Addressing Gender Differences in the Genetic and Environmental Contributions to Smoking During Adolescence

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Epidemiology of Cigarette Use

- Decrease in prevalence of cigarette use (42.4% to 19.3%)
- Less decline in smoking rates among (US) adolescents
- Prevalence of smoking in men greater than women

Genetic Epidemiology of Cigarette Use

- Nicotine Dependence is highly heritable
  - h^2 = 30-75%
- Smoking persistence
  - h^2 (males) = 59%
  - h^2 (females) = 46%
- Smoking Initiation less heritable
  - h^2 = 36-60%
  - May differ in males and females
  - Unclear how & whether heritability changes across adolescent development

Study Aims

- Identify developmental trends in smoking initiation among adolescents
- Determine the extent to which genetic and environmental effects play a role in the development of smoking initiation

The Developmental Genetic Epidemiology of Smoking Study

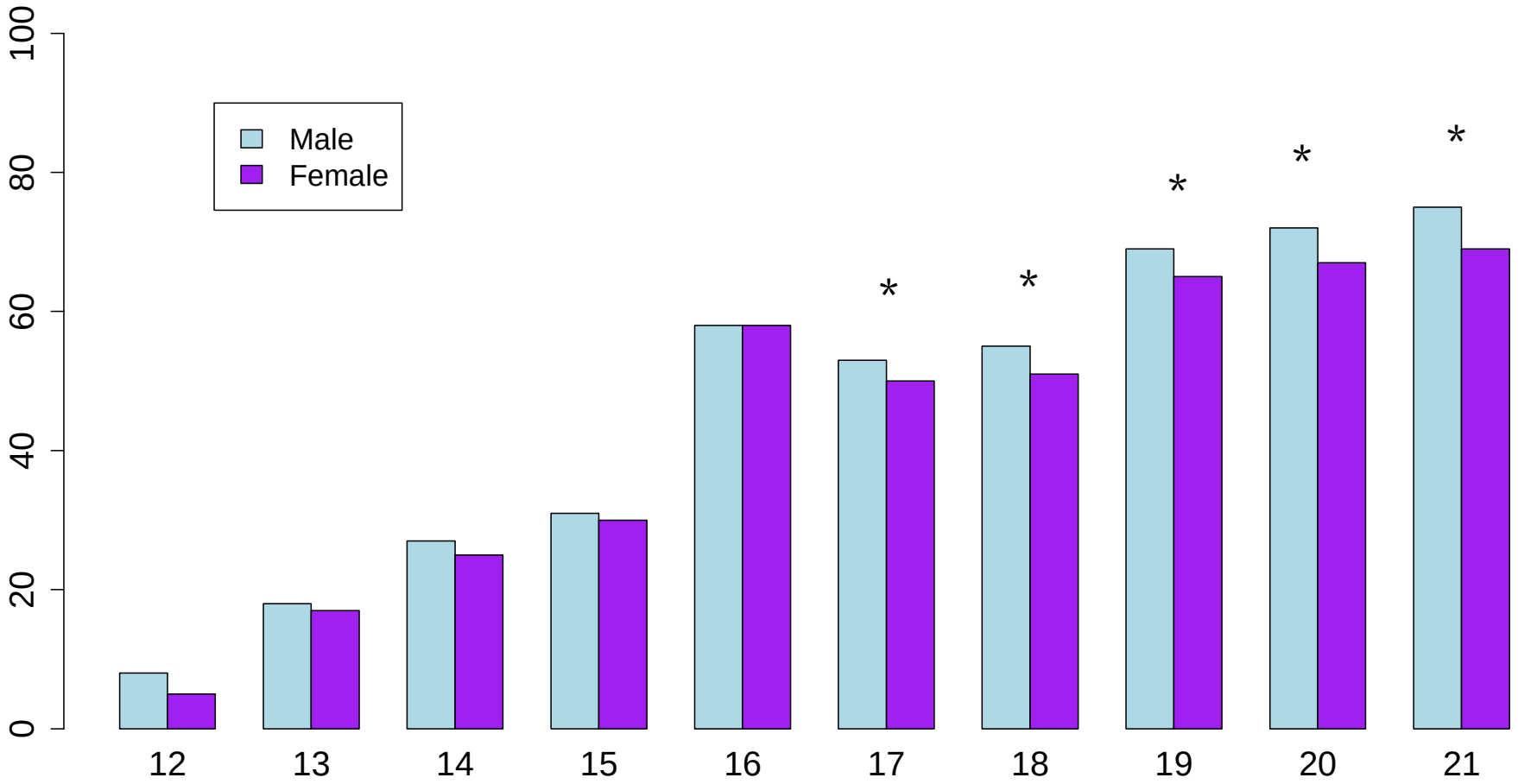
Study Abbreviation	Study Description	N
ABD	Virginia Twin Study of Adolescent and Behavioral Development	2819
MN	Minnesota Twin Family Study	4137
CO	Colorado Longitudinal & Community Twin Studies	2804
AUS	Australian Adolescent and Young Adult Twin Study	2888
MASAT	Mid-Atlantic School Age Twin Study	2210
BEL	Leuven Longitudinal Twin Study	220
NL	Netherlands Twin Register	5561
CVT	Cardiovascular Twin Study	1150
SWE	Swedish Twin Register	2593
FIN	Finnish Twin Register	6076

Measuring Smoking Initiation

Study Name	Age Range	Study Design	Lifetime Smoking
ABD	8-17	PC- 3 Waves	Have you ever smoked ?
MN	8-24	PC- 6 Waves	"Have you ever tried any form of tobacco in your lifetime?" / “Have you ever used tobacco?”
CO	8-24	PC- 2 Waves	Have you ever used tobacco?
AUS	8-24	PC- 3 Waves	Have you ever smoked even part of a cigarette?
MASAT	11-18	Cross-Sectional	How old were you when you smoked your first cigarette?
BEL	10-18	Cross-Sectional	Have you smoked at least 100 cigarettes in your life?
NL	10-24	PC- 8 Waves	Have you ever smoked?
CVT	9-18	Cross-Sectional	Have you smoked at least 100 cigarettes in your life?
SWE	8-21	PC- 4 Waves	How frequently have you smoked in the past 12 months? / Do you smoke?
FIN	16-24	PC- 4 Waves	Have you ever tried smoking?

