

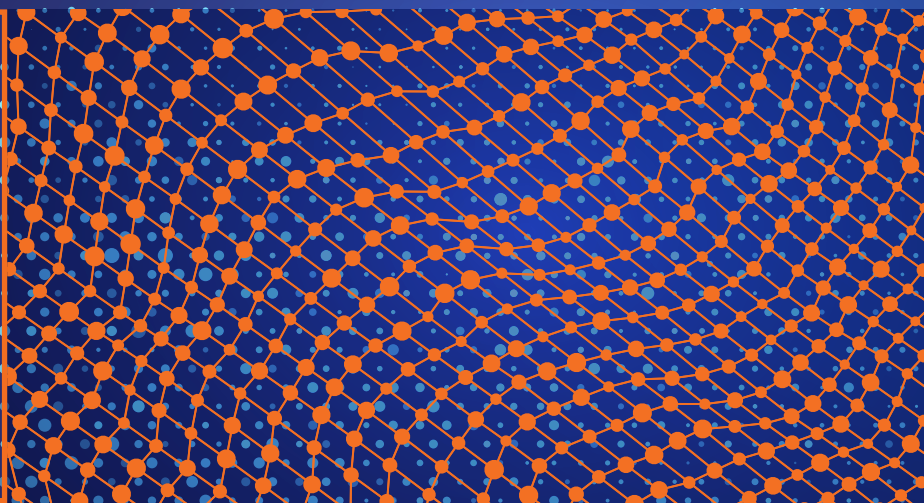


PennState
College of Health and
Human Development

The Methodology Center
ADVANCING METHODS, IMPROVING HEALTH

— 2019–2020 —

ANNUAL REPORT



THE HISTORY OF

.....

MY **VISION** WAS TO ESTABLISH A CENTER IN
WHICH BEHAVIORAL AND HEALTH **SCIENTISTS**,
METHODOLOGISTS, AND STATISTICIANS WOULD
COLLABORATE ON DEVELOPMENT OF
NEW **QUANTITATIVE METHODS**,
ADAPTATION OF EXISTING QUANTITATIVE
METHODS FOR APPLICATION IN NEW CONTEXTS,
AND **DISSEMINATION** OF METHODS.

.....

THE METHODOLOGY CENTER

Methodology Center Director Linda Collins answered our questions about how The Methodology Center became what it is today.



Linda M. Collins

*Director, The Methodology Center
Distinguished Professor, Department of
Human Development and Family Studies
Professor, Department of Statistics*

Why was a methodology-focused center needed?

There were several reasons. First, I felt more progress would be made, both in methodology and in behavioral science, if methodological research were informed by actual pressing scientific questions that arise in behavioral science. A center in which behavioral and health scientists, methodologists, and statisticians all work together would achieve this. Second, I had observed that a lot of great work was being done in the field of statistics, much of which was never used in behavioral and health research. This was because the articles describing the work were so technical that they could be understood only by quantitative specialists, and the kind of software required to implement the approaches did not exist. To place the new methods in the hands of behavioral and health scientists, there was a need for dissemination in the form of high-quality yet accessible journal articles and user-friendly software. Third, for completely selfish reasons, I needed such a center for my own professional development.

I want to mention the encouragement and mentorship of my first National Institutes of Health (NIH) project official, Larry Seitz of the National Institute on Drug Abuse (NIDA). He first suggested to me that a P50 center focused on methodology would fit well in NIDA's portfolio and encouraged me at every step of the way.

Does the Center today match your original vision?

The Methodology Center is definitely the stimulating interdisciplinary environment I envisioned, and my career has benefitted enormously from being a part of it. I did not foresee that we would someday have an external funding portfolio in the millions of dollars or that the Center would develop a national and international reputation as the go-to place for innovative methods. So, in many ways the Center has exceeded my original vision.

CURRENT RESEARCH

The Methodology Center exists to improve the behavioral and social sciences by integrating perspectives from a variety of disciplines, including statistics, engineering, psychology, and human development. In the Center, each PhD-level scientist conducts their own line of research. Creating a meaningful center from a disparate group of independent scientists requires dedication to a common mission and the development of a shared culture. The leadership of the Center, its directors and principal investigators, work separately and collaboratively to address the methodological needs of drug abuse and HIV scientists. Methodology Center scientists all collaborate on and contribute to one or more of these projects. The projects described below outline the direction and scope of the Center's research.

