

**Society for Prevention Research
18TH ANNUAL MEETING**

PRECONFERENCE WORKSHOP #3

Systems Science Methodologies for Prevention Research

**June 1, 2010
8:30 AM – 5:00 PM
Grand Hyatt Denver Downtown
Denver, Colorado**

Background and Purpose:

The 2010 SPR meeting will focus on the theme “Cells to Society.” This theme aims to address the complex and multidimensional nature of the public health context for our preventive interventions. The conference theme will highlight the vertical integration of research among biological, behavioral, social, and population levels of analysis over the lifespan and across generations. This theme fits perfectly within the systems science research perspective currently being promoted by the NIH and OBSSR. This workshop will help promote this area of inquiry and invite scientific experts in system science methodologies to present at this upcoming meeting. Attendees will have the opportunity to learn about some key system science methodologies that could be applied to future prevention research studies.

Systems science refers to an approach to problem-solving that involves taking into account the big picture in all its complexity (i.e., a system view). In doing so, systems science approaches dissect important relationships between components of a system and changes in the system over time. This topic is of particular relevance for prevention science because translational efforts in prevention are squarely aimed at maximizing the population impacts of prevention intervention-related scientific discoveries. To realize true population impacts, it is necessary for us to carefully consider the big picture public health contexts within which our interventions can be targeted.

The purpose of this interactive workshop is to introduce prevention scientists to the utility of systems science methodologies for addressing some of the challenging research questions in their field and to familiarize them with selected methodologies: system dynamics modeling, agent-based modeling, network analysis, and engineering control methods for optimizing intervention design. Following a more general introduction to the methods, there will be a separate session to highlight each of the featured methodologies. During each of these sessions, participants will receive a primer on the particular system science method being featured from an expert in that area. Next an applied researcher in the prevention science area will provide a brief description of a prevention science relevant problem amenable to the specific methodology. Finally, each session will close with a facilitated, interactive discussion between session participants, the systems science expert and the applied prevention researcher regarding how the particular method might be used in prevention science studies.

Specific learning objectives:

- Understand the unique capabilities of systems science methodologies for prevention science and how they complement and extend, but do not replace traditional methods.
- Understand what types of prevention research questions are and are not appropriate for systems science methodologies *in general*.
- Become familiar with and understand the main capabilities of *some specific* system science methodologies (i.e., system dynamics modeling, agent-based modeling, network analysis, and engineering control methods for optimizing intervention design).
- Brainstorm about potential applications of system science methodologies in prevention science, especially as applied to an integration of biological and social foci and dissemination/implementation science (type 2 translation).

AGENDA:

8:30-8:35

Welcoming remarks

Elizabeth Ginexi, Prevention Research Branch, Division of Epidemiology, Services and Prevention Research NIDA – 5 mins

Dr. Ginexi will briefly discuss SPR's Mapping Advances in Prevention Science (MAPS) priorities and provide an explanation of the relevance of this workshop for the MAPS goals. Mapping Advances in Prevention Science (MAPS) are multidisciplinary task forces funded by the SPR conference grant from the National Institutes of Health. The first MAPS (I) focuses on an integration between biological and social factors in prevention and the second MAPS (II) addresses Type 2 translational research.

8:35-9:05

Title: *What is Systems Science?*

Patricia L. Mabry, OBSSR, NIH - 10 mins – Dr. Mabry will discuss what “systems science” is and present a brief history of where systems science methods come from and what they do. She will explain why interest and funding of such approaches is growing at NIH and will provide some examples from public health to illustrate.

Q&A – 5 mins

Title: *How to Think Like an Engineer*

Linda Collins, Methodology Center, Penn State University – 10 mins - Dr. Collins will compare and contrast traditional ways of thinking about problems and designing interventions embraced by prevention scientists with the ways engineers conceptualize them.

Q&A – 5 mins

9:05-10:35

Title: *Engineering Control Theory: Leveraging Engineering Principles for Optimizing Preventive Interventions*

A Basic Primer on Engineering Control Theory

Daniel Rivera (Arizona State University) - 45 minutes

Dr. Rivera will teach a basic primer on how control engineering principles can be used for optimizing intervention design, including an introduction of terms and basic concepts with illustrations drawn from problems in behavioral health.

Engineering Control Theory Applied.

Ty Ridenour, University of Pittsburgh, and member of the SPR MAPS Biology Taskforce.
- 10-15 mins presentation plus 30 mins discussion.