**PC – Prospective Cohort Study*

Prevalence of Smoking Initiation by Age & Gender



* Significant gender difference (p <0.05)

What are the Genetic and Environmental Contributions to Smoking Initiation?

Do they Differ Across Adolescence?

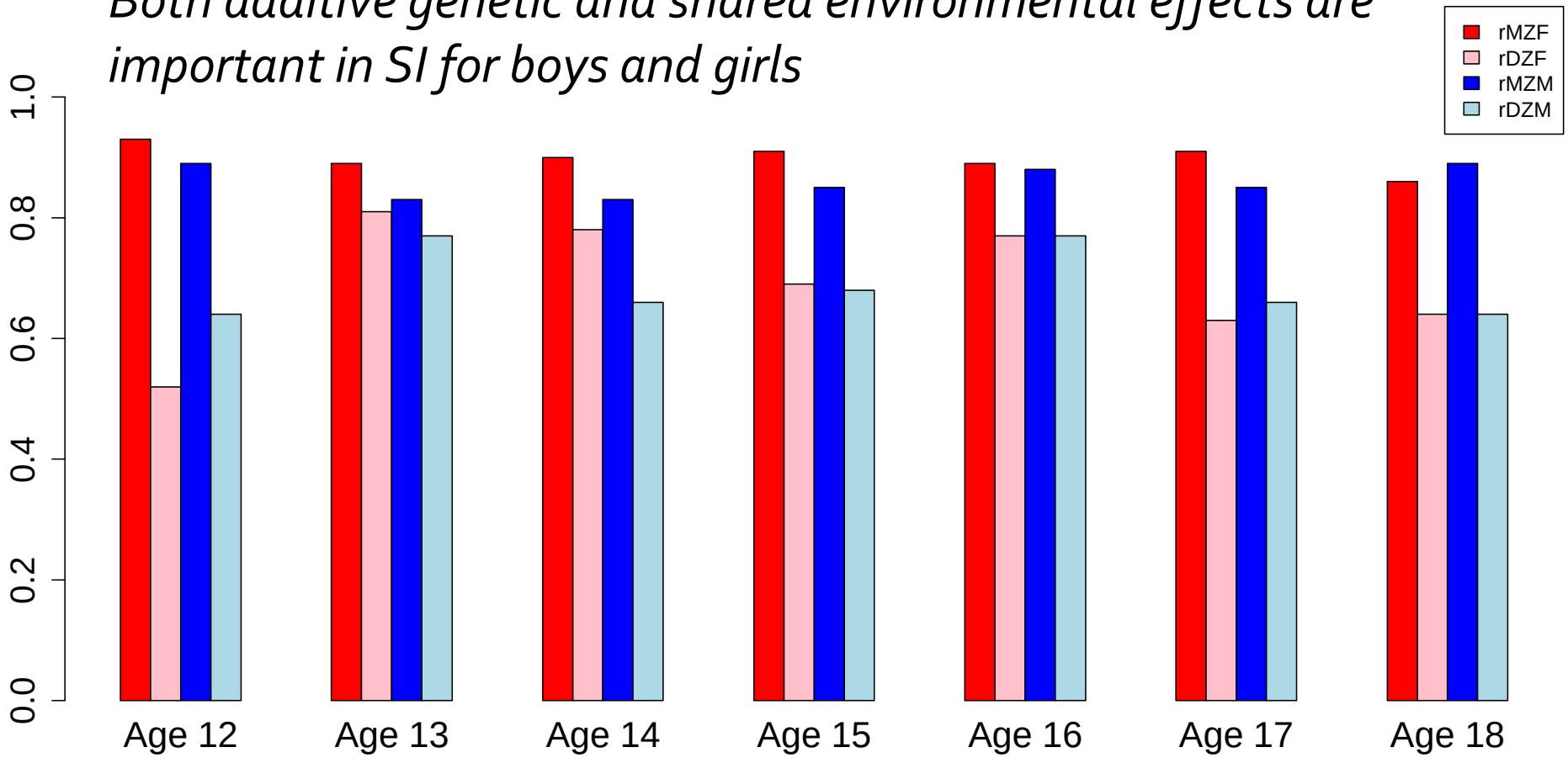
Do they By Gender?

Study Population

- 17,324 twin pairs
  - 3047 MZM, 3854 DZM
  - 2323 MZF, 2620 DZF
  - 3922 Opposite Sex
- Smoking Initiation at ages 12-18