PRINCIPAL INVESTIGATOR

Linda M. Collins

Director, The Methodology Center

*Distinguished Professor, Human Development and
Family Studies, Penn State*

Professor, Statistics, Penn State

Multiphase Optimization Strategy (MOST)

What are you working on?

My primary research interest is optimization of behavioral, biobehavioral, and biomedical interventions using the multiphase optimization strategy (MOST). MOST enables researchers to develop interventions that are not only effective, but also efficient, economical, and scalable. Over the last 15 years, my collaborators and I have been working to incorporate principles and best practices from the engineering design process and other disciplines into a framework for the development and optimization of interventions.

Why do you study this specific problem?

For a variety of reasons, many behavioral interventions are developed and then never broadly distributed and applied. MOST provides a framework through which intervention developers can improve scalability and determine which components of their intervention are contributing and which are simply dead weight. MOST also promotes more efficient experimentation and the development of a knowledge base that will move intervention science forward more rapidly.

Methods for Analysis of Intensive Longitudinal Data (ILD)

Methodology Center researchers have been developing methods for the analysis of ILD for more than ten years. Many of our researchers have collaborated on this project; with the rise of digital data and ecological momentary assessments, now the majority of our researchers analyze ILD. Recent work on time-varying effect modeling (which was developed to analyze ILD) and multilevel modeling has broadened our perspectives on the breadth and scope of what methods for ILD can and should encompass. As we begin to consider our next grants, our work on ILD is likely to evolve yet again.

How is The Methodology Center helping to advance this research?

The Methodology Center is the hub to which all the spokes of my research collaborations are joined. In order to develop, test, and expand MOST, I have collaborated with a broad array of scientists across many disciplines. The seed ideas of MOST were born from a collaboration with Methodology Center Principal Investigator Susan Murphy. To develop MOST as a method, I have worked with engineers like Daniel Rivera, professor of engineering at Arizona State University, to incorporate engineering principles into MOST. Currently, I am working with David Vanness, professor of health policy and administration at Penn State, to incorporate multi-component decision-making into MOST. In order to apply MOST in demonstration projects, I have collaborated with some of the top researchers in a variety of fields. For example, I collaborated on a smoking-cessation intervention with Timothy Baker and Michael Fiore at the University of Wisconsin's Center for Tobacco Research and Intervention and on an obesity intervention with Bonnie Spring of Northwestern University's Feinberg School of Medicine. These colleagues and many others have discussed our research at Methodology Center retreats and brown bag talks. Together, we have drawn on the diverse knowledge and perspectives of other Methodology Center researchers to develop the most robust and comprehensive framework possible and to apply MOST in meaningful projects.

Looking to the future, what makes you the most excited?

In collaboration with David Vanness, I have begun work to incorporate Bayesian decision-making principles into MOST. Researchers often have to balance multiple goals. In intervention design, multiple criteria often pull researchers and other stakeholders in multiple directions during the decision-making process. This research will allow researchers to make decisions more scientifically. I am also eager to see MOST applied more broadly so that we can bring the power of behavioral interventions to more people and build a healthier world.



PRINCIPAL INVESTIGATOR

Susan A. Murphy

*Principal Investigator, The Methodology Center
Professor, Statistics and Computer Science,
Harvard University
Radcliffe Alumnae Professor, Radcliffe Institute,
Harvard University*

Just-in-Time Adaptive Intervention (JITAI)

What are you working on?

I work on methods for collecting and analyzing data to improve mobile health (mHealth) interventions for individuals with chronic disorders such as addictions and mental illness. My primary interest concerns clinical trial design and the development of data analytic methods for informing sequential decision making in health interventions. In particular, my lab focuses on constructing real-time individualized sequences of treatments, known as JITAIs, delivered by mobile devices. JITAIs are composed of decision rules that specify, for a given context, whether to provide an intervention and, if so, which type. By using a JITAI, scientists aim to maximize intervention effects while minimizing patient burden.

