Welcome back to The Methodology Center Perspective!

I want to begin by announcing that Stephanie Lanza, the Scientific Director of The Methodology Center, has been promoted by the College of Health and Human Development at Penn State to Senior Research Associate. Everyone associated with the Center knows how important Stephanie’s contributions are—both her scientific contributions and her contributions to the overall intellectual life of the Center. Congratulations, Stephanie, on this well-deserved recognition!

This academic year we have two visiting faculty at The Methodology Center. Dr. Rachel Smith is Assistant Professor of Communication Arts and Sciences at Penn State. Her interests include social network analysis and dynamical systems. Dr. Liping Zhu is visiting from East China Normal University. His interests include variable selection and analysis of high-dimensional data. It is a treat to have both Rachel and Liping visiting.

We also have three new postdocs. One is Mariya Shiyko, who received her Ph.D. in Educational Psychology from the Graduate Center of the City University of New York. She is interested in analysis of intensive longitudinal data. The other two postdocs are Fellows in the Prevention and Methodology Training Program, which we and the Prevention Research Center run jointly. Suellen Hopfer received her Ph.D. in Communication Arts and Sciences here at Penn State, and is interested in prevention of STIs. Heather Wadlinger received her Ph.D. in Psychology at Brandeis University. She is interested in positive affect and attention from a neuroscience perspective. We look forward to getting to know all three of these talented young scientists.

Most behavioral interventions, such as interventions to prevent or treat drug abuse, are made up of many components. For example, a school-based drug abuse prevention program may have components aimed at correcting beliefs about normative drug use; combating the effects of alcohol and tobacco advertising; resisting peer pressure; and discussing expectations about positive effects of drug use. An investigator who is building an intervention that includes these components usually would like to know whether each component is having an effect and how large the effect is. If this could be determined, it would be possible to replace “dead wood” components with effective components, thereby building a more potent intervention. It would also be possible to judge whether the cost or time required to implement a particular intervention component is justified by the gain it is expected to produce.

There has been relatively little of the kind of experimentation that is needed to obtain this kind of information. The best way to obtain information about the individual effects of intervention components is through randomized experimentation that manipulates each component. However, many intervention scientists believe that such experimentation is not feasible. This belief is often based on misconceptions about what various experimental designs can deliver, and what they cost. In particular, misunderstandings about factorial experiments seem to be especially common.

The factorial experimental design is not a new idea. It was invented by Sir Ronald Fisher in the 1920’s (e.g. Fisher, 1925) and used to be given much attention in graduate-level statistics classes in the behavioral sciences. Our unscientific observation suggests that much less attention has been paid to this topic in the last 20 years or so, and that perhaps as a consequence investigators do not seem to be giving serious consideration to implementing factorial experiments. Factorial experiments are not suited to every research question in intervention science, but at the same time, they are extremely well suited to some. In our view, it would be a shame if misconceptions about the properties of factorial experiments kept investigators from considering these designs where they would be appropriate.

Since the last issue of this newsletter we have had to say good-bye to some people. Postdoc Young Min took a research position in her native Korea. Predoctoral trainee Bo Kiy in graduated and took a faculty position at the College of Charleston. We wish Bo all the best in his exciting new job. Lisa Dierker, Professor of Psychology at Wesleyan University, returned to Connecticut in June after spending the 08/09 academic year visiting the Center. It was an extremely productive and enjoyable year. Lisa, you are welcome for another visit any time!

In the yearly Society for Prevention Research Cup competition, teams of junior scientists are given the same data set and challenged to get creative with data analysis and a brief presentation. Penn State fielded the winning team at the June 2009 competition. Go PSU!

We have a very interesting Summer Institute on Longitudinal Methods lined up for June 7–9, 2010. The presenters will be Niall Bolger of Columbia University and Jean-Philippe Laurenceau of the University of Delaware, and the topic will be analysis of longitudinal dyadic data. More information may be found inside this newsletter and on our web site.

We hope you enjoy this issue of our newsletter!

