

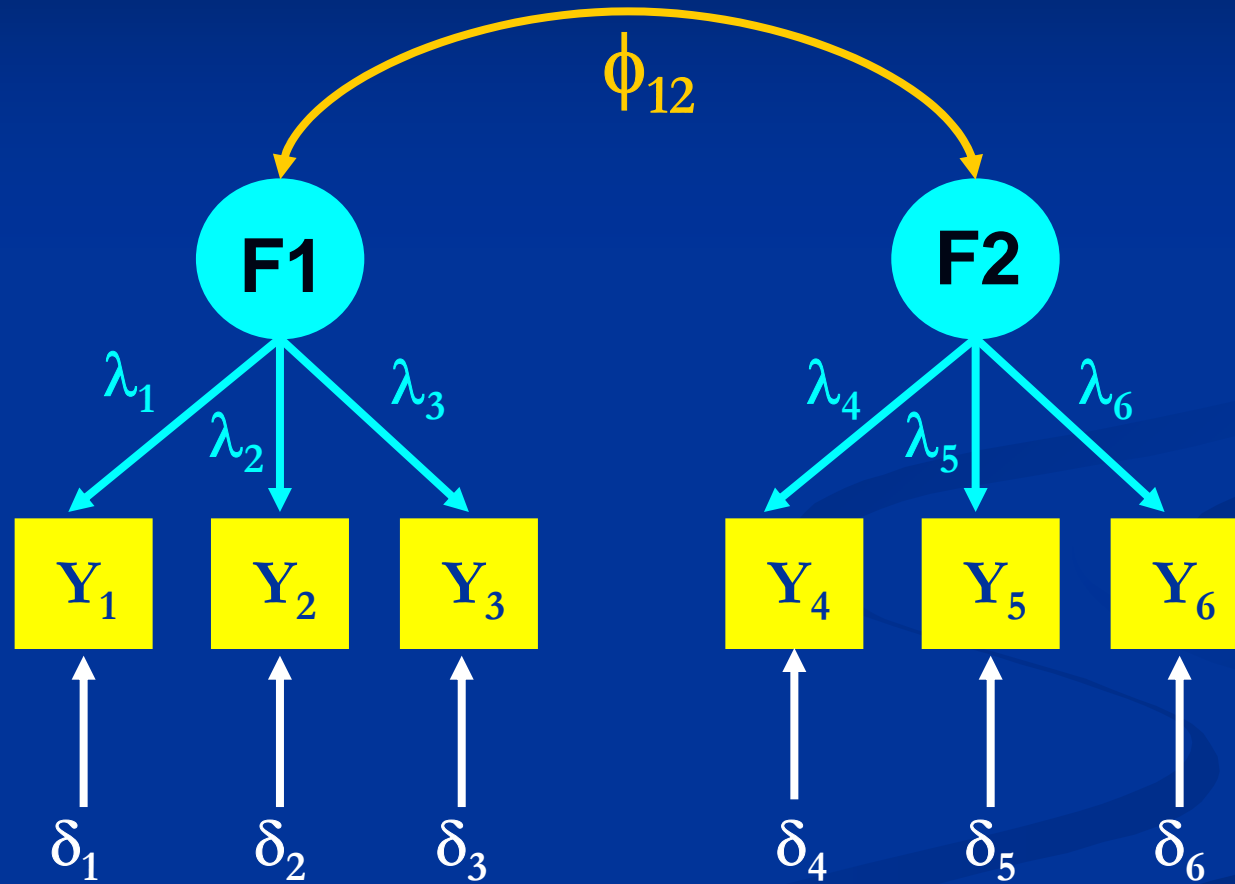
Behavioral Genetic Methods

Lecture 2

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Confirmatory Factor Model



Measurement Model

$$Y = \Lambda \xi + \delta$$

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$$\begin{array}{c} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \end{array} = \begin{array}{cc} \lambda_1 & 0 \\ \lambda_2 & 0 \\ \lambda_3 & 0 \\ 0 & \lambda_4 \\ 0 & \lambda_5 \\ 0 & \lambda_6 \end{array} \begin{array}{c} F_1 \\ F_2 \end{array} + \begin{array}{c} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ \delta_6 \end{array}$$

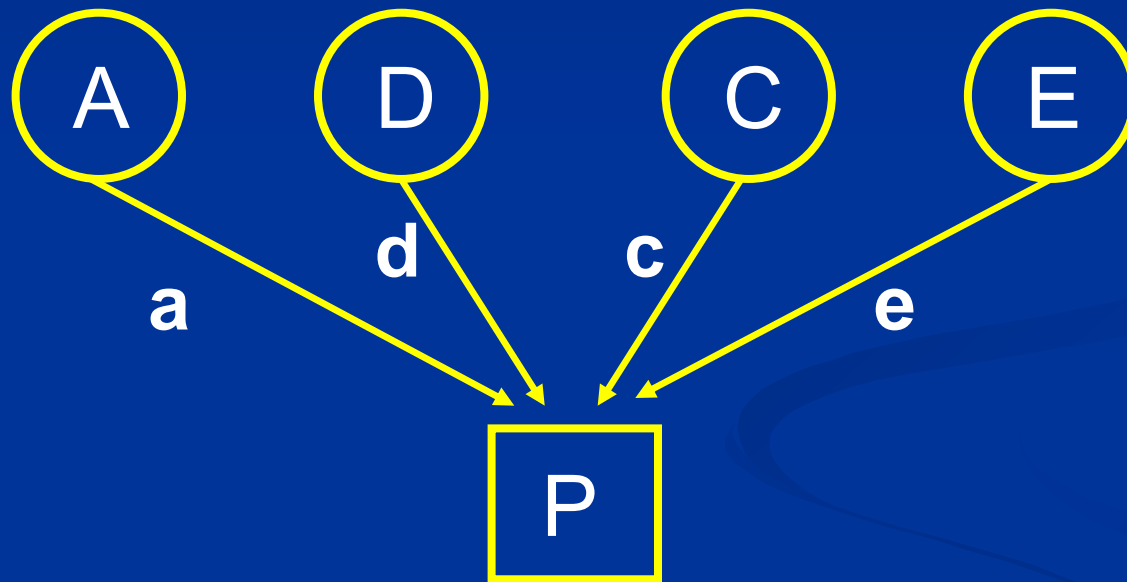
Expected Covariance Structure

$$\Sigma_y = \Lambda \Phi \Lambda' + \theta_\delta$$

$$\Sigma_y = \Lambda \quad \Phi \quad \Lambda' \quad + \quad \theta_\delta$$

λ_1	0	1	r_{12}	δ^2_1
λ_2	0	r_{12}	1	δ^2_2
λ_3	0			δ^2_3
0	λ_4			δ^2_4
0	λ_5			δ^2_5
0	λ_6			δ^2_6

Univariate Analysis



Primary goal is to decompose phenotypic/trait variance into genetic and environmental sources

BMI: Body mass index

\underline{P}_i	\underline{A}_i	\underline{D}_i	\underline{C}_i	\underline{E}_i
18	10	1	2	8
35	22	3	1	9
20	16	0	0	4
24	16	2	3	3
.
.
16	8	2	1	5
22	9	3	4	6
28	9	4	7	8

BMI

Unobserved Latent Scores

\underline{P}_i	\underline{A}_i	\underline{D}_i	\underline{C}_i	\underline{E}_i
18	?	?	?	?
35	?	?	?	?
20	?	?	?	?
24	?	?	?	?
.
.
16	?	?	?	?
22	?	?	?	?
28	?	?	?	?

