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Book Review

Handbook of Developmental Systems Theory and Methodology, P.C.M. Molenaar, R.M. Lerner, & K.M. Newell (Eds.). New York: Guilford Press, 2014, 517 pages, $106.25

When is the right moment to edit a *handbook*? There may be many moments – among them that a situation has been reached that could be considered a milestone, a stepping stone, or a moment that represents closure. The handbook that was edited by Molenaar, Lerner, and Newell (MLN) constitutes all of these, and more. This volume represents a milestone because it demonstrates clearly that dramatic progress can be made in developmental research when inductive developmental systems theory and systems methodology are used. It represents a stepping stone because it not only illustrates in examples the kind of new statements that become possible, but it also shows that mathematical models and software have developed to the extent that they become useable. It represents closure because it shows that the early phase of the development of theoretical, mathematical, and statistical concepts, theorems, and computer programs for applications of systems methodology has come to an end. The doors are open for new developments and application.

Contents of the Book

In 18 chapters, MLN present theory, mathematical models, statistics, and application examples. After a view of the issues and an overview of the book in the first chapter (written by MLN), the reader finds three chapters in the module on *relational developmental systems theory* (Part II of the book). The first of these, contributed by W.F. Overton, provides a theoretical, somewhat idiosyncratic overview of this theory. This is followed by a very instructive chapter (authored by G.J. Geldhof and collaborators) in which this theory is presented again in more concrete terms, in its application to Lerner's model of positive youth development. The third chapter in this module (J. Brown Urban et al.) uses social network analysis as an example of dynamic developmental systems modeling, and discusses its usefulness and usability in research and applied contexts.

The next module (Part III of the book) addresses issues of epigenetic development and evolution, in two chapters. M.-W. Ho, a geneticist, discusses, in the first of these two chapters, the relation between development and evolution. This discussion is based on the proposition that intrinsic dynamics of developmental processes are the source of nonrandom evolutionary change, independent of natural selection. In an impressively didactic effort, P.T. Saunders presents, in the second chapter, a discussion of Waddington's epigenetic landscape in its relation to punctual equilibrium concepts.

Part IV of the book contains two chapters on neural networks and development. The first, contributed by M.E.J. Raijmakers and collaborators, reports results of a most interesting simulation study on nonlinear epigenetic variance. These results suggest that heritability and "environmentability" indices stabilize with age. MZ correlation and heritability stabilize at a level much higher than DZ correlation, and common as well as unique environmentabilities. In the second chapter, G. Schöner discusses the historical path from the metaphor of self-organization to concrete neural models of children's cognition. By implication, this work leads to a neural grounding of cognitive development.

Part V of the book addresses issues of dynamics of development. One of the main tenets of this book is that systems dynamics of development can be properly addressed only with nonlinear models. In the first of the four chapters of this module, taking an almost contrarian stance, F. Cunha and J. Heckman rephrase cognitive development in units of the stock market, and ask whether the bell has tolled for linear models. Neatly, the authors lay out a linear model, address issues such as classical and nonclassical measurement error, and then

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present a real world data example, in which skill development is predicted from parental and environmental variables. From this study, in addition to learning about skill development, we conclude that there is life left in linear models of dynamic cognitive and noncognitive development.

In the second chapter, H.L.J. van der Maas and collaborators use the sample case of general intelligence to introduce a new approach to collecting high frequency data on development. Using phase-transition concepts that are rooted in chaos theory, the authors discuss categorical latent structure modeling and present Math Garden, their empirical data collection environment. This environment provides breathtakingly rich data and, thus, amazing opportunities to study cognitive development.

In the third of the four chapters in this module, K.W. Fischer and P. van Geert propose a dynamic network modeling framework for the analysis of dynamic development of brain and behavior. This framework is guided by the hypothesis that developmental changes involve coordination of brain – behavior elements into higher order control systems. Applied to the development of skill and talent, the models allow one to predict skill distributions which turn out to be extremely asymmetric (not normal or symmetric).

In the last chapter of this module, contributed by K.M. Newell and Y.-T. Liu, the authors aim at identifying a common set of dynamical principles in intra-individual development of movement across the life span. Although these principles are not presented in any detail, it is interesting to read how the authors' dynamical theory of change in movement and action is embedded into such concepts as Waddington's landscape of development, and how they are applied to real world data.

