

Heterogeneity

Mx class 2004



Heterogeneity Questions I

- Univariate Analysis: What are the contributions of additive genetic, dominance/shared environmental and unique environmental factors to the variance?
- Are the contributions of genetic and environmental factors equal for different groups, such as sex, race, ethnicity, SES, environmental exposure, etc.?



Heterogeneity Questions II

- Are these differences due to differences in the magnitude of the effects (quantitative)?
 - e.g. Is the contribution of genetic/environmental factors greater/smaller in males than in females?
- Are the differences due to differences in the nature of the effects (qualitative)?
 - e.g. Are there different genetic/environmental factors influencing the trait in males and females?

Groups

Comparison	Concordant for group membership	Discordant for group membership
gender	MZ & DZ: MM & FF pairs	DZ: opposite sex pairs
age	MZ & DZ: young & old pairs	
nationality	MZ & DZ: OZ & US pairs	
environment	MZ & DZ: urban & rural pairs	MZ & DZ: urban/ rural pairs

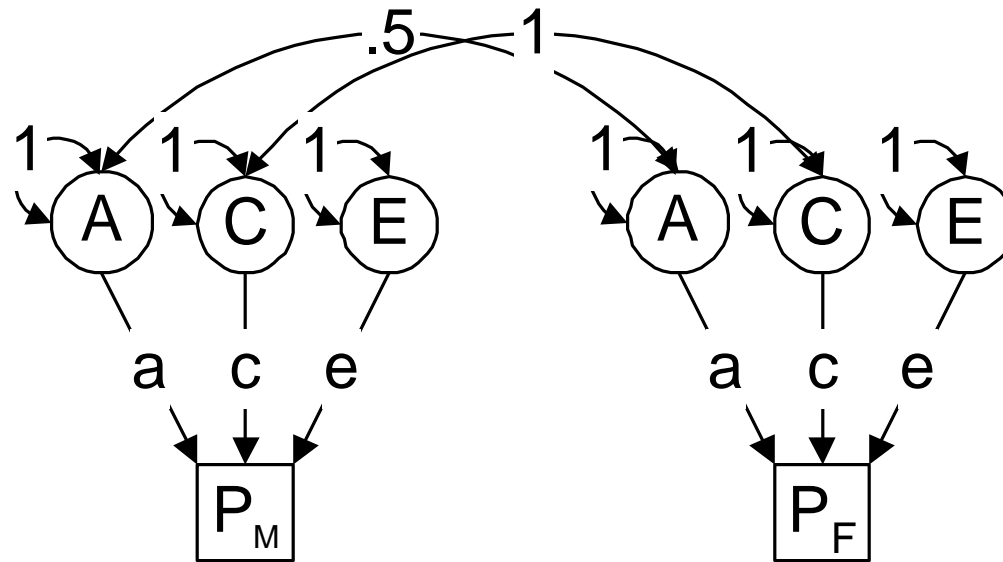
Models for Concordant Pairs

	OS	G1	G2	EP
Heterogeneity	12	$a_1 c_1 e_1$	$a_2 c_2 e_2$	6
Homogeneity	12	$a_1 c_1 e_1$	$a_1 c_1 e_1$	3