Twin-1 Twin-2

P1_i P2_i

18 20

35 31

20 19

.

.

.

.

16 20

22 19

28 33

Observed data can be summarized
in a 2x2 variance/covariance matrix

	T1	T2
T1	.7247	.5891
T2	.5891	.7915

Model for Sibling Resemblance

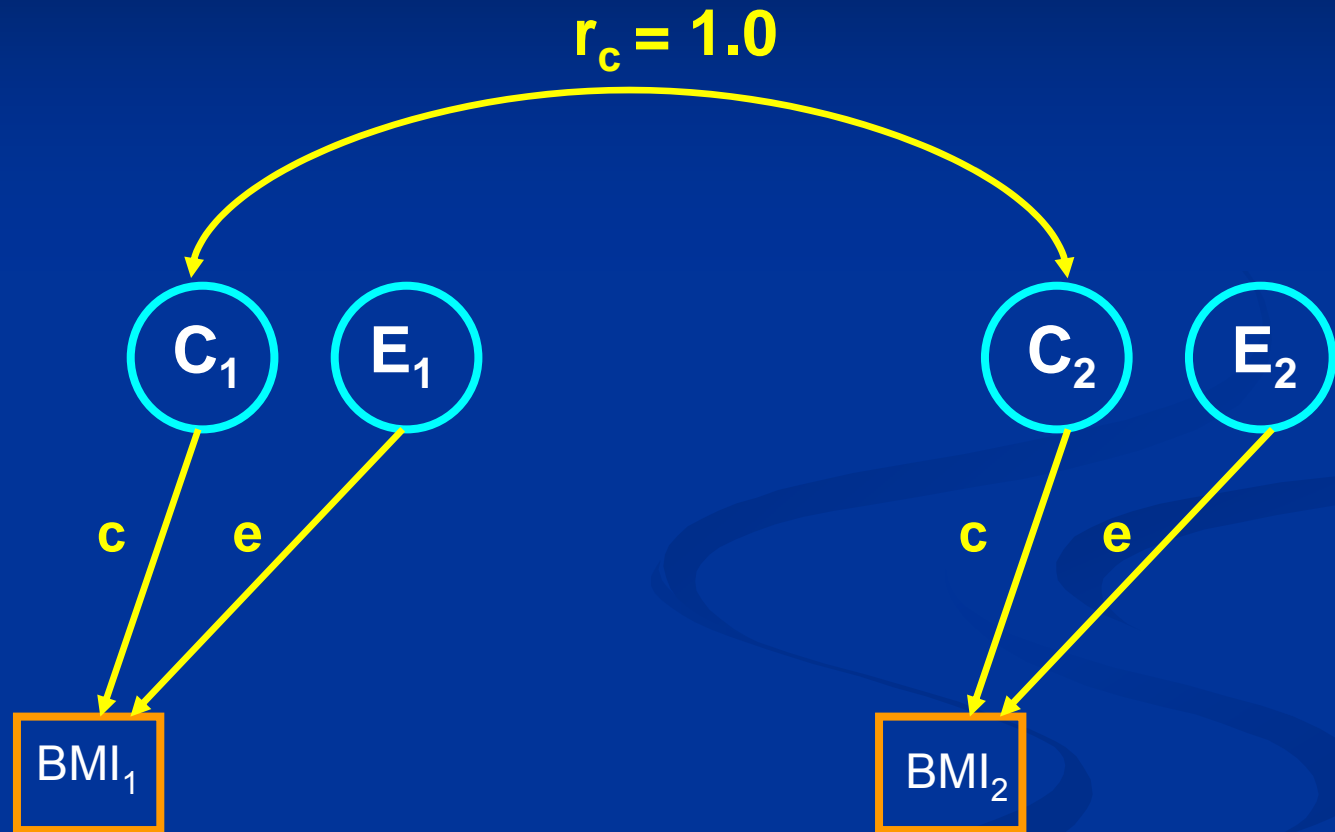
BMI₁

BMI₂

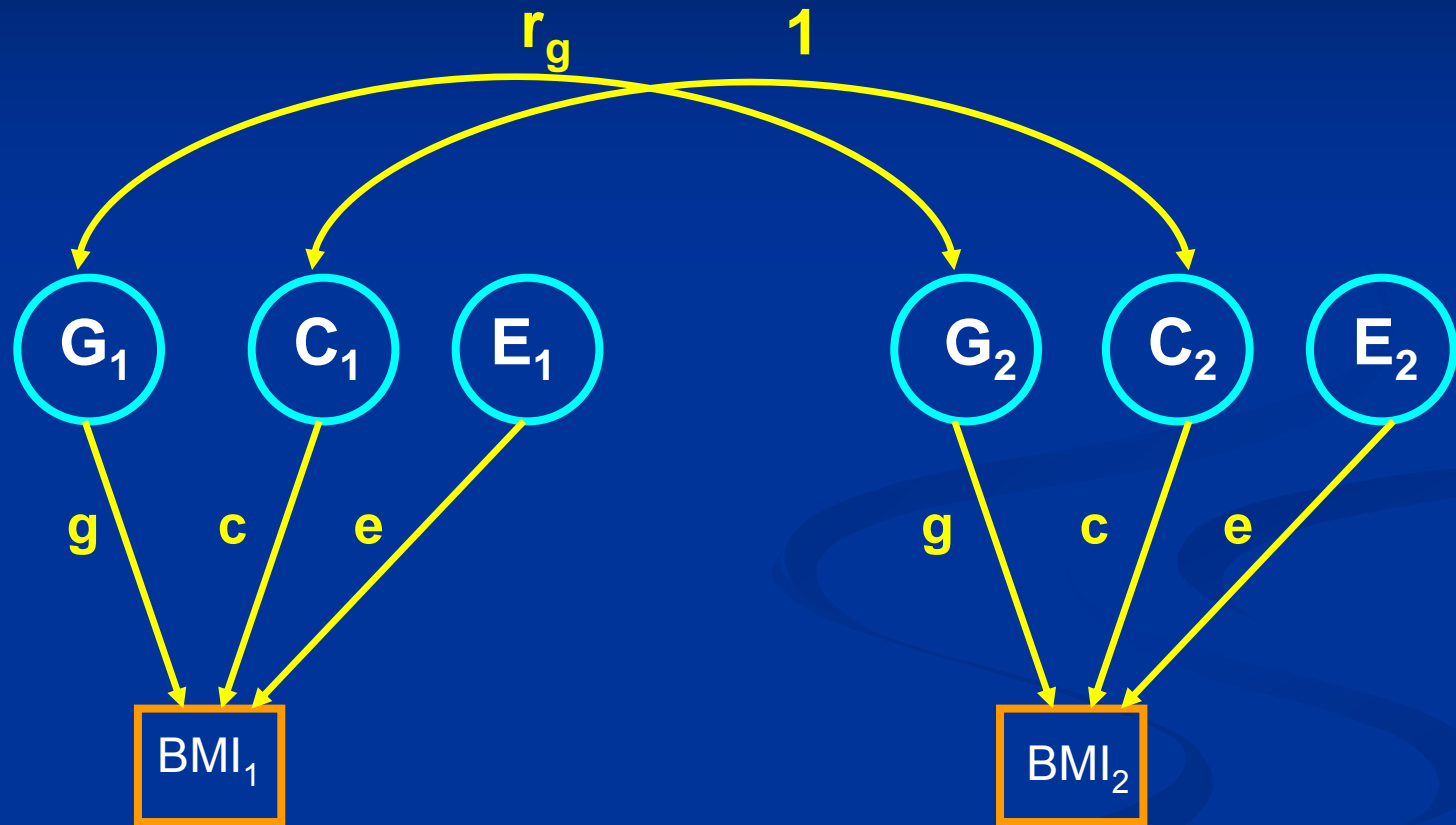
Model for Sibling Resemblance



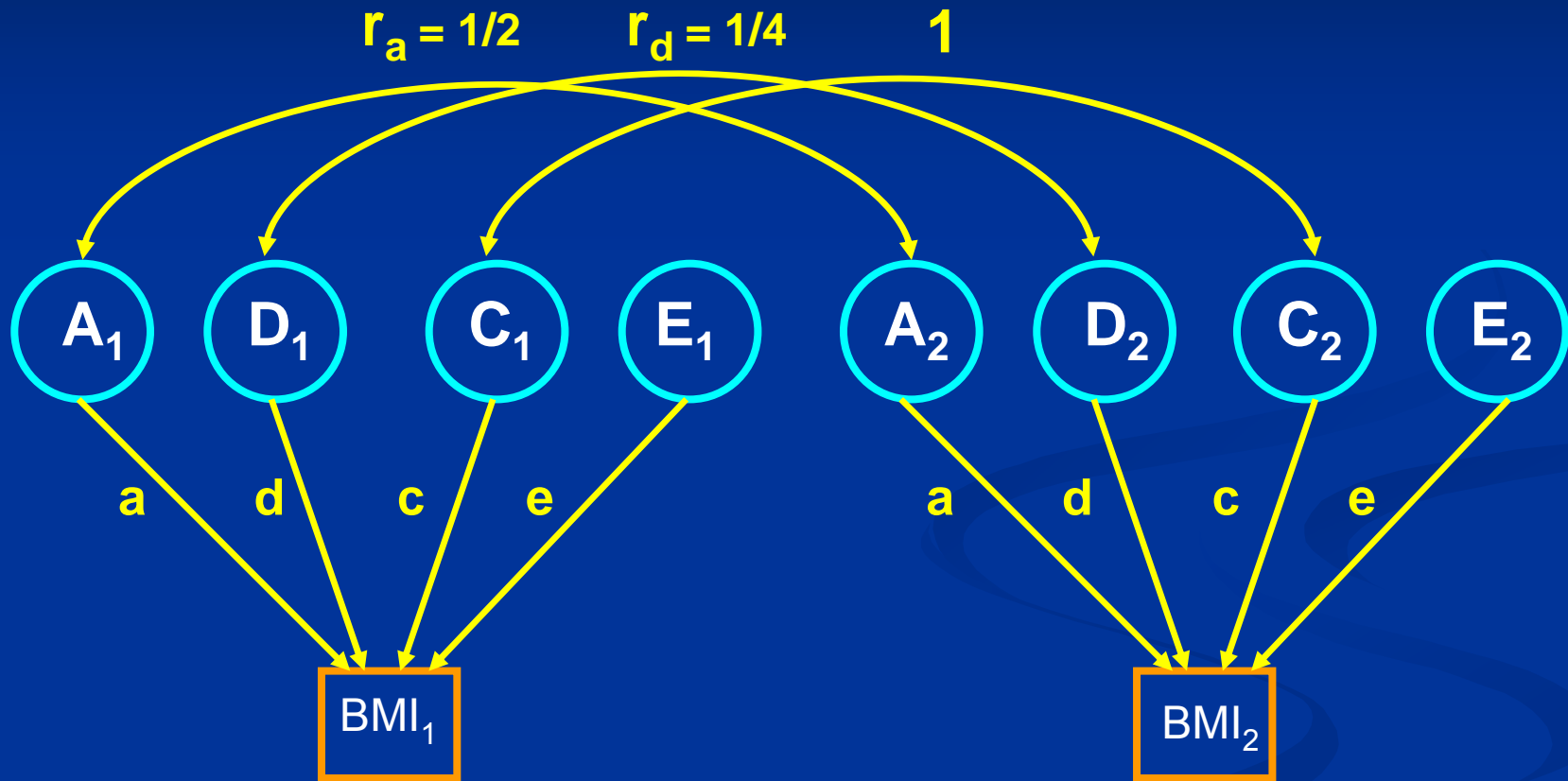
Model for Sibling Resemblance