Why do you study this specific problem?

I do this for multiple reasons. I want to help people who struggle with these disorders. Both addictions and mental illnesses are brain disorders, and their treatment is on the frontier of our scientific knowledge; this makes for exciting science. mHealth intervention development concerns sequential decisions about when and in which context a mobile device should attempt to provide support to an individual. This is a rather challenging problem because it is very easy for people to become over-burdened by the intervention. Most mHealth apps quickly fall into disuse, so there are challenges in the science of intervention about how to best leverage mobile technology to benefit participants' health and how to keep people engaged with an app that can help them.

How is The Methodology Center helping to advance this research?

The Methodology Center helps address this problem in multiple ways. First, I have great behavioral science collaborations in The Methodology Center. These collaborations help increase the quality and impact of my lab's research. Second, The Methodology Center provides a great deal of support to disseminate my methods. Third, The Methodology Center provides technical support in the development of algorithms for use in mHealth, which makes the resulting apps more usable and effective.

Looking to the future, what makes you the most excited?

I am most excited by the possibility of an algorithm acting as an intervention component in an mHealth intervention. This data algorithm would continually learn and update the timing of delivery of mHealth interventions to make these interventions effective for each individual.



PRINCIPAL INVESTIGATOR

Runze Li

*Principal Investigator, The Methodology Center
Eberly Family Chair and Professor, Statistics,
Penn State
Professor, Public Health Sciences, Penn State*

Variable Screening and Selection

What are you working on?

I am primarily interested in the development of new methods for analyzing high-dimensional data and intensive longitudinal data. I collaborate with other statisticians to extend these methods for use in behavioral research focused on preventing drug abuse and HIV-risk behavior. Our goal is to develop methods to analyze genetic data simultaneously with intensive longitudinal data. This will allow scientists to identify which genetic, individual, and social factors predict drug abuse, HIV-risk behavior, and related health behaviors.

Why do you study this specific problem?

As data become more complex, and as genetic data become more available, behavioral scientists need new methods to harness the potential that these data have to inform the prevention and treatment of drug abuse and HIV-risk behavior. In genetic studies, the number of variables is extremely large relative to the number of participants: there may be hundreds of subjects and hundreds of thousands of variables. This has a crippling effect on exploratory data analyses because nearly all multivariate procedures break down when the number of variables exceeds the sample size. As a result, it is necessary to reduce the number of variables to a subset of predictors that potentially impact the outcome of interest. That is the focus of my current work.

How is The Methodology Center helping to advance this research?

The Center helps me bridge the gap between statistical innovation and advancing the behavioral sciences. I am a statistician, and many of my collaborators are statisticians. Collaborating with other Methodology Center researchers connects me to the issues faced by drug abuse and HIV researchers and ensures that my research remains focused on addressing the critical problems in drug abuse and HIV research. My research, in turn, will help researchers address these and other problems.

Looking to the future, what makes you the most excited?

In our increasingly technological world, more data and more types of data are emerging. Researchers are developing methods that address substance abuse, HIV-risk behavior, and other behavioral issues in more focused, effective, and personalized ways. I am excited to see these data integrated and to unlock the information they contain.



PRINCIPAL INVESTIGATOR

Stephanie T. Lanza

*Principal Investigator, The Methodology Center
Director, Edna Bennett Pierce Prevention Research Center
Professor, Biobehavioral Health, Penn State*

Time-Varying Effect Modeling (TVEM)

What are you working on?

At this point, the work in the TVEM project and the latent class analysis (LCA) project are highly collaborative and tightly linked. Our research seeks to better understand two types of heterogeneity in effects. First, we are expanding methods like LCA to identify types of individuals—defined by multiple characteristics—who may be more or less susceptible to exposure to a risk factor or more or less responsive to an intervention. We refer to this approach as multidimensional moderation. Second, we are advancing TVEM to understand how time or human development affects risk factors across population subgroups. For example, TVEM has been used to understand how craving varies for people during a smoking quit attempt and to reveal developmental timing in the emergence of health disparities. We refer to this approach as dynamic moderation.

How is The Methodology Center helping to advance this research?