Dr. Ridenour will present a case example of an intervention that is in need of development. A discussion format will be used to work through the engineering method to illustrate how to improve the impact of prevention programs by way of tailoring them for specific children at risk. Interactive discussion along with the audience will be used to illustrate possible outcomes and how the method could help identify novel intervention approaches that would not be possible with traditional methods. Audience members will be an essential part of the back and forth discussion which will be team-lead by Drs. Rivera and Ridenour.

10:35-10:45 QUICK BREAK – 10 mins

10:45-11:30

Title: *Social Network Analysis: Why Connections Matter*

A Basic Primer on Social Network Analysis

Thomas W Valente, University of Southern California, 45 minutes

Dr. Valente will present the basic principles and terminology of Social Network Analysis (SNA) and its application to prevention science. The importance of network structure, key characteristics and metrics at both individual and network level will be introduced. The utility and interpretation of network maps will be covered. Case studies illustrating the power of the method for understanding behavioral etiology and its use for behavioral interventions will be discussed.

11:30-12:30 BREAK – LUNCH ON YOUR OWN – 1 hour

12:30-1:15

Social Network Analysis Applied

Scott Gest, Penn State University 10-15 mins presentation plus 30 mins discussion

Dr. Gest will draw from the PROSPER Study to present a case example of a research question that is suitable to address with SNA. At the end of the presentation, questions regarding the suitability of SNA methods to the case example will be posed for the SNA expert to address in a pedagogical fashion. Audience members will be encouraged to join in the discussion with Drs Valente and Gest.

1:15-2:45 *System Dynamics Modeling: Exploring Policy Scenarios*

A Basic Primer on System Dynamics Modeling

Kristen Hassmiller Lich, University of North Carolina, Chapel Hill (45 min)

Dr. Hassmiller Lich will explain how System Dynamics (SD) modeling fits in modeling space, including strengths and limitations. The audience will be introduced to all aspects of the SD modeling process: stakeholder engagement, identification of the problem, identifying model inputs and boundaries, parameterizing the model, model validation, model output and interpretation. Core SD concepts and terminology will be taught including stocks, flows, feedback/feedforward loops, delays, and threshold phenomena (aka “tipping points”).

System Dynamics Modeling Applied

Thomas J. Dishion, Child and Family Center, University of Oregon, and Member of the SPR MAPS Biology Taskforce. – 10-15 mins presentation plus 30 mins discussion.

Dr. Dishion will discuss his research with the family check up –an assessment driven family intervention strategy conducive to translating findings from systems dynamic modeling to specific, tailored interventions for children and families. He will provide an overview of the assessment-feedback-intervention process of the Family Check Up, and then work through a mock model building exercise with input from the audience. Demonstrate how the SD method is useful for capturing short-, intermediate-, and long term effects. Show how the SD method can be used to generate testable hypotheses and provide information on tradeoffs regarding different

interventions. Drs. Hassmiller Lich and Dishion will team lead an interactive discussion session with the workshop participants.

2:45—3:00 BREAK

3:00-4:30 *Agent Based Modeling: Generating Virtual Worlds for Experimentation and Understanding*

A Basic Primer on Agent Based Modeling

Elizabeth Bruch, University of Michigan (45 min)

Dr. Bruch will teach the basic foundations for Agent Based Modeling (ABM). She will show how imbuing “agents” with individual characteristics and decision rules, models can be developed and used to “grow societies,” generate hypotheses, and uncover emergent properties. Using NetLogo software, she will demonstrate how ABMs can be used in concert with spatial maps and social network information to generate virtual worlds in which hypotheses can be inspired and where it can be determined whether or not specified conditions could have given rise to historical outcomes.

Agent Based Modeling Applied

Anthony Biglan, Oregon Research Institute, and member of the SPR MAPS Biology Taskforce - 10-15 mins presentation plus 30 mins discussion.

Dr. Biglan will discuss ABMs in the context of his interest in large-scale Type 2 translation, dissemination/implementation for prevention science. For example, Dr. Biglan has been interested in creating a network of high-poverty neighborhoods linked through systematic efforts to implement and evaluate preventive interventions, implementing monitoring systems, and developing experimental evaluations of intervention research in networked neighborhoods in order to more systematically advance the efficiency and effectiveness of community-based preventive intervention efforts. Drs. Bruch and Biglan will co-lead an interactive discussion with the audience about these methods and possible prevention applications.

4:30-4:45 Concluding remarks

4:45-5:00 Complete feedback survey and adjourn

Audio-visual requirements – projector

Target Audience

This workshop will be accessible to prevention investigators with and without exposure to systems science methodologies

Methods

The workshop will be educational, but very interactive. There will be opportunity for open discussion and for participants to ask questions about incorporating these methods into prevention science research.