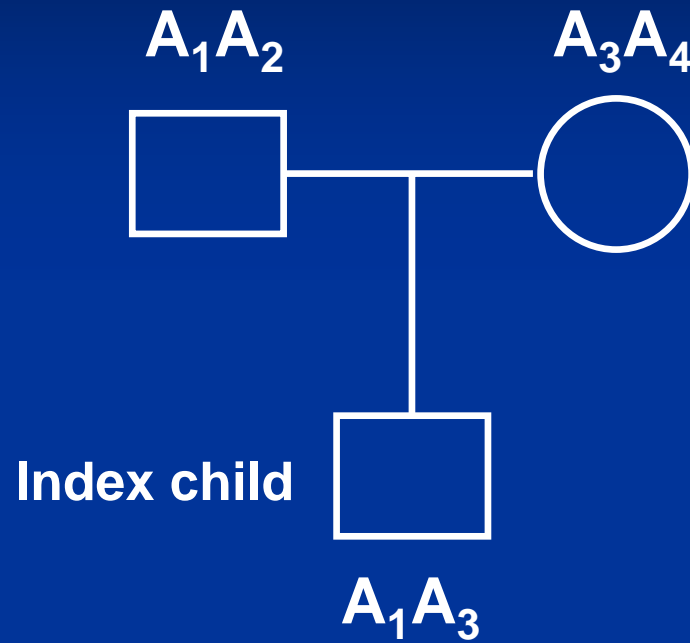
Model for Sibling Resemblance



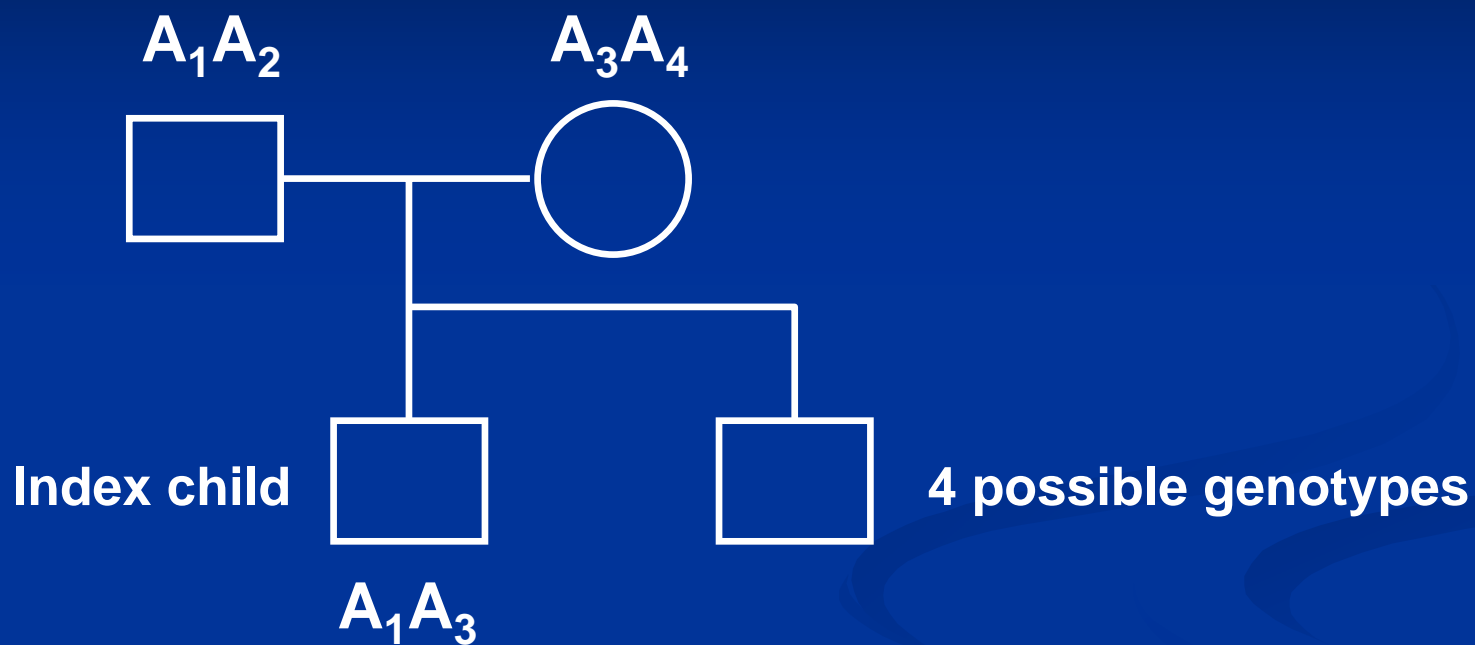
Model for Sibling Resemblance



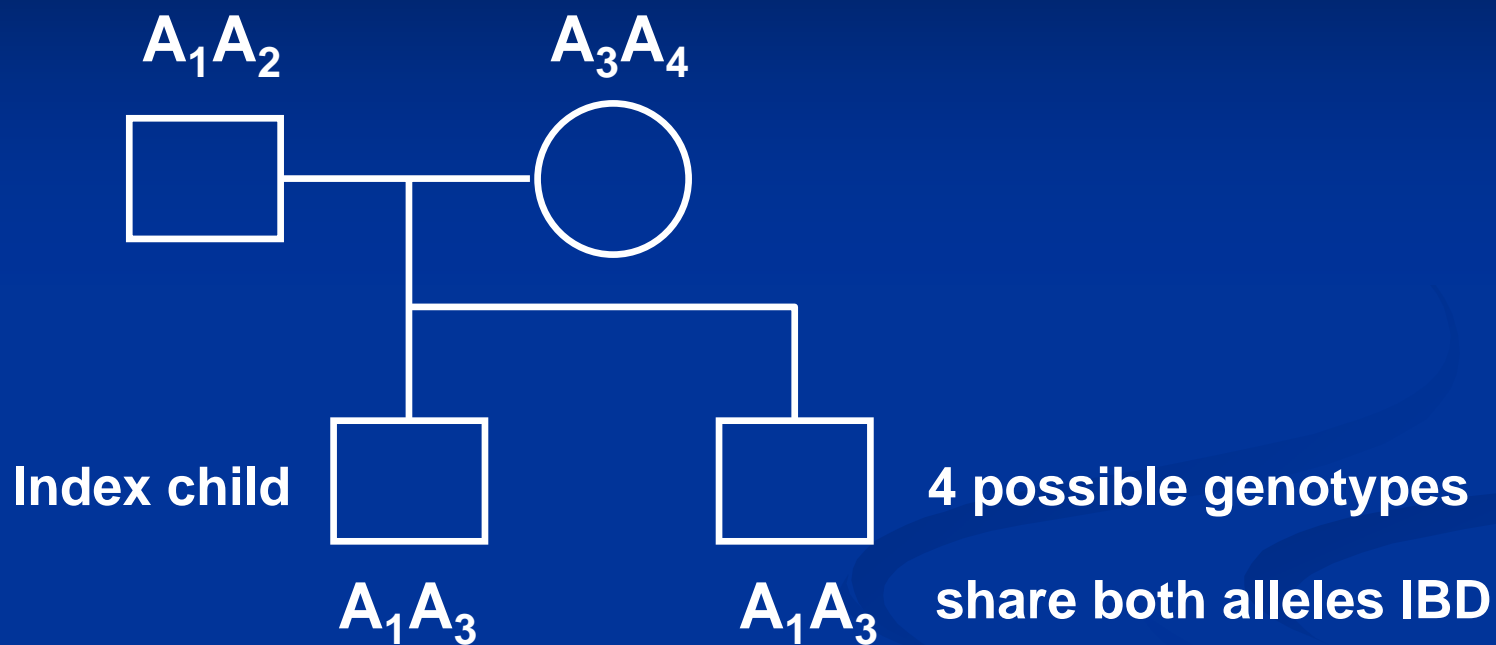
For a given locus A:



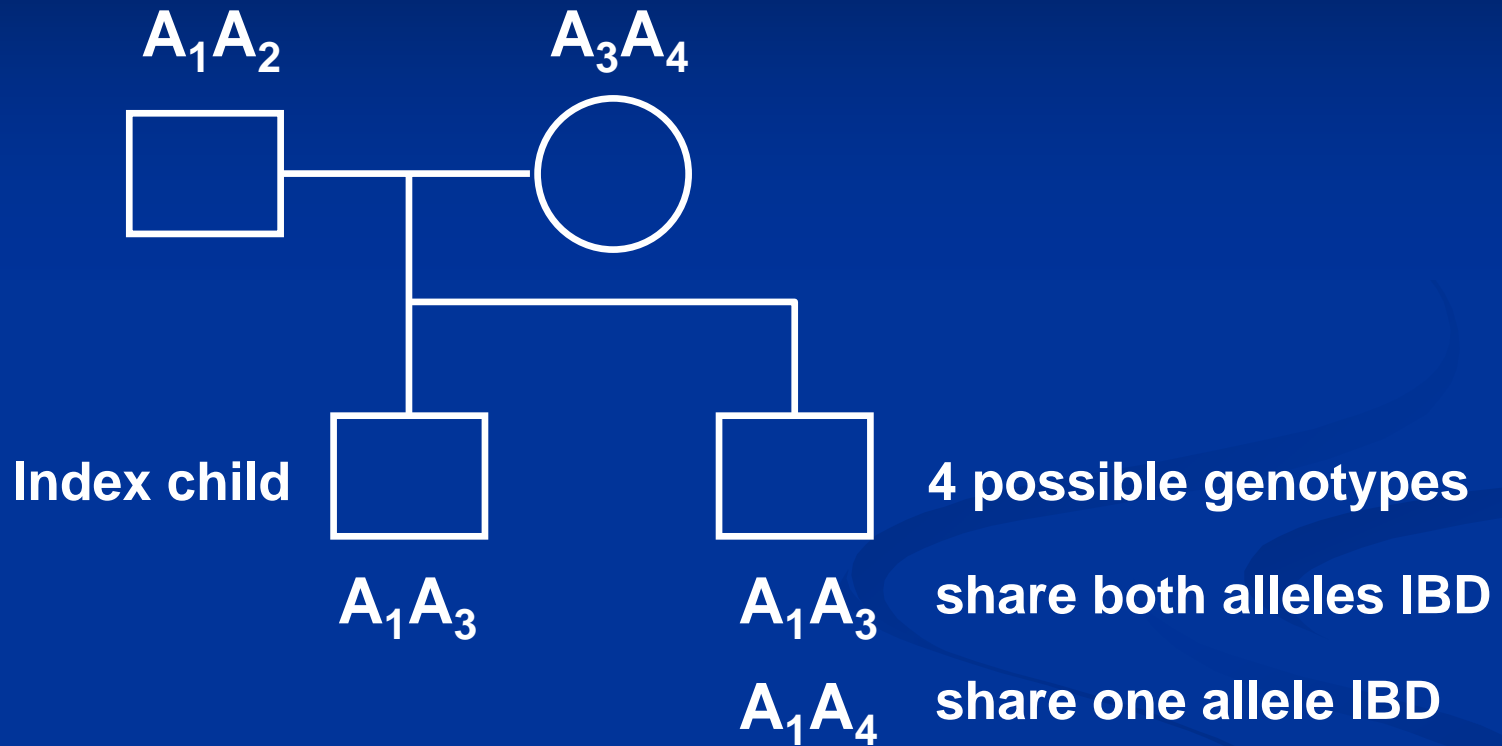
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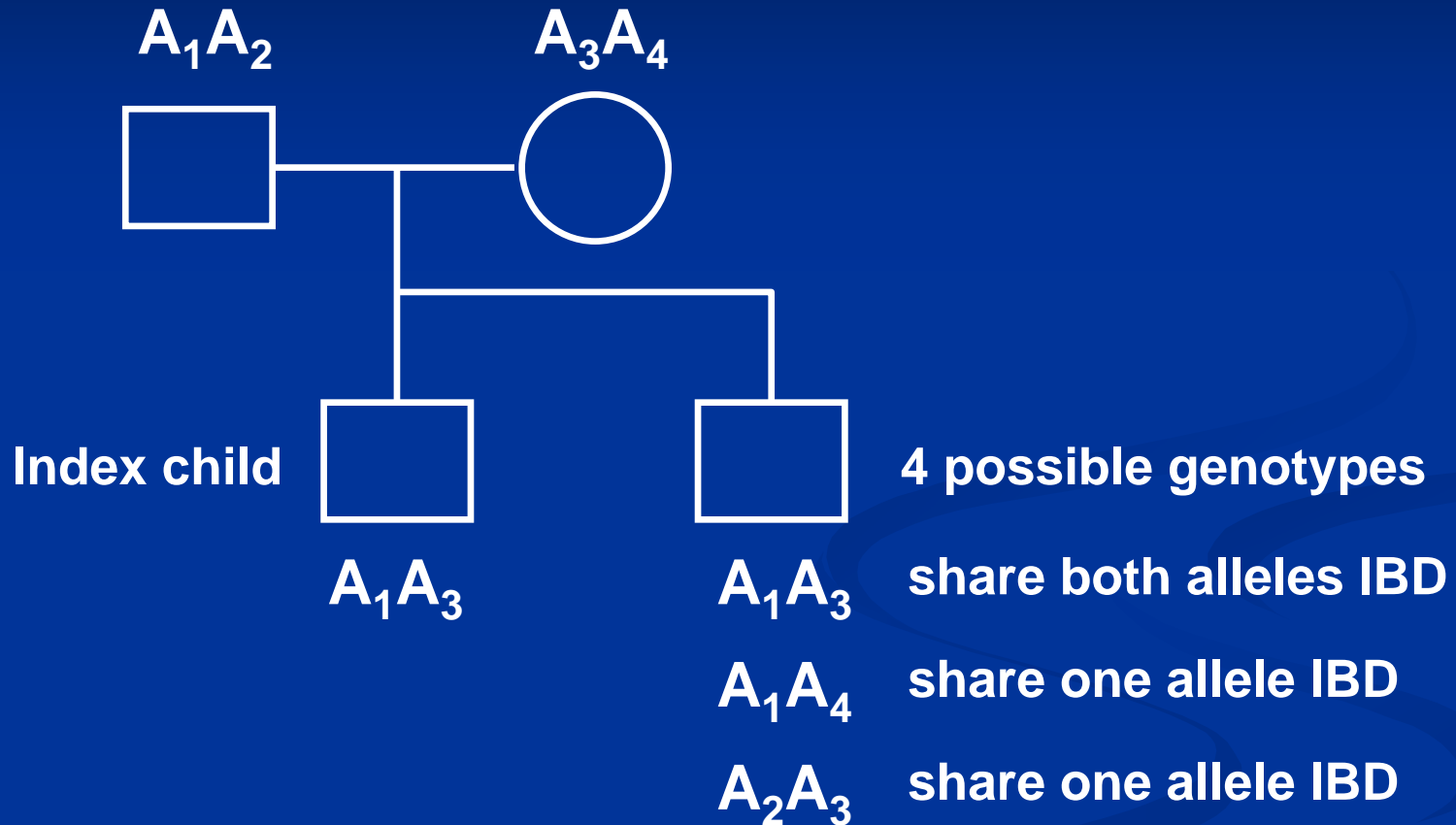
