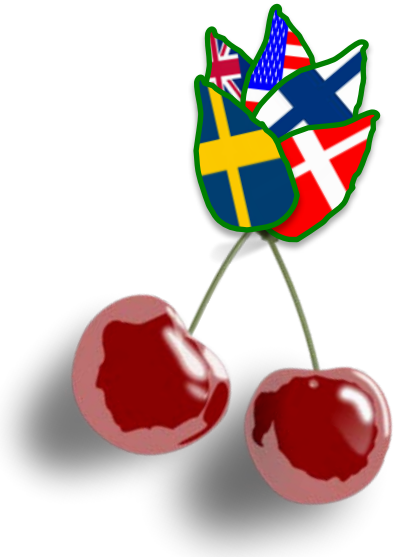
Interplay of a Country's Income Inequality in Childhood and Adult Depressive Symptoms



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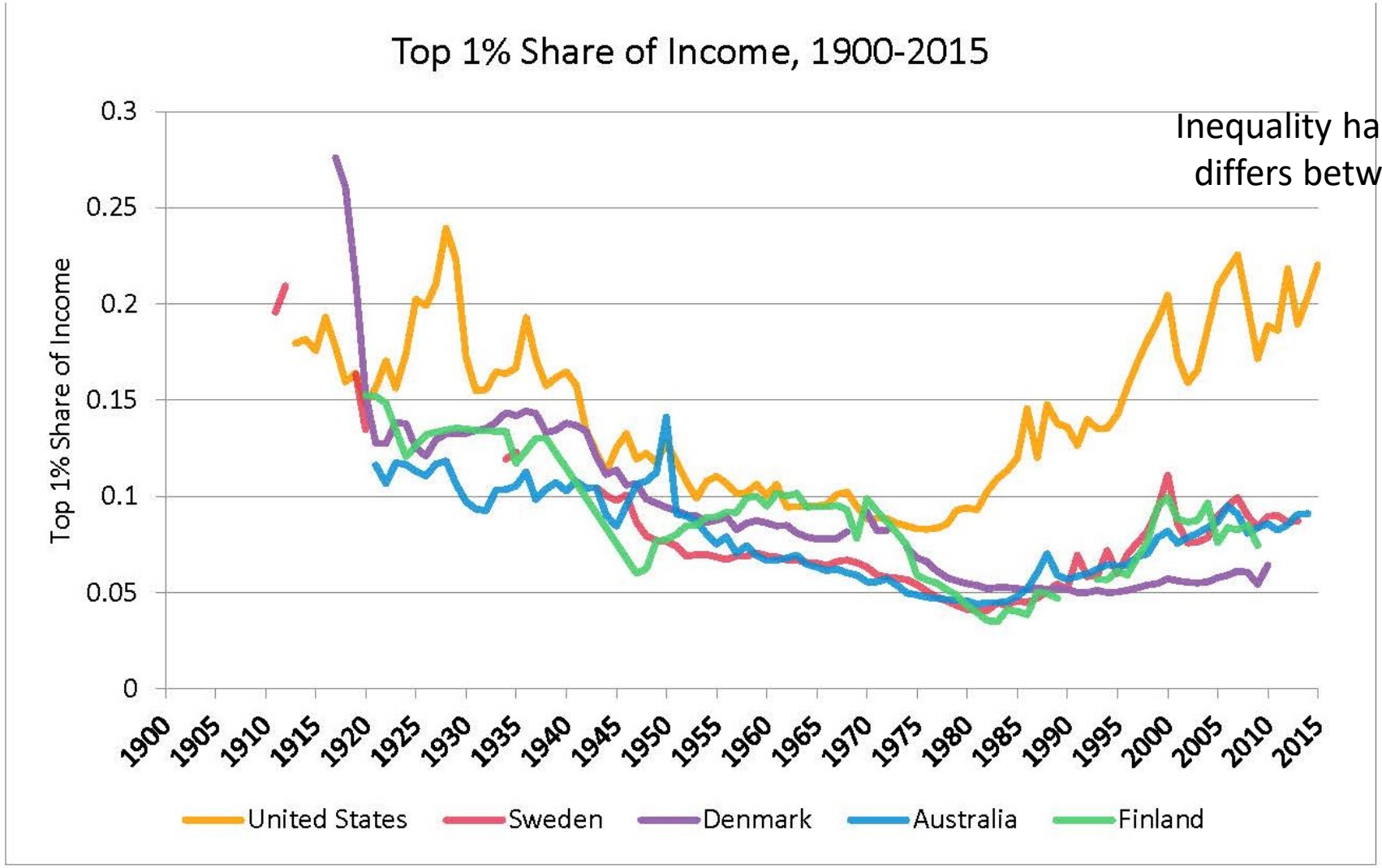
Purpose of Study

To test the relationship between inequality of income distribution within one's country during childhood and depressive symptoms in adulthood, both level of depressive symptom scores and relative contribution of genes and environment to depressive symptom scores.