Linda M. Collins, Ph.D.
Director, The Methodology Center
Penn State University

Two new articles demonstrate that factorial experiments are often a good choice for research on multicomponent interventions

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Former Trainees of the Prevention and Methodology Training Program

The Prevention And Methodology Training program (PAMT) has been funded by NIDA since 2005. This interdisciplinary program was developed and established as a collaboration between The Methodology Center and the Prevention Research Center to train researchers in the development and application of cutting-edge research methods in the design and evaluation of substance abuse and co-morbid prevention programs for children, youth, families, and communities. To date, the PAMT program has been a catalyst in the scientific career development of 16 pre-doctoral fellows. Highlighted below are former predoctoral trainees who have earned their Ph.D. at Penn State and are now establishing careers as prevention and methodology scientists. Several other PAMT trainees have successfully written NRSA awards to fund their research. Watch for features on these and other current PAMT trainees in the future!

Bethany C. Bray, Ph.D.
(bcbra@exchange.vt.edu) is an Assistant Professor in the Department of Psychology at Virginia Tech. Her research focuses on developing and applying advanced statistical methods to the longitudinal development of substance use, with emphasis on the development of comorbid problem behaviors like gambling and risky sexual behavior. Her methodological research continues to focus on associative latent transition analysis (ALTA), an approach based on latent class and latent transition analysis that models multiple developmental processes simultaneously. Currently, Dr. Bray’s work is funded by the Alcohol Beverage Medical Research Foundation.

Larissa G. Duncan, Ph.D.
(DuncanLa@ocim.ucsf.edu) is an Assistant Professor in the Department of Family and Community Medicine and the Osher Center for Integrative Medicine at the University of California, San Francisco (UCSF) Medical School. Her research is focused on investigating mindfulness in parenting, and the potential psychological and physical health benefits of family-centered preventive interventions incorporating mindfulness and mindful parenting when applied during sensitive developmental periods (such as family formation). Dr. Duncan is principal investigator of two studies aimed at assessing the impact of mindfulness skills training delivered during the perinatal period.

Jennifer Kam, Ph.D.
(kam.12@osu.edu) is an Assistant Professor in the School of Communication at The Ohio State University. Her research focuses on contextual and cultural stressors associated with minority group status, immigration, and acculturation processes that place youth at risk for substance use and other problem behaviors. Further, she is interested in examining parent, teacher, and peer communication and relationship factors as protective resources. Methodologically, Dr. Kam is interested in latent growth curve modeling, examining mediation and moderation with structural equation modeling, and applying modern strategies for handling missing data.

Lori Palen, Ph.D.
(lpalen@rti.org) is a Research Associate in the Risk Behavior and Family Research program at the Research Triangle Institute (RTI), International in Research Triangle Park, North Carolina. Dr. Palen works on multi-disciplinary teams to evaluate the Title XX Adolescent Family Life program (abstinence education; services for pregnant and parenting teens), Nebraska’s Strategic Prevention Framework State Incentive Grant (community-based prevention of underage drinking and drunk driving), the Parents Speak Up National Campaign (media campaign promoting parent-child communication about waiting to have sex), and Robert Wood Johnson’s Star Strong initiative (teen dating violence prevention).

Currently, Monique is seeking a second Masters degree in Marriage and Family Therapy with a Certificate in School Counseling from the University of Southern California. Her goal is to stay involved in prevention research related to adolescents and their extracurricular activities while providing counseling services to youth and their families.

Megan E. Patrick, Ph.D.
(meganpat@ isr.umich.edu) is a Faculty Research Fellow at the University of Michigan’s Institute for Social Research. Her research interests center on the development and prevention of adolescent and young adult health risk behaviors. Among other things, she is currently working on analyses from the national Monitoring the Future study to assess longitudinal changes in self-reported reasons for using alcohol and marijuana and developing an event-specific web-based intervention for college student Spring Break behaviors.

Brittany Rhoades, Ph.D.
(bhr162@psu.edu) is the Evaluation Research Specialist at the Evidence-based Prevention and Intervention Support Center (EPISCenter) at Penn State University. The EPISCenter aims to promote the greater use and support of evidence-based programs throughout Pennsylvania and its primary goal is to advance high quality implementation and sustainability of programs to maximize the positive impact of prevention science on outcomes for youth. Dr. Rhoades’ primary research interests focus on Type 2 translational issues, including implementation, dissemination, and sustainability of evidence-based programs in real-world contexts.

Melissa Tibbits, Ph.D.
(mtibbits@ummc.edu) is an Assistant Professor of Health Promotion, Social & Behavioral Health at the University of Nebraska Medical Center. Dr. Tibbits’ research focuses on the relationship between free time activities and health risk behaviors in adolescence. She currently is developing a graduate-level course on the etiology and prevention of health risk behaviors in adolescence, and is working with area agencies to evaluate locally implemented evidence-based preventive interventions.