We are leveraging the powerful new framework of TVEM to elucidate critical time or age periods when there is significant moderation of effects. For example, we can use this approach to pinpoint the age when a substance use risk factor (e.g., parental closeness) has a significant association with the onset of nonmedical prescription opioid use. These age periods can be estimated and compared across population subgroups, such as male versus female or college attenders versus non-attenders. These comparisons can provide more nuanced information about the most promising ages in those groups to target risk factors in interventions.

Looking to the future, what makes you the most excited?

We are excited to continue to develop these methods and disseminate them to drug abuse researchers and to apply our methods to the most contemporary data available. To that end, we are initiating a major data collection effort among young adults in daily life. These intensive longitudinal data will be used to examine daily substance use behavior patterns, including alcohol use, heavy episodic drinking, cigarette use, nicotine vaping, and multiple types (e.g., joints, hookah, vaping) of marijuana use. In order to model co-use patterns among substances, we plan to advance techniques for multilevel latent class analysis. Importantly, this methodological work will enable us to distinguish between person-level and individual-level effects of risk factors and moderating effects of risk factors.



PRINCIPAL INVESTIGATOR

Bethany C. Bray

*Core Director, The Methodology Center
Associate Professor & Associate Director for Scientific
Outreach, Center for Dissemination and Implementation
Science, University of Illinois at Chicago*

Latent Class Analysis (LCA)

What are you working on?

LCA uses multiple indicators that can be measured to understand something that cannot be measured directly. As an example, consider estimating the risk that adolescents would start smoking cigarettes in the future.

Although this “risk” cannot be measured directly, adolescents could be asked to respond to a series of questions about the quality of their schools, the quality and stability of their home environments, the poverty of their households and neighborhoods, and other factors. LCA could then be used to identify different patterns of risk factors experienced by these adolescents and whether patterns convey differential risk for starting smoking cigarettes in the future. In our research, we are developing ways to use LCA to investigate multidimensional moderation. For example, the aforementioned LCA of risk factors could be used to understand who may be more or less responsive to an intervention for cigarette smoking.

How is The Methodology Center helping to advance this research?

The Methodology Center is leading the advancement and demonstration of LCA and related methods to answer important questions about multidimensional and dynamic moderation in existing data. For instance, we are developing new methods to predict an outcome from latent class membership. Consider an example about vaping among teens. If we apply LCA to estimate levels of vaping from a latent class variable of adolescent risk factors (like the smoking example in the paragraph above), an observed variable like perceived risk associated with regular vaping, and their interaction, we will be better able to understand which individuals are most susceptible to the perception that vaping is low risk. We also are developing methods to include latent class variables, like patterns of adolescent risk factors, as predictors and outcomes in TVEM.

Looking to the future, what makes you the most excited?

We have been developing and disseminating extensions of LCA for over 20 years, and it is still exciting to see new insights revealed by people applying the method. In particular, new collaborations are expanding our LCA work to address health disparities and health equity in drug use and risky sex more directly. Also, as new types of data emerge due to technological innovation, it is exciting to apply multidimensional and dynamic moderation in emergent ways. Primarily, we are excited to extend methods for multilevel LCA. Multilevel LCA will help researchers understand which risks or protective factors are working on the within-person level versus the between-person level.

IMPROVING LIVES WITH PENN STATE

In recent years, Penn State has launched two large-scale initiatives to improve lives. Methodology Center researchers have joined in the efforts to address the opioid epidemic and protect children. Researchers at The Methodology Center focus on developing meaningful collaborations to create substantive applications of our methods. By connecting with networks of outstanding collaborators at Penn State, Methodology Center researchers can engage with a broad community of experts, policy makers, interventionists, and more, and this will lead to real, lasting change.



Consortium to Combat Substance Abuse

In 2017, 5,456 people died of an opioid overdose in Pennsylvania. Motivated by the nation's opioid epidemic, Penn State has recently consolidated its resources to address the opioid crisis and the larger problems of substance abuse in Pennsylvania and beyond via the Consortium to Combat Substance Abuse (CCSA). CCSA draws on the expertise of researchers, educators, and practitioners from Penn State campuses across the state to develop and implement effective

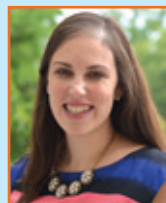
programs, policies, and practices aimed at preventing and treating addiction and its spillover effects on children, families, and communities.

