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Neural Correlates of Multidimensional Visualizations: An fMRI Comparison of Bubble and Three-Dimensional Surface Graphs Using Evolutionary Theory

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Abstract

In this article, an evolutionary argument to explain how people comprehend graphs is put forth. A theory of evolutionary fit, which argues for the correspondence between information presentation and evolutionarily adaptive brain structures, is proposed. This is complementary to cognitive fit, which argues for a correspondence between task and information presentation. In two fMRI experiments, we test this theory by comparing brain activation during a graphic comprehension task using two different graph types: bubble graphs and three-dimensional surface graphs. In accordance with our hypotheses, we find that comprehension of three-dimensional surface graphs results in greater activation of the ventral stream and greater accuracy in graphical comprehension than bubble graphs. We argue that this is because the human visual system is evolutionarily adapted to the comprehension of three-dimensional surfaces. The implication is that choosing graphical representations that match what the brain is evolutionarily specialized to process can enhance graphic comprehension.

Keywords: Graphs, visualization, fMRI, NeuroIS, three-dimensional