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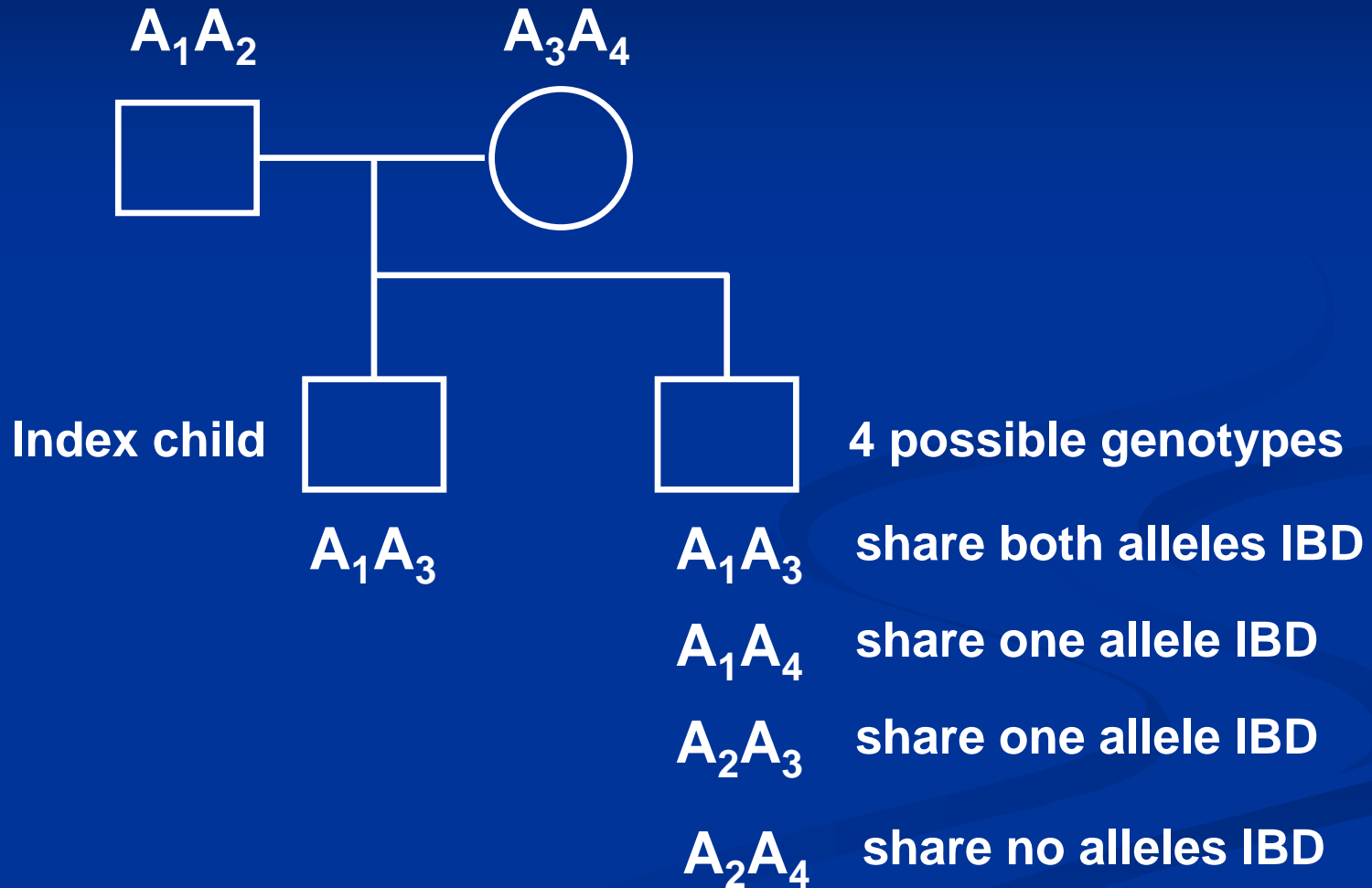
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