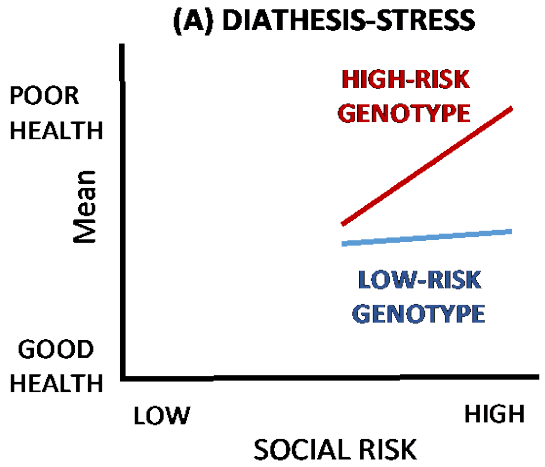


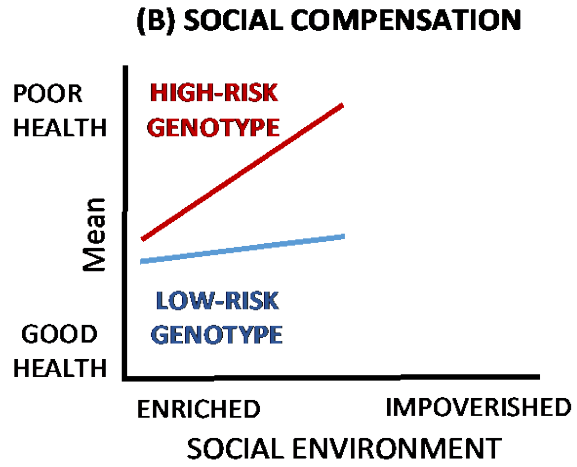
Inequality has changed over time and differs between countries in IGEMS

Our hypothesis is level of inequality to which the person was exposed as a child (Top 1% at age 10) will moderate genetic influences on depressive symptoms in adulthood

Models of GE Interplay: Means

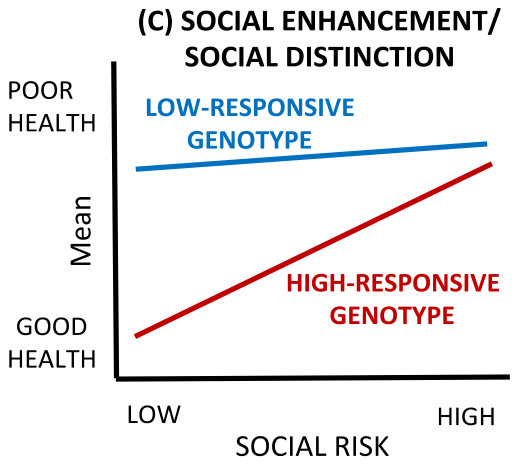
High risk E has greater impact on high risk G