Models for Concordant and Discordant Pairs

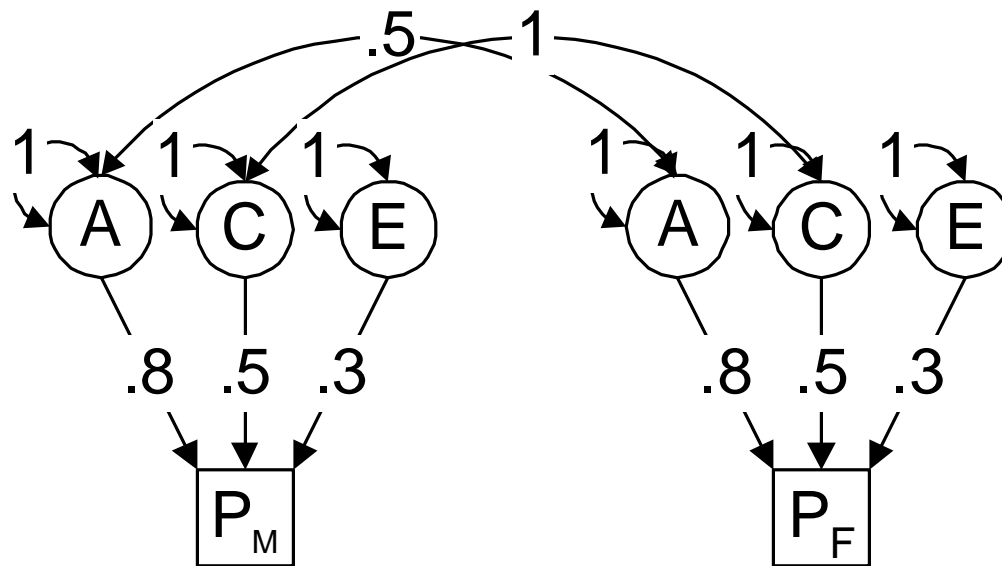
	OS	G1	G2	EP
Heterogeneity	15	$a_1 c_1 e_1$	$a_2 c_2 e_2$	6
Homogeneity	15	$a_1 c_1 e_1$	$a_1 c_1 e_1$	3
Scalar	15	$a_1 c_1 e_1$	$a_1 c_1 e_1 k$	4
General	15	$a_1 c_1 e_1$	$a_2 c_2 e_2 r_g$	7

Homogeneity Model I



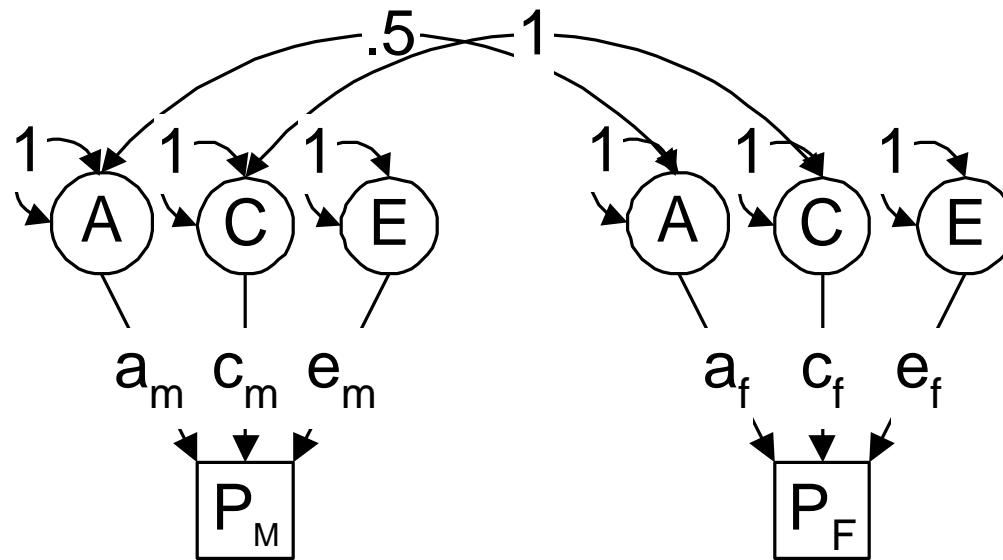
	Male	Female
Male	$a^2 + c^2 + e^2$	
Female	$.5a^2 + c^2$	$a^2 + c^2 + e^2$

