Society for Prevention Research
33rd Annual Meeting

Pre-Conference Workshop IV

Date: Tuesday, May 27, 2025
Time: 8:30am-5:00pm

Title: An Introduction to Multilevel Latent Class Analysis (MLCA) for Intensively Collected Prevention Science Data

Organizer and Presenter:

- Bethany C. Bray, Associate Director for Scientific and Infrastructure Development, Institute for Health Research and Policy, University of Illinois Chicago

Presenters

- Ashley N. Linden-Carmichael, Associate Professor, College of Education, University of Oregon

- Natalia Van Doren, Postdoctoral Research Fellow, Department of Psychiatry and Behavioral Sciences, University of California San Francisco

Purpose of the workshop, including specific learning objectives. In other words, what new skills and knowledge will the attendees take away?

Latent class analysis (LCA) is an effective analytic approach for advancing knowledge across numerous health behaviors. Contemporary studies in prevention science often include intensive longitudinal data (ILD) such as daily diaries, ecological momentary assessments, and passively collected data from ambulatory assessment devices (e.g., physical activity, sleep). Although historically the outcomes modeled using ILD have been unidimensional (i.e., a single variable or scale score), many constructs may be better measured multidimensionally as a latent class variable. This workshop will introduce attendees to multilevel latent class analysis (MLCA) to analyze complex outcomes measured at many timepoints. This innovative method can help answer questions in many areas of prevention science: What are common patterns of daily substance use and co-use? How are daily affect and context associated with daily health-risk behavior patterns and which may serve as optimal targets for a just-in-time prevention program?

One classic approach to analyzing ILD is mixed-effects modeling, where the variance on a repeatedly measured outcome is partitioned into between-person and within-person components. Then, effects of person-level and day- or moment-level predictors and their cross-level interactions are estimated.

A second classic approach to analyzing ILD are generalized estimating equations (GEE), which take a marginal approach (i.e., across all persons and all days/moments) to modeling the repeatedly measured outcome and predictors at all levels. Both a mixed-effects approach and a marginal approach to MLCA will be discussed and demonstrated in this workshop.

The overall goal of this practical workshop is to provide attendees with the conceptual understanding and practical knowledge to be able to posit and address new research questions using MLCA. There are two primary objectives:

Objective 1. Attendees will be able to identify and explain attributes of MLCA, including describing the types of data structures necessary for MLCA. Importantly, attendees will be able to posit new research questions that can be addressed by applying MLCA to intensively measured constructs.

Objective 2. Attendees will gain theoretical and practical knowledge of the use of Mplus, SAS, and R software to accomplish the following:

(a) estimate a baseline MLCA to estimate day- or moment-level latent class membership while accounting for the nested structure inherent in repeated measures data using both a mixed- effects and a marginal approach;
(b) identify and interpret the effects of person-level predictors and day- or moment-level predictors on latent class membership; and
(c) identify resources available on the LCA Knowledge Base website (e.g., annotated syntax and output, recommended readings) so that they can apply MLCA in their own research

Target workshop audience

The target audience are prevention scientists who have an interest in analyzing intensive longitudinal data (e.g., daily diary data, ecological momentary assessments) to model dynamic, multidimensional constructs such as patterns of behavior, affect, or context and their associations with person-level and day- or moment-level predictors.

Materials to be provided to attendees.

Attendees will receive an electronic download the week before the conference that includes all PowerPoint slides, annotated Mplus, SAS and R programming code that will be easily modifiable for use in their own work, and annotated output. Attendees will also receive a link to the Latent Class Analysis Knowledge Base, a website that serves as a comprehensive hub for resources.

Brief CVs of all presenters, and a brief explanation of how the presenters are qualified to conduct the workshop.

This workshop will be led by three instructors with complementary backgrounds: Bethany Bray (innovative research methods, prevention science, human development), Ashley Linden-Carmichael (health psychology, experimental psychology), and Natalia Van Doren (clinical psychology). All three instructors have been instrumental in expanding applications of mixture modeling broadly and multilevel latent class analysis (MLCA) specifically. Dr. Bray is a world-leader on training applied researchers to apply these methods; she has published more than 100 peer-reviewed papers using mixture modeling and has taught more than 40 invited workshops on the topic. Drs. Linden-Carmichael and Van Doren are experts on intensive longitudinal data and the application of latent class analysis (LCA) and MLCA to address questions about underlying subgroups based on shared characteristics (e.g., substance use, affect) in daily life. All three presenters have published numerous papers using LCA and MLCA and have led and/or presented multiple workshops on innovative statistical methods. CVs for Drs. Bray, Linden-Carmichael, and Van Doren are appended to the end of this proposal.

