Visual Spatial Tasks Predict Visual Spatial Talent & Mathematical Giftedness

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Could the Impossible Figures Task Predict Mathematical Giftedness?

There are numerous predictors of giftedness and talent. Here we focus on two: The Impossible Figures Tasks and Mental Rotation.

The Impossible Figures Task

During the The Impossible Figures Task, (IFT) participants are presented with line drawings of objects that are either possible (could exist in 3D space) or impossible (could not exist in 3D space (see figure 1). The IFT was designed to measure holistic or global perception (von Karolyi, 2001). Although priming experiments employed impossible figures more than 20 years ago (Schacter, Cooper, & Delany, 1990), it was discovered more recently that an Impossible Figures Task could also be used to predict visual-spatial talent (von Karolyi, 2001). On the original version of the IFT, Lim, Asay, and von Karolyi (2011) found students in spatial majors (Art, Physics, and Astronomy) outperformed students in an aspatial major (Psychology). Chan, (2007, 2008, 2009, 2010) also found, on his variants of the IFT, that students in spatial majors (Fine Arts and Architecture) outperformed those in aspatial majors (Social Sciences, English, Education). It is noteworthy that Chan (2010) also found a positive association between performance on the IFT and performance on Mental Rotation Tasks.

Mental Rotation

During Mental Rotation (MR) tasks, participants are presented with drawings of either a 2D or 3D object and are challenged to select an option that correctly represents the object as seen from another angle (see figure 2). The relationship between Mental Rotation and Mathematical giftedness is so well established that talent search programs use them to select participants (Gallagher, 1992; Stumpf & Eliot, 1999). Mental rotation calls upon geometric thinking (Battista, 1990). Thus one might speculate that geometric thinking abilities underlie at least some of the association between mental rotation and mathematical giftedness. In general, tasks calling upon 3D visualization are known to be more difficult than are those calling on 2D visualization (Hoyek, Collet, Fargier, & Guillot, 2012). This may be because the higher memory load demand required by the 3D MR tasks (Stumpf & Eliot,1999).

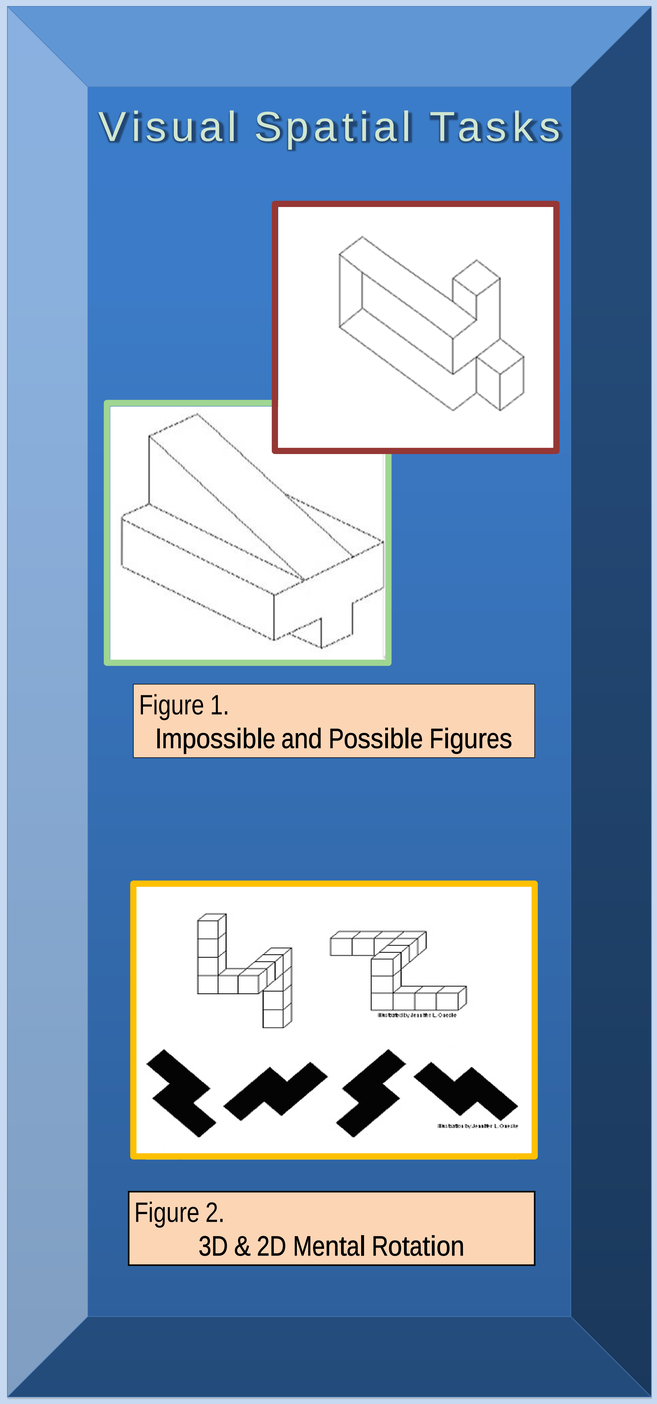

Figure 1.
Impossible and Possible Figures

Figure 2.
3D & 2D Mental Rotation

Mathematics places high demand on information processing capacity, including memory. Thus one might speculate that the high memory demand of 3D MRTs explains the association between MRTs and mathematical giftedness. Might other tasks that both employ representations of 3D objects and combine high memory demand with geometric thinking also predict mathematical giftedness? In other words….

Could the Impossible Figures Task Also Predict Mathematical Giftedness?

To evaluate a figure's impossibility, one must evaluate its hypothetical possibility in 3D space. It seems logical that geometric thinking is required to solve the impossible figures test, though this assertion must be tested.

Things become even more speculative when we consider the IFT's memory load. Impossible figures defy priming conventions. Some argue that they cannot be primed (Schecter, 1992); others argue that they produce negative priming effects or actually hinder memory (Soldan, Hilton, & Stern, 2009). In sum, impossible figures elicit atypical memory responses . In the IFT task, however, figures remain on the screen until the participant takes action. It seems therefore that the memory load, should be minimal; however, given past priming studies, such an assumption would need to be tested.

Our review of the literature, therefore, leads us to the inevitable conclusion that future research is necessary to answer a number of questions (see below).

References

~ Please See Handout ~

Future Research Questions

- *What is the nature of the association between 3D Mental Rotation and Impossible Figures tasks?*
- *Does Impossible Figures Task performance also predict Mathematical Giftedness?*
- *How do mathematics majors compare to other spatial majors on the Impossible Figures and Mental Rotation tasks?*