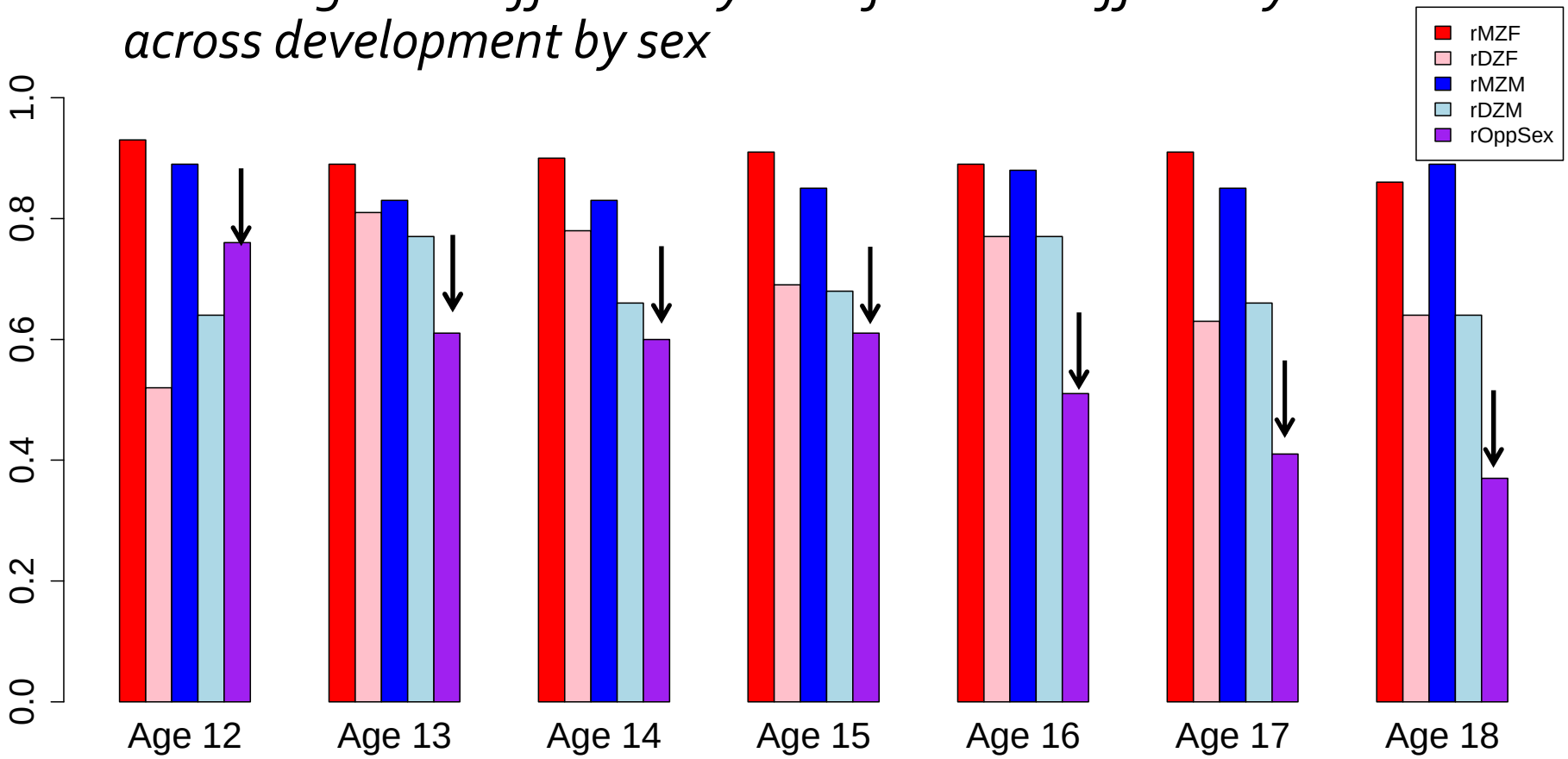
Twin Correlations of Smoking Initiation by Age

Both additive genetic and shared environmental effects are important in SI for boys and girls

