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New Methods for New Questions: Obstacles and Opportunities

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Two forces motivate this special section, “New Methods for New Questions in Developmental Psychology.” First are recent developments in social science methodology and the increasing availability of those methods in common software packages. Second, at the same time psychologists’ understanding of developmental phenomena has continued to grow. At their best, these developments in theory and methods work in tandem, fueling each other. Newer methods make it possible for scientists to better test their ideas; better ideas lead methodologists to techniques that better reflect, capture, and quantify the underlying processes. The articles in this special section represent a sampling of these new methods and new questions. The authors describe common themes in these articles and identify barriers to future progress, such as the lack of data sharing by and analytical training for developmentalists.

Keywords: methodology, causal inference, latent class

This special section, “New Methods for New Questions in Developmental Psychology,” was motivated by two forces. The first involves recent developments in social science methodology and the increasing availability of those methods in common software packages. Widely available software offers new methods for handling missing data, multilevel models, data collected under complex sampling schemes, and alternative measurement models (such as item response theory) to name just a few. What is most striking is that many of these methods are now available in combinations. One can model latent classes at different levels in a multiclass model with data that were collected with differential probabilities of selection under alternative assumptions for missing data. Although many of these methods have been available to the methodological elite for some time, they required knowledge of complicated computer languages and of substantive areas, such as numerical optimization.

At the same time, psychologists’ understanding of developmental phenomena has continued to grow. Our understanding of neighborhood effects, for example, has moved from analyses of poverty rates in census tracts to a more refined understanding of the underlying mechanisms that influence children’s growth and well-being, such as collective efficacy (Elliott et al., 1996; Sampson, Raudenbush, & Earls, 1997) and the ways families manage their resources (Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999).

At their best, these developments in theory and methods work in tandem, fueling each other. Newer methods make it possible for scientists to better test their ideas; better ideas lead methodologists to methods that better reflect, capture, and quantify the underlying processes.

The articles in this special section represent a sampling of these new methods and new questions. The articles cover a range of methods, but some common themes emerge. The most common involves person-centered approaches, such as latent class analyses or configural frequency analysis (Mun, von Eye, Bates, & Vachillo, 2008; von Eye, Mun, & Bogat, 2008). These methods are particularly well suited for questions concerning diagnoses or for identifying subgroups of individuals with particular traits (e.g., particularly amenable to intervention). Other articles extend these models in important ways by examining the dynamics of behavior (Flaherty, 2008; Kaplan, 2008; Lanza & Collins, 2008;).

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Causal modeling was the focus of four articles, and these articles addressed an area in which developmental psychologists have much to learn from other social scientists and statisticians. The articles included here help teach not only that some degree of causal inference is possible outside of an experiment, but also that across the field, we psychologists must strengthen our arguments and analytic methods to make such inferences. Many of the articles submitted to *Developmental Psychology* rush to one of two extremes: They either argue that causal modeling is impossible outside of an experiment or make wild causal claims based on weak arguments. For example, developmentalists often claim that temporal ordering establishes causality. For example, simply flipping through the journal, it is easy to find articles claiming that if X precedes Y , then X causes Y , or that if X_t is related to Y_t , controlling for Y_{t-1} , then X causes Y . Neither claim is necessarily true. Both reflect considerable methodological and conceptual confusion: For example, t and $t-1$ may represent time points of measurement and may have no significance for the underlying developmental processes. Furthermore, controlling for Y_{t-1} actually may make a causal interpretation more difficult (Glymour, Weuve, Berkman, Kawachi, & Robins, 2005). For example, including lagged dependent variables as explanatory variables creates statistical problems in the presence of autocorrelated errors, a problem that has been known in other social sciences for four decades (Durbin, 1970; Taylor & Wilson, 1964). Still, temporal ordering can help identify causal relationships. That ordering, however, is neither sufficient nor necessary for doing so.

