Adolescents' Mental Health and Human Capital: The Role of Socioeconomic Rank

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Motivation

- The cost of mental ill-health for the economy as a whole are high

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$2.5 trillion

2010

$6 trillion

2030

Motivation

- The cost of mental ill-health for the economy as a whole are high

- Adolescence a critical period in the development of mental health disorders

- Consequences of mental health problems during adolescence severe

  $\rightarrow$ Persistence of mental health problems

  $\rightarrow$ Importance of unimpeded development for human capital formation

Motivation

- This paper: investigates the role of adolescents' relative SES within their peer group for their mental health and human capital

    → SES defined as average parental education

- Adolescence a period of 'social reorientation' towards peers

- Sociology and social psychology: relative social context important for personal development

  e.g. Social Comparison Theory (Festinger, 1954), Relative Deprivation Theory

This Paper

- Estimate causal effect of adolescents' high school-cohort SES-rank on:

This Paper

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Short-run Outcomes

- Mental health

- Cognitive ability

- Self-esteem

- Popularity

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Long-run Outcomes

- Mental health

- Educational attainment

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Short-run Outcomes

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- Self-esteem

- Popularity

Long-run Outcomes

- Mental health

- Educational attainment

- Identification: use variation in SES distributions across cohorts & within schools, leveraging survey data from US high schools

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Main Findings

1. A higher socioeconomic rank in high school translates into better
   depression scores, cognitive ability, self-esteem and popularity

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2. Persistent effects of socioeconomic rank on depression scores and educational attainment in adulthood

Main Findings

1. A higher socioeconomic rank in high school translates into better depression scores, cognitive ability, self-esteem and popularity

2. Persistent effects of socioeconomic rank on depression scores and educational attainment in adulthood

3. Rank effects larger in cohorts with high degree of inequality

Roadmap

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Data

The National Longitudinal Study of Adolescent to Adult Health

- Nationally representative study of 7th to 12th graders in U.S. schools starting in 1994/95

  $\rightarrow$ General survey of $\sim$ 90,000 students from 145 schools (In-School)

  $\rightarrow$ Repeated in-home surveys of a sub-sample of students

Data

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  - $\rightarrow$ General survey of $\sim$ 90,000 students from 145 schools (In-School)

  - $\rightarrow$ Repeated in-home surveys of a sub-sample of students

- Key features:

  - $\rightarrow$ Well-established outcome measures   ▸ Measures

  - $\rightarrow$ SES information for complete cohorts

  - $\rightarrow$ Covers multiple cohorts within each school

  - $\rightarrow$ Tracks students for more than 10 years

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Definition of SES-Rank

- Socioeconomic status (SES): average educational attainment of the parents

Data

Definition of SES-Rank

- Socioeconomic status (SES): average educational attainment of the parents

- Student i is ranked by their socioeconomic status

  $\rightarrow$ by school s

  $\rightarrow$ by cohort c

$$\text{Rank}_{isc} = \frac{\text{absolute rank} - 1}{\# \text{ students in school cohort} - 1} \qquad \in [0, 1]$$

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Identification

Identification Problem

- Objective: Estimate a causal rank effect

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- Problem 1: Peer groups are endogenously formed
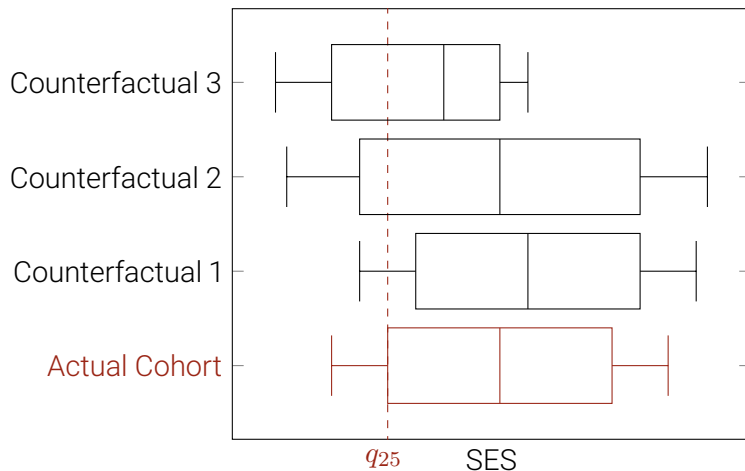
    $\Rightarrow$ School and cohort fixed effects

Identification

Identification Problem

- Objective: Estimate a causal rank effect

- Problem 1: Peer groups are endogenously formed

    $\Rightarrow$ School and cohort fixed effects

- Problem 2: Direct effect of parental socioeconomic status

    $\Rightarrow$ Flexible functional form

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Identification

Illustration of Identifying Variation

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Identification

Identification Assumptions

Assumption 1: Functional Form

$$y_{isc} = \beta \mathsf{Rank}_{isc} + f\left(\mathsf{SES}_{isc}\right) + \gamma X_{isc} + g\left(s, c\right) + u_{isc}.$$

- *g* captures different school and cohort fixed-effects specifications

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Identification

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- g captures different school and cohort fixed-effects specifications