Materials

Participants will receive a complete set of slides.
Maximum number of attendees – 40

Meeting Chairs

Elizabeth M. Ginexi, Ph.D. (Primary contact)

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Elizabeth M. Ginexi, Ph.D. is a Health Scientist Administrator in the Prevention Research Branch at the National Institute on Drug Abuse (NIDA) / National Institutes of Health (NIH) where she serves as the Program Official for NIDA's Transdisciplinary Prevention Research Center (TPRC) program. Dr. Ginexi is an Applied Social Psychologist with expertise in family- and community-based etiology and prevention research, and in quantitative data analysis techniques for longitudinal randomized intervention trials. She joined the Prevention Research Branch (PRB) at NIDA in July 2003 where she has been developing a research portfolio that emphasizes transdisciplinary approaches to prevention research and that encourages incorporating innovative technologies and discoveries from the basic sciences including the cognitive, neurobiological, psychological and social sciences, as well as computational statistics, and engineering into the development and testing of preventive intervention and health communication strategies. Prior to coming to NIDA, Dr. Ginexi was a Senior Study Director at Westat, where she participated in the development and implementation of several large-scale community-based drug abuse treatment and prevention evaluations funded by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and the Substance Abuse and Mental Health Services Administration (SAMHSA). Prior to working at Westat, Dr. Ginexi worked as a Research Scientist and Lecturer at the George Washington University, where she played a major role in data collection, data management, and analysis for several large longitudinal field studies involving mental health preventive interventions and services research. She received her masters and doctoral degrees in Applied Social Psychology from the George Washington University and she completed postdoctoral training under two Public Health Service Grant National Research Service Awards, one through Children's National Medical Center, and the other at the Center for Mental Health Policy at Vanderbilt University.

Linda M. Collins, Ph.D.

Title: Professor and Director
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Linda M. Collins, Ph.D. is the Director of the Methodology Center at Penn State and Principal Investigator of the *Center for Prevention and Treatment Methodology*, a P50 Center funded by NIDA since 1996. Dr. Collins' work has been funded continuously by NIDA for nearly 25 years. Dr. Collins is interested in design, measurement, and statistical methodology for prevention research. Her current interests include phased experimental approaches for optimization of behavioral interventions for prevention and treatment; experimental designs for building adaptive interventions; applying ideas from engineering, such as control theory, to intervention optimization; and statistical methods for longitudinal research, particularly Latent Transition Analysis (LTA), a method for fitting models of discrete development. With Dr. Daniel Rivera, Professor of Chemical Engineering at Arizona State University, Dr. Collins has a

Roadmap grant to study how to express behavioral interventions as dynamical systems. Dr. Collins has received the Cattell Award for outstanding early career contributions to multivariate behavioral research, Pennsylvania State University's Faculty Scholar Medal in the Social and Behavioral Sciences, and is co-recipient (with frequent collaborator John Graham) of the 2004 Society for Prevention Research's President's Award. She is a Fellow of the American Psychological Association and the Association for Psychological Science, a past president of the Society of Multivariate Experimental Psychology, and President of the Society for Prevention Research.

Patricia L. Mabry, Ph.D.

Senior Advisor

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Dr. Mabry is a Senior Advisor in the Office of Behavioral and Social Sciences Research (OBSSR) at NIH. She is committed to developing resources and creating opportunities for the NIH investigator community (and beyond) in order to encourage and support the development of behavioral and social science research projects featuring *interdisciplinary* and *Systems Science* approaches http://obssr.od.nih.gov/scientific_areas/methodology/systems_science/index.aspx. Since joining OBSSR in November 2005, Dr. Mabry has been instrumental in catalyzing interest in and support for systems science across the 27 institutes and centers that comprise NIH. Dr. Mabry leads the systems science programmatic activities for OBSSR, including PAR-08-224, *Using Systems Science to Protect and Improve Population Health (R21)* <http://grants.nih.gov/grants/guide/pa-files/PAR-08-224.html> and the annual *Institute on Systems Science and Health*, and is the project officer for a contract to support the *Collaborative Obesity Modeling Network (COMNet)*. In 2006 Dr. Mabry led the production of the *Interdisciplinary Methodology and Technology Summit*, an NIH Roadmap for Medical Research activity <http://nihroadmap.nih.gov/interdisciplinary/summit0806/agenda.asp>, and in 2007 she co-led the development of a funding opportunity announcement under the NIH Roadmap entitled, *Facilitating Interdisciplinary Research via Methodological and Technological Innovation in the Behavioral and Social Sciences (R21)*. In 2007, in collaboration with CDC, Dr. Mabry initiated and guided the production of the *2007 Systems Science Symposia Series* and led OBSSR's sponsorship of the conference, *Complex Systems Approaches to Population Health* (videocasts/podcasts of these and other events are available at http://obssr.od.nih.gov/training_and_education/videocast/videocast.aspx#ssh). Dr. Mabry has been recognized for her efforts; she was a member of the team that received the inaugural **Applied Systems Thinking Prize** from the Applied Systems Thinking Institute in 2008 <http://www.asysti.org/Prize/2008asystprizewinner.aspx>, and received an individual Merit Award from NIH in 2008 in recognition for her leadership and contributions in systems science.

