



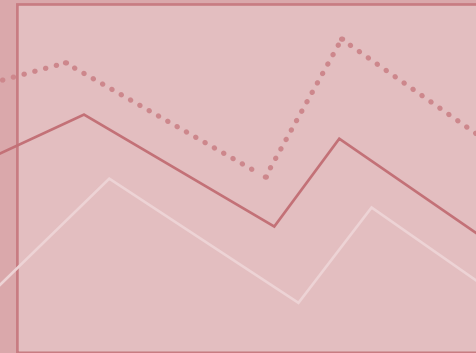
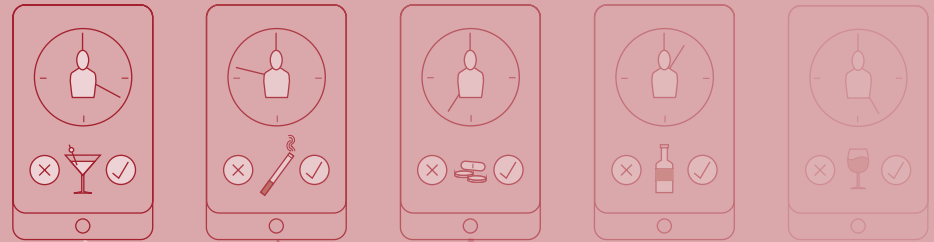
**PennState**  
College of Health and  
Human Development

**The Methodology Center**  
ADVANCING METHODS, IMPROVING HEALTH

2018 - 2019

ANNUAL

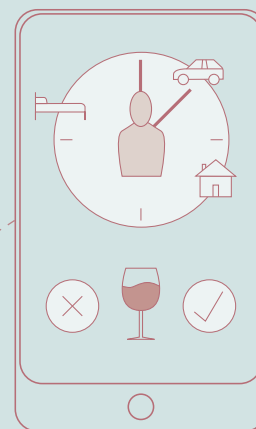
REPORT



# THE METHODOLOGY CENTER

works to advance public health by developing, improving, and disseminating experimental design methods in the social, health, and behavioral sciences. We draw upon and integrate ideas and perspectives from a variety of disciplines—including statistics, engineering, psychology, and human development—to develop new quantitative methods for research.

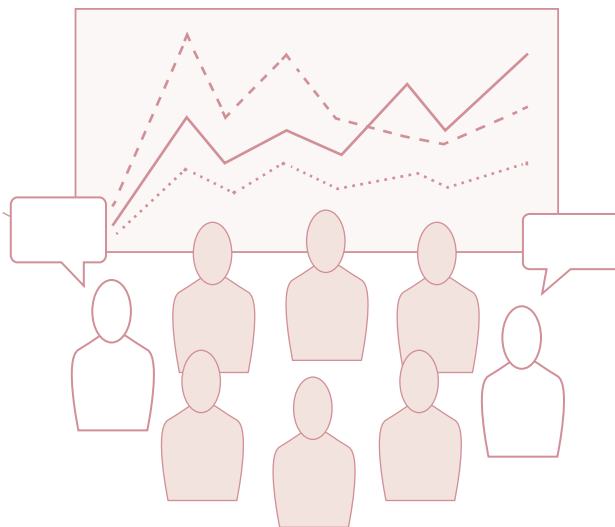
WE FOCUS ON THE NEEDS OF **DRUG ABUSE**  
AND **HIV RESEARCH**, BUT THESE METHODS  
ARE APPLICABLE TO MANY VITAL  
PUBLIC HEALTH ISSUES.



## [ from the director ]



**Linda M. Collins**  
**Director, The Methodology Center**  
**Distinguished Professor, Human Development and Family Studies**  
**Professor, Statistics**



As emergent technologies and long-running studies create diverse types and unprecedented volumes of data about drug abuse and related problems, there has never been a more exciting time to work on research methods. Many excellent panel studies, like Monitoring the Future from The University of Michigan Institute for Social Research, are mature enough to provide rich opportunities for secondary data analysis; new methods are helping scientists unlock the rich information contained in these data. The emergent field of mHealth provides manifold opportunities for new analytic methods and new experimental designs. The growing availability of genetic data means that new methods are needed to integrate genetic and behavioral data. At The Methodology Center, we are developing methods to address all of these issues and more.