Announcing the 2010 Summer Institute on Longitudinal Methods: Analysis of Longitudinal Dyadic Data

Each year since 1996 The Methodology Center has organized a Summer Institute on Longitudinal Methods, sponsored by Penn State and the National Institute on Drug Abuse. The Institute provides researchers who have varying levels of methodological training the opportunity to familiarize themselves with longitudinal data analysis. In addition, the Institute was designed to facilitate the exchange of ideas among researchers focused on drug abuse and related behaviors. The most recent Institute, held in June 2009, featured a workshop on latent class and latent transition analysis by Linda Collins and Stephanie Lanza of The Methodology Center. The 2009 Summer Institute was featured in Penn State LIVE, the official news source for Penn State University (http://live.psu.edu/story/40416).

We are pleased to announce the 2010 Institute, Analysis of Longitudinal Dyadic Data. Niall Bolger, Professor of Psychology at Columbia University, and Jean-Philippe Laurenceau, Associate Professor of Psychology at the University of Delaware, will present the workshop on June 7-9, 2010. Each year we limit the number of participants in order to allow for in-depth discussion periods and time for participants to interact with the presenters. Applications for the Institute are currently being accepted.

More information about the Institute and the online application form can be found at http://methodology.psu.edu/summerinstitute.
Members of the Center have recently published two new articles that are intended to clear up misconceptions about factorial experiments and, we hope, help restore them to their rightful place in the intervention scientist's toolkit. One article, Collins, Dziak, and Li (2009), has been published in Psychological Methods and is aimed at behavioral scientists and methodologists working in the behavioral sciences. The other, Chakraborty, Collins, Strehcher, and Murphy (2009), has been published in Statistics in Medicine and is aimed at medical researchers and biostatisticians. Below are several examples of points made in one or both of these articles:

- **Factorial experiments make extremely efficient use of research subjects.** Given that a certain number of independent variables is to be examined, a single factorial experiment that manipulates all of the independent variables requires far fewer subjects than an approach in which a separate experiment is conducted for each variable. In fact, making efficient use of research subjects was one of Fisher's objectives in inventing the factorial experiment.

- **Adding an independent variable to a factorial experiment will increase the number of experimental conditions ("cells"), but does not necessarily require an increase in sample size.** By contrast, whenever an experimental condition is added to a randomized clinical trial (RCT), a sample size increase is required. This is an example of how RCT's and factorial experiments have very different properties and are suited to very different research questions.

- **In a factorial experiment main effects can be readily interpreted even if there are interactions.** This is the case as long as -1/1 coding is used for the independent variables, as is the norm in statistics and engineering, rather than the 0/1 coding which has become the norm in the behavioral sciences and to an extent in biostatistics.

- **Fractional factorial designs can be very efficient and are worth consideration.** The number of experimental conditions in a factorial experiment increases rapidly as the number of independent variables increases. This can make factorial experiments expensive if the cost of implementing each condition is high. In this case investigators may want to consider a special kind of factorial design called the fractional factorial. In a fractional factorial experiment only a subset of conditions are implemented, in order to conserve resources. The subset is chosen carefully in a statistically principled manner. Fractional factorial designs are used routinely in fields like engineering.

- **Even when a factorial experiment involves a lot of conditions, it can still be more economical overall than many alternative experiments.** This tends to be true particularly when experimental subjects are expensive or difficult to obtain.

**REFERENCES**

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**Factorial experiments continued from page 1**

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**Recent Activity in The Methodology Center**

The book *Latent Class and Latent Transition Analysis: With Applications in the Social, Behavioral, and Health Sciences*, by Linda Collins and Stephanie Lanza, is now available for pre-order from the publisher (http://www.wiley.com) and other online vendors.

Runze Li gave two invited talks in recent months. In May, he presented at the Spring Research Conference on Statistics in Industry and Technology in Vancouver, Canada. The title of the talk was Regularization Parameter Selections via Generalized Information Criterion. Runze also presented at the 2009 Joint Statistical Meetings, which was held August 1-6 in Washington, D.C. His talk was titled Variable Selection for Partially Linear Measurement Error Models.

