Pupillometry investigation in extremes of imagination

Close your eyes and think of enjoying a meal with friends. Can you picture the table? Can you hear the murmur of conversation? Music playing in the background? Can you smell and taste the cake in the oven? Can you feel the cutlery in your hands? The contact of the back of the chair with your shoulders? Everyone of us will have imagined this differently. Some will have experienced these mental representations in full immersion reality: as though they are living the moment. They see the image, they hear the sounds, they smell and taste the foods and they feel the touch and movement of their bodies in the scene. Others may have experienced only the sounds. Intellectually they 'know' the experience but there were no images. That may hold true for all of these sensory modalities.

Aphantasia a definition: Aphantasia is the term coined by Adam Zeman to describe "reduced or absent voluntary imagery" (p.379); the inability to visualize "in the mind's eye" (Zeman, Dewar, & Della Sala, 2015). It is estimated that around 2 - 6% of individuals do not experience any mental representations (Watkins, 2018). Everything is dark and silent, but still there is a 'knowing'. At the other extreme of visual imagery, a similar proportion of the population have 'hyperphantasia' (imagery that is 'as vivid as real seeing') (Zeman et al., 2015). The Vividness of Visual Imagery Questionnaire (VVIQ) (Marks, 1973), has been shown to distinguish individuals with aphantasia from the general population. This questionnaire and newer variants are the gold standard for the identification of aphantasia.

What are the unanswered questions about aphantasia? As the research in this domain is in its infancy, there are many unanswered questions. To date all research has been in English. It is unknown if these results will replicate across language or culture. The focus has been entirely on visual imagery, as such there is little information regarding other modes of mental representation.

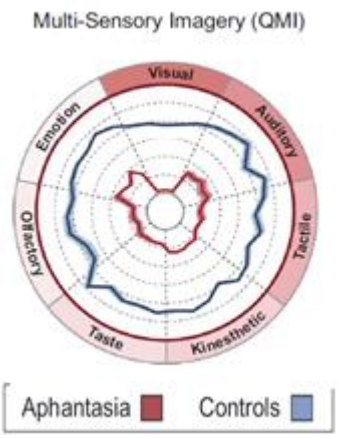

Figure 1 : Group differences in visual imagery ability on scale sub-components. Radar plots for multisensory imagery (Dawes, Keogh, Andrillon, & Pearson, 2020)

The primary questionnaire used to assess aphantasia (VVIQ) is vision-specific. More recent research has used a more general measure, the Questionnaire upon Mental Imagery (QMI). However, this has yet to be validated as a tool for the identification of aphantasia across other modalities.

Origins and links to comorbid conditions. It is possible that imagery is (like most psychological variables) normally distributed across the population (Taine, 1870; Galton, 1880). Individuals with aphantasia and hyperphantasia may represent the two extremes of this continuum. Indeed, individual differences in perception are variable and evident across a range of perceptions (e.g., touch, sound, smell/taste). More recent work has explored individual differences in auditory imagery, typically in the form of the « inner voice » (Alderson-Day & Fernyhough, 2015). Overall, the median inner speech frequency in most experience sampling studies is 20% (Hurlburt et al., 2013). However, there is broad interindividual variability, with some individuals reporting zero frequency of inner speaking episodes when randomly probed, and others reporting inner speaking 100% of the probed times (Mihelic, 2010; Heavey and Hurlburt, 2008). Other modalities of imagery (olfactive, tactile, kinesthesic) remain to be investigated.

Development, validation and deployment of non-introspective (objective) markers of aphantasia and hyper-phantasia for visual modalities. Until recently, the diagnosis of aphantasia relied solely on self-report and subjective clinical scales (primarily VVIQ) which are by definition, subjective and as such prone to methodological bias (see for example, Kreitchmann, Abad, Ponsoda, Nieto, & Morillo, 2019; Kuncel & Tellegen, 2009).
Attempts at providing objective measurements of aphantasia have recently been made, however. Keogh & Pearson (2018) demonstrated priming effects related to phantom perception (the many conscious experiences that do not rely on retinal stimulation: hallucinations, mental imagery, perceptual filling-in, synaesthesia, pareidolia and other visual illusion (Pearson & Westbrook, 2015)) that were not present in individuals with aphantasia.