In this year's Annual Report, we highlight ways in which our methods are making a difference in drug abuse research. We are funded by a P50

Center of Excellence grant from the National Institute on Drug Abuse, and advancing drug abuse research is our top priority, although our work is broadly applicable across behavioral, health, and social sciences. Toward that end, we are constantly developing new methods, applying those methods through collaborations with top drug-abuse researchers, and disseminating our methods to other drug-abuse researchers.

For information about new methodological resources and training opportunities, sign up for our electronic newsletter at the bottom of our webpage, [methodology.psu.edu](http://methodology.psu.edu).

Thank you in advance for spending a few minutes to learn about our Center's research.

A handwritten signature in blue ink, which appears to read "Linda Collins".

## VARIABLE SCREENING AND SELECTION



### PRINCIPAL INVESTIGATOR

Runze Li,  
Penn State

### PRIMARY FUNDING SOURCE

Methodological development of variable screening is funded through our Center grant, P50 DA039838 from the National Institute on Drug Abuse (NIDA).

### DRUG ABUSE OR HIV RELEVANCE

In genetic studies, there may be hundreds of participants and hundreds of thousands of variables. Nearly all techniques for exploratory data analysis break down when the number of variables exceeds the sample size. High-dimensional variable-screening procedures allow researchers to narrow the subset of variables for analysis. This research will allow behavioral scientists to incorporate genetic data into their studies. Because it is still in the statistical development phase, we are only beginning to scratch the surface of these methods' potential for drug abuse and HIV research; most of the work to date has occurred on simulated or rodent data. Runze's statistical work on a previous NIDA P50 grant led to the development of TVEM, and this work will bear similar fruit in time.

## MULTIPHASE OPTIMIZATION STRATEGY (MOST)



### PRINCIPAL INVESTIGATOR

Linda M. Collins,  
Penn State

### PRIMARY FUNDING SOURCE

Methodological development of MOST is funded through a number of collaborations, funded primarily by NIDA, the National Cancer Institute, and the National Institute on Alcohol Abuse and Alcoholism.

### DRUG ABUSE OR HIV RELEVANCE

MOST is a framework for engineering effective, efficient, economical, and scalable health interventions. It enables intervention designers to understand which parts of an intervention are contributing to the outcomes. MOST is being used in many projects addressing drug abuse and related health problems. For example, researchers at New York University's Center for Drug Use and HIV Research and Intervention, led by Marya Gwadz and Linda, have been using MOST in an intervention for HIV-positive people who are not currently receiving antiretroviral therapy (ART) or are not taking ART properly. The intervention is designed to improve their engagement with the healthcare system and ART.

## LATENT CLASS ANALYSIS (LCA)



### PRINCIPAL INVESTIGATOR

Bethany Bray,  
Penn State

### PRIMARY FUNDING SOURCE

Methodological development of LCA is funded through our Center grant, P50 DA039838 from NIDA.

### DRUG ABUSE OR HIV RELEVANCE

LCA enables researchers to detect unobservable (latent) subgroups within a population. By expanding LCA models, we enable intervention scientists to target subgroups who are most likely to benefit. In a recent article in *Prevention Science* (Bray et al., 2018), Methodology Center researchers Bethany, John Dziak, Stephanie Lanza, and their frequent collaborator Megan Patrick from The University of Minnesota integrated modern techniques for determining causality (specifically, inverse propensity weighting) with LCA with a distal outcome. The authors were able to predict problem drinking at age 35 based on a person's reasons for drinking at 19 years of age.

\*See back cover for references.

## JUST-IN-TIME ADAPTIVE INTERVENTION (JITAI)



### PRINCIPAL INVESTIGATOR

Susan Murphy,  
Harvard University

### PRIMARY FUNDING SOURCE

Methodological development is funded through our Center grant, P50 DA039838 from NIDA. Development of individual JITAI is funded by a variety of NIH grants.