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Three articles represent applications of the latest developments in this area of methodology, some of them borrowing from other fields with rich traditions of work on this problem (Gennettian, Magnuson, & Morris, 2008; Hong, & Yu, 2008; Stuart & Green, 2008). A fourth article (Haviland, Nagin, Rosenbaum, & Tremblay, 2008) extends these methods to a longitudinal context.

Other articles applied methods that are well known outside of psychology but have been used relatively little in developmental studies. These include qualitative and mixed-methods research (Yoshikawa, Weisner, Kalil, & Way, 2008) and data mining (Gruenewald, Mroczek, Ryff, & Singer, 2008). Another article examined a growing area in psychology (i.e., the interaction of genes and environment; Price & Jaffee, 2008). Another article combined a traditional concern of psychologists (measurement) with the creative use of data (Curran et al., 2008). Guryan, Jacob, Klopfer, and Groff (2008) contributed an article that made use of technology in a novel way to answer questions of long-standing interest in the field. All of the articles applied these methods to substantive questions of interest.

What do these articles tell psychologists about the development of theory and methods? Progress appears a bit uneven. Some of the methods do seem to be in search of a theory. For example, the application of latent class analysis in developmental psychology seems stunted by uncertainty about whether the underlying constructs are actually discrete rather than continuous. This uncertainty is understandable given the limited usefulness of data for distinguishing the two models (Bartholomew, 1987). Hopefully, these developments will lead psychologists to probe more deeply into the question of whether the phenomena of interest involve discontinuities and, in turn, to consider of what discrete constructs imply for measurement.

In some instances, in contrast, theory does seem to spur a method's development. For example, dyadic interactions are a linchpin of developmental psychology. For many years, researchers have largely chosen one construct to be the dependent variable (e.g., children's behavior) and another to be the explanatory variable (e.g., parenting). Theory indicates that such variables influence each other and evolve together, but (with notable exceptions) empirical work seldom incorporates such simultaneity (Patterson, 1986). The articles in this section move the methodology for modeling dyads forward in a way that better reflects the underlying theory.

The articles and the topics covered—as well as the topics not covered—identify areas for future research. Broad areas of social science methodology are completely missing from the articles included or even among the submissions themselves. For example, we received no articles that incorporated nonparametric or semi-parametric methods, such as various smoothing techniques. We also received no articles on the latest developments in clinical trials methodology, such as group sequential trials (Jennison & Turnbull, 2000). Surely such articles would be of interest to developmental psychologists evaluating interventions of one sort or another, especially when iatrogenic effects are possible (e.g., in a group therapy for conduct-disordered youth; Dishion, McCord, & Poulin, 1999).

We also were particularly disappointed that we received no applications of qualitative methodology. The original solicitation explicitly indicated that we would welcome such contributions. Other missing areas represent methods used in other areas of

psychology, such as taxometrics. Given the importance of distinguishing latent constructs from latent classes, such methods seem especially important. (This omission is surprising given that the American Psychological Association recently published a book on that very topic; Schmidt, Kotov, & Joiner, 2004.) Another theme we observed among the set of submissions is that developments in methodology can run the risk of being driven by a narrow range of software, notably Mplus (Muthén & Muthén, 1998, 2005). Perhaps this relationship is to be expected, and an economist would hardly fault a manufacturer for being responsive to consumer demands. Nonetheless, when an entire field relies on a single piece of software, the field becomes subject to needs and interests of the software developers. One problem is that most developmentalists do not work with software—like Stata (StataCorp, 2007) or R (R Development Core Team, 2007)—that can be easily extended to incorporate new methods.

This set of excellent articles nevertheless illustrates another theme: Psychologists need to know more about how these methods perform in real-world situations. We encouraged our authors to submit articles based on real data, not simulated data. Certainly such simulations are invaluable for assessing the statistical properties of estimators and estimation procedures, but analyses with a range of real data are important as well. Developmentalists analyzing data need a sense of whether more complex methods provide new insights or whether the findings based on traditional methods are robust. This need seems especially pressing in instances where the methods accomplish related ends (e.g., latent class analysis and configural frequency analysis). Researchers need to know the situations in which each method matches the research question and performs best.