Launched in 2018, Methodology Center Principal Investigator Stephanie Lanza is serving as the director of the CCSA. Stephanie is also director of our sister center, The Edna Bennett Pierce Prevention Research Center. Under Stephanie's leadership, the CCSA has begun providing seed funding to interdisciplinary teams of Penn State researchers who develop projects that address substance abuse, initiated 12 new strategic hires of tenure-track faculty, and held its inaugural conference, "Envisioning a Future Free from Addiction: Research, Programs, and Practice to Prevent Substance Abuse."

Stephanie talked about the goal of the CCSA. "Penn State recognized the need for sweeping action to address the nation's wide-ranging substance abuse issues. The University invested in the CCSA to fuel innovative, interdisciplinary research on substance misuse and develop programs to intervene. Penn State is stepping up with the 'all hands on deck' approach called for by NIH Director Francis Collins and NIDA Director Nora Volkov. The expertise that exists throughout The Edna-Bennett Pierce Prevention Research Center, The Methodology Center, the College of Health and Human Development, and the University gives Penn State an excellent start on this work."

Methodology Center Director Linda Collins serves on the CCSA advisory board, and the majority of The Methodology Center's researchers have participated in CCSA events or applied for seed grants.

Learn more about the CCSA at <https://combatsubstanceabuse.ssri.psu.edu/>.



Child Maltreatment Solutions Network

Roughly 675,000 children are found to be victims of maltreatment each year in the United States, and they face a lifetime of mental, emotional, behavioral, and physical consequences. With the economic burden in the U.S. exceeding \$124 billion for child maltreatment-related costs, the importance of preventing maltreatment and mitigating damaging outcomes for victims cannot be overstated. The Child Maltreatment Solutions Network (CMSN) at Penn State was launched in 2012 with the mission of improving the lives of children by focusing on the causes, prevention, detection, consequences, and treatment

of child maltreatment. For the past three years, Methodology Center Investigator Kate Guastaferro has collaborated with CMSN Director Jennie Noll on the development and implementation of child sexual abuse prevention strategies.

If you stop by The Methodology Center offices, chances are good that you will find Kate's office empty. She spends several days each month crisscrossing Pennsylvania to prevent sexual abuse. In designing a comprehensive sexual abuse prevention strategy, Kate discovered that no parent-focused sexual abuse curriculum existed, so she and Jennie developed one with input from Edna Bennett Pierce Prevention Research Center Investigator Meg Small. Kate trains providers to deliver community-based, school-based, and parent-focused interventions; observes the implementation of those interventions; and collects data in agencies, schools, and homes of at-risk parents around the state. When Kate joined The Methodology Center as a postdoctoral fellow in 2016, her training focused on the multiphase optimization strategy (MOST) with Linda Collins, and Kate became eager to apply it to sexual abuse prevention. Her prevention training and applied experience, however, led Kate to the conclusion that randomization would be virtually impossible for the prevention study she wanted to conduct, so she decided to run a staggered implementation design, adhering to the resource management principle of MOST. She remains committed to bringing MOST to child-maltreatment research in the future.

When Kate is in The Methodology Center, she is often hauling a large box of surveys to administer or analyze. Kate said, "I believe there is no reason the prevalence of child sexual abuse cannot be zero. I'm committed to finding the most effective intervention strategy and incorporating all levels of a community to achieve this goal. And, I'm fortunate to have the training, support, and infrastructure of The Methodology Center and CMSN in this pursuit."

Other Methodology Center researchers, including former PAMT postdoctoral fellow Peter Rivera and Investigator Bethany Bray, have collaborated on this research and with other CMSN researchers. Additionally, CMSN houses the Center for Healthy Children, which was created by a multimillion-dollar grant from The Eunice Kennedy Shriver National Institute of Child Health and Human Development in 2017.

Learn more about the CMSN at <https://www.solutionsnetwork.psu.edu/>.

