REPRESENTATIONAL COMPETENCY, VISUOSPATIAL ABILITY, AND METAL IMAGERY: AN EXPLORATORY STUDY

Lauren Baade[a], Gwen Lawrie[a], Effie Kartsonaki[a], Hassan Khosravi[b]

Presenting Author: Lauren Baade (l.baade@uq.edu.au)
[a]School of Chemistry and Molecular Biosciences, The University of Queensland, Brisbane, Queensland, 4072, Australia
[b]Institute for Teaching and Learning Innovation, The University of Queensland, Brisbane, Queensland, 4072, Australia

KEYWORDS: mental imagery, representational competency, visuospatial ability

SUBTHEME: Equity, Diversity and Inclusion

In chemistry, students' ability to interpret and translate between different representations – known as representational competences – is critical for learning. These enable students to form internal representations that integrate with prior perceptual or conceptual knowledge, allowing them to develop mental models that support problem-solving and decision-making (Rau, 2017). Additionally, visuospatial abilities related to interpreting chemical representations are considered essential for the development of expertise in chemistry. Traditionally, it is assumed that all chemists develop the ability to "see" chemistry in their mind (Kozma & Russell, 2005). However, this notion is challenged by 'aphantasia', which describes the inability by an individual to form visual mental images and is estimated to affect 2-4% of the population (Dance et al., 2022).

Prior research indicates that novice chemistry students rely on imagistic strategies when solving visuospatial problems, but shift towards analytical methods as they gain expertise (Hegarty et al., 2013). However, experts may still use imagistic approaches depending on the nature of the task and personal preference (Stieff & Raje, 2010). Interestingly, there is no conclusive evidence that analytical strategies are always superior to imagistic in solving chemistry problems, despite the former being more prevalent among experts. Nonetheless, question arises of where aphantasic students are situated in relation to the imagistic/analytic dichotomoy.

As part of a doctoral research project, several questions under investigation include: Are aphantasic chemistry students capable of using imagistic strategies? Does apahantasia effect students' representational competencies? Are there implications of inclusivity in assessment for students who lack, or have low, visual mental imagery? This presentation will share insights from several studies involving university chemistry students who have varying degrees of visualisation abilities. Quantitative and qualitative data have been analysed. The significance of diversity in visual mental imagery will be discussed in terms of inclusive teaching approaches.

REFERENCES

Dance, C. J., Ipser, A., & Simner, J. (2022). The prevalence of aphantasia (imagery weakness) in the general population. *Consciousness and Cognition*, *97*, 103243.

Hegarty, M., Stieff, M., & Dixon, B. L. (2013). Cognitive change in mental models with experience in the domain of organic chemistry. *Journal of Cognitive Psychology*, *25*(2), 220-228.

Kozma, R., & Russell, J. (2005). Students becoming chemists: Developing representational competence. *Visualization in science education*, *1*, 121-146.

Rau, M. A. (2017). Conditions for the effectiveness of multiple visual representations in enhancing STEM learning. *Educational Psychology Review*, *29*, 717-761.

Stieff, M., & Raje, S. (2010). Expert algorithmic and imagistic problem solving strategies in advanced chemistry. *Spatial Cognition & Computation*, *10*(1), 53-81.