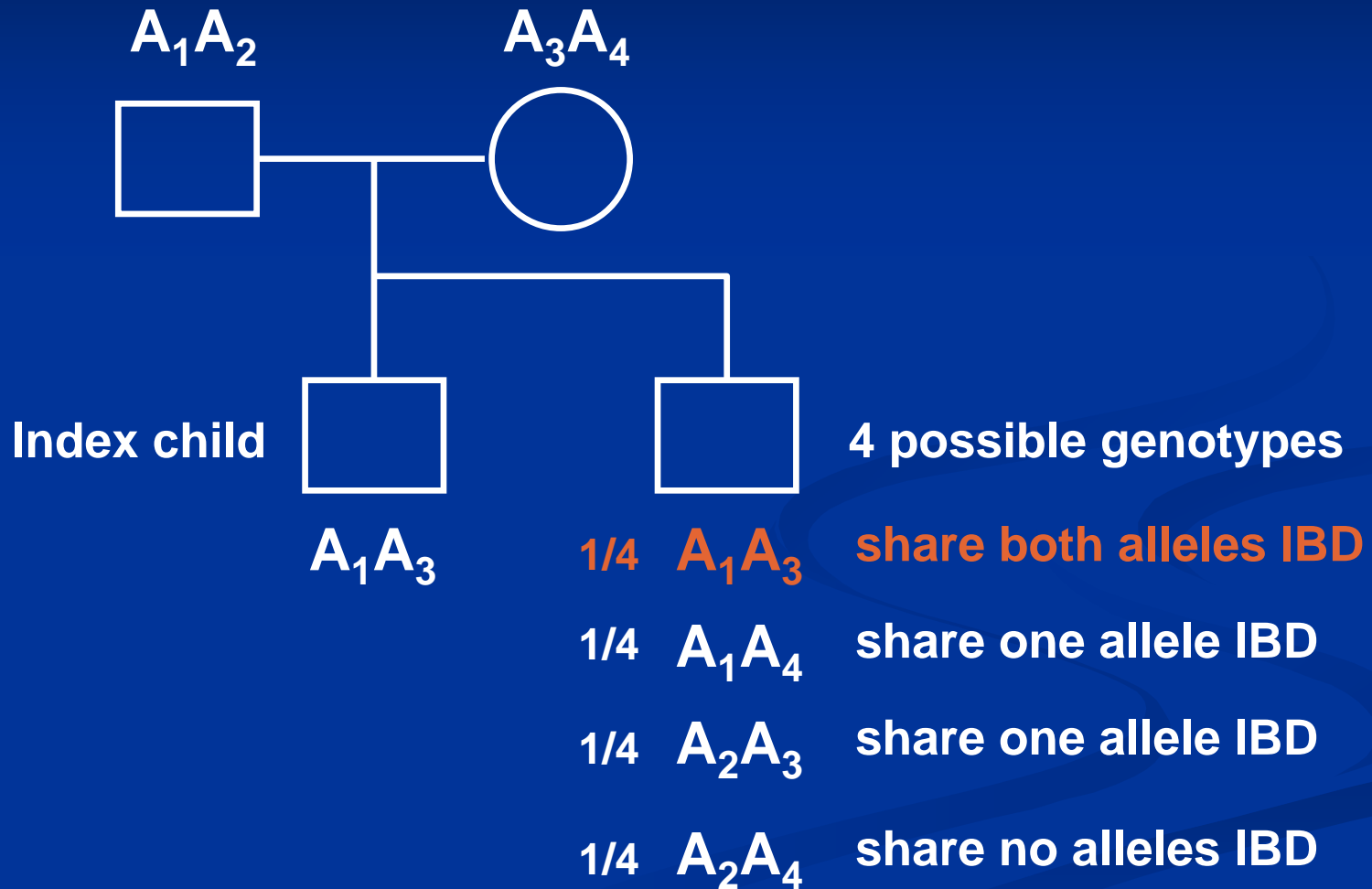
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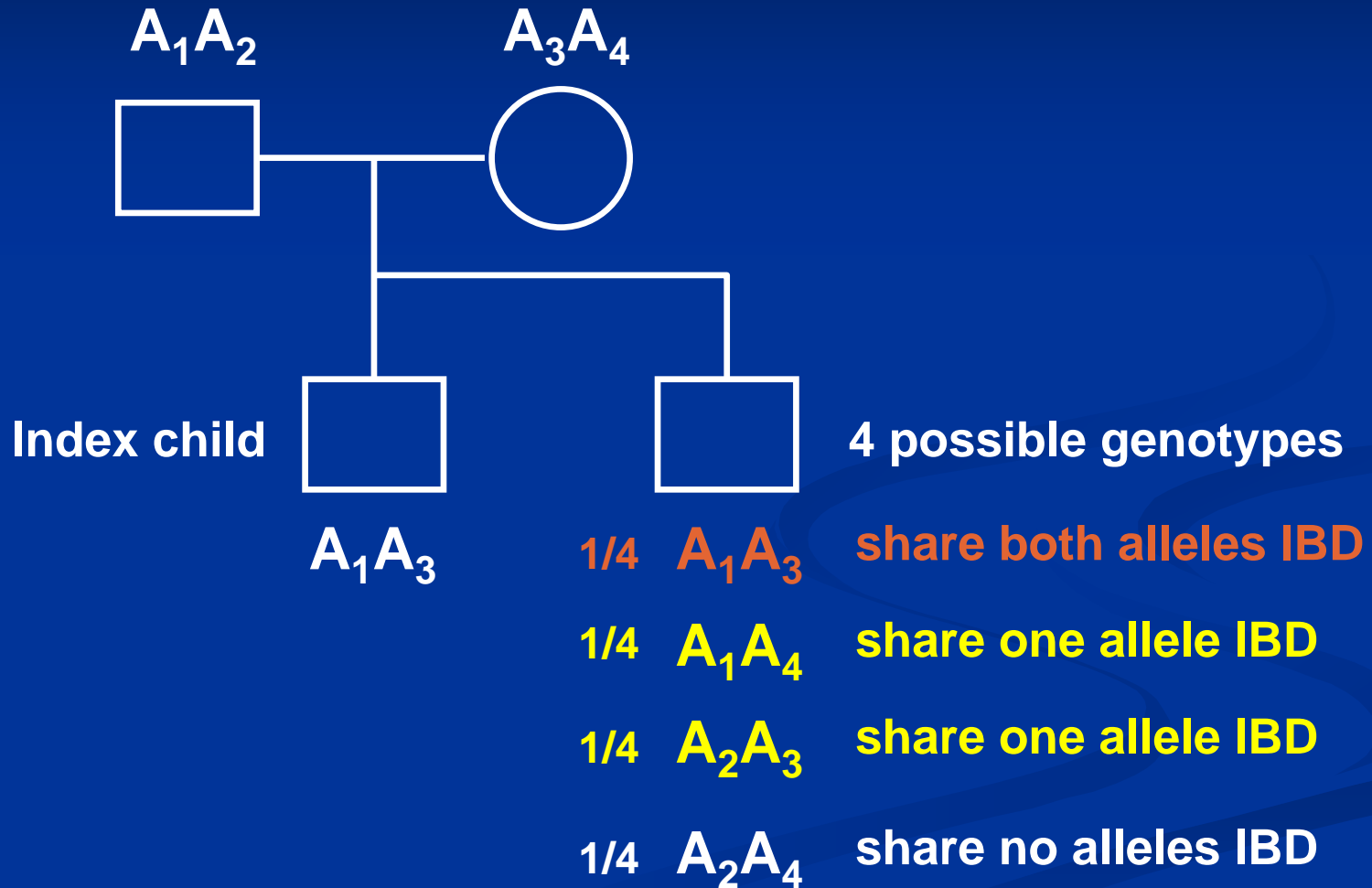
For a given locus A:



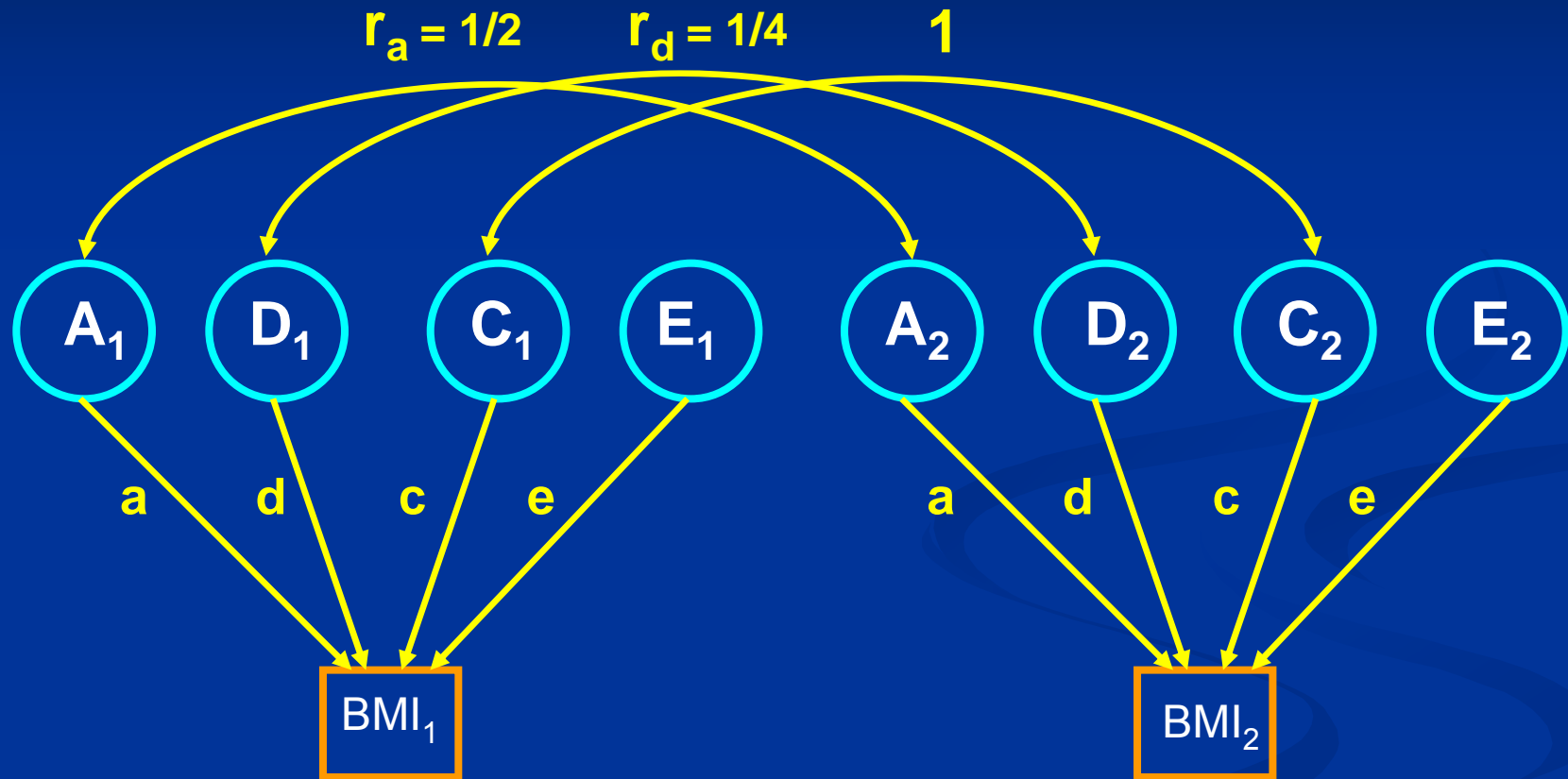
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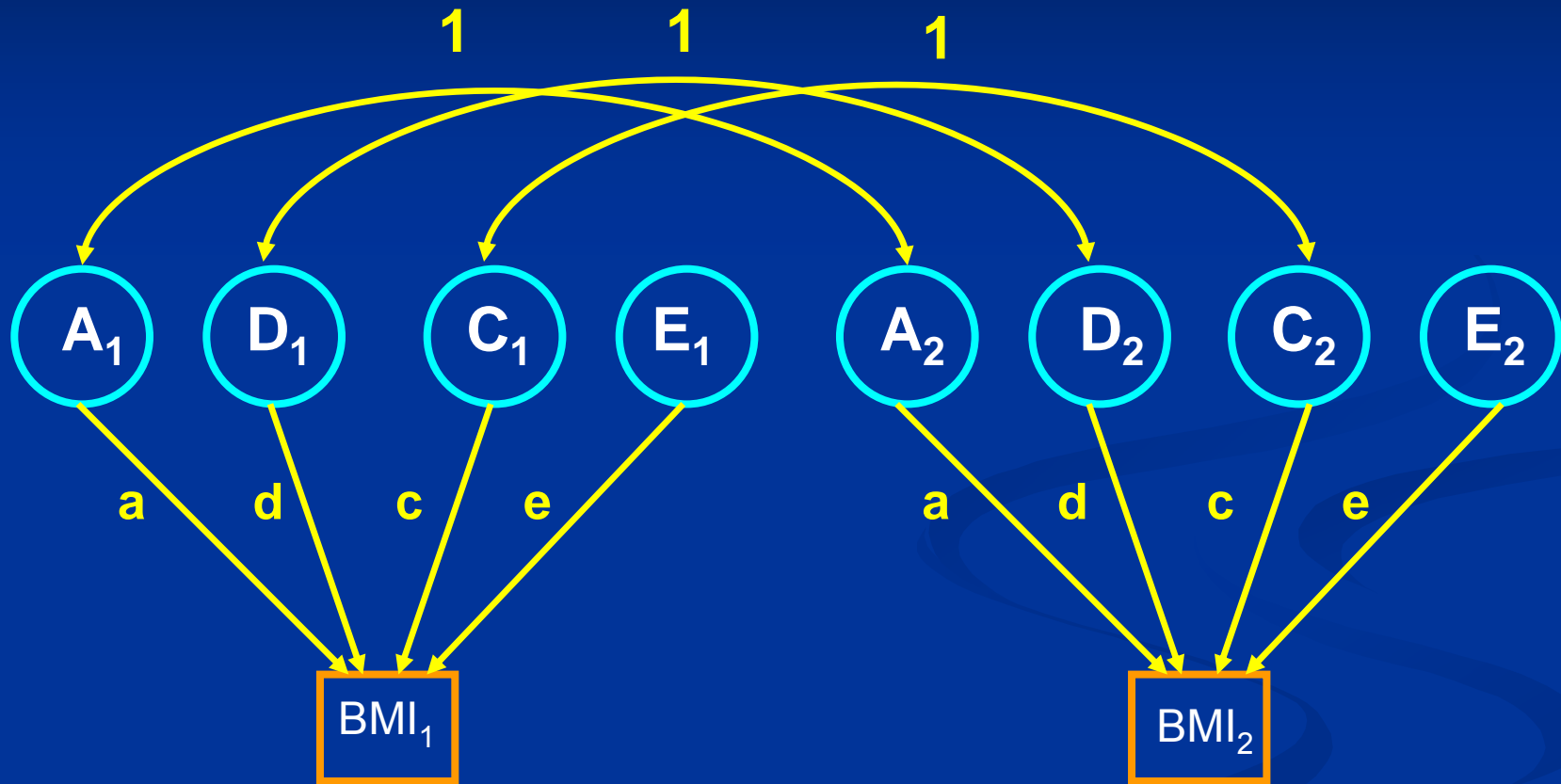
For a given locus A:



Model for Siblings (or DZ Twins)



Model for MZ Twins



Expected Covariance Structures

$$\Sigma_{MZ} = \Lambda \Phi_{MZ} \Lambda'$$

	T1	T2
T1	$a^2 + d^2 + c^2 + e^2$	$a^2 + d^2 + c^2$
T2	$a^2 + d^2 + c^2$	$a^2 + d^2 + c^2 + e^2$

$$\Sigma_{DZ} = \Lambda \Phi_{DZ} \Lambda'$$

	T1	T2
T1	$a^2 + d^2 + c^2 + e^2$	$1/2a^2 + 1/4d^2 + c^2$
T2	$1/2a^2 + 1/4d^2 + c^2$	$a^2 + d^2 + c^2 + e^2$