Dr. Mabry is currently focusing much of her work on fostering opportunities for behavioral, social and population scientists to learn from and team up with people in other disciplines, especially those in disciplines grounded in mathematical and computational sciences (e.g., computer science, engineering, mathematics, operations research). To this end, she is one of three Conference Organizing Chairs for the *2010 International Conference on Social Computing, Behavioral Modeling, and Prediction (SBP10)* at which she is creating opportunities for such cross-fertilization. Dr. Mabry also spends some time writing and publishing in scientific journals primarily on the topics of tobacco control and systems science. Dr. Mabry earned her Ph.D. in Clinical Psychology from the University of Virginia (1996). She has worked in small business, academia, and government, and her professional experience falls into several broad categories: conducting original intervention research for tobacco cessation, providing counseling and psychological services to individuals and couples, teaching behavioral aspects of medicine to medical students, writing NIH Small Business Innovation Research (SBIR) grant applications, and programmatic development at NIH.

Invited Speakers

Daniel E. Rivera, Ph.D.

Professor

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Daniel E. Rivera is Professor of Chemical Engineering and Program Director for ASU's Control Systems Engineering Laboratory (<http://csel.asu.edu>). Prior to joining ASU in 1990, he was a member of the technical staff at Shell Development Company in Houston, Texas. He has been a visiting researcher with the Division of Automatic Control at Linköping University, Sweden, Honeywell Technology Center in Phoenix, AZ, the University "St. Cyril and Methodius," in Skopje, Macedonia, the National Distance Learning University (UNED) in Madrid, Spain, and the University of Almería in Andalucía, Spain. His research interests include the topics of robust control system design and dynamic modeling via system identification. He has examined the application of control engineering principles to problems in diverse settings, among these chemical processing, semiconductor manufacturing, and enterprise systems/supply chain management. His primary focus at this time is examining how control engineering principles can improve prevention and treatment interventions in behavioral health. In 2007, Dr. Rivera was awarded a K25 Mentored Quantitative Research Career Development Award from the National Institute on Drug Abuse to study control systems approaches for fighting drug abuse. He is co-PI (with Professor Linda Collins at Penn State University) of a Roadmap grant that is exploring how to express behavioral interventions as dynamical systems. Dr. Rivera is a member of the American Institute of Chemical Engineers (AIChE), the Institute of Electrical and Electronic Engineers (IEEE), the American Society for Engineering Education (ASEE), the Society for Prevention Research (SPR), and the National Hispanic Science Network on Drug Abuse (NHSN). He currently chairs the IEEE Control Systems Society's Technical Committee on System Identification and Adaptive Control.

Ty A. Ridenour, Ph.D., M.P.E.

University of Pittsburgh

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Dr. Ridenour is an Assistant Professor and Co-Investigator of the NIDA-funded Center for Education and Drug Abuse Research (CEDAR) at the University of Pittsburgh. His research interest interests are novel applications of methodologies to enhance targeted prevention, etiology of substance abuse and antisocial behavior, and development of self-report assessments for children. His background and training spans Educational and School Psychology, Psychiatric Epidemiology, Juvenile Justice, Neuropsychology, and Prevention. Dr. Ridenour currently serves as Chair of the Early Career Preventionist Network.

Thomas W Valente, Ph.D.

Professor

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Thomas W. Valente is Professor and Director of the Master of Public Health Program in the Institute for Prevention Research, Department of Preventive Medicine, Keck School of Medicine, University of Southern California. Valente is author of Network Models of the Diffusion of Innovations (Hampton Press, 1995), Evaluating Health Promotion Programs (2002, Oxford University Press); and the forthcoming Social Networks and Health: Models, Methods, and Applications (Oxford University Press). Valente uses network analysis, health communication, and mathematical models to implement and evaluate health promotion programs designed to prevent tobacco and substance abuse, unintended fertility, and STD/HIV infections. He is also engaged in mapping community coalitions and collaborations to improve health care delivery and reduce healthcare disparities. Valente received his BS in Mathematics from the University of Mary Washington, his MS in Mass Communication from San Diego State University, and his PhD from the Annenberg School for Communication at USC. He was recently a visiting scientist at NIH for 6 months.

