

Proceedings of the Annual General Donald R. Keith Memorial Conference
West Point, New York, USA
May 4, 2017
A Regional Conference of the Society for Industrial and Systems Engineering

Exploring the Impact of “Unknown Unknowns” on Fuzzy Cognitive Maps

Samuel Mahle¹, Matthew Dabkowski², and Roberto Fufaro³

¹Department of Systems Engineering, United States Military Academy, West Point, NY 10996, USA

²Operations Research Center, United States Military Academy, West Point, NY 10996, USA

³Department of Systems and Industrial Engineering, University of Arizona, Tucson, AZ 85721, USA

Corresponding author's Email: samuel.mahle@usma.edu

Author Note: The corresponding author submitted this paper in partial fulfillment of his Honors Program in the Department of Systems Engineering at the United States Military Academy. He would like to thank his advisors - LTC Dabkowski and Dr. Furfaro - for their mentorship and assistance throughout the project.

Abstract: Fuzzy Cognitive Maps (FCMs) are useful tools for modeling the causal relationships between the factors (or concepts) that affect a system’s behavior. Introduced in the mid-1980s by Bart Kosko, FCMs have been used effectively in a variety of applications, not only within soft knowledge domains, such as political science, military science, and history, but also inside the hard sciences, to include planetary science, environmental science, and medicine. No matter their application, FCMs are typically designed with the goal of modeling the knowledge of subject matter experts (SMEs), where the map’s nodes and edges are derived from SME input. Accordingly, the FCM design process inherently assumes that SMEs are aware of and accurately model every concept that impacts a given system, but this is not necessarily the case. With this in mind, this paper strives to understand how “unknown unknowns,” both true and perceived, can affect an FCM’s convergence. In particular, should the introduction of a new concept, modeled here by the addition of a node and its causal relationship(s), greatly impact the steady-state of an FCM, further research should be conducted to investigate whether such a concept exists. Otherwise, the FCM may be considered robust against unforeseen external influence, and decision maker confidence in the FCM should increase.

Keywords: Fuzzy Cognitive Maps, Unknown Unknowns, Emergence