### DRUG ABUSE OR HIV RELEVANCE

Adaptive interventions are treatments that are tailored to a patient's individual and changing needs. A JITAI is an adaptive intervention that provides treatment exactly when and where it is needed using mobile technologies like smartphones. In a collaboration between Susan, Bonnie Spring at Northwestern University, and Santosh Kumar at The University of Memphis, researchers are developing Sense<sup>2</sup>Stop, a smartphone app that will provide stress-management support for chronic smokers who are quitting. JITAI is being developed to address many public health issues.

## INTENSIVE LONGITUDINAL DATA (ILD)



### PRINCIPAL INVESTIGATOR

Michael Russell,  
Penn State

### PRIMARY FUNDING SOURCE

Methodological development of methods for the analysis of ILD is funded by pilot project funding from our Center grant, P50 DA039838 from NIDA.

### DRUG ABUSE OR HIV RELEVANCE

The Methodology Center has developed methods for the analysis of ILD for more than ten years. Walls and Schafer's 2006 book, *Models for Intensive Longitudinal Data*, has been cited hundreds of times. Runze Li led the project that resulted in the development of TVEM. Michael is conducting a pilot project to develop and apply new methods to analyze ecological momentary assessment data and biosensor data. He is collecting data about collegiate drinking behavior; by comparing data from anklets that measure alcohol consumption to self-report data from the same individuals, he will be able to determine the accuracy of self-reported drinking behavior and examine within- and between- person differences in drinking behavior.

## TIME-VARYING EFFECT MODELING (TVEM)



### PRINCIPAL INVESTIGATOR

Stephanie Lanza,  
Penn State

### PRIMARY FUNDING SOURCE

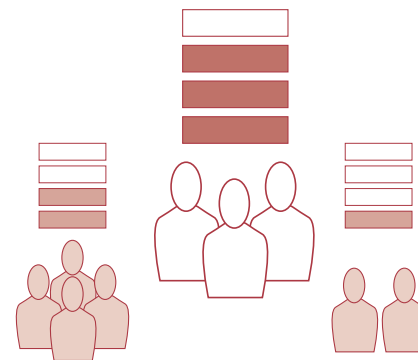
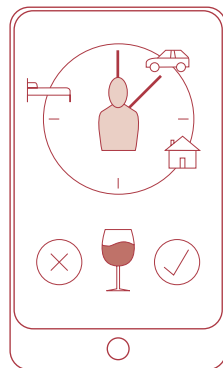
Methodological development of TVEM is funded through P50 DA039838 from NIDA. Drug abuse applications are funded through R01 DA039854 from NIDA.

### DRUG ABUSE OR HIV RELEVANCE

TVEM is a flexible tool that can be used to answer questions about associations over time. It accommodates multiple data types, including intensive longitudinal data, panel data, and cross-sectional data. TVEM enables researchers to model relationships between variables without making assumptions about how those relationships change over time. TVEM is being broadly applied in drug abuse research. One of the first applications examined how factors like mood and craving interact to influence relapse when people quit smoking (Shiyko et al., 2012). TVEM has since been applied to understanding age-related differences; one recent study examined high-intensity drinking (8+ drinks for women or 10+ drinks for men) across ages 18 to 64 (Linden-Carmichael et al., 2017).

# SUMMER INSTITUTE ON INNOVATIVE METHODS

*The Summer Institute on Innovative Methods is funded by R13 DA020334 from the National Institute on Drug Abuse. We have hosted Summer Institutes each year since 1996 and are currently in the middle of a 5-year cycle on analyzing intensive longitudinal data (ILD), which are data with many measurements over time. Each of the first four years, researchers from around the country gather to learn about and practice using a different analytic approach to ILD. To culminate the series, we will host a conference on innovations in ILD analysis that can help enable the development of real-time adaptive interventions, like interventions on a smartphone that can respond to a user's location, biological response, or expressed need.*



2016

## INTRODUCTION TO ECOLOGICAL MOMENTARY ASSESSMENTS (EMA)

### Presenter

Joshua Smyth, Professor of Biobehavioral Health and Medicine, Penn State

EMA are data collected in real time (momentary) in the course of a subject's natural environment (ecological). EMA enable researchers to gather high-quality data without worrying about distortions that occur due to either laboratory settings or the faulty nature of recall when people report on behavior or feelings at a later time. The workshop provided an overview of both why and how to design research studies that include EMA approaches, including introducing practical components such as study design and analysis.