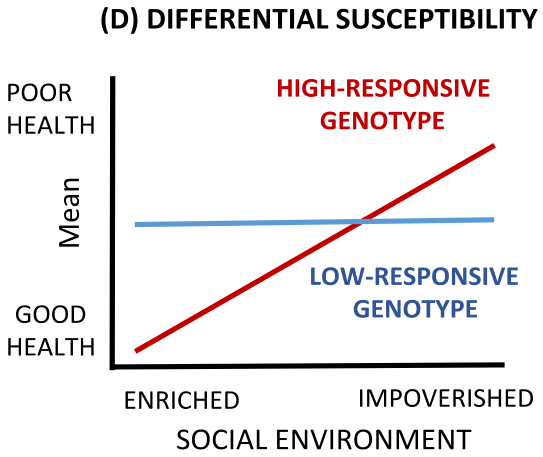




Enriched E prevents expression of high risk G

Low risk E benefits responsive G

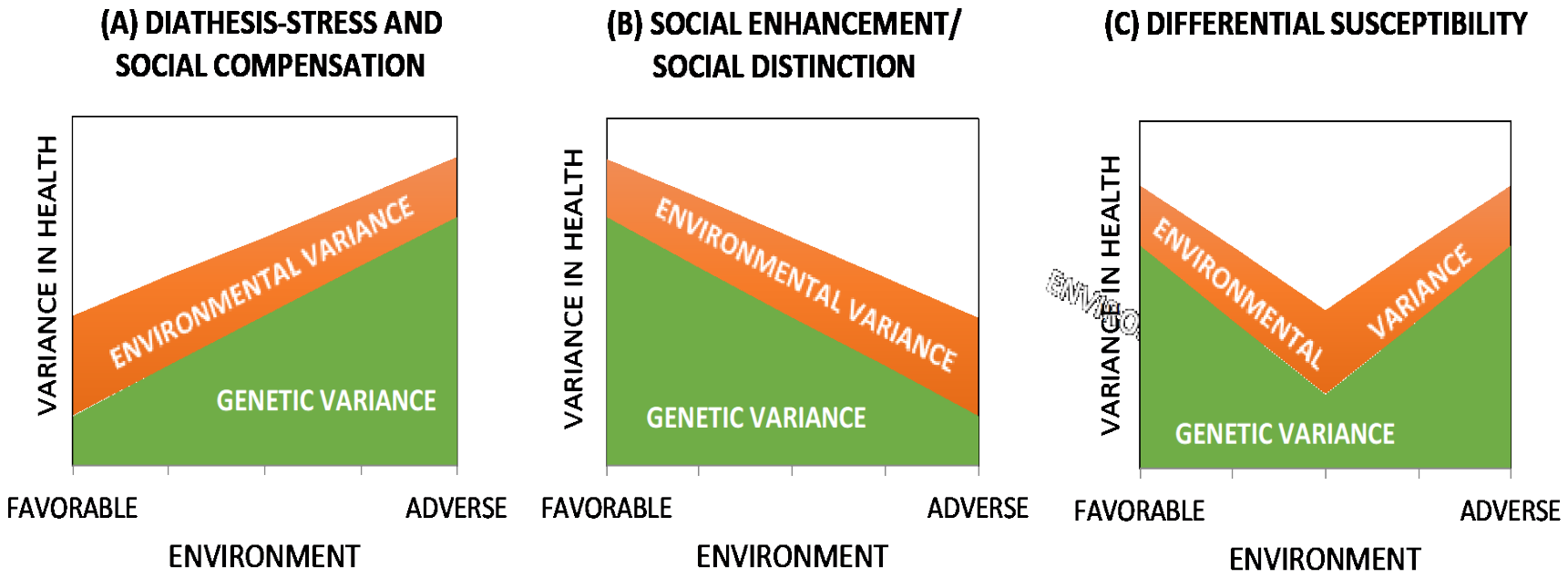




E impacts responsive G at both positive and negative extremes

Boardman et al, 2013; Reiss et al, 2013

Models of GE Interplay: Variances



Different models make very different predictions about impact on genetic and environmental components of variance