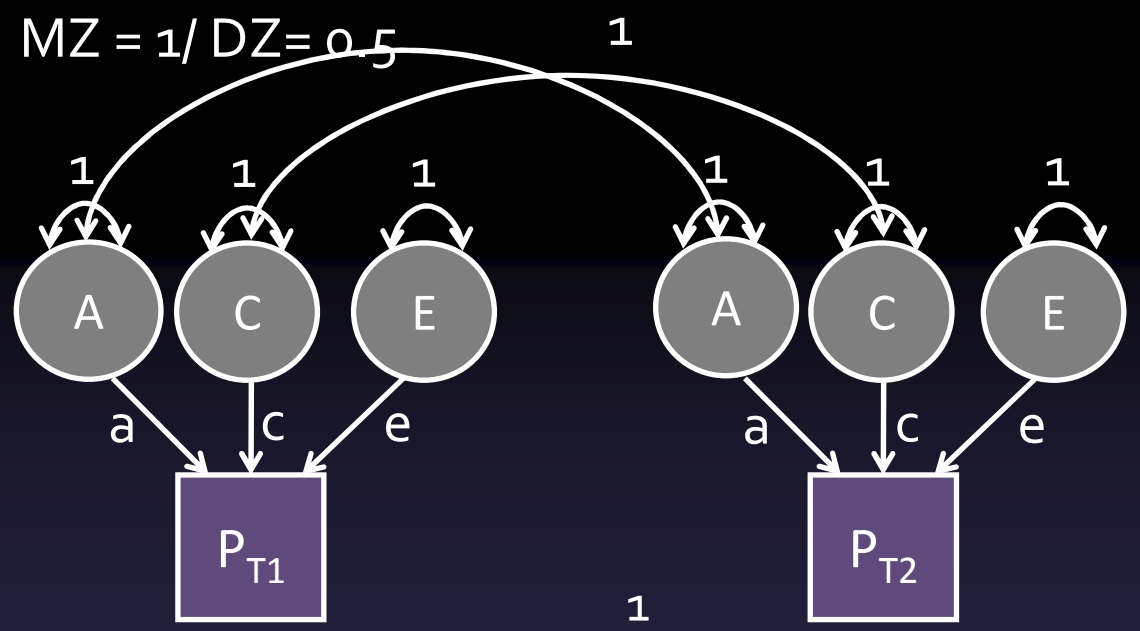


Twin Correlations of Smoking Initiation by Age

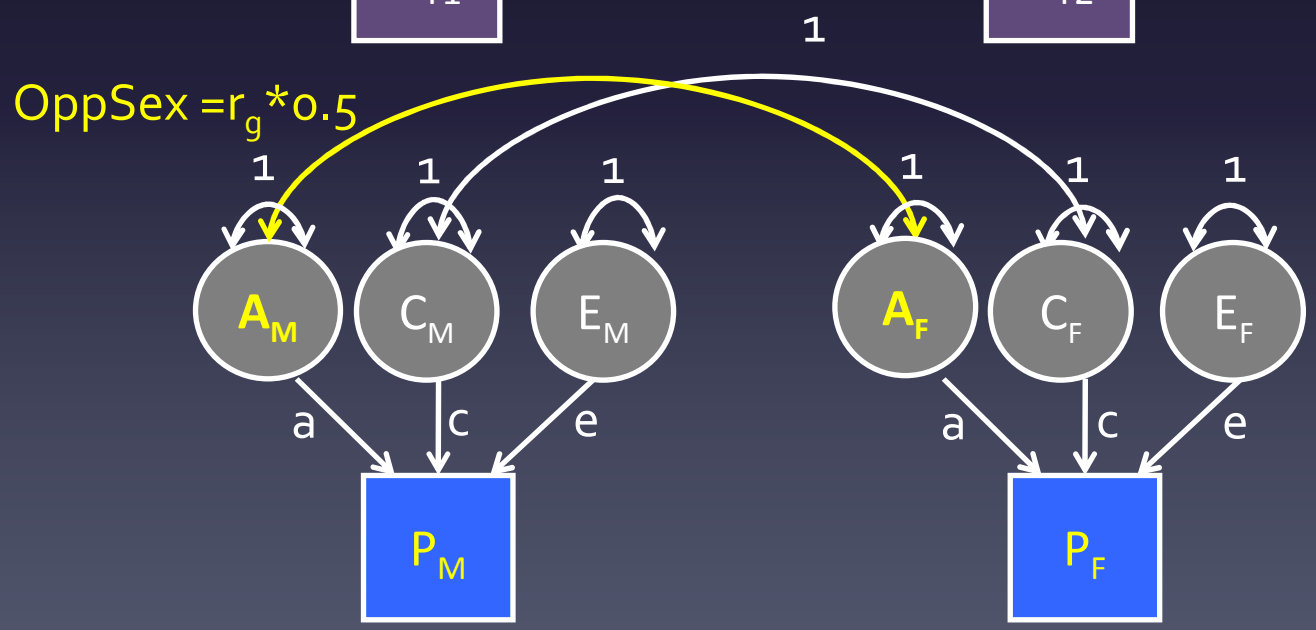
Additive genetic effects may also function differently across development by sex



Classical Twin Model + Sex Differences



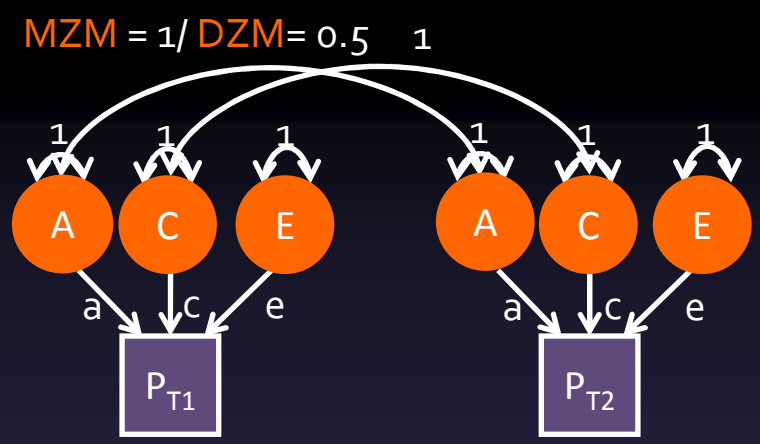
Are there differences in the sources influencing SI in males and females?

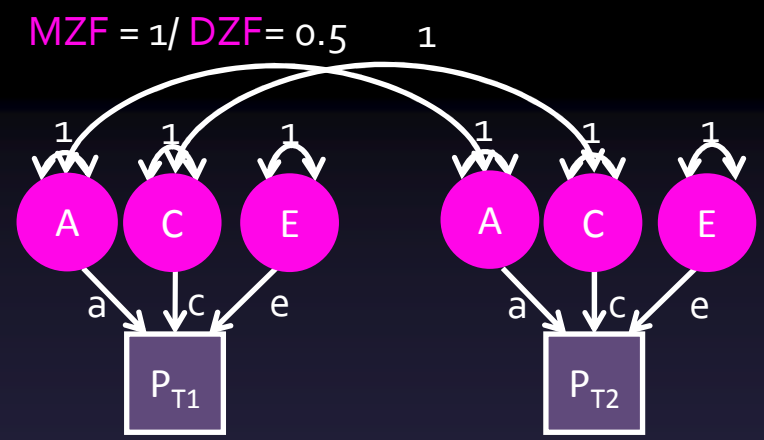


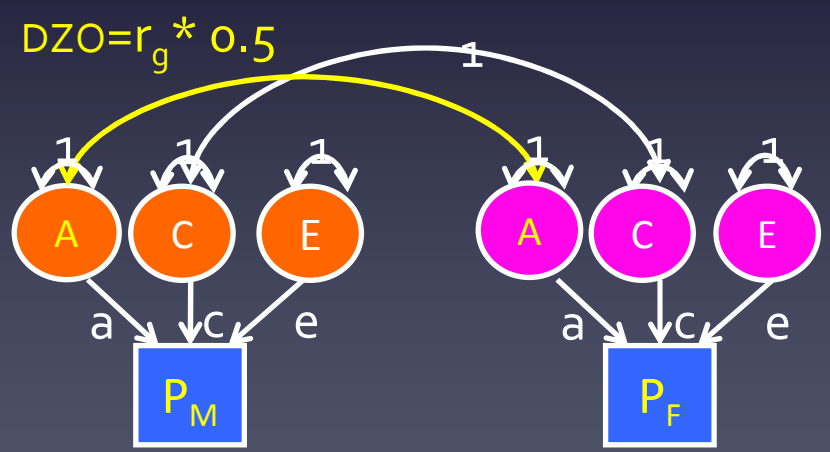
Are the contributions of genetic/env effects equal in males and females?