Bethany C. Bray, Ph.D. is Associate Director for Scientific and Infrastructure Development at the Institute for Health Research and Policy at the University of Illinois Chicago. She is co-investigator of a NIDA R01 aimed at identifying and disseminating best practices for MLCA using daily diary data. She has a long track-record of disseminating advances in latent class modeling, including having taught more than 40 invited, hands-on workshops and creating the Latent Class Analysis Knowledge Base website. Dr. Bray's research focuses on the development and application of advanced latent class modeling techniques to questions about the development of substance use, with a special emphasis on its relation to the development of comorbid risk behaviors, such as risky sexual behavior and gambling. Her technical work has focused on flexible approaches to adding predictors, outcomes, moderators, mediators, and inverse propensity score weights to latent class models. Her work has been funded through the National Institutes of Health, the Alcohol Beverage Medical Research Foundation, and the National Center for Responsible Gaming. Dr. Bray has published articles in a variety of methodological and applied journals, such as *Structural Equation Modeling*, *Methodology*, *Prevention Science*, *Journal of Studies on Alcohol and Drugs*, and *Journal of Adolescent Health*. Her work has won awards from the National Council on Problem Gambling and the National Center for Responsible Gaming. Dr. Bray has mentored numerous early-career prevention scientists on these methods and won the Society's Friend of ECPN Award for this work in 2023. She has taught graduate-level courses on research methods, psychometrics, and categorical data analysis. She has also taught hands-on workshops on latent class, latent profile, and latent transition analysis, as well as on programming in Mplus, SAS and R. She has extensive experience presenting technical material to applied scientists.

Ashley N. Linden-Carmichael, Ph.D. is Associate Professor in the College of Education and Research Scientist in the Prevention Science Institute at the University of Oregon. Her research uses innovative methods for and analysis of intensive longitudinal data (daily diary, ecological momentary assessment) to examine psychosocial (mental health, affect) predictors of substance use among adolescents and young adults. She recently completed an NIAAA K01 award and is PI of an NIAAA R21 and Co-I of a NIDA R01 aimed at identifying and disseminating best practices for MLCA using daily diary data. She has authored nearly 100 peer-reviewed manuscripts and co-authored the first comprehensive textbook on time-varying effect modeling, an innovative statistical method for examining associations across continuous time.

Natalia Van Doren, Ph.D. is a Postdoctoral Research Fellow in the Department of Psychiatry and Behavioral Sciences at the University of California, San Francisco. Her fellowship is funded by a NIDA T32 in Substance Use Disorders Treatment and Services Research. Her work seeks to advance our understanding of the mechanisms underlying addictive behaviors using digital phenotyping (e.g., smartphones and wearables) to inform the development of personalized interventions using novel technologies. She has authored more than 30 peer-reviewed manuscripts and has extensive experience implementing innovative methods for daily diary data, including MLCA. She has worked with Drs. Bray and Linden-Carmichael for more than 6 years and has published with them on MLCA.

Outline of workshop, including (a) roles of presenters if more than one is listed, and (b) which aspects of instruction are hands-on.

Morning:

- Drs. Bray and Linden-Carmichael will discuss intensive longitudinal data (ILD), including daily diaries, ecological momentary assessments, and passively collected data.
- Dr. Bray will present a conceptual introduction to latent class analysis (LCA), so that attendees have foundational knowledge of this powerful analytic approach. Attention will be given to research questions that can be addressed with this statistical technique and to data structures traditionally used with this technique.
- Dr. Bray will lead the group in a practical discussion about attendees' ILD and latent class constructs they plan to analyze in their own research.

Lunch: Questions and open

discussion. Afternoon:

- Dr. Bray will present a detailed, step-by-step example of MLCA based on daily diary data from a study of young adult substance use. This example will include the research questions being addressed, the mixed-effects and marginal approaches to addressing these questions, the parameters being estimated and their interpretations, and recommended practices. Dr. Bray will also walk through syntax and output to fit the models and interpret results.
- Drs. Linden-Carmichael and Van Doren will each present practical demonstrations of MLCA from their own work; annotated syntax from their published studies will be provided.
- Attendees will be separated into three groups based on research interests. Each group will engage in a practical discussion of using MLCA in their own work, with discussion in each group facilitated by one of the workshop instructors. These small-group discussions will enable attendees to consult on topics such as refinement of their scientific questions, data structure and data requirements, and which software packages might work best for their studies.