Homogeneity Model II



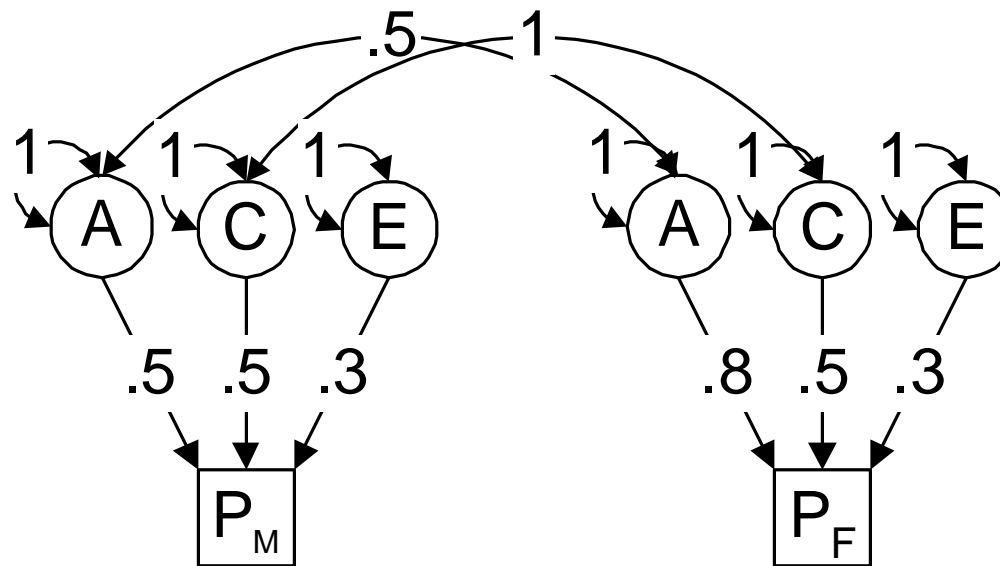
	MZm	MZf	DZm	DZf	DZmf
Variance	.98	.98	.98	.98	.98
Covariance	.89	.89	.57	.57	.57
Correlation	.91	.91	.58	.58	.58

Heterogeneity Model I



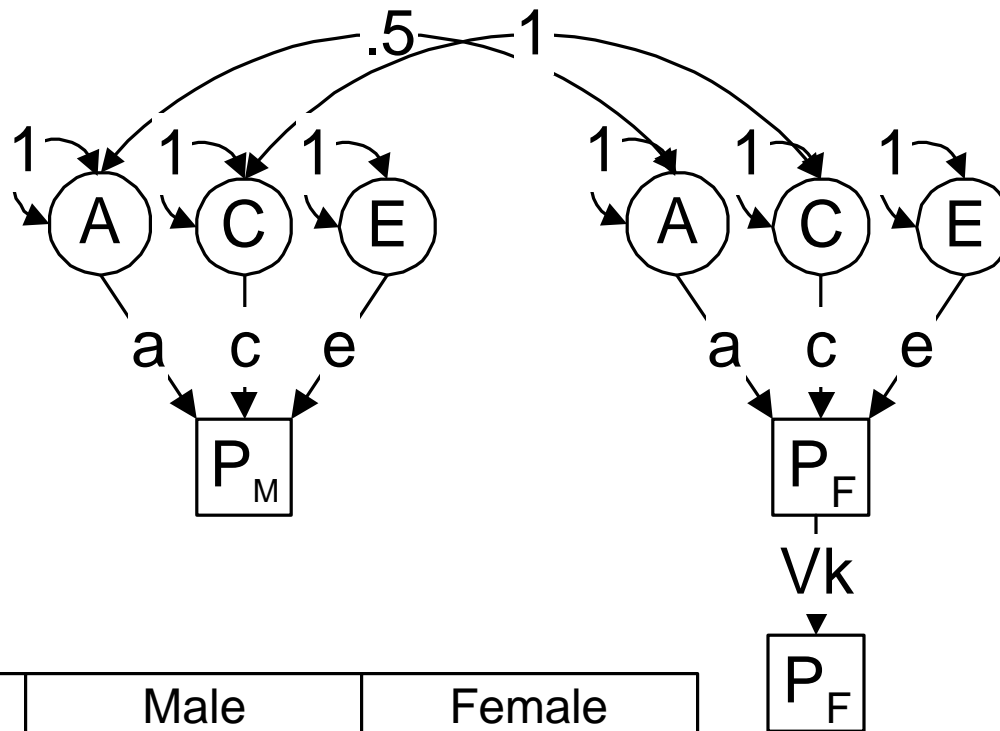
	Male	Female
Male	$a_m^2 + c_m^2 + e_m^2$	$.5a_m a'_f + c_m c'_f$
Female	$.5a_f a'_m + c_f c'_m$	$a_f^2 + c_f^2 + e_f^2$