We are very proud of Penn State's leadership, research, and innovation in substance abuse and child maltreatment. We look forward to the improvements that these initiatives will continue to create in the lives of people in need.

ONLINE RESOURCES

Our funding from the National Institute on Drug Abuse specifies that The Methodology Center should “serve as a national resource to the drug abuse research community.” We do this primarily through the publication of interdisciplinary articles that develop and expand innovative research methods, giving presentations at scientific conferences, and conducting and hosting trainings on innovative methods. Beyond that, we are always developing mechanisms to educate and connect with as many researchers as possible. Our home for these tools is our website, methodology.psu.edu.



Webinars

Every semester we host 1 & 1 webinars, where a methodological expert gives a live, one-hour presentation on an innovative research method and then allows one hour for questions from the audience. Videos of the webinars are then archived on YouTube and our website.



Introductory videos

In addition to the in-depth introductions available through our webinars, we also offer brief, five to 15 minute conceptual overview videos of many of our research projects.



Podcasts

For nine years we have hosted a podcast series that deals with a broad range of topics of interest to drug abuse researchers and methodologists. 35 episodes are currently available.



Software

We create and distribute software for experimental design and data analysis. Our software has been downloaded many thousands of times and used in hundreds of peer-reviewed publications.



Helpdesk

We provide users' guides with our software and maintain an email helpdesk to support any problems users encounter with the software we create.



Teachers' Corners

Teachers' Corners provide resources like slideshows, student exercises, and reading lists for instructors who want to incorporate instruction on innovative methods into their teaching.



FAQs

Most our research projects, including TVEM, LCA, MOST, and JITAIs, include lists of frequently asked questions where researchers can browse for the information they need about a new method.



Grant-writing tips

Running an experiment that follows MOST requires a paradigm shift from traditional experimental design. In order to help grant reviewers understand MOST, our website includes tips for writing a grant that includes MOST.



Online consulting

Again, because MOST requires a large investment of time and resources, The Methodology Center offers free consulting sessions on MOST. Researchers can apply through our website.


TVEM Learning Path

Our newest resource is a tool for self-directed learning of time-varying effect modeling (TVEM). TVEM is an extension of linear regression that allows the association between two variables to be modeled without making assumptions about the nature of the association. It allows scientists to understand the way associations between variables change over time.


The TVEM Learning Path comprises videos, links, and SAS code that allow SAS users to teach themselves how to plan, prepare data for, and run a TVEM. The Learning Path enables users of all levels to jump in wherever they need information. Within each section, there may be different ways to get the same information (e.g., watching a video, listening to a podcast, running a SAS exercise).

In the image on the right, a single section of the Learning Path is open. In this section, users can download the TVEM users' guide, watch a video about running a TVEM, or download the macro, SAS code, and dataset to run the code themselves.

LEARN TVEM AT
[METHODLOGY.PSU.EDU/RA/TVEM/LEARN](https://methodology.psu.edu/ra/tvem/learn)

**PennState**
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The Methodology Center
advancing methods, improving health

SEARCH 

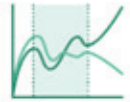
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» The Methodology Center » Research Areas » Time-Varying Effect Modeling » Teach Yourself TVEM

TEACH YOURSELF TVEM

How to use the TVEM Learning Path

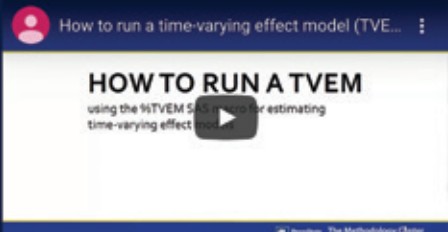
The videos, links, and SAS code below are designed to allow SAS users to teach themselves how to plan, prepare data for, and run a [time-varying effect model \(TVEM\)](#). This page is designed for users of all levels to be able to jump in wherever they need information. Within each section, there may be different ways to get the same information (e.g., watching a video, listening to a podcast, or running a SAS exercise). Users who possess basic familiarity with a given subject may want to download and run SAS code immediately. Users who are new to a subject may want to watch a video before running the relevant code.



