Nonlinear Epigenetic Variance: Review and Simulations

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Abstract: In behavior genetics phenotypic variance is decomposed into genetic and environmental factors. However, interpreting these factors as sources (causes) of individual differences requires caution. A substantial portion of phenotypic variance may be due to non-linear (epigenetic) processes during ontogenesis. We present simulation studies of nonlinear epigenetic variance using a computational model of neuronal network. Time series for monozygotic (MZ) and dizygotic (DZ) twins were generated, and analyzed using conventional behavior genetic modeling. Nonlinear epigenetic variance was subsumed under the nonshared environmental factor. As a result, observed heritabilities and unique environmentabilities increased with time, whereas common environmentabilities decreased. Phenotypic effects of nonlinear epigenetic processes appear as unsystematic variance. In conventional twin analyses the existence of such processes complicates identification and quantification of the ultimate genetic and environmental causes of individual differences. Nonlinear dynamical system theory provides a challenging perspective on the development of individual differences, which may enrich behavior genetic studies.