From Between-Person Statistics to Within-Person Dynamics

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Abstract
Change is the most prominent aspect of research endeavors in developmental and educational psychology. To date, preferred methods for studying change, especially those that rely on quantitative methodologies, are based on sample-based correlational analyses conducted with longitudinal panel studies. In this article we argue that research designs need to move beyond a between-person research strategy because dynamic processes occur within individual children and adolescents. The aim is to provide developmental and educational researchers with a guide to gathering and analyzing data so as to be able to answer questions about processes of change and development from a within-person perspective. Our discussion of current practices and our guidance on future research is based on a dynamic systems view on development.

Keywords: time series data, individual development, dynamic systems theory, cross-lagged panel model

Von stichprobenbasierten Statistiken zu individuellen Dynamiken

Zusammenfassung

Schlagwörter: Zeitreihendaten, individuelle Entwicklung, Dynamische Systemtheorie, Cross-Lagged-Panel Model
1 Introduction

As developmental and educational psychologists, the most prominent aspect of our research endeavors is change – ranging from short-term learning advancements to mid-term career development to the emergence and life-long formation of personality and personal identity. Before approaching these research topics methodologically, a necessary first step is to think thoroughly about the nature of the phenomena under study. The choice of methods, including research designs, data analysis tools, and analytic techniques should reflect “fidelity to the phenomena” (Freeman 2007). Other authors (e.g., Magnusson 1999) have repeatedly emphasized this point, namely that the subject matter rather than methodological conventions should dictate the approach and means that we use to study (Toomela 2007), and that loyalty to the phenomena should be favored over “playing the politics of social positioning within psychology or showing allegiance to a particular method” (Beckstead 2009, p. 226).

In this article we would like to demonstrate that the quest for a better understanding of children’s and adolescents’ developmental processes requires more than the conventional toolbox of sample-based path models (Hamaker 2012; Molenaar 2013). Instead, a focus on intraindividual processes and the diversity of intraindividual functioning is favored. First, we give a brief introduction to the paradigmatic contribution that Dynamic Systems Theory (DST) has made to developmental science (e.g., Fogel 2011; Thelen/Smith 1994; Witherington 2007) and its methodological implications. Against this backdrop, an empirical example that employs widely-used analysis strategies is presented to show their limitations with regard to understanding developmental dynamics. Then, as an alternative strategy, we describe a within-person research example of teacher behavior and student motivation using highly frequent in situ measures. Based on this project, which is still at quite an early stage, potential research questions and their handling with innovative methodology will be outlined.

2 Human development from a dynamic systems perspective

Ultimately, the alleged nature of the phenomena to be studied depends on researchers’ prevailing worldviews or paradigms, on how they think humans function and develop. In everyday research, this ontological prerequisite is often skipped and delegated to philosophy-oriented scholars who explicitly outline different paradigms or worldviews (e.g., Baltes/Reese/Nesselroade 1988; Levenson/Crumpler 1996; Lickliter/Honeycutt 2015; Overton 1998, 2015; Witherington 2015). A mechanistic worldview seems to prevail in many areas. It represents the legacy of behaviorism and takes a Humean–Newtonian perspective on science. This worldview is characterized by drawing a clear distinction between antecedents and outcomes, stimuli and responses, linked by (efficient) causality, and the fragmentation of human beings into atomistic elements represented by observable behaviors and/or latent psychological constructs. The dominant tools for obtaining empirical evidence have been experiments and questionnaire-based surveys.

By contrast, the dynamic systems (DS) perspective, promoted by the pioneering work of Thelen (1989) and Thelen and Smith (1994), has exerted a growing influence on devel-
opmental research over the last decades, as, for example, documented in a special issue of *Developmental Review* (see Howe/Lewis 2005) and a special section of *Child Development Perspectives* (see Hollenstein 2011). Some core elements of a DS view on human development will be briefly outlined below.

**Holism.** Although there is no denying that elements, i.e., factors, constructs, and variables, are operative in a given system, the study of individual elements and their (unique) relationships has no explanatory power in regard to change/development within the system as a whole. Change in one element is related to change in many, if not all, other elements of the system and, in addition, to change in their mutual functional relationships. Against this backdrop, the widely pursued quest for a “pure” mechanism between a predictor X and a dependent variable Y by virtue of holding constant all other variables (elements of the system) is counterproductive and devoid of any connection to the reality of human existence.

**Self-organization, emergence, and circular causality.** In contrast to the views of widely used mechanistic stimulus-response models, the functional structures and the accompanying constraints on the individual’s state space are created neither by unidirectional socialization nor by contextual constraints. Rather, in real-time interactions as well as in self-reflections (given advanced cognitive abilities at later developmental stages) at the day-to-day level, individuals actively form functional associations between cognitions, emotions, and behaviors for a narrower or wider scope of situations with a greater or lesser probability of occurrence. In the DS framework, these structures are referred to as attractor states, i.e., an individual’s habitual ways of thinking, feeling, and acting in certain situations. A system can have varying numbers of attractors of varying sizes and strengths. The more often a particular pattern occurs, the more easily it becomes activated on subsequent occasions. Hence, these attractors result from day-to-day actions and interactions without being genetically determined or unilaterally shaped by contextual constraints (Witherington 2007). Instead, they follow the principles of emergence and self-organization. Probably the most important feature of self-organization is circular causality (see Witherington 2007, 2011). “Circular causality suggests that interactions among lower order elements provide the means by which higher order patterns emerge; in turn, these emergent patterns exert top-down influences to maintain the entrainment of lower order components” (Granic/Patterson 2006, p. 104). More simply, the higher order structures, the so-called attractor landscapes, represent developmental outcomes (such as personality characteristics, attributional and behavioral styles, self-concept features etc.) that strive for continuity. Their change occurs at the slow pace of developmental time. These changes are not only quantitative but are mostly qualitative structural changes such as the move from concrete to formal operations. Day-to-day actions and interactions are substantially influenced by these structures (top-down causality), but it is day-to-day actions and interactions (micro-processes) that form, modify, and/or completely alter these higher order structures at the same time (bottom-up causality). Above and beyond psychology, DS thinking has initiated paradigmatic changes in business and economics, climate and climate change models, developmental and evolutionary biology, sports and biomechanics, and medicine and neuroscience (Fogel 2011), to name just a few fields.