χ^2 goodness of fit</i> | <i>p</i> |
|------------------------|--|----------------|--|----------|
| | <i>Imagers</i> | <i>Aphants</i> | | |
| Imagery | 75.6 | 59.4 | 17.1 | <0.001 |
| Non-Imagery | 66.1 | 76.2 | 3.47 | =0.063 |
| Visual Imagery | 77.9 | 54.1 | 21.7 | <0.001 |
| Non-Visual Imagery | 69.1 | 75.5 | 2.72 | =0.099 |
| CBT | 79.5 | 61.4 | 16.1 | <0.001 |
| Non-CBT | 65.3 | 74.9 | 2.40 | =0.121 |
| CBT Imagery | 78.9 | 57.6 | 16.7 | <0.001 |
| CBT Non-Imagery | 81.5 | 75.9 | 0.46 | =0.498 |
| CBT Visual Imagery | 80.3 | 50.5 | 23.5 | <0.001 |
| CBT Non-Visual Imagery | 78.4 | 77.4 | 0.03 | =0.860 |

1113

1114 These tests revealed significant differences between aphants and imagers in the effectiveness of
 1115 different techniques used in therapy. Specifically, therapies that included mental imagery, visual
 1116 imagery, CBT, CBT and imagery, and CBT and visual imagery techniques were all considered less
 1117 effective for aphants compared to imagers. On the other hand, therapies that used no imagery,
 1118 nonvisual imagery, non-CBT, CBT without imagery, and CBT with nonvisual imagery were all
 1119 considered similarly effective for aphants and imagers.

1120

1121 *The efficacy of CBT for different mental health conditions*

1122 Because we obtained a high number of respondents who had tried CBT, we were able to look
 1123 at the effectiveness of CBT across different mental health conditions. The results are summarized in
 1124 **Table 3.**

1125 Table 3. Summarizing the percentage of individuals who found CBT effective for all mental health
 1126 conditions together, and individually for each mental health condition separately. Bayes Factors
 1127 indicate whether imagers and aphants found CBT differently effective.

| <i>Condition</i> | <i>Percentage who found CBT effective</i> | | | <i>BF_{10Poisson}</i> | <i>N</i> | | |
|------------------|---|----------------|----------------|-------------------------------|----------------|----------------|--------------|
| | <i>Total</i> | <i>Imagers</i> | <i>Aphants</i> | | <i>Imagers</i> | <i>Aphants</i> | <i>Total</i> |
| All | 63.8 | 79.5 | 61.4 | 214 | 117 | 757 | 874 |
| GAD | 63.9 | 77.9 | 61.7 | 6.88 | 77 | 486 | 563 |
| Social anxiety | 57.3 | 77.1 | 54.4 | 5.29 | 35 | 239 | 274 |
| Depression | 64.7 | 82.6 | 62.0 | 209 | 86 | 579 | 665 |
| PTSD | 59.1 | 80.4 | 55.0 | 46.7 | 46 | 240 | 286 |
| ED | 50.4 | 82.4 | 45.7 | N/A ¹ | 17 | 116 | 133 |
| Body dysmorphia | 54.2 | 80.0 | 50.0 | N/A | 10 | 62 | 72 |
| Schizophrenia | N/A | N/A | N/A | N/A | 3 | 4 | 7 |
| Bipolar disorder | 66.2 | 84.6 | 61.5 | N/A | 13 | 52 | 65 |
| DID | N/A | N/A | N/A | N/A | 2 | 33 | 35 |
| OCD | 60.0 | 75.0 | 55.8 | 1.52 | 24 | 86 | 110 |
| BPD | N/A | N/A | N/A | N/A | 3 | 53 | 56 |

1128 ¹N/A under *BF_{10Poisson}* indicates that there were not at least 5 observations per cell for Contingency
 1129 Tables tests. N/A under percentages indicates that there were not at least 5 observations for that cell.

1130

1131 In summary, imagers found CBT generally more effective than aphants, with a success rate of 79.5%
 1132 in imagers compared to 61.4% in aphants; this led to a significant difference in effectiveness in a

1133 Bayesian Contingency Tables test ($BF_{10\text{Poisson}} = 214, N = 874$). Broken down for each mental health
1134 condition, we only found moderate evidence for a difference in CBT effectiveness for generalized
1135 (GAD; $BF_{10\text{Poisson}} = 6.88, N = 563$) and social anxiety disorders ($BF_{10\text{Poisson}} = 5.29, N = 274$). We found
1136 extremely strong evidence for a group difference in CBT effectiveness for both depression ($BF_{10\text{Poisson}}$
1137 $= 209, N = 665$) and PTSD ($BF_{10\text{Poisson}} = 46.7, N = 286$). We found anecdotal evidence for a group
1138 difference in CBT effectiveness for OCD ($BF_{10\text{Poisson}} = 1.52, N = 110$). There were not enough
1139 observations per cell to analyze any other mental health condition.

1140

1141 ***Limitations of the registered quantitative analyses***

1142 The single most important caveat in interpreting the quantitative results is that mental health journeys
1143 are incredibly complex, and are unique experiences to the individual. As just a few examples, a single
1144 individual may have several comorbid mental health conditions, some of which are diagnosed and
1145 others not; they may have tried multiple types of therapies with varying amounts of success for one
1146 or more conditions; or they may develop different conditions at different points over a lifetime. All
1147 this to say that a single questionnaire cannot capture these complexities, and it is not possible to know
1148 on which specific conditions and which specific therapies the current results reflect. Interestingly, and
1149 unexpectedly, we received a large number of open comments from respondents to the questionnaire,
1150 detailing various aspects of their mental health journeys. Given the limitations of the questionnaire,
1151 we felt it would be important to perform an additional, exploratory analysis on these comments, to
1152 better understand this complex and individualized experience.

1153

1154 ***Conflict of interest statement***

1155 The authors declare no conflicts of interest, and no author will receive a financial advantage from the
1156 direction of any result in this work.

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