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Annual Report

The Methodology Center

PENN STATE | 2013-14

The Methodology Center

is an interdisciplinary research center within the College of Health and Human Development at Penn State. We develop new quantitative methods for social, behavioral, and health sciences research focusing on vital public health issues, especially alcohol, tobacco, and other drug abuse and HIV.

Welcome to The Methodology Center's Annual Report

As a National Institute on Drug Abuse P50 Center of Excellence, The Methodology Center serves as a national resource on cutting-edge applied statistical methods for the behavioral, social, and health sciences. Our objective is to improve public health by improving public health research. We identify important emerging methodological issues based on our knowledge of the field and our collaborations with behavioral scientists. Center scientists then conduct original research to develop new methodological approaches and incorporate approaches developed in other disciplines to meet those needs.

The Methodology Center comprises more than 20 Ph.D.-level scientists and a host of graduate student trainees. We have created a stimulating work environment that brings together researchers from a dozen disciplinary backgrounds, including statistics, biostatistics, mathematics, human development, psychology, and public health. Our original research draws from and integrates many disciplinary perspectives on methodology. Methodology Center Principal Investigator Susan Murphy recently was named a MacArthur Fellow (i.e., a MacArthur "Genius") for her work on the sequential, multiple assignment, randomized trial (SMART) for building treatments that adapt to patient need. In this research, Susan collaborates with computer scientists to develop the methods needed to design efficient SMARTs and analyze the resulting data. For more on SMARTs, see pages 9-11.

We enthusiastically seek collaborations with behavioral scientists to both improve public health and expand research methods. One example is Methodology Center Principal Investigator Runze Li's collaboration with Saul Shiffman of the University of Pittsburgh. Saul is a leader in innovative approaches to collecting intensive longitudinal data by means of ecological momentary assessment. Runze is a leader in approaches to analysis of intensive longitudinal data. Their collaboration is developing new mechanisms for understanding the complex nature of the process of smoking cessation. Now if that isn't a match made in heaven…

You will learn more about our research in the following pages. I am proud to share this report with you, and I hope you enjoy reading it as much as we have enjoyed preparing it.

Linda Collins
Director, The Methodology Center
Professor, Department of Human Development and Family Studies
Professor, Department of Statistics

To learn more, visit **methodology.psu.edu**.

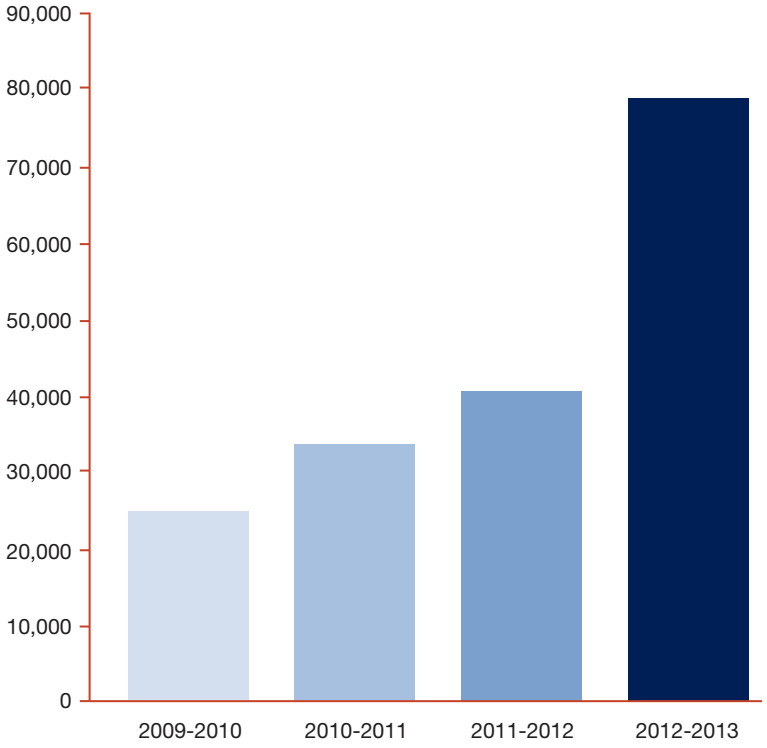
Dissemination

The Methodology Center disseminates methods to behavioral researchers via in-person presentations and online resources. Our recent emphasis on dissemination has led to many more researchers using our methods and software.

