The Relationship Between the Structure of Interindividual and Intraindividual Differences: A Theoretical and Empirical Vindication of Developmental Systems Theory

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Abstract

Proponents of the Developmental Systems Theory (DST), like Gottlieb and Lerner, have questioned the relevance of behavior genetics for the study of developmental processes. In this chapter the criticism of DST wil be reformulated in a way which is consistent with Wohlwill's thesis that the study of developmental processes requires analysis of intra-individual differences, not inter-individual differences. The reasoning concerned is straightforward: a) Behavior genetics is a branch of applied multivariate statistics, conjoined with simple and uncontroversial Mendelian laws of inheritance; b) Standard multivariate statistics, including (developmental) behavior genetics, is based on analysis of inter-individual differences; c) The results of an analysis of inter-individual differences of a given phenotype may not be related at all to the structure of intra-individual differences of the same phenotype; d) Developmental processes give rise to intra-individual variation and also inter-individual heterogeneity. From the above reasoning, the reformulated conclusion of DST follows.

In this presentation a) and b) in the above reasoning will be taken to be self-evident. As to d), a concise appeal to the mathematical statistical literature will suffice to show that developmental processes constitute a subset of the class of dynamical systems, where the standard definition of a dynamical system is given in terms of a collection of time-dependent distribution functions characterizing the structure of within-system (i.e., intra-individual) variation over time. This leaves open the possibility to introduce additional specifications concerning between-system (i.e., inter-individual) variation of the time-dependent within-system structure. The main part of the presentation will be devoted to a defense of c), namely that the results of an analysis of inter-individual differences may not be related at all to the structure of intra-individual differences. The hypothesis that an analysis of inter-individual variation yields qualitatively the same results as an analysis of intra-individual variation of the same measures is known in mathematical statistics as the ergodicity hypothesis. The classical theorems about ergodicity show that it only holds in case a process is strictly stationary, i.e., the collection of time-dependent distribution functions characterizing the process has moments which are constant in time. This implies that developmental processes, which almost by definition have at least some moments which vary in time, are nonergodic and hence for these developmental processes there is no relationship between analyses of inter- and intra-individual variation. In a simulation study it will be shown that behavior genetical factor analysis of inter-individual variation can yield results that are entirely unrelated to the structure of intra-individual variation of each of the subjects making up the sample.

The psychometrical and practical consequences of this finding will be discussed at some length. In the final part of this talk it will be indicated how a more valid analysis of nonergodic intra-individual variation by means of time series analysis techniques like dynamic factor analysis can be carried out. A simple inductive methodology, new in the behavioral sciences, will be sketched with which lawful relationships generalizing over genuinely homogeneous populations of subjects can be derived.