

DADA Spring 2007

Abstracts

**Information Flow and Symmetry Breaking in Interpersonal Coordination**

Dr. Stevev Boker, Department of Psychology, University of Virginia

The semantic content of conversation is accompanied by coordinated prosody, head movement, eye movements, eyebrow movement, smiles, and other facial changes. Coordination between conversants' movements and/or facial expressions can be observed when an action generated by one individual is predictive of a symmetric movement by another. Both spatial and spatiotemporal symmetry is commonly observed in conversation and may be linked to mirror neuron systems that organize embodied coordination into a perception--action loop. Overt expressions of symmetry thus are likely to be indicative of mutually shared inner states. But the greater the symmetry between two individuals, the greater the redundancy in their embodied states. The greater the redundancy, the less information is transferred in a nonverbal communications channel. Therefore, symmetry breaking must also be a component of coordination in conversation. High degrees of nonstationarity in dyadic coordination have been observed in a recent set of motion tracking experiments. Current methods for estimation of nonstationarity in the association between variables are discussed and the results of application of these methods to motion tracked dyadic conversations are presented. These results suggest that the ongoing mutual estimation of affect that occurs during human interaction may be framed as a dynamical systems model, and that this step may help us better understand emotion regulation.

**Representing Changes and Potential Nonstationarities in Dynamical Systems Using State-Space Modeling**

Dr. Sy-Miin Chow, Department of Psychology, University of Notre Dame

State-space modeling and the associated Kalman filter algorithms have been compared to structural equation modeling techniques in various contexts but their strengths in representing intraindividual change and instances of nonstationarity in change have not received much attention. In this presentation, I use empirical and simulated examples to illustrate the utility of a time-varying growth curve model in representing growth and nonstationarities therein when formulated as a state-space model. To outline the ways in which nonstationarities can be detected and represented using state-space models, modeling examples are structured around the growth curves of  $N = 33$  older adults on a letter series task over 120 measurement occasions. Additional modeling options are also provided to explicate how the time-varying growth curve model can be extended to accommodate irregularly spaced data and features of autoregressive (AR) and stochastic regression models. Further extensions of this model as representations of self-organizing nonlinear dynamical systems with time-varying parameters will also be discussed.

### **New developments with maximum likelihood factor scores**

Dr. Michael C. Neale, Department of Psychiatry and Human Genetics, Virginia Commonwealth University.

Factor scores have been in popular use for many years, as a way to summarize an individual's score on a latent trait of interest. Although straightforward to compute from a set of continuous measures, their estimation when the observed data are binary or ordinal is more involved. In both cases, factor scores suffer from the self-evident truth that they are not all born equal. Scales with items that discriminate primarily in the top half of the population distribution of the latent trait yield less accurate factor scores for those at the lower end of the distribution than at the upper end. I will describe the use of marginal maximum likelihood in Mx to obtain factor scores from ordinal data, and discuss alternative methods of dealing with their varying degrees of imprecision. These methods include significance testing and finite mixture distribution modeling. The potential to detect non-normal population distribution in the latent trait, and to analyze it appropriately will also be considered. Examples from genetically informative studies and from non-genetic studies will be presented.

### **Hazard Functions and Reaction Time**

Dr. Michael Kubovy, Department of Psychology, University of Virginia

An interesting large dataset containing  $10^6$  reaction times from 20 subjects performing a search task allows us to explore the potential of hazard functions for the understanding of cognitive processes. In particular, the hazard functions rise first and decline later, which is the opposite of many hazard functions which show "infant mortality" (i.e., high hazard) at early times, followed by "maturity with the possibility of accidental death" (i.e., a nearly flat range), followed by "aging" (i.e., a steeper rise).

### **Deconstructing Correlations**

Dr. Sriram Natarajan, Department of Psychology, University of Virginia

The correlation between difference scores is a special case of the correlation between two linear combinations and is a non-linear function of 8 parameters. This function can be approximated by a linear model in various parameter domains. Contrary to conventional wisdom, these linear models show that, in certain domains (e.g., latency data), the correlation between difference scores can increase (rather than decrease) as the correlation between the difference score components rises.