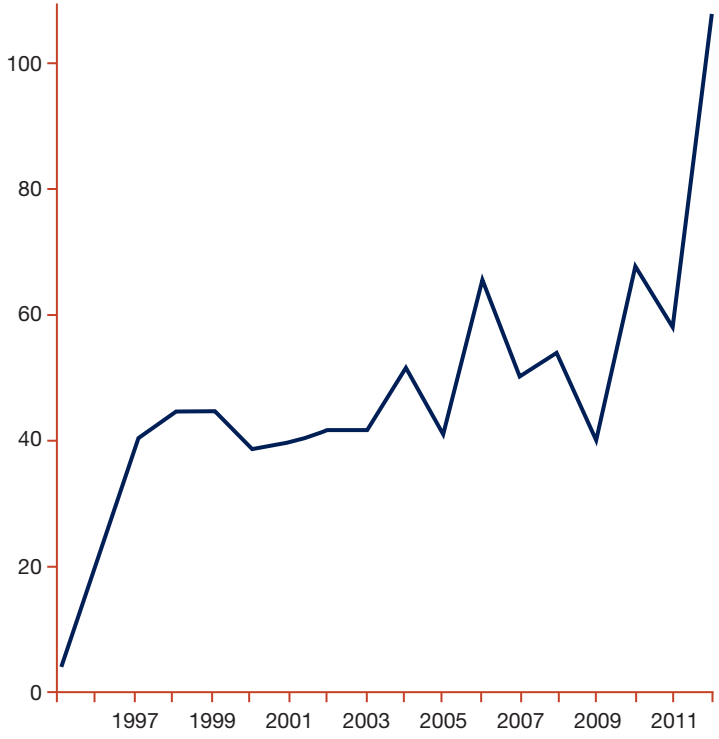
Free software this year

5 new releases, 6,000+ downloads

Website visits per grant year

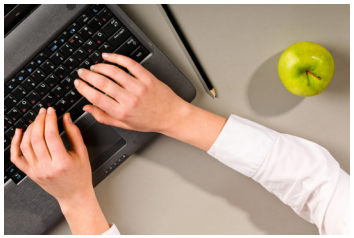


Presentations, workshops per year



New Grants

Opt-in: Optimizing intensive intervention for weight loss



National Institute of Diabetes and Digestive and Kidney Diseases

Co-PIs: Bonnie Spring, Northwestern University; Linda Collins

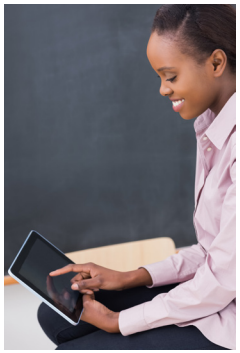
Aim: to develop an Internet-and-phone-based weight-loss intervention using MOST. This will allow an effective but expensive intervention to be delivered at much lower cost.

Prescription opioid dependence: Physiology, emotion, and treatment outcome

National Institute on Drug Abuse

Co-PIs: Roger Meyer, Scott Bunce, Penn State School of Medicine; Center Investigator: Stephanie Lanza

Aim: to study physiological and behavioral changes during recovery from addiction to prescription opioids. This study will use EMA data collected via smartphones to better understand the recovery process of recently detoxified patients and its link to later relapse.



A systems science approach to sexual risk behavior in young women

National Institute of Child Health and Human Development, Office of Research on Women's Health

PI: Sara Vaselinko; Investigators: Runze Li, Stephanie Lanza

Aim: to understand the changing sexual risk behavior of young women across multiple relationships. Researchers will employ time-varying effect models to analyze electronic diary data to learn how sexual risks change over time and to understand disparities between racial, ethnic, and socioeconomic groups.