Conceptual Introduction to TVEM

Preparing to Run a TVEM

Running a TVEM



HOW TO RUN A TVEM

using the %TVEM SAS macro for estimating time-varying effect

This video describes the steps for running the %TVEM SAS macro. To run the exercise in this video, first download the macro and users' guide. Then, download this SAS code `running_a_tvem.sas` and this data set `simaddhealth.sas7bdat`. (Note: you do not need to watch the video to run the code.)

There is a separate macro for running a weighted TVEM, but users are strongly encouraged to understand the %TVEM SAS macro before using the %WeightedTVEM SAS macro.

Steps covered include:

- 00:36 reading in a data set
- 01:57 including the macro in SAS
- 02:46 running an intercept-only model (code description, how to run, and output)

For a text description of the code, see section 4.3 of the users' guide (PDF).

PILOTING THE WAY TO A HEALTHIER WORLD

The Methodology Center pilot-project program provides small grants (funded by our National Institute on Drug Abuse P50 Center-of-Excellence grant) to engage researchers in new (to them) areas of social science or methodological research. As an interdisciplinary center, we believe that multiple perspectives are necessary to answer the pressing questions in social, health, and

behavioral research. Our pilot projects help recruit new scientists to answer these questions and allow established researchers to explore new avenues of inquiry.

At this point during our current P50 grant, we have funded eight pilot projects. Below are two recent pilot projects that represent some of the promise inherent in the pilot-project program.



Ashley Linden-Carmichael

Understanding Co-Use of Marijuana and Alcohol

Ashley Linden-Carmichael is assistant research professor in The Edna Bennett Pierce Prevention Research Center and Investigator at The Methodology Center. Ashley researches the co-use of multiple substances, especially alcohol and marijuana. She recently completed a Methodology Center-funded pilot project that helped her address new questions about the experience and risks of co-use. In order to explore these questions, Ashley first needed to understand how substance users talk about their experiences.

How drunk do you feel?



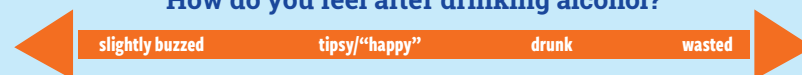
Traditional substance-use studies often ask individuals to rank their intoxication on a scale from 0-100. In data collected during Ashley's pilot study, participants felt this system was arbitrary and hard to use accurately. Some participants said they didn't know what it means if, for example, they report that their level of intoxication was 68 on Thursday night and 73 on Friday. Although it is possible to measure objectively how much people drink, it is also important to understand how they feel when they are drinking or using marijuana for multiple reasons. Most importantly, when deciding whether they are sober enough to drive, people often over-rely on feelings of intoxication rather than the amount they actually consumed.

Describing intoxication

Not only is measuring dosage effects a challenge, but alcohol, marijuana, and the co-use of both all produce different types of intoxication. The intoxication that attends co-use is subjectively different than the experience of alcohol intoxication plus the experience of marijuana intoxication. Do co-users typically perceive the effects of the multiple intoxicants to be offsetting or amplifying? This remains open research.

To explore how substance users talk about their experience of intoxication, Ashley recruited two cohorts of alcohol and marijuana co-users on Amazon's Mechanical Turk, a crowdsourcing marketplace where participants around the nation sign up to complete online tasks. The first cohort of participants completed surveys in which they listed words that describe their subjective feelings of impairment during a substance use episode (e.g., buzzed, stoned). They were asked to complete this task for alcohol alone, marijuana alone, and the co-use of alcohol and marijuana. From these data, Ashley culled the most frequently used words. The second cohort was asked to rank-order the previously identified terms for alcohol intoxication, marijuana intoxication, and intoxication by co-use. So far, Ashley and her collaborators have developed new scales for evaluating subjective intoxication for both alcohol and marijuana. The co-use scale is still under development. In a daily diary sample of young adults, Ashley found that participants responded well to the new scale when asked to rank their level of intoxication, with participants demonstrating higher means and variances than those who used the preexisting scale. Use of more contemporary language and scale anchors may better capture the full range of young adults' feelings of intoxication.

How do you feel after drinking alcohol?