When data are partitioned into two groups, the Pearson  $r$  can be decomposed into a between-group component which is the product of two effect sizes (ESp) and a within-group component (WGc) which is the sum of within-group correlations weighted by a coefficient that is inversely related to ESp magnitude. Both zero and nonzero correlations can arise in multiple ways and this decomposition delineates the respective contributions of concordance in group means and quantitative linearity to the Pearson correlation.

## **Spousal Interplay of Activity Trajectories: Longitudinal Results From the German Socio-Economic Panel Study**

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Adopting and maintaining an active lifestyle is considered an integral part of successful development across the entire adult lifespan. Based on the assumption that such endeavors are approached within the context of social networks such as partnerships, the present study aimed at integrating individual and social aspects into the study of lifespan changes in lifestyle activities. Specifically, we were interested in the dyadic interplay between both partners' engagement in consumptive and productive activities as well as their age-related changes over time. We also explored the potential role of individual difference covariates such as age, education, length of marriage, and health to test whether couple associations reflect one or more underlying variables. To study these issues, we used longitudinal data from initially 1,941 couples (aged 27-92 years at baseline) from the German Socioeconomic Panel Study who participated in yearly assessments over a period of up to 13 years. Applying multivariate growth curve models allowed us to (1) examine the extent to which individual activity trajectories were related with those of the respective partners and (2) how the covariates differentially affected the activity trajectories for husbands and wives. Our results complement current knowledge on processes underlying successful aging by illustrating the importance of considering relationship partners in maintaining an active life into old age.

## **Nonlinear Structured Growth and Growth Mixture Models in Mplus**

Kevin J. Grimm, Ph.D., Curry School of Education, University of Virginia

Nonlinear structured growth curves or growth curves that follow a specified nonlinear function enable researchers to model complex developmental patterns with parameters that are easily interpretable. These models tend to be fit in nonlinear mixed-effects programs such as NLMIXED in SAS or NLME in Splus. However, Browne (1993) described how such models can be fit in a structural modeling framework using Taylor-series expansion. In this presentation I discuss how certain variations of these nonlinear curves can be fit using M/plus/ – a commonly used general latent variable modeling program. I then extend these models by incorporating the mixture modeling component to search for latent classes that follow distinct nonlinear developmental patterns. The use of these models is described and applied to data from the Early Childhood Longitudinal Study - Kindergarten Cohort (ECLS-K), a nationally representative longitudinal study of early schooling experiences from kindergarten through fifth grade.

## **An Overview of Regularization with an Application to the Detection of Pre-Diabetes**

Yan Liu and Dan Keenan, PhD, Department of Statistics, University of Virginia

The present talk is motivated by the question of whether it is possible to construct a quantitative method, based upon a time sampling of glucose, insulin, C-peptide and glucagon blood concentrations, by which one can clinically identify subjects who are pre-diabetic. The regulation (or loss of it) of blood glucose involves feedback modulation by each of the biomolecules on the secretion rates of the others. This research is part of the PhD thesis research of Yan Liu, a 3<sup>rd</sup> year PhD student in Statistics. The methods that are most appropriate for recovering their secretion rates are nonparametric methods. Nonparametric means that the “parameter” is infinite-dimensional (e.g., an entire function), whereas the data is finite. It is the process of regularization by which the two (infinite and finite) are reconciled. The history and an overview of regularization/nonparametric modeling will be the first half of the talk (given by Dan Keenan). The aim of this first part is to give the quantitative psychologist a different or new perspective on such modeling. Yan Liu will then describe the application of such methods to diabetes data.

## **Approximate Entropy as a Measure of the Regularity/Irregularity of a Time Series Profile**

Xin Wang and Dan Keenan, PhD, Department of Statistics, University of Virginia

Approximate Entropy (ApEn) and Cross-ApEn are, respectively, measures which quantify the degree of regularity (or irregularity) of a time series and the joint regularity between two series. The aim of the present talk is to introduce these methods to the quantitative psychology community. They have been widely applied in medicine. One of the first applications was to the detection of a change in heart-rate patterns that precedes sudden-infant death syndrome (SIDS). The motivation for ApEn came from the dynamical systems concept of “correlation dimension.” A major shortcoming to the application of ApEn and Cross-ApEn is the lack of a theoretical basis by which to calculate standard errors. Rectifying this is the PhD thesis research of Xin Wang, a 3<sup>rd</sup> year PhD student in Statistics. In the first part of the talk, Dan Keenan will present some overview remarks on the methods, and Xin Wang will then go through several examples showing how the methods are applied. We will also briefly discuss an alternative to ApEn (called SampEn) developed by Doug Lake and Dr Randall Moorman of the UVa medical school.