2017

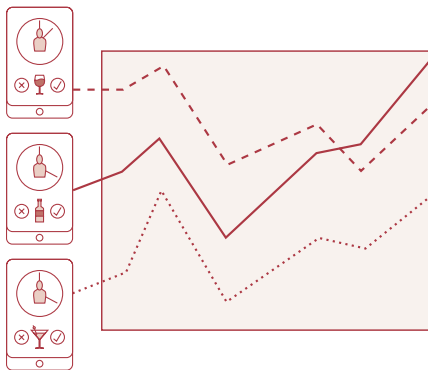
## STATISTICAL POWER ANALYSIS FOR ILD STUDIES

### Presenters

Jean-Philippe Laurenceau, Unidel A. Gilchrist Sparks III Chair and Professor of Psychological and Brain Sciences, University of Delaware

Niall Bolger, Professor of Psychology, Columbia University

In order to use resources properly, researchers planning a study need to determine the sample size necessary to provide the statistical power to detect the differences or effects that have been hypothesized. Power analyses for ILD studies are complex because researchers must specify both the number of subjects and the number of time points. This workshop provided a practical guide to conducting power analyses for studies using daily diaries, ambulatory assessments, EMA, experience sampling, and related research designs.



2018

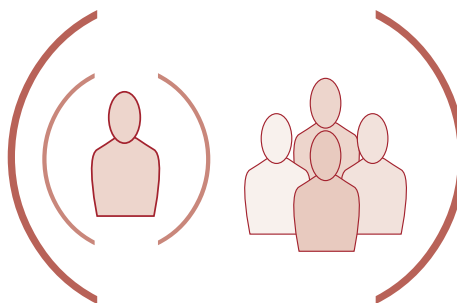
## ANALYSIS OF EMA DATA

### Presenters

*Stephanie Lanza, Director, Edna Bennet Pierce Prevention Research Center and Professor of Biobehavioral Health, Penn State*

*Michael Russell, Assistant Professor of Biobehavioral Health, Penn State*

This workshop provided attendees with the theoretical background and applied skills necessary to use multilevel modeling and time-varying effect modeling (TVEM) to identify and address innovative and interesting research questions in ILD streams such as daily diary data and EMA. Workshop time was spent in lecture, software demonstrations, computer exercises, and discussion. By the end of the workshop, participants fit several multilevel and time-varying effect models in SAS and had the opportunity to fit and interpret preliminary models using their own data.



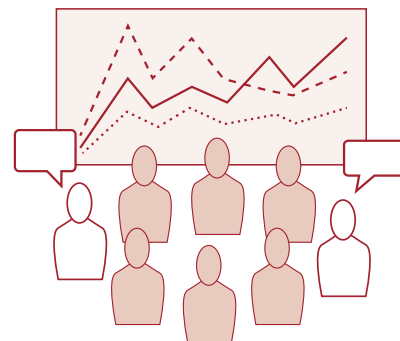
2019

## VARIABILITY IN ILD USING MIXED LOCATION-SCALE MODELING

### Presenter

*Donald Hedeker, Professor of Biostatistics, University of Chicago*

Because EMA studies assess subjects many times, EMA data contain variance both between subjects and within subjects. Traditionally, these variances have been modeled as homogenous. By modeling differences in both between- and within-subject variability, researchers are able to better understand how individual subjects influence the mean response (i.e., the location) and the scale (i.e., individual variability). In this workshop, participants will be introduced to mixed location-scale models for understanding variability. Examples will be presented that focus on how variation in subjects' characteristics is associated with smoking.