Understanding co-use

Ashley also collected pilot data about co-use in a daily diary study. This project was one step of several that led to her application for an early-career K01 award from the National Institute on Alcohol Abuse and Alcoholism. The grant, which will fund Ashley's salary for five years and protect her time for training and research, was awarded in May of 2019. In her new project, Ashley will use transdermal alcohol sensors to track blood-alcohol content. These data will be paired with surveys to identify predictors of co-use at the person level (e.g., sex or typical substance use behavior), the day level (e.g., day of the week), and moment level (e.g., social setting or mood). Ashley's pilot project helped her build the foundational knowledge necessary to apply for the K, and her research now may provide intervention scientists with a better understanding of the antecedents of alcohol and marijuana co-use.



David Vanness

Optimizing Interventions: How to Balance Multiple Criteria When Making Decisions

David Vanness is professor of health policy and administration at Penn State and an investigator at The Methodology Center. He is an economist by training and has focused much of his research and teaching on the application of Bayesian methods to health technology assessment and medical decision-making. Recently The Methodology Center funded his pilot project to collaborate with Linda Collins and other scientists to incorporate Bayesian multi-criteria decision analysis (MCDA) into the multiphase optimization strategy (MOST).

A Better approach to developing interventions

As described on page 3, MOST is a framework for optimizing behavioral interventions. MOST relies on principles from engineering and other fields to ensure efficiency and careful management of available resources. One step in MOST is the identification of an optimization criterion. For example, intervention designers might want to design the most effective intervention possible, the most effective intervention that can be delivered for under \$200 per participant, or the most effective intervention that can be delivered in under 30 minutes.

Some interventions, however, target multiple outcomes. MOST has been applied to several projects with multiple outcomes. The ItMatters project, a collaboration between Linda and David Wyrick's group at the University of North Carolina at Greensboro, targets the intersection of risky drinking and risky sexual behavior. Bonnie Spring at Northwestern University is collaborating with Linda on OptIn, which targets both weight loss and nutrition. When multiple outcomes are important, intervention developers need a scientific way to balance the potentially competing interests.

Beyond outcomes, other factors may need to be considered when designing interventions. For example, an intervention designer may need to weigh one or more measures of effectiveness against cost, side effects, participant burden, and/or adherence rates. To create an empirical framework for making these decisions, David is introducing Bayesian MCDA principles into MOST. In Bayesian MCDA, Bayesian statistics are used to estimate how much we know from available data about the performance of different treatment options along several domains. Then, decision-weights are applied to each domain to assess tradeoffs, because no single intervention is likely to perform the best in all domains. Incorporating these decision-making principles into MOST will empower researchers to create interventions that balance competing needs.

How to decide

To make decisions, intervention designers need to work with other stakeholders—including people who will deliver the intervention, funders, and likely participants—to agree upon the relative importance of each priority. The standard practice in intervention design relies on investigators using their best judgement to make choices informed by data. MOST already provides an empirical framework for selecting what is included in an intervention. By incorporating Bayesian decision analysis, David, Linda, and their collaborators will enable intervention designers to use MOST to design interventions that are efficient, scalable, and designed to address multiple goals according to each goal's importance.

To learn more about MOST, visit methodology.psu.edu/ra/most or read Linda's 2018 book on the topic, *Optimization of Behavioral, Biobehavioral, and Biomedical Interventions: The Multiphase Optimization Strategy (MOST)*.

SPOTLIGHT ON JOHN DZIAK



Those of you who are familiar with the Center know that, for more than a decade, John Dziak has been contributing to scientific projects and our software development. He has collaborated on multiple publications with almost every principal investigator, and he is technical lead on several of our most popular software products, including SAS PROC LCA and the SAS %TVEM macro. His achievements recently resulted in his promotion to associate research professor.

In addition to his work in the Center, John contributes a lot of himself to worthy causes around the world. In order to facilitate better postsecondary education in the developing world, he compiled a list of free, open-access, online textbooks. Peruse the list at <https://downloadablebooksforuniversities.wordpress.com/>. If you have suggestions for inclusion, contact John on Twitter @dziakj1. John, congratulations and keep up the good work in The Methodology Center and in the larger world!

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