Included Studies and Characteristics of Participants

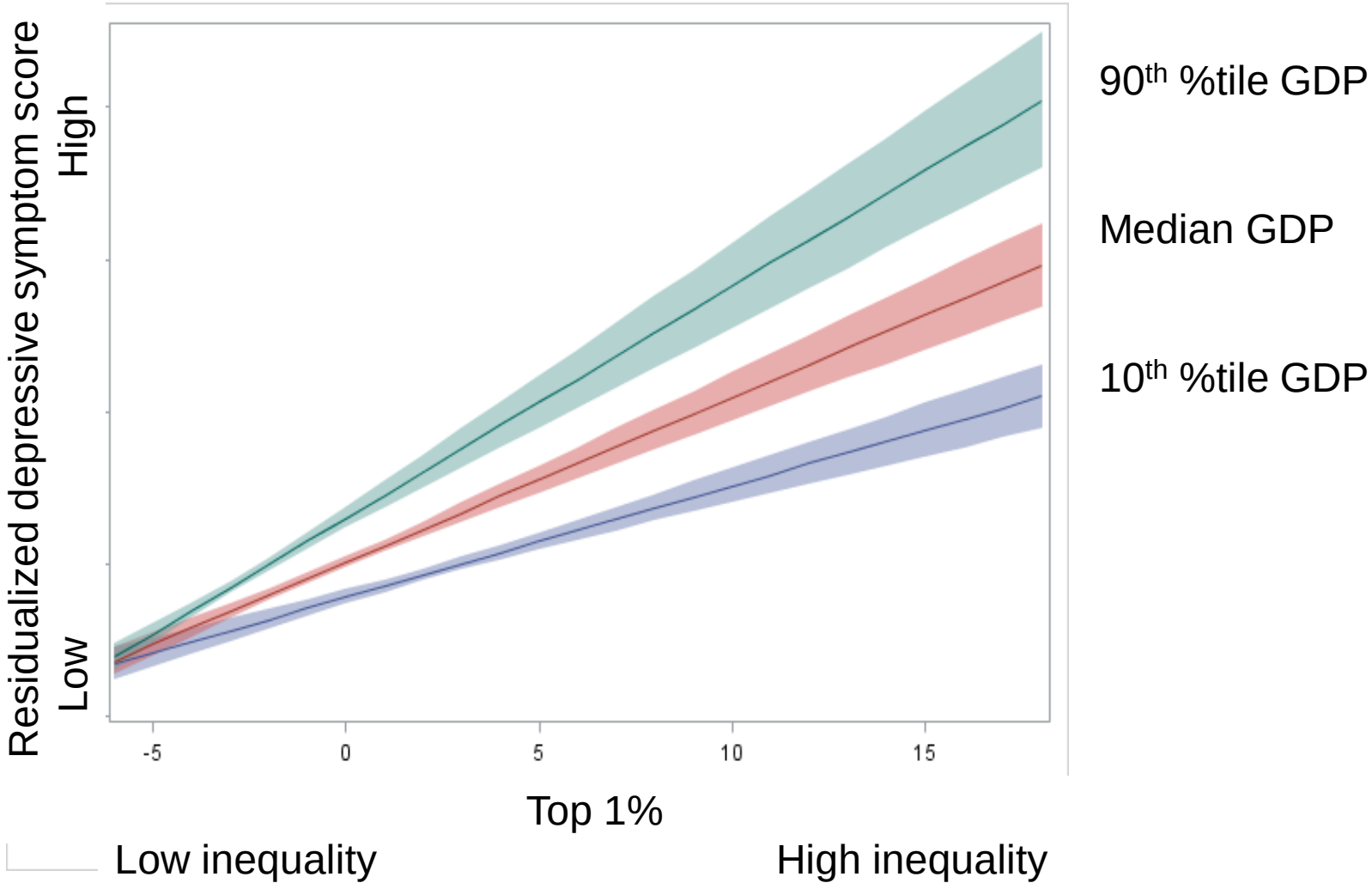
Study	N individuals	birth year	test year
Danish Twin Registry LSADT, MADT	8769	1892 – 1952	1995, 1998
Swedish Twin Registry: SATSA, OCTO-Twin, GENDER, TOSS	5114	1891 – 1971	1987, 1991, 1995-1997, 1997 or 2004
Finnish Twin Registry	8163	1945 - 1957	1981
Australian Over 50s study	2821	1899 - 1944	1993-1995
U.S.: Minnesota Twin Studyof Aging and Development, VETSA, MIDUS twins, Carolina African American Twin Study of Aging, NAS-NRC	7635	1897 - 1978	1984-1994, 2003-2007, 1995-1996, 1999-2003, 1998

