Published in final edited form as:
IEEE Pulse. 2013 ; 4(6): 41–47. doi:10.1109/MPUL.2013.2279621.

Systems Modeling of Behavior Change

Daniel E. Rivera and
School for Engineering of Matter, Transport, and Energy, Ira A. Fulton Schools of Engineering, Arizona State University, Tempe

Holly B. Jimison
College of Computer and Information Science and the School of Nursing, Bouvé College of Health Sciences, Northeastern University, Boston, Massachusetts

Daniel E. Rivera: daniel.rivera@asu.edu; Holly B. Jimison: h.jimison@neu.edu

Systems science techniques are becoming increasingly important as tools for modeling behavior change and as enablers for delivering more effective tailored interventions [1], [2]. Systems approaches offer a fresh perspective on the understanding of behavior change, providing a means for better capturing complexity, exposing gaps in the existing body of knowledge, enhancing the predictive capability of models, and ultimately enabling optimal decision making in behavioral intervention settings.

The approaches that have been applied to model behavior change are diverse in nature; these include computational/mathematical modeling, agentbased modeling, dynamical systems modeling, and network analysis. Powerful computational environments as well as the increasing ability to gather large amounts of behavioral data (in the field through ecological momentary assessment or otherwise) facilitate the use of systems modeling approaches in behavior change.

There are many challenges to using data from sensors in the home and environment to infer robust and meaningful estimates of clinically meaningful behaviors. Health monitoring and interventions in natural settings typically make use of inexpensive and unobtrusive sensors. For example, data collection techniques may be based on computer or mobile phone interactions, motion sensors, or global positioning system (GPS) information. Sophisticated models and analysis techniques are required to address issues of noise, bias, and context effects and to classify behaviors in real time. The constraints of making inferences with systems that emphasize low cost and scalability require careful modeling and analysis techniques to reap the benefits of obtaining information from many forms of ubiquitous but noisy or indirect data for inferring health behaviors.

Here, we illustrate how systems and computational modeling approaches can impact behavior change and optimize interventions for health involving behavioral outcomes with two examples. The first, in “Using Sensor Data and Model Inference to Tailor Home Health Interventions for the Elderly,” is an example of integrating health behavior change variables with computational inference about behaviors and health states for tailoring interventions. The second, “Dynamical Systems Modeling of a Gestational Weight Gain Intervention,” demonstrates how behavioral theories from psychology come into play in developing a comprehensive dynamical model for an intervention to manage gestational weight gain.

Supplementary Material

References

1. Mabry PL, Marcus SE, Clark PI, Leischow SJ, Mendez D. Systems science: A revolution in public health policy research. Amer. J. Pub. Health. Jul 2010; 100(7):1161–1163. [PubMed: 20530757]
2. Hassmiller Lich K, Ginexi EM, Osgood ND, Mabry PL. A call to address complexity in prevention science research. Prev. Sci. 2013 Jun; 14(3):279–289. [PubMed: 22983746]