

Phrase	Verbal	Intrinsic vs. Emergent?	References	Experimental design and estimation from data	GxE interpretation from data
Spatial Cov_{GE}	Cov_{GE} is the covariance between phenotypic deviations due to genotype (genotypic effects) and phenotypic deviations due to environment (environmental effects) across spatial locations. Stated differently, Cov_{GE} occurs when the environmental and genotypic effects on the phenotype across spatial locations covary positively or negatively.	Emergent metapopulation-scale phenomenon.	This paper, Levens 1968, Falconer 1989, Conover and Schultz 1995	This paper	Evolution of different mean reaction norms among individuals sampled from different spatial locations
Covariance between phenotype and environment	The association between phenotypic expression of a single genotype and the environment of growth (i.e., the reaction norm)	evolved state of environmentally induced production of alternate phenotypes from a given genotype	DeWitt and Scheiner 2004	To estimate reaction norms, several progenies from each family, clone, or genotype are grown in a discrete number of environmental treatments	Evolution of different mean reaction norms among progeny from different families, clones, or genotypes
“Genetic covariance in character states”	<p>“In the character state approach, the reaction norm for a particular character is modelled as the set of phenotypic values that would be expressed in each environment by a given genotype and evolutionary models are based on population means and genetic (co)variances of these character states” Via et al. 1995.</p> <p>The means of this bivariate normal distribution represents the mean (i) phenotype at one value of the environment and (ii) mean phenotype at another value of the same environment, and the diagonals in the covariance matrix represent the additive genetic variance for (i) and (ii), respectively. The off diagonal in the covariance matrix is an additive genetic covariance that represents the association between the additive effect of a mutation on the phenotype at one value of the environment and the same phenotype at the other value of the environment.</p>	Intrinsic property of the genotype-phenotype map and the external environment	Reviewed in Via et al. 1995	“Because measurements of different character states must be made on separate individuals, the usual statistical methods for calculating the genetic correlation are not applicable. In this case alternatives may be employed, such as the correlation of family means or the re-expression of genotype-environment interaction as a genetic covariance between character states expressed in different environments.” (Via and Lande 1985)	Unclear (de Jong 1995)
“Genetic covariance in polynomial coefficients”	<p>“In the polynomial approach, the reaction norm is described by a polynomial function of the phenotypic values expressed by a genotype across a range of environments, and evolutionary models are based on the population means and genetic (co)variances of coefficients of the polynomial.” (Via et al. 1995)</p> <p>The means of this bivariate normal distribution represents the mean parameter values in the polynomial, and the diagonals in the covariance matrix represent the additive genetic variance for each parameter. The off diagonal in the covariance matrix is an additive genetic covariance that represents the association between the additive effect of a mutation on one parameter and another parameter in the polynomial function.</p>	Intrinsic property of the genotype-phenotype map and the external environment	Reviewed in Via et al. 1995	Genetic and phenotypic variances and covariances can be estimated using the animal model (Lynch and Walsh 1998)	Genetic variance for reaction norm slope > 0
“bivariate normal distribution of slope (plasticity) and elevation (breeding value) in the reference environment”	<p>The means of this bivariate normal distribution represents the mean (i) reaction norm intercept and (ii) slope in the reference environment. The diagonals on this covariance matrix in this bivariate normal distribution represent the additive genetic variance for the (i) reaction norm intercept and (ii) slope. The off diagonal in this bivariate normal distribution is an additive genetic covariance that represents the association between the additive effect of a mutation on the reaction norm intercept and the reaction norm slope.</p> <p>Linear norms of reaction for each genotype are sampled at random from a population with this bivariate normal distribution.</p>	Intrinsic property of the genotype-phenotype map and the external environment	Lande 2009	Genetic and phenotypic variances and covariances can be estimated using the animal model (Lynch and Walsh 1998)	Additive genetic variance for reaction norm slope > 0
“bivariate distribution of a phenotype split into its genetic and environmental components”	<p>In this IBM-based approach, the phenotype is modeled as a combination of additive genetic and environmental components with a bivariate distribution.</p> <p>The means of this bivariate normal distribution represents the mean (i) reaction norm intercept and (ii) slope in the reference environment. The diagonals on this covariance matrix in this bivariate normal distribution represent the additive genetic variance for the (i) reaction norm intercept and (ii) slope. The off diagonal in this bivariate normal distribution is an additive genetic covariance that represents the association between the additive effect of a mutation on the reaction norm intercept and the reaction norm slope.</p>	Intrinsic property of the genotype-phenotype map and the external environment	Coulson et al. 2017 Coulson et al. 2021	If relatedness information is available and the infinitesimal model is assumed, genetic and phenotypic variances and co-variances can be estimated using the animal model (Lynch and Walsh 1998).	Additive genetic variance for reaction norm slope > 0

