EXPLORATORY STUDY OF THE LINK BETWEEN APHANTASIA AND INTEROCEPTIVE SKILLS

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Abstract

Introduction: Aphantasia, the absence or marked reduction of mental imagery (Zeman et al., 2024), provides an opportunity to investigate how mental imagery contributes to bodily self-representation and interoception, defined as the perception and regulation of internal bodily signals (Garfinkel et al., 2015). Preliminary findings indicate reduced physiological reactivity, reduced emotional response and reduced attention to bodily cues in aphantasia (Wicken et al., 2021; Monzel et al., 2024). However, empirical investigations are limited. This study aimed to investigate whether aphantasia is associated with specific characteristics in three dimensions of interoception (accuracy, sensibility, awareness; according to the tridimensional interoceptive model of Garfinkel et al., 2015). *Methods:* Thirty-three healthy adults were divided into two groups: 9 aphantasic participants (4 women; M_{age}=34.22, M_{VVIQ}=32) and 24 controls (20 women; M_{age}=35.00, M_{VVIQ}=127.71). Group classification was based on the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973), which assesses the clarity, detail, and lifelike quality of mental images. All participants completed the Body Perception Questionnaire (BPQ; Porges, 1993) and the Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012) to evaluate interoceptive sensibility, the Heartbeat Counting Task (HBC) to measure interoceptive accuracy, and confidence ratings to assess interoceptive awareness. *Results:* Compared to controls, the aphantasic group exhibited significantly lower interoceptive accuracy (W=35, p=.003, rrb= -.676), reduced sensibility in BPQ (W=9.0, p <.001, rrb= -.917), and diminished scores on five of eight MAIA subscales (all p <.01). Regarding interoceptive awareness, a significant correlation was observed between interoceptive accuracy and confidence levels in the control group (r=.643; p < .001) but not in the aphantasic group (r= -.183; p=.638). VVIQ scores correlated positively with sensibility in BPQ (r=.791, p < .001) and in five MAIA dimensions (r=.502–.689, p <.01) and with interoceptive accuracy (r=.595, p < .001). *Conclusion:* These findings indicate that reduced visual imagery vividness in aphantasia is associated with lower interoceptive accuracy and sensibility, suggesting a link between imagery vividness and multiple interoceptive dimensions. Moreover, interoceptive awareness (i.e., reflecting the congruence between confidence and performance) appears also affected by imagery deficits, suggesting an underestimation of accuracy skills by aphantasics.

Keywords: *Aphantasia, visual imagery, interoception, heartbeat counting task.*

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1. Introduction

Mental imagery, defined as the ability to generate mental experiences in the absence of external sensory input, exhibits considerable interindividual variability. While most individuals experience imagery with moderate vividness, a subset of the population reports either an almost complete absence of mental imagery called aphantasia (Zeman, 2024). Aphantasia, estimated to reach around 1% of the population, is often familial. Although aphantasia is typically defined as the absence of visual imagery, it can also extend to other sensory modalities and, in some individuals, encompass all forms of sensory imagery (Zeman, 2024). Individuals with aphantasia often report difficulties, or even an inability, in generating mental pictures of people, places, or events, instead relying on factual or semantic representations (Milton et al., 2021). It has been associated with reduced autobiographical memory and face recognition difficulties, suggesting a multifaceted neurocognitive basis (Monzel et al., 2024; Wicken et al., 2021; Zeman, 2024). However, its implications for interoception remain underexplored. Indeed, more recent perspectives propose that vivid mental imagery also depends on the integration of interoceptive information into sensory and cognitive representations (Silvanto & Nagai, 2025). Interoception, defined as the perception and representation of internal bodily states, contributes critically to emotional awareness, self-referential processing, and subjective experience (Critchley & Garfinkel, 2017). According to Garfinkel et al. (2015), interoception can be characterized along three dimensions: interoceptive accuracy, referring to objective performance in tasks such as heartbeat counting task (Schandry, 1981); interoceptive sensibility, which captures subjective beliefs or attention to internal signals; and interoceptive awareness, reflecting the metacognitive correspondence between accuracy and confidence in one's interoceptive judgments. Previous studies suggest that mental imagery can be understood as the integration of sensory and interoceptive signals, and aphantasia may reflect a disruption in this integration, which could explain its links to reduced autobiographical memory, emotion perception, and traits such as autism, alexithymia, and dyspraxia (Silvanto & Nagai, 2025). Integrating this framework, this study examined whether the absence of visual imagery in aphantasia is associated with reduced interoceptive accuracy, sensibility and awareness, combining behavioral tasks and self-report measures.

2. Methodology

2.1. Participants

Thirty-three healthy French-speaking adults participated in this study divided into two groups according to the *Vividness of Visual Imagery Questionnaire* score (VVIQ; Marks, 1973). This questionnaire measures the vividness and clarity of visual mental imagery through 16 items in two conditions (closed eyes and open eyes condition) in which participants rate, on a 5-point Likert scale, how clearly, they can visualize specific scenes, objects, or familiar people. The score of 32 was taken as the threshold indicating the absence of visual mental imagery. Therefore, the first group consisted of 9 individuals with aphantasia (APH; 4 women; M_{VVIQ}=32; SD_{VVIQ}=*0*) and the second group of 24 controls with typical imagery (CTRL; 20 women; M_{VVIQ}=127.71; SD_{VVIQ}=*11.89*) matched for age (W=107.5; p=1.000; M_{APH}=34.22; M_{CTRL}=35) and education level (W=107.5; p=1.000; M_{APH}=14; M_{CTRL}=14.33). Two control participants with unusually low VVIQ scores (≤ 80) were identified as outliers and excluded from the analyses. Inclusion criteria were the absence of neurological, psychiatric, or neurodevelopmental disorders, substance abuse, uncorrected sensory deficits, and being a native French speaker. To assess cognitive functioning, participants completed four subtests (Matrix Reasoning, Arithmetic, Coding, Information) of the WAIS-IV (Wechsler, 2008). Participants with a score below a standard score of 7 on one of subtests were excluded. No significant difference between the groups was observed on the four subtests. Anxiety was assessed using the STAI-Y (Spielberger, 1983); participants scoring ≥ 40 on either subscale were excluded. No significant difference between the groups was observed on the scale State (W=116; p=.760) and the scale Trait (W=113.5; p=.837). Each participant signed a written informed consent form in accordance with the Declaration of Helsinki and the General Data Protection Regulation (GDPR) (European Parliament, 2016). An information letter outlining the aims and requirements of the study was given to each participant.