Heterogeneity Model II



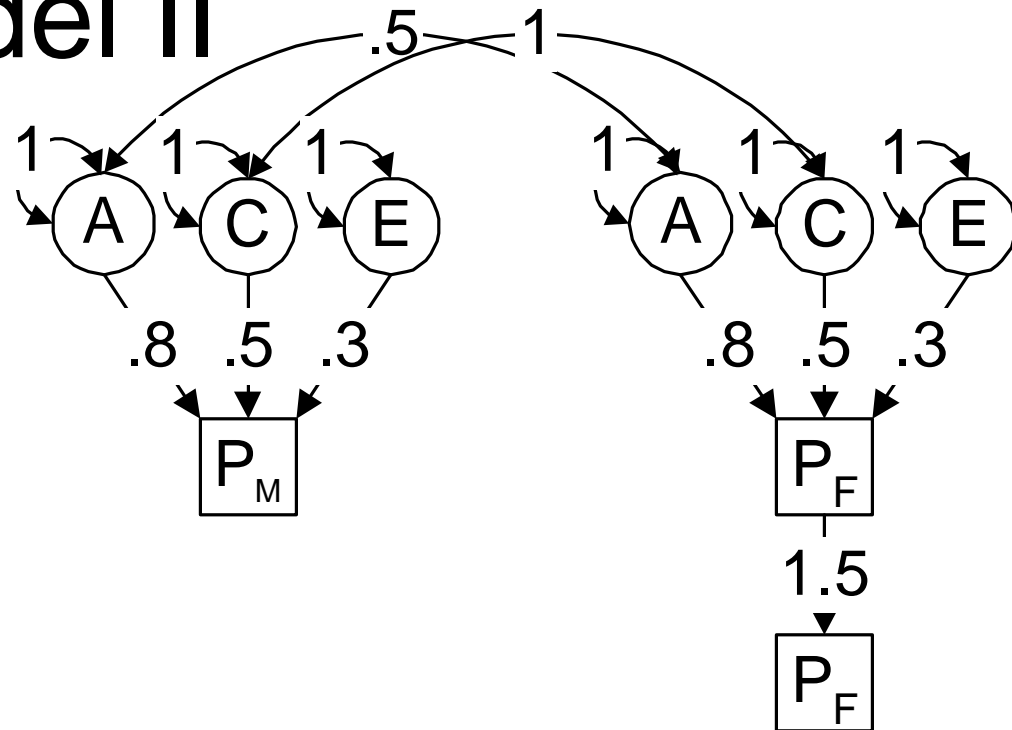
	MZm	MZf	DZm	DZf	DZmf
Variance	.59	.98	.59	.98	.59/.98
Covariance	.50	.89	.38	.57	.45
Correlation	.85	.91	.64	.58	.59

Scalar Model I



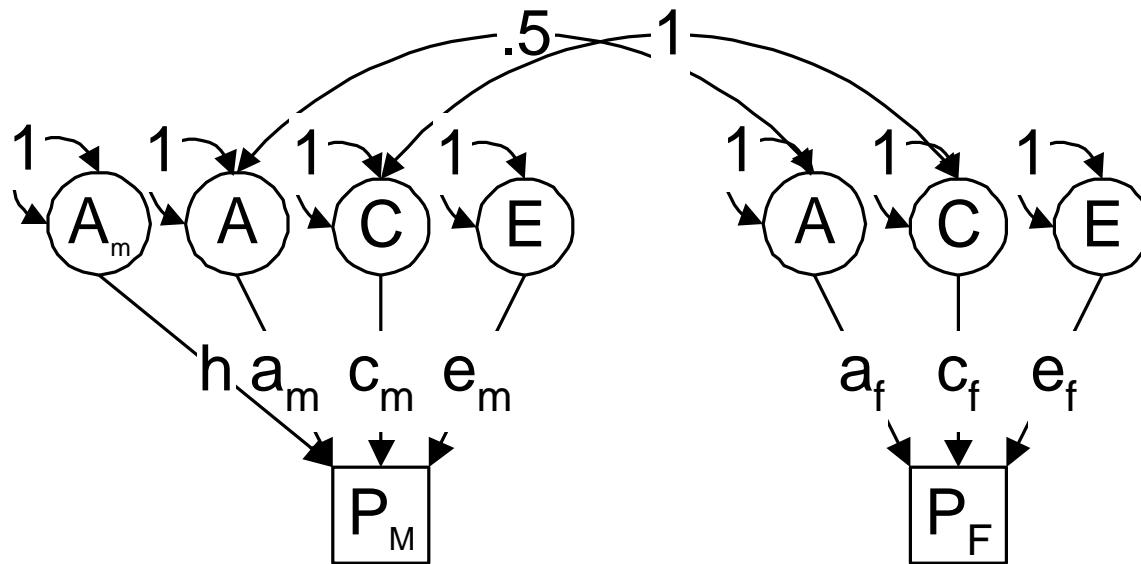
	Male	Female
Male	$a^2 + c^2 + e^2$	
Female	$V_k(.5a^2 + c^2)$	$k(a^2 + c^2 + e^2)$