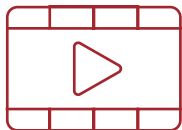
2020

## CONFERENCE ON USING EMA TO DEVELOP REAL-TIME ADAPTIVE INTERVENTIONS

### Participants

*Methodologists and prevention scientists who focus on mHealth solutions for drug abuse*

This two-day summit will assemble methodological experts in ILD and leading drug-abuse and HIV researchers who are working with ILD. Together, they will initiate research projects that will apply cutting-edge methods to develop ecological momentary interventions (EMI). Just as EMA are gathered in real time in subjects' natural environments, EMI are delivered in the moment and location they are needed. This conference will help researchers harness the potential of EMI to address smoking, drinking, drug abuse, and HIV-risk behavior.



## VIDEO

Before researchers or graduate students commit to getting more training, they can watch a brief, conceptual overview video about a method. Videos in our Methods Introduction video series present brief, example-based explanations of methods that allow viewers to assess a method's applicability to their research questions. The video, "Introduction to LCA With Bethany Bray," has been watched more than 6,000 times since it was released in April of 2016.



## TEACHERS' CORNERS

Methodology Center Teachers' Corners are intended for instructors of graduate-level methods classes who want to introduce innovative methods in their classes. The basic format includes introductory readings for instructors, instructors' slides, a student reading list, and a hands-on exercise, though this varies somewhat depending on the method. These resources make it possible for more instructors to disseminate new methods. Teachers' Corners also enable researchers who do not teach methods classes to explore an analytic method by doing the student exercise on their own.



## 1 & 1

In 1 & 1 webinars, an expert methodologist gives a one-hour, live, video presentation on a method followed by a one-hour question-and-answer session. After the presentation, a recording is uploaded to YouTube, making it available in perpetuity. Our first four webinars were attended by over 200 researchers, and the videos have been watched hundreds more times on YouTube.