2.2. Material

The HeartBeat Counting task (HBC; Schandry, 1981) is used to assess objectively the **interoceptive accuracy.** The participants should count each heartbeat they feel in your body. There were six trials at different times: 25,30,35,40,45 et 50s. The real beats were evaluated by a pulse oximeter. An accuracy score: 1 − (|nbeatsreal − nbeatsreported|)/((nbeatsreal + nbeatsreported)/2) is calculated for each trial and then an average is calculated over the 6 trials. The accuracy score is between 0 (low interoceptive accuracy) and 1 (high interoceptive accuracy). The participants also judged their confidence in interoceptive accuracy after the task on Likert scale from 1 to 7. This subjective data is used to assess **interoceptive sensitivity** in addition to two questionnaires: Body Perception Questionnaire (BPQ; Porges, 1993) and the Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012). The former assesses subjective perception of internal body sensations (Mehling et al., 2012; Porges, 2003). The latter assesses subjective metacognition interoception. This questionnaire is composed of 8 subscales (noticing, not-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening and trusting. Finally, **interoceptive awareness** involves combining objective measures of interoceptive accuracy (e.g., heartbeat counting performance) with subjective confidence ratings to examine the relationship between perceived and actual interoceptive ability (i.e., congruence between confidence ratings and HBC accuracy; Garfinkel et al., 2015). This subjective score was then correlated with the average accuracy score for estimate the interoceptive awareness. The closer r is to 1, the more confidence is adjusted to the actual performance, indicating a high level of interoceptive awareness.

3. Results

Intergroup comparisons using Mann–Whitney tests revealed that, aphantasics showed higher difference between reported beats and real beats for the interoceptive accuracy (M_{APH}=.55, SD_{APH}=.20) than controls (M_{CTRL}=.79, SD_{CTRL}=.09; W=35, p=.003, rrb=-.676). For the interoceptive sensibility, aphantasics showed significantly lower scores in confidence judgements of the HBC task (M_{APH}=1.44, SD_{APH}= .53) compared to controls (M_{CTRL}=3.63, SD_{CTRL}=1.47; W=18.5, p <.001, *rrb*=-.829). For the questionnaire, aphantasics' scores were significantly lower in BPQ (M_{APH}=78.44, SD_{APH}=20.45) compared to controls (M_{CTRL}=114.38, SD_{CTRL}=9.17; W=9.0, p <.001, *rrb*= −.917) and also at five subscale of MAIA (*noticing* (p=.001), *attention regulation* (p=.009), *emotional awareness* (p=.008), *self-regulation* (p=.006) and *body listening* (p=.007)). However, there was no significant difference for subscale *not-distracting* (p=.156), *not-worrying* (p=.453), and *trusting* (p=.178). In terms of interoceptive awareness, a significant correlation was observed between interoceptive accuracy and confidence levels in the control group (r=.643; p<.001) but not in the aphantasic group (r=-.183; p=.638). Correlation analyses across the full sample revealed strong associations between VVIQ scores and accuracy (r=.595, p < .001), interoceptive sensibility in confidence rating (r=.544, p=.001), in BPQ (r=.791, p <.001), and in five MAIA subscales (r = .502–.689, all p < .01). Regression analyses confirmed that imagery vividness significantly predicted variance in accuracy (R^2 = .299), in sensibility with BPQ (R^2 = .626), confidence rate (R^2 = .296) and MAIA subscales (R^2 = .252–.474, all p < .01).

4. Discussion

The findings demonstrate that reduced imagery vividness in aphantasia is associated with diminished interoceptive accuracy and sensibility (evaluated by auto-reported questionnaire and confidence score at the HBC), supporting the hypothesis of a functional link between visual mental imagery and internal bodily perception. The present findings show also a dissociation between objective and subjective measures of interoception in aphantasia. While controls displayed a significant positive correlation between interoceptive accuracy and confidence, indicating that more accurate participants felt more confident, this relationship was absent and even slightly negative in the aphantasic group. This pattern suggests that aphantasics may experience impaired interoceptive metacognition. Empirical findings also support the idea that aphantasia involves atypical metacognitive functioning in general. Aphantasics show reduced confidence in memory and associative imagery tasks, even when their objective performance is intact (Wittmann & Şatırer, 2022). These results are aligned with recent models proposing shared neural bases between imagery, interoception, and self-monitoring (Silvanto & Nagai, 2025). Together, these results suggest that visual imagery contributes not only to sensory representation but also to metacognitive awareness of bodily states. However, the small sample size and gender imbalance limit generalization, warranting replication with larger and more diverse cohorts. Future research should adopt longitudinal and neuroimaging approaches to clarify causal pathways and explore whether interventions such as mindfulness training or biofeedback can improve interoceptive competence in aphantasia.

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