Adaptive intervention for minimally verbal children with autism in the community

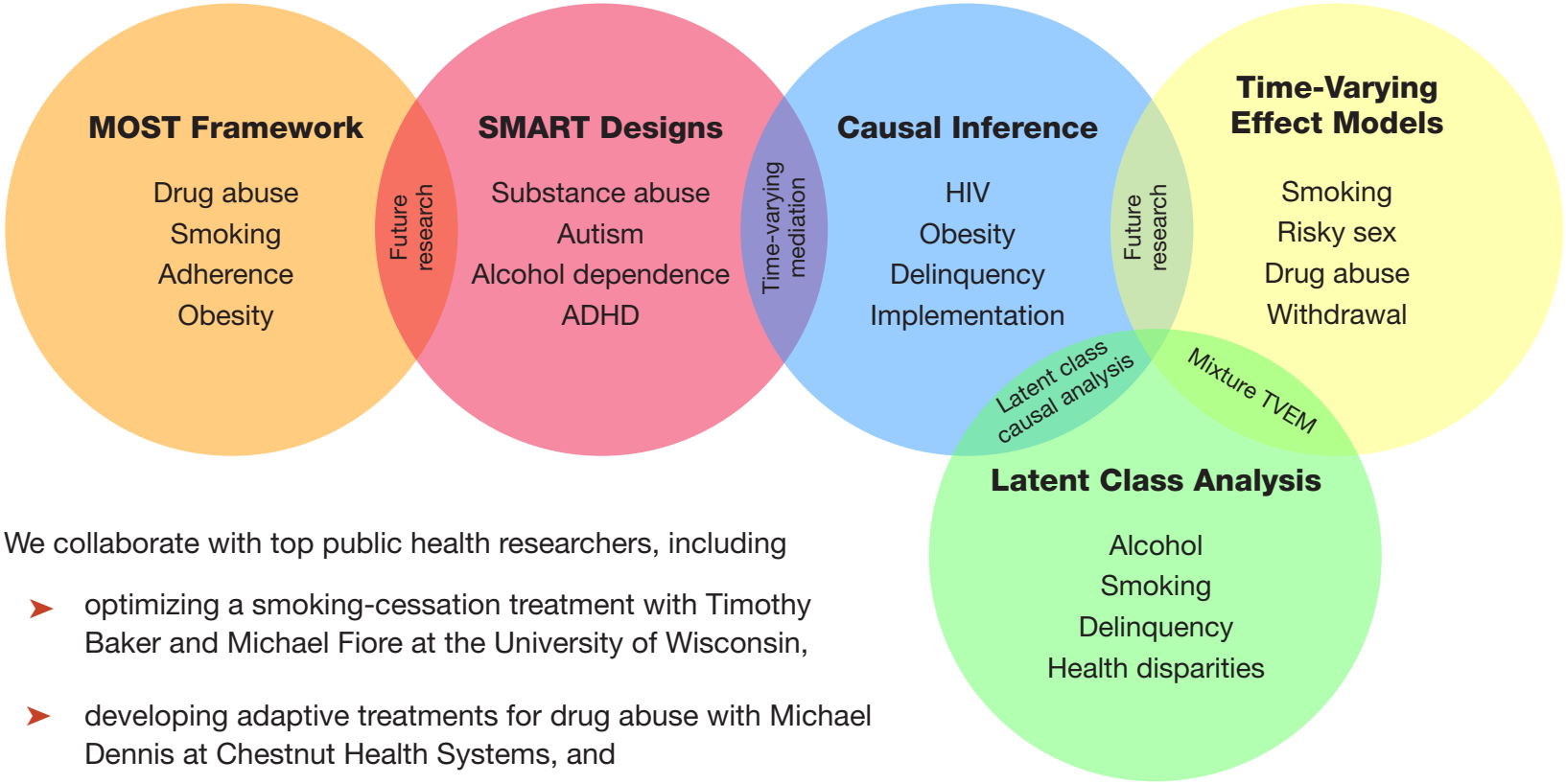
National Institute on Child Health and Human Development, Autism Centers of Excellence

PI: Connie Kasari, University of California, Los Angeles; Center Investigator: Daniel Almirall

Aim: to develop an adaptive intervention that increases the amount of verbal communication for children with autism. This is one of several grants on which Methodology Center researchers contribute expertise in SMART. See pages 10-11 for more information.

Collaboration

We foster methodological and behavioral science collaborations.



We collaborate with top public health researchers, including

- optimizing a smoking-cessation treatment with Timothy Baker and Michael Fiore at the University of Wisconsin,
- developing adaptive treatments for drug abuse with Michael Dennis at Chestnut Health Systems, and
- studying the impact of responsive feeding on childhood obesity with Leann Birch at Penn State.

Research Projects

The Methodology Center has five highly collaborative research projects. Each project addresses a critical problem in data analysis or experimental design. To foster new collaborations, The Methodology Center funds pilot projects by researchers from a variety of disciplines.