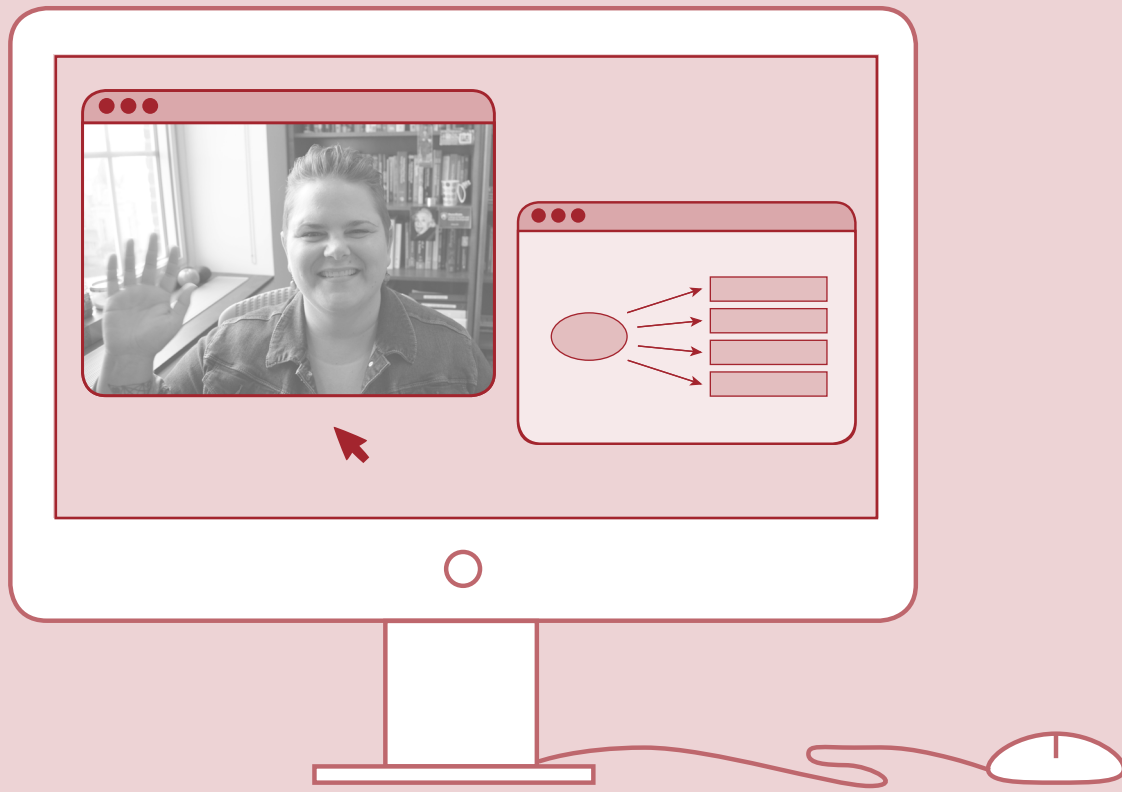


## CONSULTING

Our latest initiative provides a free consulting session to intervention designers who are interested in using the multiphase optimization strategy (MOST). We have been pilot testing this concept during the 2018 spring semester and believe it has the potential to help researchers implement methods to construct optimized interventions and thereby advance science more rapidly. If this initiative is successful, we may expand it to other methods.



# LEARN FROM US



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# METHODS TO COMBAT DRUG ABUSE



## METHODS IN ACTION: ADDRESSING AMERICA'S DRUG ABUSE PROBLEMS

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Although research methods are interesting and exciting in their own right (Well, they are to us!), they are only a means to an end. The best experimental design method in the world has limited value to society unless researchers use it to design studies that answer important questions. As a result, researchers at The Methodology Center not only develop methods but also collaborate with experts in drug abuse prevention and treatment to apply those methods. These collaborative projects address critical public health issues while serving as demonstrations so that other researchers in the same field become familiar with cutting-edge methods. This facilitates faster dissemination of those methods through the field while also moving the science of drug abuse prevention and treatment forward. Below is a sample of our projects that apply cutting-edge methods to drug-abuse research.

### ALCOHOL



One of the most exciting areas of behavioral health research is the field of mHealth interventions. Although these interventions hold great promise, much of that promise has yet to be realized, in part because people typically quit using apps very quickly. In an effort to improve engagement with app-based data collection, Susan Murphy and a team of researchers are creating the substance abuse research assistant (SARA).

SARA is an app for gathering data about drug use in high-risk young adults. It features a gamified interface; specifically, it resembles an aquarium in which study participants can win fish by completing evaluations about their drinking behavior on a given day. The study includes a micro-randomized trial to determine when and in which contexts SARA's engagement strategies are most effective. By keeping young adults better engaged in data collection, researchers are able to collect data about participants' perceptions of loneliness, mood, and stress in order to target interventions more precisely.

In another project, Runze Li is working to address gaps in scientific knowledge about health disparities related to alcohol use. Historically, studies of health behaviors such as drug and alcohol abuse have included far more male participants than female participants. In an article published in *Statistical Methods in Medical Research* (Yang et al., 2017), the authors examined gender differences in the development of alcohol-use patterns. The authors found that alcohol consumption increased in early adolescence at a similar rate among both males and females. From middle adolescence to young adulthood, both groups continued to increase, but the rate of increase was much higher for males. Both males and females showed decreased drinking after the age of 24, suggesting that maturation reduces drinking behavior.

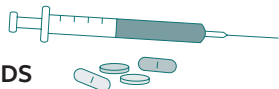
\*See back cover for references.

## SMOKING



Over the last 15 years, The Methodology Center has developed an active Center-to-Center collaboration with the University of Wisconsin's Center for Tobacco Research and Intervention (UW-CTRI). The partnership with UW-CTRI spans many researchers and methods, but the largest and longest-running collaboration is between researchers from UW-CTRI and Linda Collins. Together they are developing an intervention to enable people to quit smoking. Using the multiphase optimization strategy (MOST), which was developed by Linda and her collaborators, the researchers are developing an intervention for use in doctors' offices and other primary care settings that is optimized to help people maintain abstinence from smoking.