Are there different sets of genes in males and females for SI?

Models Tested - "Full"





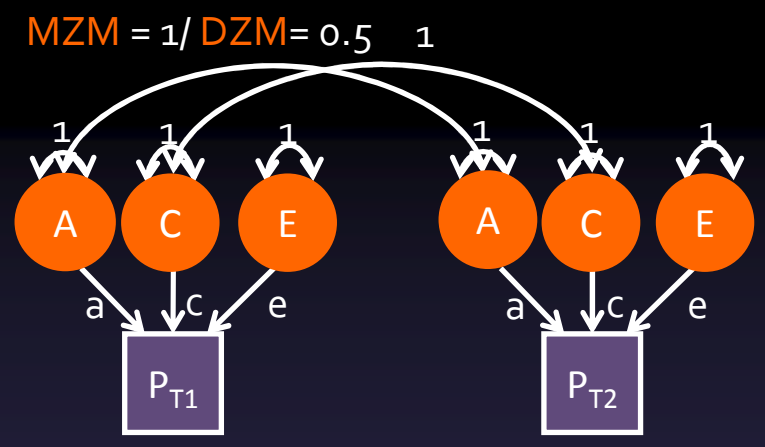


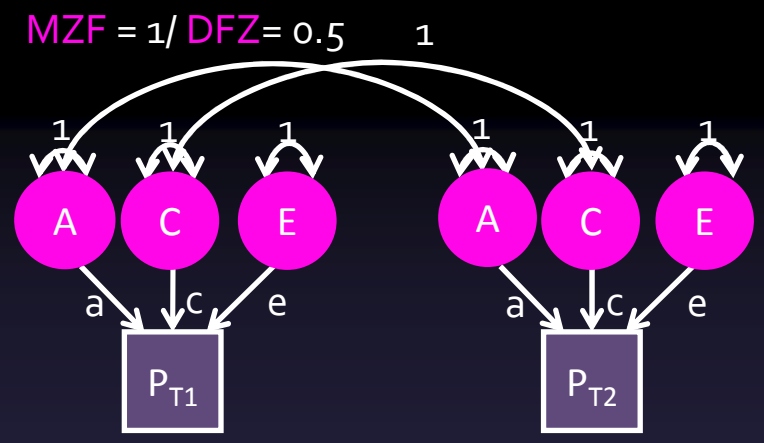
Af/ Cf/ Ef

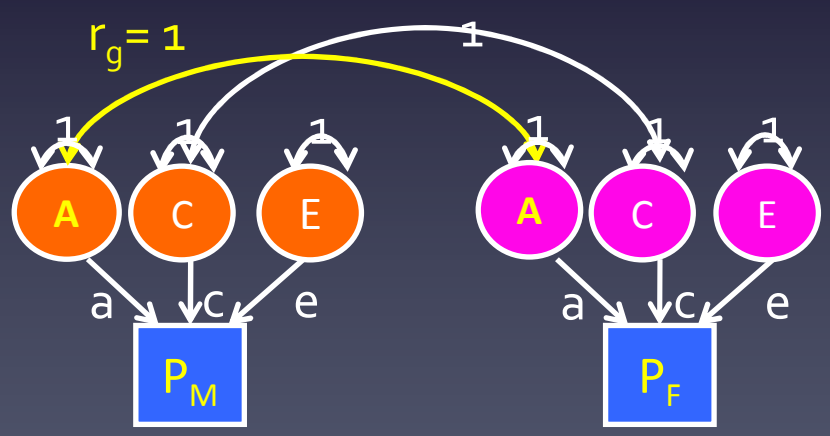
Am/ Cm/ Em

r_g => correlation between set of genes that contributes to SI in males & females is estimated

Submodel 1, $r_g = 1$





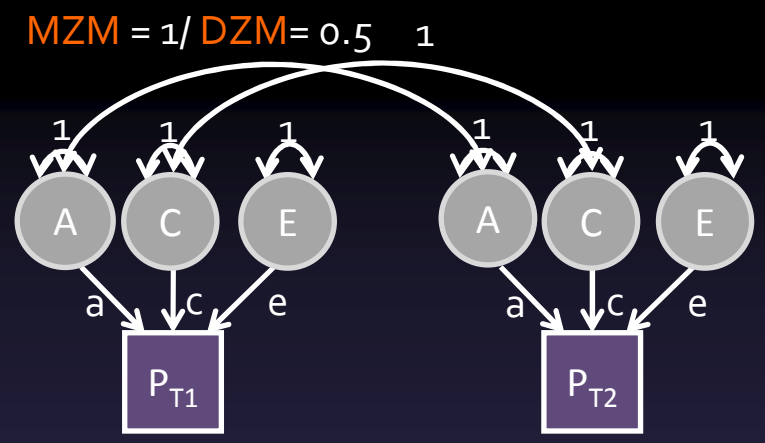


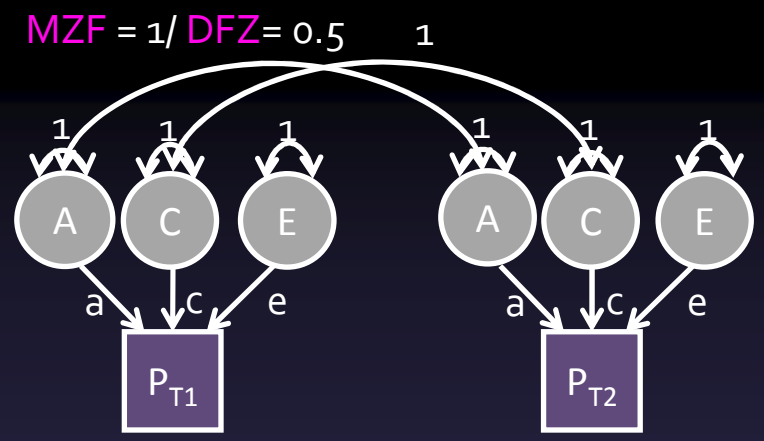
r_g=1- A set of common genetic effects are shared between males/females