Latent Class Analysis (LCA)

Latent class analysis (LCA) uncovers unobservable subgroups within a population. By expanding the available LCA models, we make it possible for scientists to better understand complex behaviors and to target interventions to the subgroups who will benefit most. Central to this project is the ongoing development of PROC LCA, SAS software for conducting LCA that has been downloaded thousands of times.

2013 HIGHLIGHT

New methods and software integrating causal inference with LCA

NEXT STEP

To develop new recommendations for dealing with missing data in LCA

RECENT GRANT

Advancing tobacco research by integrating system science and mixture models

National Cancer Institute: R01-CA168676

PI: Stephanie Lanza; Investigator: Runze Li

Stephanie Lanza
Principal investigator

Research Projects

Causal Inference

Causal inference research seeks to identify the impact of exposure to a particular treatment or condition. Center work on causal inference focuses on using propensity scores to infer cause in observational studies. This allows scientists to more accurately identify agents of change and thus develop more effective and efficient interventions.

2013 HIGHLIGHT

New methods and software integrating causal inference with LCA

NEXT STEP

To estimate the causal effect of implementation fidelity on youth enrolled in a life-skills curriculum

RECENT GRANT

Marginal causal models for observational studies in obesity research

National Institute of Diabetes and Digestive and Kidney Diseases: R21-DK082858

PI: Donna Coffman

Donna Coffman
Principal investigator

Time-Varying Effect Models (TVEM)

Time-varying effect models (TVEM) enable researchers to answer new questions about complex data collected using mobile technology. TVEMs allow researchers to uncover changes in relationships between variables in a flexible way. Researchers are also exploring new ways to jointly model time-varying effects and time to an event.

2013 HIGHLIGHT

Grant awarded to integrate mixture models with TVEM to identify profiles of withdrawal among quitting smokers

NEXT STEP

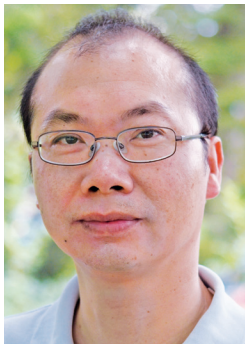
To publish special issue of *Nicotine and Tobacco Research* on new methods for tobacco research

RECENT GRANT

A systems science approach to sexual risk behavior in young women

National Institute of Child Health and Human Development: R03-HD077011

PI: Sara Vaselinko; Investigators: Runze Li, Stephanie Lanza



Runze Li
Principal investigator

Research Projects

Multiphase Optimization Strategy (MOST)

The multiphase optimization strategy (MOST) is a framework for engineering effective and efficient behavioral interventions. MOST emphasizes careful management of research resources to maximize the gain of scientific information. This framework can be used to develop new behavioral interventions, improve existing interventions, and promote Type I and Type II translation of research.

2013 HIGHLIGHT

Newly funded projects focusing on weight loss, drug and alcohol prevention, and fear reduction in cancer survivors

NEXT STEP

To develop an online weight loss intervention that is maximally effective and efficient

RECENT GRANT

A tobacco intervention laboratory

National Cancer Institute: P50-CA143188

Core PI: Linda Collins

Linda Collins
Principal investigator

Sequential, Multiple Assignment, Randomized Trial (SMART)

Sequential, multiple assignment, randomized trial (SMART) experimental designs provide high-quality data for constructing and optimizing adaptive interventions. Adaptive interventions are treatments that are individually tailored to meet a patient's changing needs. They can improve patient outcomes while decreasing cost and burden.

2013 HIGHLIGHT

Approximately 20 SMARTs in the field funded by the National Institutes of Health

NEXT STEP

To extend methods to analyze data from a SMART to handle a broader array of outcomes

RECENT GRANT

Reinforcement-based treatment for pregnant drug abusers

National Institute on Drug Abuse: R01-DA014979

PIs: Margaret Chisolm, Hendrée Jones; Consultant: Susan Murphy

(See pages 10-11 for more information.)

Susan Murphy
Principal investigator

Featured Project: SMART

Individualized Treatment, Grounded in Science

Susan Murphy
Photo courtesy of the John D. and Catherine T. MacArthur Foundation

CHALLENGES IN TREATING BEHAVIOR

Imagine a clinician treating a woman who is pregnant and addicted to cocaine; the immediate goal is to help the woman stay off drugs during pregnancy. Unfortunately, within a few weeks, a drug screen shows she has used cocaine. Should the clinician increase the number of therapy sessions or refer the woman for admission to residential care? Conversely, if the woman stays off drugs for an extended period, should the clinician continue providing the same treatment, or would it be better to reduce therapy in order to reduce cost and the patient's time commitment? Treatments often change when a patient's circumstances change, but until recently, clinicians lacked an empirical, data-based method to help them design behavioral interventions that adapt to patient response.