Scalar Model II



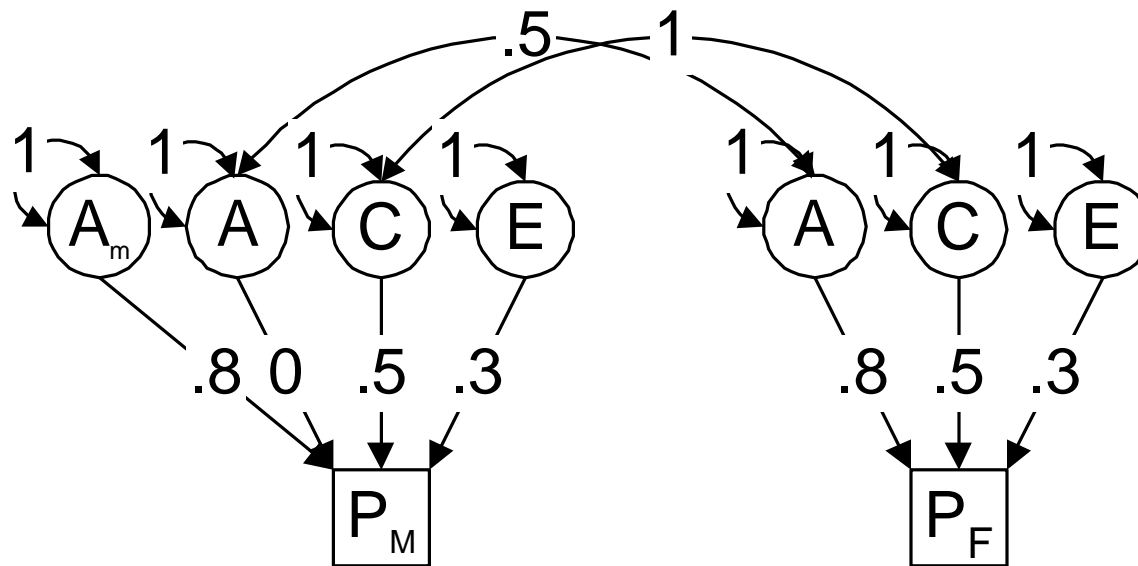
	MZm	MZf	DZm	DZf	DZmf
Variance	.98	2.20	.98	2.20	.98/2.2
Covariance	.89	2.00	.57	1.28	.85
Correlation	.91	.91	.58	.58	.58