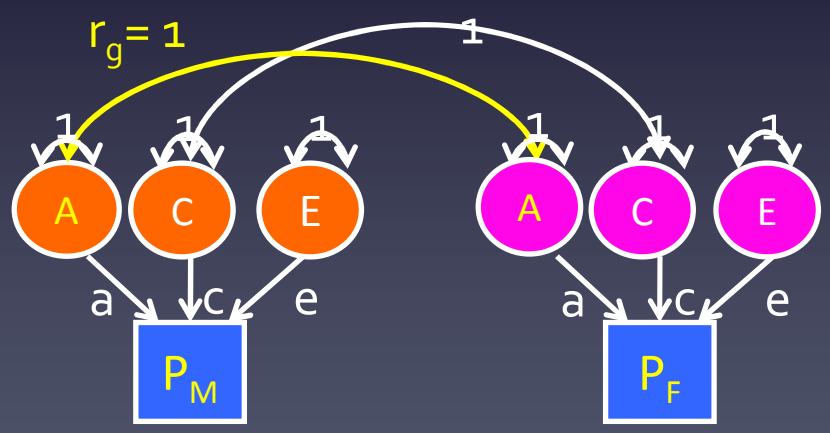
Am/ Cm/ Em

Af/ Cf/ Ef

Submodel 2, $r_g = 1$ *and* A/C/E Equal in Males and Females



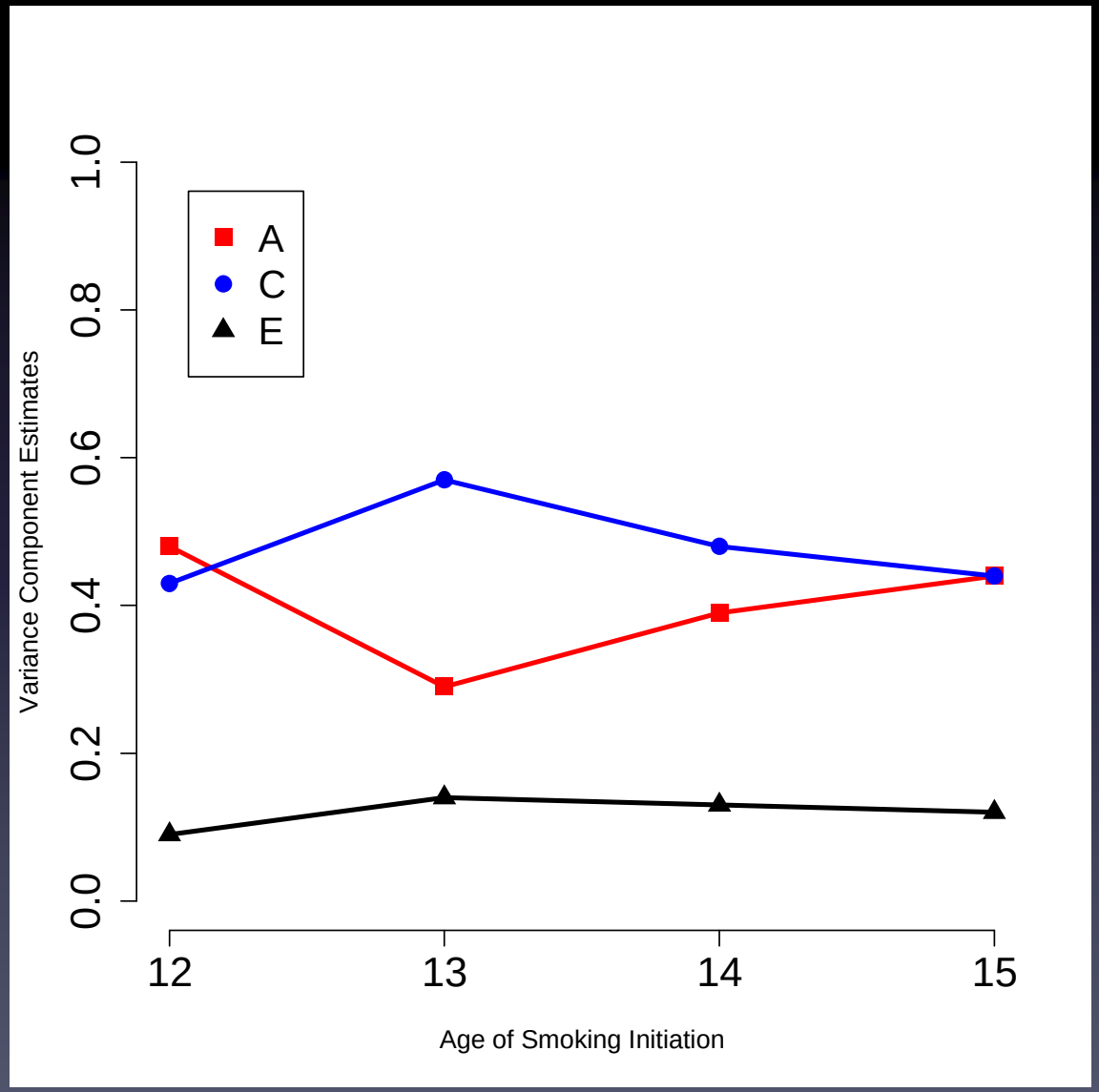




A/C/E- No specific genetic effects in males and females