Measures and means by age by country

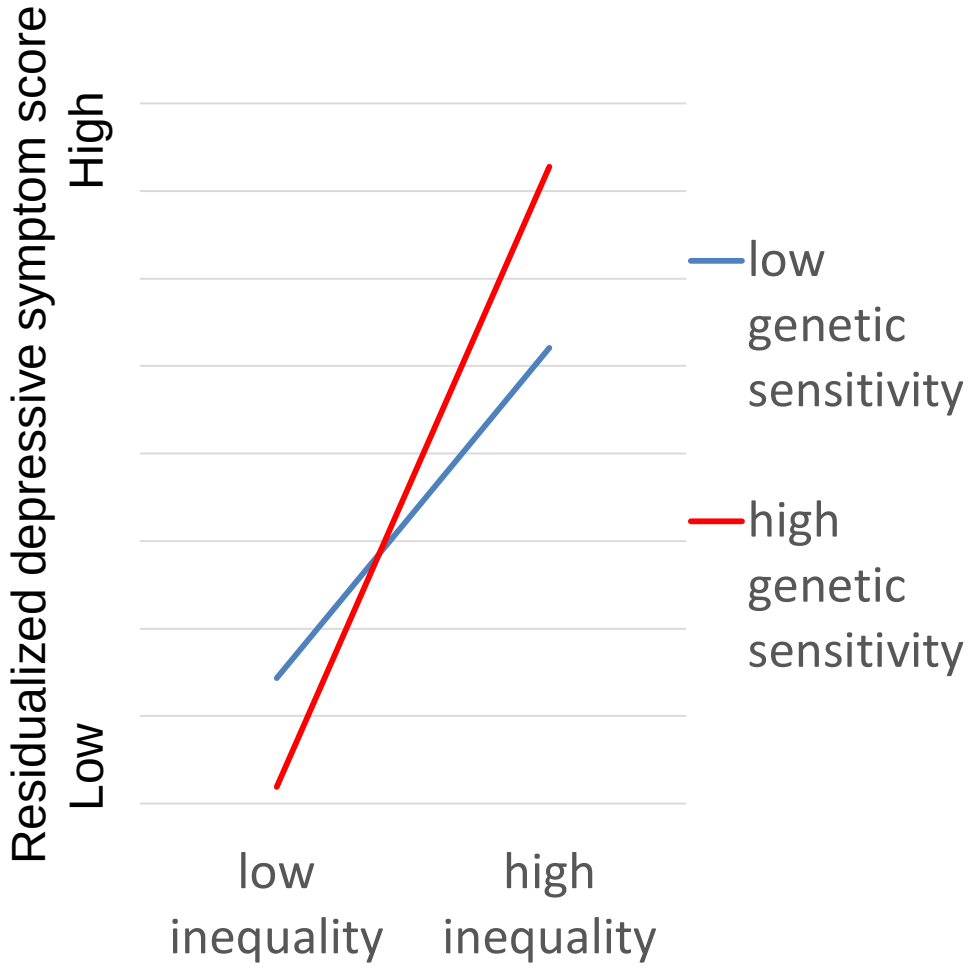
	Measure	Mean	Std Dev	Age
Denmark	Camdex	20.4	4.5	45-102
Sweden	CES-D*	23.3	4.9	29-97
Finland	CES-D*	23.9	5.0	53-67
Australia	GHQ-12*	21.5	4.6	50-95
U.S.	CES-D*, CESD-11*, GDS*	21.5	4.4	22-92

*harmonized to Camdex

Adult depressive symptom score (residualized by age, age*2, sex) by Top 1% at age 10, across country and cohort



Adult depression symptom scores by childhood inequality for high and low genetic sensitivity, MZ pairs



Genetic sensitivity = absolute value of difference between depression scores for members of a MZ pair, regressing out the twin pair's mean (Keers et al, 2016).

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	0.328	0.138	2.37	0.0176
depr_diff	-0.207	0.193	-1.08	0.2823
top1%	-0.709	0.190	-3.74	0.0002
depr_diff*top1%	0.332	0.266	1.25	0.2124