This project has demonstrated the practical possibilities of factorial experiments. In MOST, many types of experimental designs—not just the typical randomized controlled trial—are considered. As part of this project, which was based in primary care facilities, the investigators ran three factorial experiments involving a total of 80 experimental conditions at one time. The series of factorial experiments helped the researchers to determine empirically what should be included and what should be omitted from the final intervention. In this manner, the researchers developed an efficient intervention that works in the real world.



## OPIOIDS

The burgeoning opioid epidemic in the United States is one of the most urgent and devastating health crises that we face currently. In a recent article in *Drug and Alcohol Dependence* (Vasilenko et al., 2017), Methodology Center researchers used time-varying effect modeling (TVEM) to examine the prevalences of a variety of substance-use disorders. They examined how drug abuse varies across a wide age range for different segments of the population (based on race, ethnicity, and gender) without making assumptions that drug use will follow a predictable age trend. In other words, TVEM does not force the curve to be linear or quadratic.

In their examination of opioid use data, the authors found that opioid abuse is most prevalent among White Americans in their 20s and 30s. Among people in their 40s and 50s, opioid abuse was more common among Black and Latino/

Latina Americans; during these two decades, abuse among Whites was lower, while abuse among Blacks and Latinos/Latinas was higher. These findings can be used to help target groups for prevention and treatment at specific ages.

TVEM can be used to address a broad range of questions about development and timing in drug abuse research. This research team is now using TVEM to examine how the link between opioid use and risk factors such as chronic pain varies across people of different ages.



## MARIJUANA

In a recent article (Bray et al., 2016), Bethany Bray and her collaborators applied latent class analysis (LCA) to a sample from the long-running Monitoring the Future (MTF) study. The sample included participants who provided marijuana use data at age 19 or 20 and again at age 35. The analysis revealed five classes of reasons for using marijuana in young adulthood: Experimental, Get High & Relax, Typical, Typical & Escape, and Coping & Drug Effect. "Typical" reasons included "to feel good or get high," "to have a good time with my friends," "to experiment," and "to relax." The authors found that young-adult class membership could be used to predict marijuana use and problems with marijuana use at age 35. This indicates that understanding users' motivations in late adolescence and early adulthood can help us identify subgroups of people who might benefit from intervention to prevent future problems.

LCA has been an area of research at The Methodology Center for two decades, and our researchers continue to expand and apply latent class models. MTF has been collecting data about adolescent and young adult drug use behavior for more than 40 years. By applying LCA with a distal outcome to MTF, the researchers were able to glean new insights from existing data.

Most of the methods we develop have been applied across a broad range of health-risk behaviors. Visit [methodology.psu.edu](http://methodology.psu.edu) for more examples. Continued collaboration between methodologists and drug abuse researchers will result in a better understanding of how to address the drug abuse problems that we face in our society and, eventually, a society where people are able to lead healthier lives.



## METHODS AROUND THE WORLD

Linda M. Collins received a Fulbright award to study at the National University of Ireland (NUI) Galway, which is home to one of the Republic of Ireland's premier medical schools. Linda worked for three weeks with researchers who are interested in using the multiphase optimization strategy (MOST) to optimize behavioral, biobehavioral, or biomedical interventions. She also presented a two-day workshop on MOST for NUI Galway faculty. She enjoyed working with NUI Galway faculty, loved the lively city of Galway, and was impressed with the magnificent west coast of Ireland, which she saw for the first time.

TO LEARN MORE ABOUT THE METHODOLOGY CENTER, VISIT [methodology.psu.edu](http://methodology.psu.edu).

### OUR FUNDING

Research at The Methodology Center is funded by grants from the National Institutes of Health, primarily the National Institute on Drug Abuse, the National Cancer Institute, the National Institute of Diabetes and Digestive and Kidney Diseases, and the National Institute on Alcohol Abuse and Alcoholism. The Methodology Center also receives significant support from Penn State's College of Health and Human Development.

### CITATIONS

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