General Model I



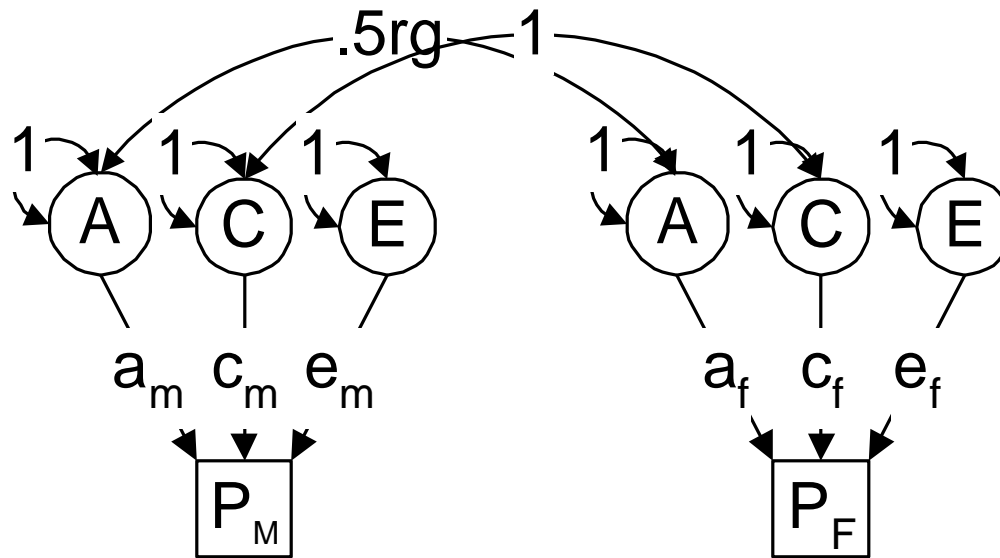
	Male	Female
Male	$a_m^2 + c_m^2 + e_m^2 + h^2$	$.5a_m a'_f + c_m c'_f$
Female	$.5a_f a'_m + c_f c'_m$	$a_f^2 + c_f^2 + e_f^2$

General Model II



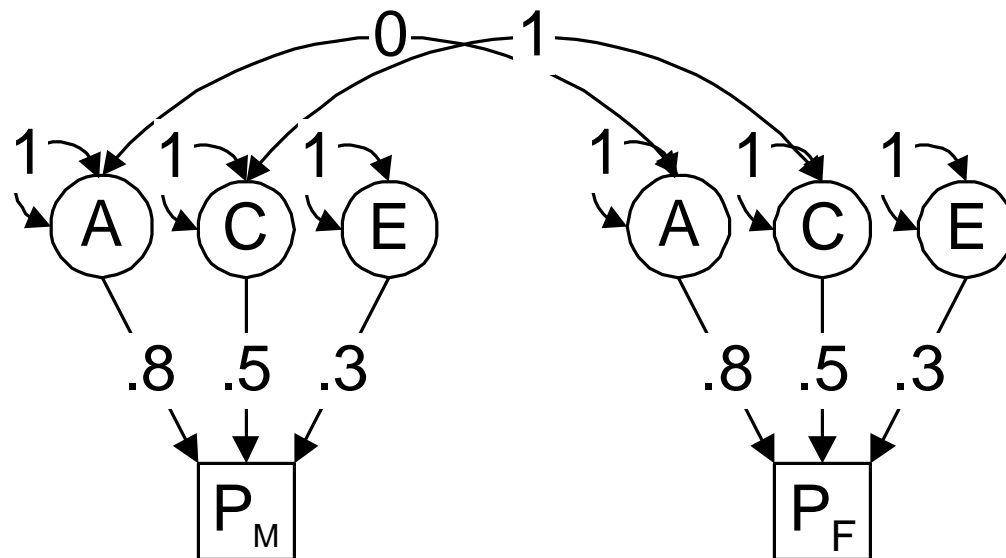
	MZm	MZf	DZm	DZf	DZmf
Variance	.98	.98	.98	.98	.98
Covariance	.89	.89	.57	.57	.25
Correlation	.91	.91	.58	.58	.26

General Model III



	Male	Female
Male	$a_m^2 + c_m^2 + e_m^2$	$.5r_g a_m a'_f + c_m c'_f$
Female	$.5r_g a_f a'_m + c_f c'_m$	$a_f^2 + c_f^2 + e_f^2$

General Model IV



	MZm	MZf	DZm	DZf	DZmf
Variance	.98	.98	.98	.98	.98
Covariance	.89	.89	.57	.57	.25
Correlation	.91	.91	.58	.58	.26

Summary of Models

- Homogeneity Model:
 - no quantitative, no qualitative differences
- Heterogeneity Model:
 - quantitative but no qualitative differences
- Scalar Model:
 - special case of heterogeneity model with proportional quantitative differences
- General Model:
 - quantitative and qualitative differences



Heterogeneity

- differences in variance components
- NOT mean differences
- group membership
- continuous heterogeneity