Depressive symptom score twin correlations, by country

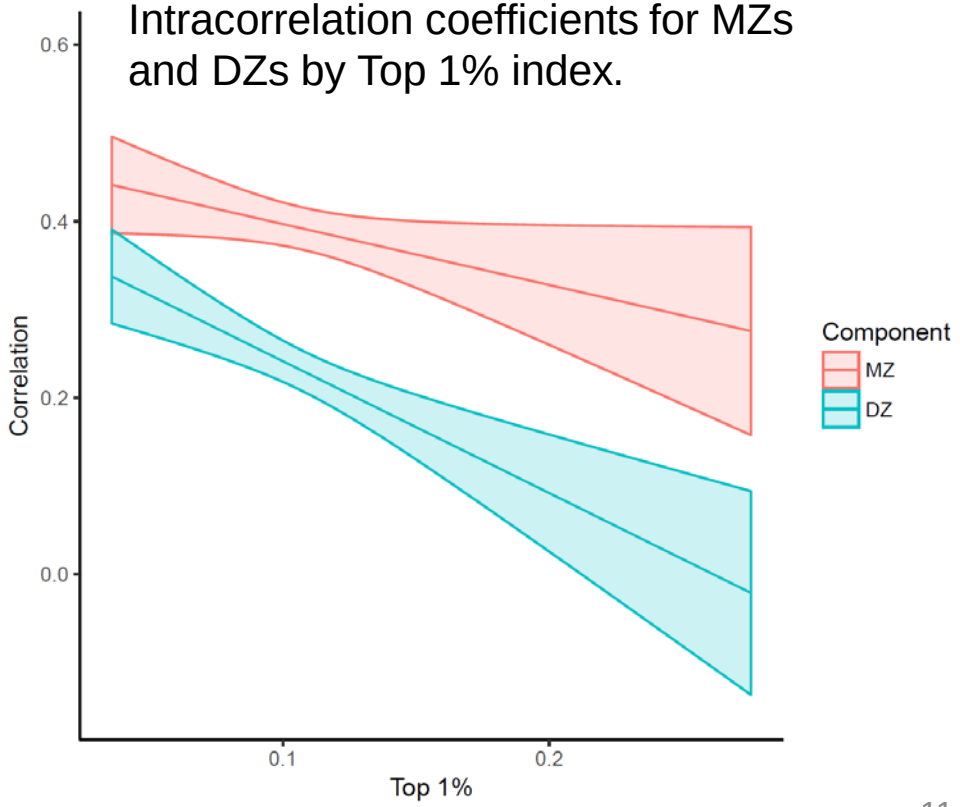
ICC by country						
	Denmark	Sweden	Finland	Australia	US	Total
MZ	0.43	0.35	0.30	0.27	0.36	0.40
DZ	0.16	0.18	0.16	0.10	0.19	0.24

Modified twin correlation model*

	Intercept		Slope	
	b_0	SE	b_1	SE
Main Effect of SES				
Top 1%	21.00	0.01	-0.13	0.01
Moderation by SES				
$\log(\sigma^2_{DEPR})$	3.13	0.01	-0.02	0.002
r_{MZ}	0.39	0.01	-0.01	0.004
r_{DZ}	0.23	0.01	-0.02	0.003

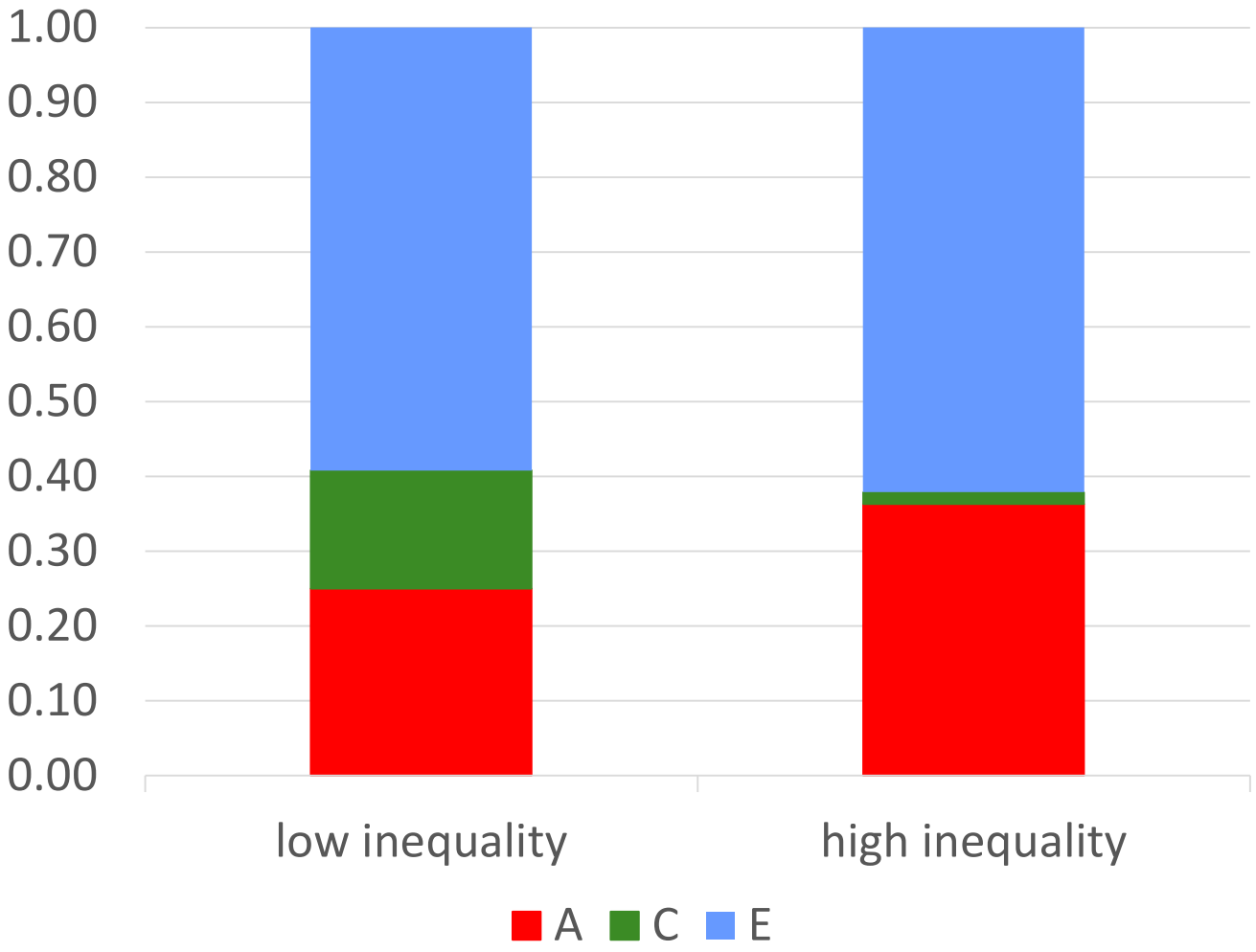
Faster divergence of DZ similarity across Top 1% compared to MZ similarity implies increasing genetic effects with greater inequality.