## **The Cognitive Reserve Hypothesis: A Longitudinal Examination of Age-Associated Declines in Reasoning and Processing Speed**

Elliot Tucker-Drob, Department of Psychology, University of Virginia

The term cognitive reserve is frequently used to refer to the ubiquitous finding that, during later life, those higher in experiential resources (e.g. education, knowledge) exhibit higher levels of cognitive function. This observation may be the result of either (1)

experiential resources playing protective roles with respect to the cognitive declines associated with aging or (2) the persistence of differences in functioning that have existed since earlier adulthood. These possibilities were examined by applying accelerated longitudinal structural equation (growth curve) models to 5 year reasoning and speed data from the no-contact control group (N=690, 65 to 89 years of age) of the ACTIVE (Advanced Cognitive Training for Independent and Vital Elderly) study. Education and vocabulary knowledge, as markers of cognitive reserve, were strongly related to levels of cognitive functioning, but unrelated to rates of cognitive change, both before and after the (negative) relationships between levels and rates were controlled for. These results suggest that cognitive reserve reflects the persistence of earlier differences in cognitive functioning rather than differential rates of age-associated cognitive declines.

### **Issues in the Analysis of Data from Measurement-of-Mediation Designs**

Rick Hoyle, Professor, Department of Psychology, Duke University

Statistical mediation concerns the process or mechanism by which a causal variable influences one or more outcomes. Since the 1986 publication of Baron and Kenny's influential paper on statistical mediation and moderation, tests of mediation in psychological research have increased in number. The typical test makes use of the measurement-of-mediation design, in which the causal variable is manipulated or measured, after which the putative mediator and outcomes are measured. In this non-technical talk, I first position the measurement-of-mediation design among the multiple strategies for studying statistical mediation in behavioral research. I then present findings from a simulation study of the effects of measurement error in the mediator on inferences from data generated by measurement-of-mediation designs. I then address the neglected concern of isolating putative mediators when they are measured rather than manipulated. I address this concern in the context of a broader treatment of the use of partialling as a means of achieving isolation when manipulation and random assignment are not possible. I conclude with recommendations for optimizing tests of mediation in psychological research.

### **Longitudinal Data Analysis with Multivariate Zero-Inflated Count Data**

Lijuan Wang, Department of Psychology, University of Virginia

Count data with excess zeros are often observed in the study of substance use or illegal behavior. The data, for example, come from a self-report question like "In the last 30 days, how many times have you used marijuana right before or during school or work hours?" A generalized linear mixed model with log and logit mixture link in the explanatory IRT framework is introduced to estimate individuals' trait levels based on multivariate measures of the construct. A longitudinal extension of the model is also introduced. The models are applied to analyze the substance use data from the National Longitudinal Survey of Youth (1997 cohort). This study serves as a part of my dissertation research.

## **Energy Networks and Information Loss**

Ryan Quinn, Professor, Darden Business School, University of Virginia

Research on organizational networks has exploded in recent years, bringing a relational view to the study of organizations, highlighting resource flows, informal organization, and other topics that have eluded empirical research in the past. Although the dominant view of organizational networks has been focused on information exchange, scholars have recently begun to focus their attention on the importance of networks based in the affective nature of relationships. One of the most recent views to emerge of affective networks is energy networks, which seek to study the impact of how much people energize (or de-energize) their colleagues on the performance of individuals and organizational units. One preliminary study, for example, found that being central in an energizing network predicted the energizing person's performance four times as powerfully as information-based network measures and other forms of information use. Lacking from such research, however, is an analysis of the validity of the constructs and an examination of how such networks function and evolve. Using teams of MBA students we find support for the convergent and discriminant validity of energy networks. And using a computer simulation, we develop propositions for understanding how energy networks function and evolve. Our simulation suggests provocative propositions for the evolution of these networks. For example, networks with structures similar to those measured empirically occur when agents tend to forget attributions about others' energizing-ness over time but do not tend to forget attributions of others' de-energizing-ness, but agents must also be generally pre-disposed to assume that interacting with others will be an energizing rather than a de-energizing experience.