Part VI of the MLN book focuses on the dynamics of social interaction. In the first of the two chapters in this module, E. Ferrer and J. Steele discuss five differential equation models of dynamic dyadic interaction, taken from various disciplines. These models are used to analyze data from the Dynamics of Dyadic Interaction Project. Results are discussed from the perspective of predicting dyadic behavior 1–2 years after completion of data collection and, equally important, from the perspective of the designer of a study who needs a sufficient length of a time series to be able to apply these models.

The second chapter in this module is among the highly didactic ones in this volume. S.M. Boker and coauthors present an introduction into phase-space modeling, specifically, a differential equations model for the ovarian hormone cycle. Data matrices are specified as well as the basic equations, a simulation study is presented and results are related to one study participant's data. The chapter ends with one of the main tenets of dynamic modeling, maybe modeling in general: researchers should aim "for models of *how and why* rather than just models of *what*" (p. 389).

In Part VII of the book – it contains just one-chapter – S.-M. Chow and collaborators discuss models of regime-switching. Specifically, the authors discuss cusp catastrophe models and propose, as an alternative, mixture structural equation models with regime switching. The main elements of such models are laid out explicitly, and models are applied to alcohol dependence data. In the discussion, the authors emphasize the elegance of the cusp catastrophe model but note that some of the restrictive constraints of these models can be relaxed in their structural models.

Part VIII of this volume presents two chapters on nonergodic developmental systems. In the first of these, W.F. Velicer et al. discuss idiographic applications in the Molenaar sense along with issues of generalizability. Connections to the well known Ecological Fallacy are drawn, and sample applications to stereotypy data from autistic children, to longitudinal patterns from a nicotine harm reduction study, and to patterns of adherence in sleep apnea are discussed. The importance of person-specific estimation of parameters is stressed for, both, description of individuals and generalization.

In the second chapter, contributed by P.C.M. Molenaar and J.R. Nesselroade, ergodicity is explicitly introduced and discussed. It is noted that developmental processes are almost always nonergodic, because they are nonstationary, and dynamic factor models are presented for the analysis of nonstationary processes. These models are extensions of Molenaar's (1985) dynamic factor models. The dangers of pooling are illustrated using a structural model of a four-variate time series. In a way similar to the examples used by von Eye and Bergman (2003), the example suggests that the model that is based on aggregated data fails to describe any individual case. A model is discussed that allows one to accommodate subject-specific factor loadings and any other parameters in state-space models (which are defined in this chapter as well).

A synopsis of the entire book is presented by P.K. Wood, in Part IX of the book, which contains just this synopsis. The author adopts a philosophy of science perspective, and discusses the approaches presented in this book from the perspectives of the historian, the

researcher, and the individual at the beginning of a scholarly career. New arguments are introduced into the discussion of Waddington's epigenetic landscape, and priorities for systems research are discussed with respect to research traditions.

Evaluation

From the perspective of this reviewer, there can be no doubt that this book represents a major accomplishment. The editors have managed to convince the leading authors in the field to contribute a most exciting collection of chapters, each of which is worth reading. The book shows that gigantic progress has been made, that methods of modeling and analysis are ready to be used, that software exists and is distributed for free, and the examples presented in some of the chapters are mouth-watering.

As is usual in edited volumes, the chapters differ greatly in almost all respects. Some are didactic (e.g., Chapter 6 by Saunders and Chapter 14, by Boker et al.), others are idiosyncratic (e.g., Chapter 2, by Overton; this chapter presents part of the theoretical underpinnings of the approaches discussed in this book, but one wonders about the benefit of some of the unusual (re-)definitions). Some chapters are theoretical in nature, others present data examples, or simulation results. Some chapters provide an overview of existing models, others introduce new models. All this contributes to the excitement about this book.

Is there anything to criticize? The only element that I was missing was the history of systems research. Authors like G.J. Klir are not mentioned who is viewed by many as one of the founders of systems research and who started the International Journal of General Systems. This journal is interdisciplinary and may be viewed as a target journal for model development and application, regardless of the discipline that furnished data (cf. the discussion of publication strategies in Wood's chapter). Apart from that, I don't see much to criticize.

Therefore, **in sum**, the Handbook of Developmental Systems Theory and Methodology, edited by Molenaar, Lerner, and Newell represents a corner stone in the development of methodology and methods for developmental research. Developmental scholars in all disciplines will consider themselves happy having this volume on their desks, students will learn about cutting-edge thinking in developmental science, and empirical researchers will learn how to design studies, collect and analyze data, and interpret results. This is the most exciting book I have had the pleasure of reading in a long, long time.

Alexander von Eye
Michigan State University
Department of Psychology
East Lansing
MI 48824-1116, USA
E-mail: voneye@msu.edu

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