Intracorrelation coefficients for MZs and DZs by Top 1% index.



*Turkheimer, Beam, Sundet & Tambs, 2017

ACE estimated from twin correlations

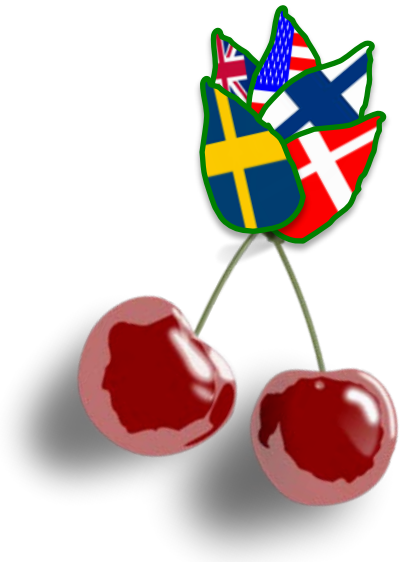


Summary of Findings

- Adult depressive symptom scores were higher for those who were exposed to greater inequality of income distribution within their country during childhood
- There was not significant support for an interaction between genetic sensitivity to depression and exposure to income inequality
- Twin correlation models significantly supported moderation of genetic and environmental influences by exposure to income inequality. There was greater variance in adult depression and there was greater relative contribution of genetic influences to depressive symptom scores among those exposed to greater inequality, consistent with the diathesis-stress model

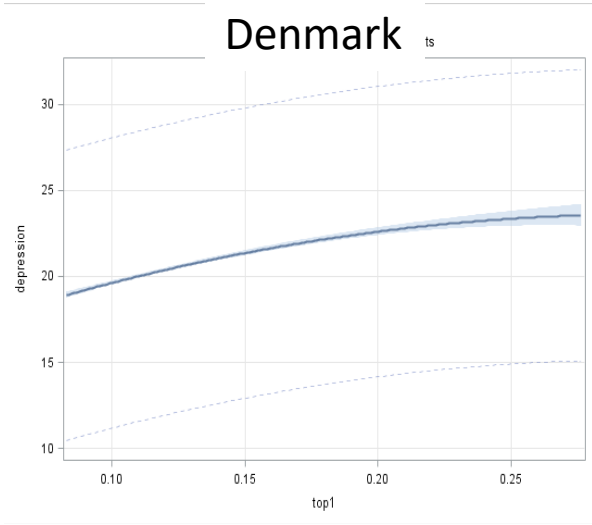
Future Work

- Test whether association between level of adult depressive symptoms scores and $PRS_{depression}$ is moderated by country-level inequality during childhood
- Test whether difference between one's rearing SES and country-level inequality in childhood (relative deprivation) moderates level of depressive symptom scores and relative contribution of genes and environment to depressive symptom scores