r_g=1- A set of common genetic effects are shared between males/females

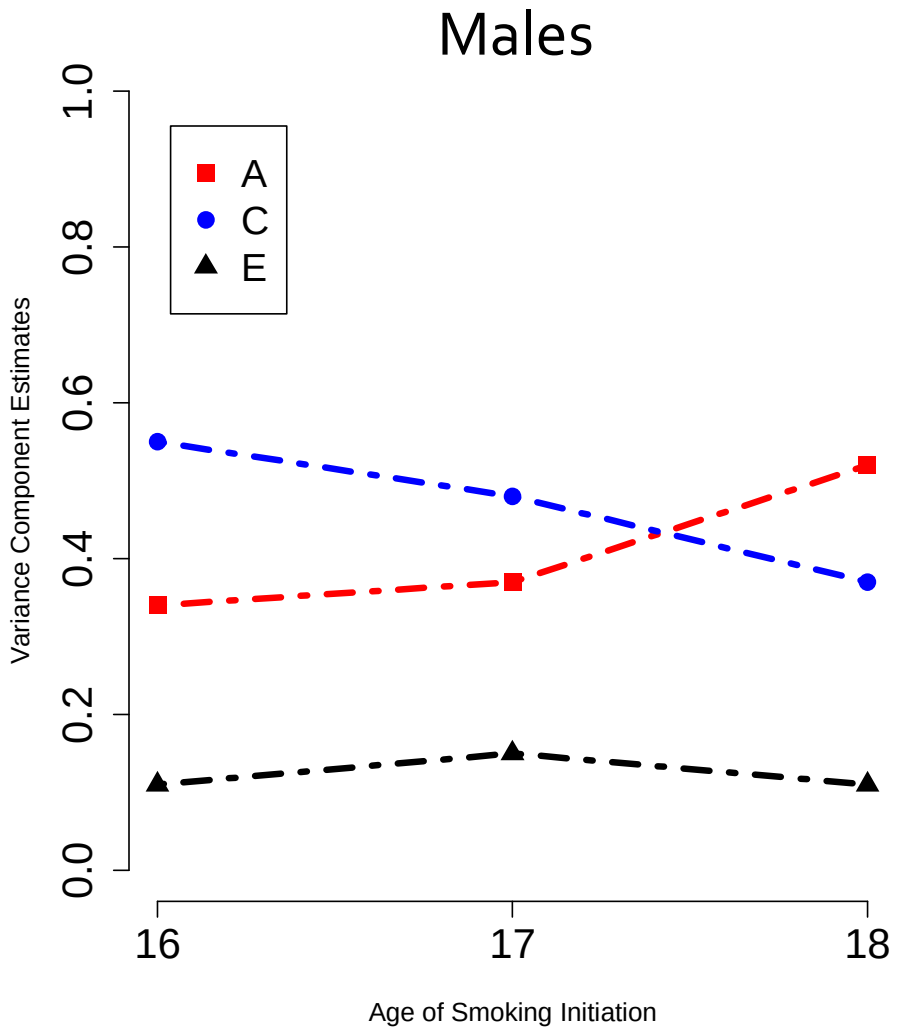
Standardized Parameter Estimates for Males and Females

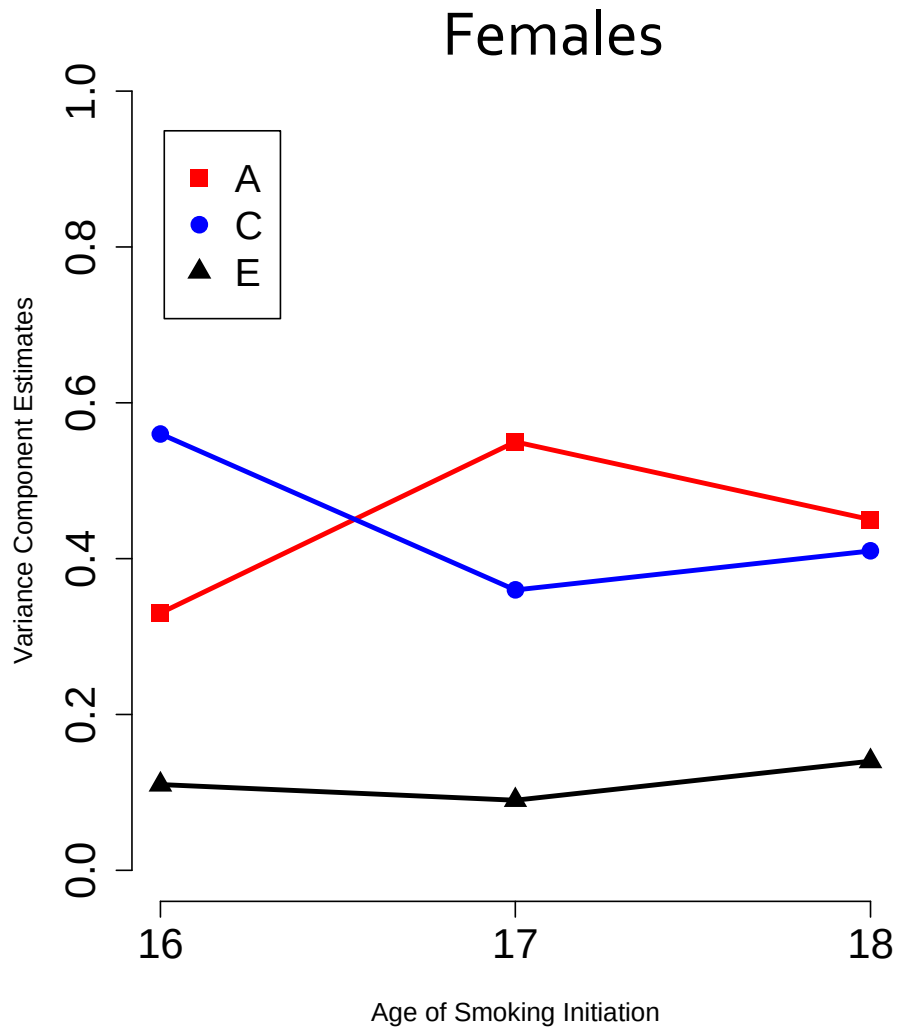


Results- Early Adolescence (12-15)