Scott Gest, Ph.D.

Pennsylvania State University

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Scott Gest is Associate Professor of Human Development & Family Studies at the Pennsylvania State University. His research program focuses on the role of children's peer relationships in emerging patterns of academic and behavioral adjustment in school settings from middle childhood through adolescence. One current project focuses on how teaching practices in elementary classrooms may contribute to youth outcomes in part by affecting the emerging properties of classroom peer networks (funded by the William T. Grant & Spencer Foundations). A second project involves analysis of a 5-year longitudinal study of peer network dynamics and school adjustment across the transition to middle school (funded by National Science Foundation). A third project focuses on the role of friendship networks on emerging patterns of substance use and the possible role of school-based interventions in altering friendship network processes (funding from NIDA and William T. Grant Foundation, W. Osgood, PI). A third project involves period follow-ups of children who participated in a Head Start intervention designed to enhance social-emotional and emergent-literacy skills as they progress through elementary school (funding from NICHD, Karen Bierman, PI).

Kristen Hassmiller Lich, Ph.D., MHSA.

University of North Carolina at Chapel Hill

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Dr. Hassmiller Lich is an Assistant Professor in the Department of Health Policy and Management at the University of North Carolina at Chapel Hill. She received her Master in Health Services Administration (MHSA, 2000) and PhD in Health Services Organization and Policy (2007) from the University of Michigan School of Public Health. Dr. Lich specializes in the application of operations research and complex systems modeling techniques to health policy and management decision making. She has worked most extensively on tobacco control, including two key modeling projects. In the first, she built a dynamic simulation model to predict and compare the benefits of various tobacco-control policies in the US. In the second, a dynamic infectious disease model was built to advance understanding of the relationship between smoking and tuberculosis, and to estimate the effects of tobacco (and tobacco control) on population-level tuberculosis outcomes such as incidence and mortality rates. Other current research projects include: using decision support models to improve systems of mental health care in North Carolina and applying System Dynamics methods to improve stroke-related strategic planning in the Veterans' Health Administration. Dr. Lich's research passion is to advance the way we use models (both quantitative and qualitative) to improve policy-decision making, and to engage system stakeholders in the process. She has been invited to talk about the use of models to inform policy in a variety of settings, including the Centers for Disease Control and Prevention, the National Institutes of Health, and numerous meetings and workshops.

Thomas James Dishion, Ph.D.

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Tom Dishion received his Ph.D. in Clinical Psychology from the University of Oregon. His interests include understanding the development of antisocial behavior and substance abuse in children and adolescents, as well as designing effective interventions and prevention programs. In particular, he and colleagues have examined the contribution of peer and family dynamics to escalations in adolescent substance use, delinquency, and violence. His intervention research focuses on the effectiveness of family-centered interventions, and the negative effects of aggregating high-risk youth into intervention groups. He is currently Director of Research at the Child and Family Center and Professor of Clinical Psychology, both at the University of Oregon. Prior to that, he was a research scientist at Oregon Social Learning Center. He has published over 90 scientific reports on these topics, a book for parents on family management, and two books for professionals working with troubled children and their families.

Elizabeth E. Bruch, Ph.D.

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Elizabeth Bruch is an assistant professor of Sociology and Complex Systems at the University of Michigan, and a faculty member at the Population Studies Center. She earned her Ph.D. at the University of California, Los Angeles. Her research spans a broad array of population phenomena in which the actions of individuals and other units (such as families, couples or neighborhoods) are dynamically interdependent. Her current work examines the conditions under which income inequality and economic factors associated with neighborhood choice can exacerbate or attenuate race segregation.

Anthony Biglan, Ph.D.

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Dr. Biglan is a Senior Scientist at Oregon Research Institute and Director of the Center on Early Adolescence. He has been doing research for the last 30 years on the prevention of adolescent problem behaviors and has conducted numerous experimental evaluations of interventions to prevent tobacco, alcohol, and other drug use, high-risk sexual behavior, reading failure, and aggressive social behavior. He and colleagues at the Center for Advanced Study in the Behavioral Sciences published a book summarizing the epidemiology, cost, etiology, prevention, and treatment of youth with multiple problems (Biglan et al., 2004). His current work focuses on the dissemination of evidence-based practices in high poverty communities and the use of mindfulness interventions to reduce distress and increase people's openness to innovation. Dr. Biglan is a former president of the Society for Prevention Research.