Although we hope that these articles signal progress in the application of new methods to new questions in developmental psychology, a range of barriers slows progress. First and foremost are two issues of training. First, if our experience with finding reviewers is any indication, developmental psychology needs more methodologists. Any journal faces challenges in getting reviews, but the problems with obtaining reviews for this issue were especially formidable. We asked more than 200 scholars to review the 30 articles submitted for consideration. Many turned us down, indicating that they lacked the methodological expertise needed.

Second, and more problematic, is the methodological training nonmethodologists receive in developmental psychology. Most developmental psychology programs do not seem to recognize that statistics is a field of mathematics. On the basis of an informal survey of 20 graduate programs in developmental psychology, most developmental psychologists apparently take a course or two in statistics, but that course is often focused on applications rather than the underlying mathematical structure.

The result of this training is apparent in the submissions to the journal. Seldom do articles actually present the model in mathematical form; the submissions generally refer to this or that particular procedure by name. That level of detail probably was sufficient when the statistical procedures were fairly simple. When an article indicates that the analyses relied on a standard regression model with four covariates, readers generally know what was done. However, in complex models mixing latent classes with latent trajectories and nonlinear link functions, it is difficult or impossible to know what was actually done. For example, in these models, distributional assumptions or the choice of optimization

routines becomes critical; one would have to be very familiar with the software used to understand what was done. Further complicating matters are advances in statistical computing. Various estimation procedures are available for essentially the same model, and the choice of method often has implications for the properties of the resulting estimates.

Researchers who are not methodologists still need to know enough of the underlying statistical procedures to identify and interpret the key features of estimation. Available software makes a powerful array of statistical tools available; proper application depends on something more than pointing and clicking the right options

We believe that an important goal for the field is to bridge the chasm between the statistical methodologists in developmental psychology and developmentalists applying the methods they develop. Methodologists in psychology seem to be as well trained as specialists in other social sciences. In our experience, where developmental psychology lags behind other social sciences, notably economics, is in the statistical expertise of applied researchers. The training in economics generally involves two or three courses in mathematical statistics; furthermore, economics training builds on a foundation of mathematics that economists use in their theories. Although psychologists may eschew the mathematical theories (perhaps correctly), there is no doubt that the mathematical training gives economists a leg up in learning statistics. One might learn how to maximize a utility function to understand human behavior; the mathematics of maximizing a likelihood function is basically the same.

Another barrier to further methodological development in developmental psychology is the relatively limited culture of data sharing. If researchers developing methods are unable to assess a range of data sets, then understanding whether and how new methods can be applied is difficult. For example, the manual for one software package indicates that one can estimate multilevel models with data collected as part of complex sampling and that one can estimate those models in a flexible way (i.e., using adaptive quadrature; Hesketh-Rabe, Pickles, & Skrondal, 2001). Practical experience, however, indicates that generating parameter estimates can take literally weeks, making any assessment of the robustness of key model assumptions difficult or impossible. Methodologists are interested in determining whether and how their methods function in real world applications, but applied researchers need to share their data with them.

One explanation psychologists give for not sharing their data is that they spend too much time collecting it. Of course, one could argue that they collect too much data. (It is helpful to remember as well that the bulk of these data are collected with taxpayer money.) There are many large data sets that were competently collected and are well documented, representative of meaningful populations, and publicly available. Those data sets increasingly include developmentally appropriate measures. Those data sets represent a much sounder basis for further research in both theory and methods. New methods applied to unrepresentative or small samples are not especially useful, no matter how much effort went into data collection. No more useful are new insights gained from such data. Furthermore, the discourse that occurs between different researchers examining the same data set with different methods and different theories proves to be beneficial for the field as a whole. By not sharing or working from the same data sets, the field of

developmental psychology is denied a major avenue for advancement.

Our hope is that the articles presented here advance the natural development of methodology and conceptual research in developmental psychology and stimulate progress in overcoming these barriers.

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