Interventions that adapt to a patient's preference, previous response to treatment, or condition at the right times can improve patient outcomes while decreasing cost and burden. The sequential, multiple assignment, randomized trial (SMART) was developed by Methodology Center Principal Investigator Susan Murphy and her collaborators to enable researchers to build high-quality adaptive interventions.

A SMART APPROACH TO INDIVIDUALIZING TREATMENT

The example above is based on the National Institute on Drug Abuse (NIDA)-funded project, "Reinforcement based treatment for pregnant drug abusers," led by Hendrée Jones and Margaret Chisolm at Johns Hopkins University. In this trial, researchers are using a SMART to build an adaptive intervention to treat pregnant drug abusers. Adaptive interventions repeatedly adjust the type or dosage of an intervention based on individual characteristics, such as baseline level of addiction or response to initial treatment. Treatment is adapted to each individual in order to achieve the best possible outcome for the whole population. In a SMART, treatment for each participant is randomized at each stage; the data can then be used to develop decision rules that will guide clinical practice on whether and

how to change the course of treatment based on each individual's needs.

NIH is funding approximately 20 SMARTs for issues including cocaine use, depression, weight loss, ADHD, and autism.

This is just one of approximately 20 SMARTs currently funded by NIDA; the National Institute of Mental Health; the National Heart, Lung, and Blood Institute; the National Institute on Alcohol Abuse and Alcoholism; and other institutes. These studies are being used to design effective adaptive interventions to treat critical health issues including cocaine use, depression, problem drinking, obesity, ADHD, and autism.

Data from SMARTs are useful in informing and improving the tactics and strategies used by clinicians in practice. From autism to alcoholism, scientists are using SMART to improve the quality of people's lives. At the same time, methodologists continue to develop and advance the science behind SMART. As more researchers employ SMART, we move closer to improving the health of our nation.

THE MIND BEHIND THE METHOD

Susan Murphy is both the architect and the driving force behind SMART. Susan is H. E. Robbins Professor of Statistics, professor in the Department of Psychiatry, and research professor in the Institute for Social Research at the University of Michigan. She has worked as a principal investigator at The Methodology Center since its inception in 1995.

Recently, her work on SMART drew recognition from the John D. and Catherine T. MacArthur Foundation; she was named a MacArthur Fellow in 2013. As she told the MacArthur Foundation, "I really like math. I like how it works. I like the fact that it's clean. I wanted very much to have some impact on real life—to be able to help people in some way and to use mathematics, and in particular statistics, to help people."

"I wanted very much to use mathematics to help people."
- Susan Murphy

Susan recognized that statistical innovation meant little if behavioral and social science researchers, who have the clinical expertise necessary to tackle major health problems, did not adopt the method. She has worked tirelessly to disseminate SMART so that, today, many researchers are using SMART to develop empirically grounded adaptive interventions. She has mentored graduate students, postdocs, and junior researchers in the method, and now she and her colleagues, including Daniel Almirall and Inbal Nahum-Shani, consult with researchers who are planning SMARTs, train researchers to implement SMARTs, and conduct original research to advance SMART methodology. Perhaps most importantly, Susan has fostered relationships with behavioral and health researchers of the highest caliber so that implementations of SMART have the greatest possible impact on public health.

CENTERED ON PUBLIC HEALTH

Susan's work reflects The Methodology Center's mission. Regardless of their discipline, researchers at The Methodology Center use ideas from across the sciences, liberal arts, and engineering to develop solutions for our society's most urgent health problems. SMART relies on Q-learning, a data analysis method originating in computer science, and Susan is working with clinicians and computer scientists again in her newest line of research, just-in-time adaptive interventions (JITAIs). JITAIs are individualized sequences of treatment that can be delivered anytime and anywhere via a smartphone; the treatments are individualized based on moment-to-moment patient response to treatment, level of current risk, or geographic location. With her colleagues at The Methodology Center and across the country, Susan continues to create new ways to use mathematics to help people.

For more information on SMART, visit methodology.psu.edu/ra/adap-inter.

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advancing methods, improving health

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