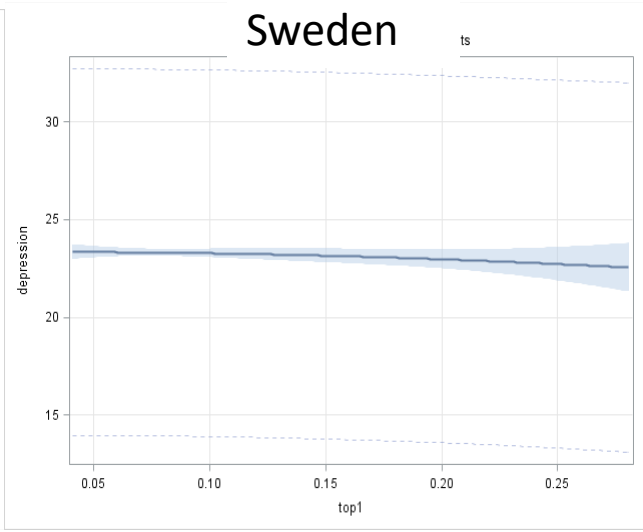


Depressive symptoms by Top 1%, by country

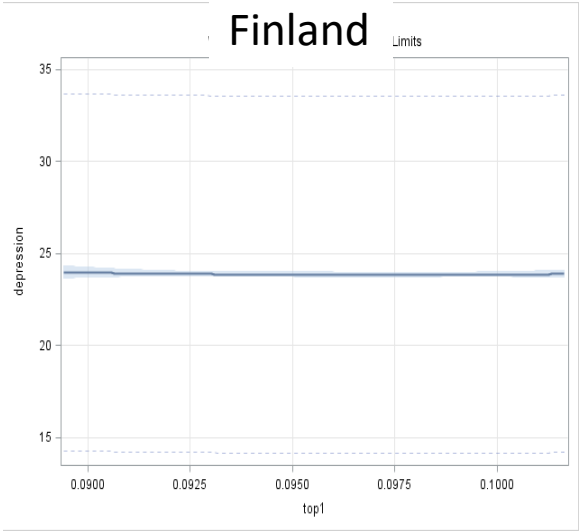
Denmark



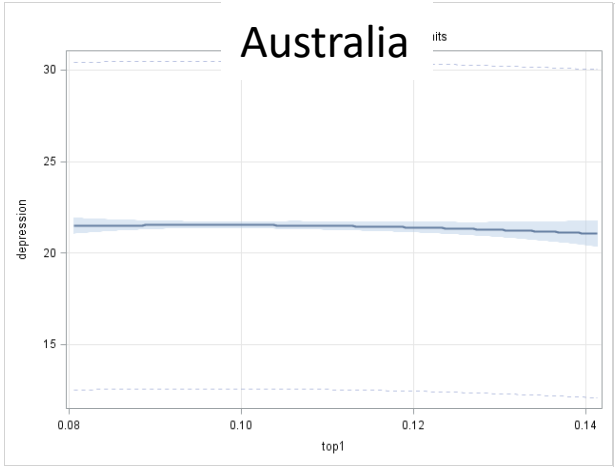
Sweden



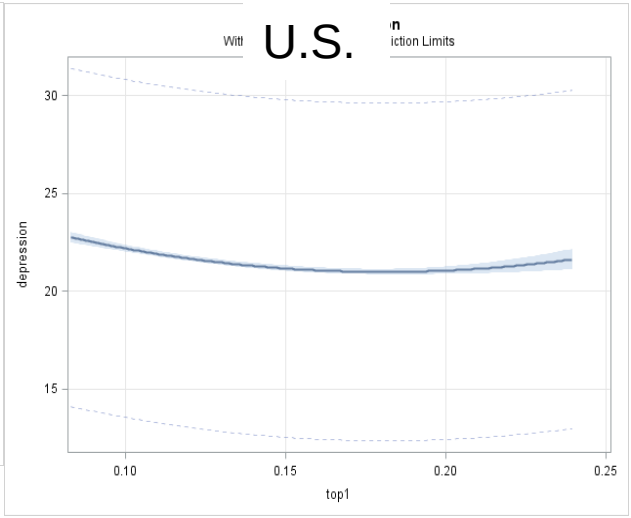
Finland



Australia



U.S.



Twin correlation models by country