The goal of the project will be to 1) replicate the works of (Kay, Keogh, Andrillion, & Pearson, 2021) that show an absence of pupil response to lightness imaging. 2) adapt the work of lamirel and collaborators (Lamirel et al., 2018) to find if imagery can modulate pupil cycle time.

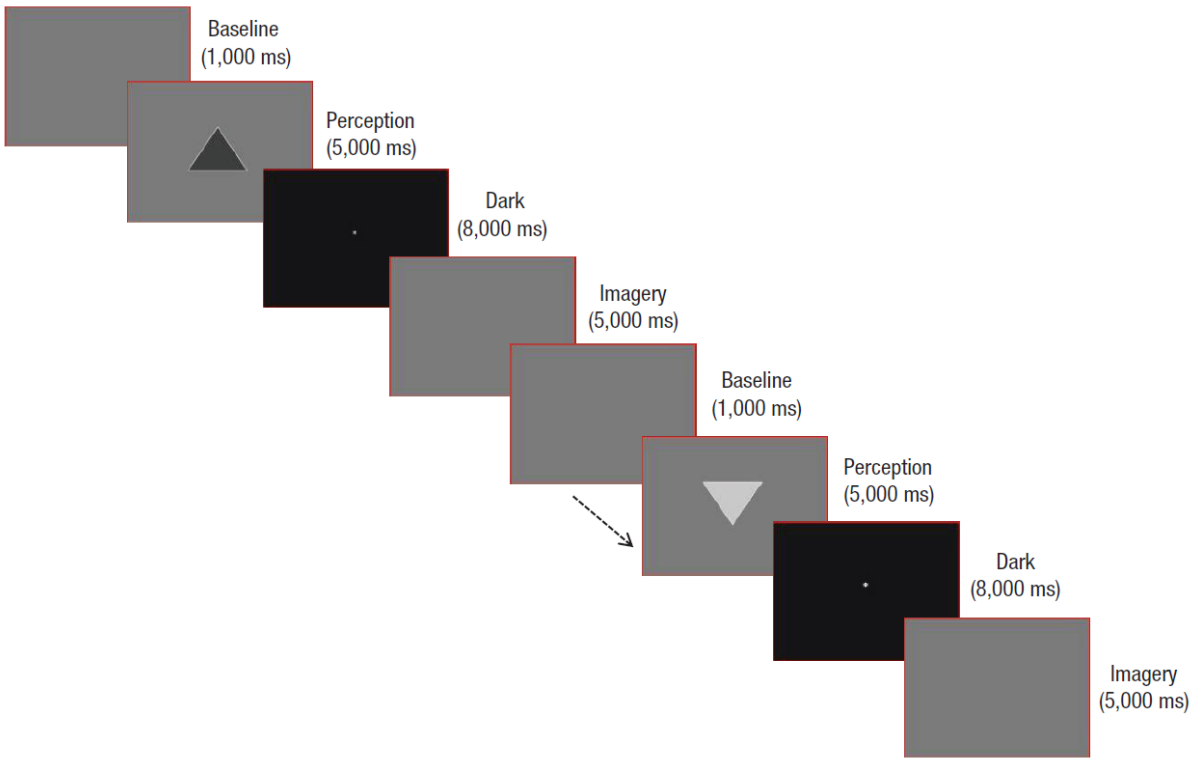

Figure 2: Schematic illustrating the experimental paradigm. After a measurement of baseline pupil diameter during presentation of an empty (from Laeng and Sulutvedt, 2014)

The candidate will be responsible in part for the development of objective measures of aphantasia in visual modalities and eventually the adaptation of these measures for use online. It is expected this will involve the use of software programs such as, *matlab*, *limesurvey* and *python.*

The doc candidate will be responsible for the management of the experimental procedures. This includes the efficient management of the online process. They will also be responsible for the recruitment and the ethical management of the participants and the associated data.

Importantly the candidate will establish a database of individuals with aphantasia, hyperphantasia and controls that would be interested in being involved in further research.

The candidate must have coding skills (Matlab or Python are preferable), signal processingexperimental or physiological experience will appreciated. It is mandatory to have a strong interest in research and a will to pursue in a PhD.

The internship will be directed by Alan Chauvin (LPNC, UGA) and Nathalie Guyader (Gipsa-Lab, UGA) in close collaboration with Hélène Loevenbruck (LPNC, UGA) and Nicole Huson (LPNC associate, UGA)

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