SUPPLEMENT TO

CHAPTER 6, V1[1]:

SIMULATING PSYCHOLOGICAL PHENOMENA AND DISORDERS

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Cognitive Neuroscience and Psychotherapy: Network Principles for a Unified Theory

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SIMULATION ANIMATES CAUSAL MECHANISMS

This supplement continues the case for simulation made by Tryon (2014) in Chapter 6 for conducting simulations. Psychological explanations are frequently dynamic in that they presume complex interactions unfolding over time. The term psychodynamics implies change over time. However, presentations of psychological explanations are almost always static. Words on a page are static. Structural equation modeling diagrams are static. Their path coefficients imply a dynamic role but SEM diagrams with path coefficients are static. In short, contemporary presentation of psychological explanations are like photographs; static depictions. Like photographs, SEM diagrams contain all of the elements.

Simulations **animate** psychological explanations in roughly the same way that **movies** animate **pictures**. Movies are literally a sequence of still images that are shown in sequence at a rate that exceeds the human flicker fusion threshold[2]. This is the rate at which stimuli that appear and disappear are perceived to appear continuously. Just as movies are dynamic and convey much more than still photographs, so simulations provide much more information than do still images. Simulations bring psychology to life. Contemporary PDP-CNN simulations are like old time movies that initially only contained black and white images. Hopefully, they will follow how movies developed when they acquired sound, then color and now are shot in high definition and 3D. Developing such simulators is a big science challenge but one that will enable significant and substantial new knowledge to be gained.

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[1] V1 stands for Version 1 which implies that subsequent chapter updates will become available.

[2] http://en.wikipedia.org/wiki/Flicker_fusion_threshold

Simulators can serve as repositories of the world's neuroscience and psychological science information. Such a tool could be used to simulate client's personality to better understand how they will react to new situations. For example, Read et al. (2010) simulated personality by coding for the approach goals/motives of friendship, sex/romance, being liked, helping others, dominance, achievement, mastery, exploring fun, fairness-equality-Justice, uniqueness and material gain. They also coded for the avoidance goals/motives of rejection and embarrassment, guilt, failure, physical harm, loss of control, interpersonal conflict, effort, and risk/uncertainty.

BIG NEUROSCIENCE INITIATIVES

SyNAPSE[3]

The acronym SyNAPSE stands for *Systems of Neuromorphic Adaptive Plastic Scalable Electronics.* SyNAPSE is an IBM project whose aim is to enable what they call cognitive computing; their term for processing information in parallel like the brain does. Their objective is to build a 100 trillion synapse system that will fit within a two liter soda bottle and consume less than one kilowatt of power. It contains two very informative videos. They tell of efforts by seven IBM laboratories and four universities to combine neuroscience, nanotechnology, and supercomputing.

Blue Brain Project[4]

The Blue Brain Project is a collaboration by IBM and the Swiss Federal Institute of Technology to build a virtual human brain to build a virtual human brain that will contain the world's neuroscience knowledge in a way that can be used to conduct experiments that would otherwise be impossible.

The BRAIN Initiative[5]

BRAIN is an acronym for the NIH funded **B**rain **R**esearch through **A**dvancing **I**nnovative **N**eurotechnologies initiative. This project aims to accelerate the development and application of innovative technologies that will produce a revolutionary new dynamic picture of the human brain.

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[3] See http://research.ibm.com/cognitive-computing/neurosynaptic-chips.shtml
[4] See http://bluebrain.epfl.ch.
[5] See http://www.nih.gov/science/brain/index.htm

Thomas Insel questioned what the goals of the BRAIN initiative are. Here is a copy of the email message that I sent to Thomas Insel on 2/29/14.

> The February 22, 2014 issue of *Science News* carried the following comment of yours regarding the BRAIN Initiative on page 17 "It isn't clear what victory will look like on this project". I agree that goals are needed for such an expensive project and therefore I propose the following four goals for your consideration: 1- A 3D computerized map identifying functional neural networks and their interconnections. 2- A complete wiring diagram. 3- A parallel-distributed processing connectionist neural network model in Emergent, or some more powerful language to be developed by the project, that can articulate and animate all of the well replicated neuroscience that the project finds, discovers, and/or creates. 4- Simulations of at least several major psychological/psychiatric disorders using the simulator mentioned above as Goal 3.

The simulator requested in Goal 3 is to psychology and neuroscience what the Hubble telescope is to astronomy and what the super collider is to physics. It is a necessary tool to do cutting edge research. It is worth what it will cost.

The Human Connectome Project[6]

The Human Connectome Project is creating a map of the human brain based on 1,200 healthy adults.

SIMULATION RELUCTANCE

Some students are reluctant to comment on the assigned simulation readings because they do not understand the simulation details well enough to evaluate the validity of the claims made by the authors including their conclusions. I address possible reasons for this reluctance below.

My first question is “Do you question the validity, merit, correctness of the false color diagrams associated with fMRI results on the basis that you do not understand brain scan acquisition and post processing details well enough to evaluate the validity of these images?” My

[6] See http://humanconnectome.org

second question is "Do you question the validity, merit, correctness of the false color diagrams associated with weather maps on the basis that you do not understand meteorological measurements and post processing details well enough to evaluate the validity of these images?" I suggest that the answer is "no" in both cases but for different reasons. First, the fMRI images always have a correct brain shape that is clearly recognized and accepted as valid. But it is the false coloring of brain regions to indicate their activation levels that is at issue.

How do you know that they got those colors right? The fact of the matter is that you don't and that does not bother you. Perhaps that is because they got the brain shape right. Or it may be because many other psychologists trust fMRI results. Or it's because you accept fMRI as an established technology that has been fully validated by people that you trust to get it right. Physicians use MRI scans to diagnose injuries. You may trust weather maps because they are on TV and in newspapers. You may trust them because you believe that simulations are valid tools in the hands of physicists.

In conclusion, simulations are tools used by practitioners of mature sciences. Psychology is an immature science and therefore does not often use simulations. Hence, most psychologists and students of psychology are unfamiliar with simulations and have not received the necessary training to critically evaluate them. Nor have they read about other psychologists using simulations to where they can trust their work. Psychometrics is a major exception. Here simulations are a fundamental tool that is responsible for much of what we currently know about statistics. Simulations are run to provide evidence of assertions. Most psychologists do not have the training to critically evaluate these simulations yet they trust the knowledge generated by them because they trust the scientists who do this work to get it right. The paradigm shift that I call for requires that simulations be extended to other areas of psychology than statistics. I refer to simulations in the areas of personality, social, clinical, and developmental psychology that only a few psychologists currently do. I expect that many psychologists, and students of psychology, will come to trust the findings of these basic researchers and will confidently incorporate findings from this basic research into their applied research and clinical practice. The **Bio↔Psychology Network** explanatory system aims to facilitate this future.

REFERENCES[7]

Tryon, W. W. (2014). *Cognitive neuroscience and psychotherapy: Network Principles for a Unified Theory*. New York: Academic Press.

[7] References not included in this list are in the reference section of the Tryon (2014).