- Moderate additive genetic effects (0.30-0.50) and shared environmental effects (0.43-0.60)
- Magnitude of genetic and environmental effects same in males and females
- Same sets of genes in males and females

Standardized Parameter Estimates





Results- Late Adolescence (16-18)

- Sex-specific genetic and environmental effects
  - A/C/E and r_g

- Increasing additive genetic effects in males and females
  - Males- 0.34-0.52
  - Females- 0.33-0.55
- Significant shared environmental effects
  - Males- 0.37-0.55
  - Females- 0.36-0.41

- Weak unique environmental effects

Limitations

- Western samples- Generalizability
  - Nicotine use in low/middle income countries
- Data are currently analyzed as discrete time points
  - Possibly no significant differences across ages
- Analyzed to address effects of shared environment (r_c) but difficult to resolve

Implications for Prevention/Education

- Timing of Different Types of Intervention
- General messages directed to both boys and girls may still be valuable in early adolescence
- Gender-specific, personalized messages in later adolescence
  - Including biological information such as genetics could be beneficial
- Adolescent smoking prevention geared towards parents who smoke may improve by including familial/genetic risk

Thank You!

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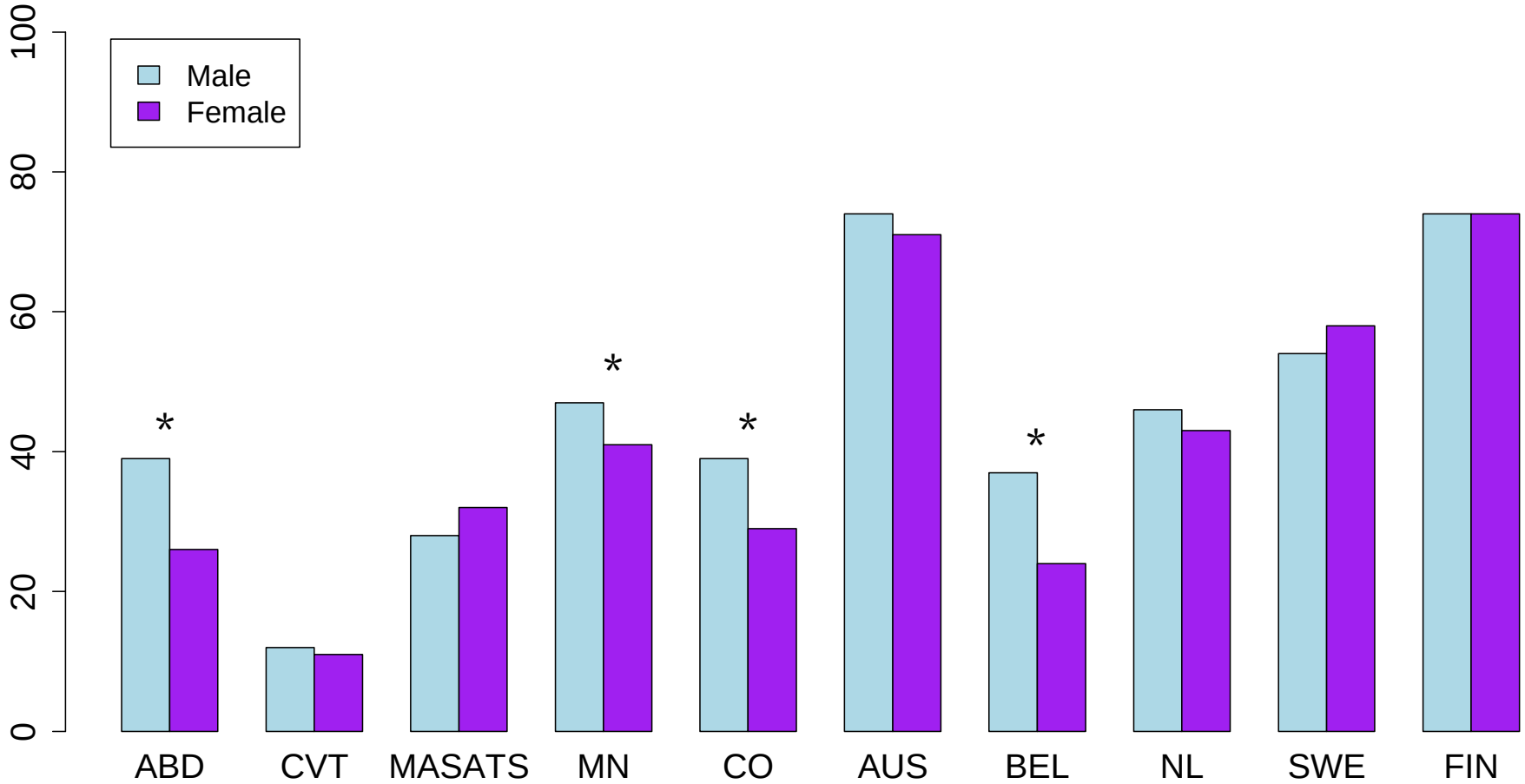
Prevalence of Smoking Initiation by Gender and Study



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