Stephanie Lanza presented an invited talk at the Interagency Federal Methodological Meeting: “Subgroup Analysis in Prevention Research” in September. The title of the talk was Subgroup Analysis from a Latent Class Analysis Approach.

Susan Murphy was an invited speaker at the 2009 annual Meeting of the American Control Conference held in June at St. Louis, MO. Her talk was titled Using Clinical Trial Data to Construct Policies for Guiding Clinical Decision Making.

Michael Cleveland presented an invited talk on November 6 at Penn State University's Center for Family Research in Diverse Contexts. His presentation was titled Understanding Risk and Protective Factors at the School-Level: Links to Adolescent Substance Use.

Susan Murphy gave two invited talks in September. She presented SMART Designs for Constructing Adaptive Treatment Strategies at the 15th Annual Duke Nicotine Research Conference at Duke University in Durham, N.C. and Exploratory Analyses at Generating Proposals for Individualizing and Adapting Treatment at the Behavioral Pharmacology Research Unit at Johns Hopkins University in Baltimore, MD.

Along with colleagues, Susan Murphy gave an invited talk at the October NIH Roadmap meeting, “Facilitating Interdisciplinary Research: Methodological and Technological Innovation in the Behavioral and Social Sciences,” which was held in Washington, D.C. The title of her talk was Methodology for Adaptive Treatment Strategies.

Our online community continues to grow! Please visit our website at http://methodology.psu.edu to learn more about the Center, including a searchable database of our publication database and to receive RSS feeds of recently published articles. The Methodology Center also connects with you and the scientific community through a variety of web-based outlets, including Facebook and Twitter. We are @methodoctr (http://twitter.com/methodoctr) and our Facebook URL is http://www.facebook.com/methodoctr.

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**Our Mission**

We are devoted to the advancement and dissemination of statistical methodology related to research on the prevention and treatment of problem behaviors. Our work is funded by the National Institutes of Health and the National Science Foundation.

Visit us on the Web: http://methodology.psu.edu/
Ask a Methodologist

I am trying to develop a drug abuse treatment intervention. There are six distinct components I am considering including in the intervention. I need to make the intervention as short as I can, so I don’t want to include any components that aren’t having much of an effect. I decided to conduct six experiments, each of which would examine the effect of a single intervention component. I need to be able to detect an effect size that is at least d=.3; any smaller than that and the component would not be pulling its own weight, so to speak. I have determined that I need a sample size of about N=200 for each experiment to maintain power at about .8. But then I did the math and figured out that with six experiments, I would need 6 X 200 = 1200 subjects! Yikes! Is there any way I can learn what I need to know, but using fewer subjects?

— Signed, Experimental Design Gives Yips

Dear EDGY,

Have you considered examining all six components in a single factorial experiment? If you did this, you would need only 200 subjects total to maintain power at .8 for testing the main effect of each component. This experiment would have 2^6=64 experimental conditions, with only a few subjects per condition. (In practice, you might want to use either 192 or 256 subjects so you could have equal numbers of subjects in each condition.) Unlike the approach of separate individual experiments, this factorial experiment would enable estimation of interactions.

Of course, an important question is whether it is feasible for you to implement 64 experimental conditions. You do not mention the context in which you are conducting this research. For example, if this is an internet-delivered intervention, the conditions may be feasible.

If it is not feasible for you to conduct an experiment with 64 conditions, but you would nevertheless like to take advantage of the economy associated with factorial experiments, you may want to consider conducting a fractional factorial experiment. Fractional factorial designs are used commonly in engineering. In general, these designs are most useful when there is no a priori reason to believe that the higher-order interactions are sizeable. There are a lot of different fractional factorial designs to choose from, each representing a different set of trade-offs between efficiency and assumptions. For example, with six independent variables there is a fractional factorial design available to you that would involve only 16 experimental conditions. This design has the same sample size requirements as the complete factorial experiment, that is, N=200 to maintain power at .8. Other fractional factorial designs are available to you that require less stringent assumptions.

For a comparison of the economy of factorial experiments vs. individual experiments, and a brief tutorial on fractional factorial designs, see Collins, Dziak, and Li (2009).

A Note to Readers

Do you have a burning question you would like to ask a methodologist? We would like to hear from you! Submit questions you would like to see answered in the spring newsletter to mc@psu.edu. Be sure to put “Ask a Methodologist” in the subject line. If we select your question you will receive one of our highly sought-after mugs from the Summer Institute on Longitudinal Methods!