  $\rightarrow$ Model 1: $g\left(s, c\right) = \theta_s + \theta_c$

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Identification

Identification Assumptions

Assumption 1: Functional Form

$$y_{isc} = \beta \mathsf{Rank}_{isc} + f\left(\mathsf{SES}_{isc}\right) + \gamma X_{isc} + g\left(s, c\right) + u_{isc}.$$

- g captures different school and cohort fixed-effects specifications

  $\rightarrow$ Model 1: $g\left(s, c\right) = \theta_s + \theta_c$

  $\rightarrow$ Model 2: $g\left(s, c\right) = \alpha W_{sc} + \theta_s + \theta_c$

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Identification

Identification Assumptions

Assumption 1: Functional Form

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- g captures different school and cohort fixed-effects specifications

  $\rightarrow$ Model 1: $g\left(s, c\right) = \theta_s + \theta_c$

  $\rightarrow$ Model 2: $g\left(s, c\right) = \alpha W_{sc} + \theta_s + \theta_c$

  $\rightarrow$ Model 3: $g\left(s, c\right) = \theta_s \times \theta_c$

▸ Balancing test

Roadmap

Contemporaneous Rank Effects

Depression

Cognitive Ability

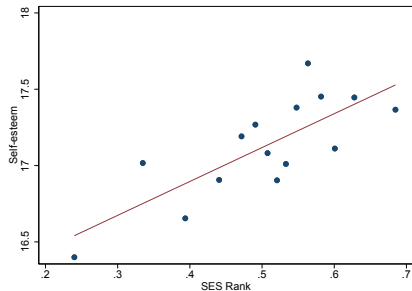Introduction
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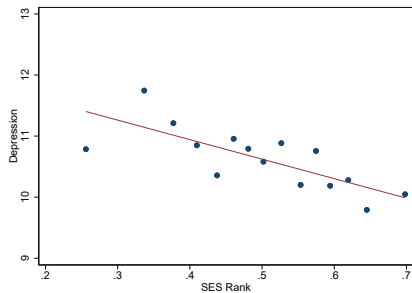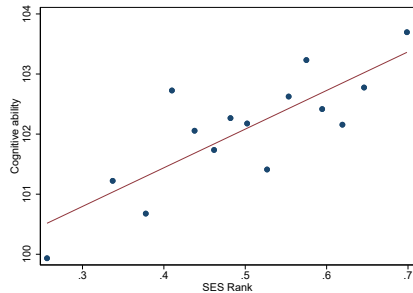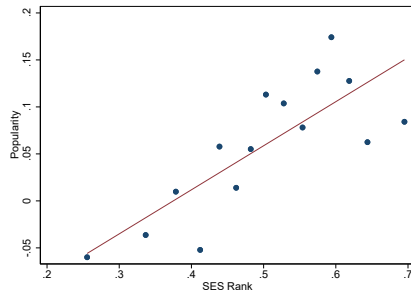
Contemporaneous Rank Effects

▸ Effect Size

Self-esteem

Popularity

Heterogeneity by Cohort-Level Inequality

How does the degree of inequality affect the rank-outcome gradient?

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Heterogeneity by Cohort-Level Inequality

How does the degree of inequality affect the rank-outcome gradient?

Inequality quintile	1st	2nd	3rd	4th	5th
Depression	-0.65***	-0.75***	-0.94***	-0.82***	-1.00***
	(0.24)	(0.21)	(0.21)	(0.23)	(0.26)
Cognitive ability	1.26***	1.64***	1.66***	1.75***	2.92***
	(0.32)	(0.32)	(0.32)	(0.33)	(0.47)
Self-esteem	0.21***	0.26***	0.36***	0.35***	0.40***
	(0.10)	(0.10)	(0.09)	(0.11)	(0.14)
Popularity	0.11***	0.10***	0.13***	0.13***	0.13***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)

Standard errors clustered at school level in parantheses. Quintiles based on cohort-level standard deviation in SES.

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Cognitive ability	1.26***	1.64***	1.66***	1.75***	2.92***
	(0.32)	(0.32)	(0.32)	(0.33)	(0.47)
Self-esteem	0.21***	0.26***	0.36***	0.35***	0.40***
	(0.10)	(0.10)	(0.09)	(0.11)	(0.14)
Popularity	0.11***	0.10***	0.13***	0.13***	0.13***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)

Standard errors clustered at school level in parantheses. Quintiles based on cohort-level standard deviation in SES.

$\rightarrow$ Rank effects uniformly stronger in high-inequality cohorts

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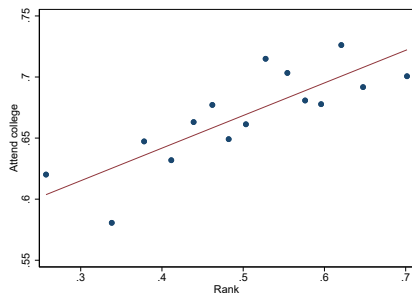
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Long-Run Outcomes (2007/08)

- Individuals between 24 – 32 years old

- Depression: 10-item CES-D

  ▸ Measure: CES-D

- Education: Binary outcome variables for college attendance and completion

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Persistent Rank Effects

▸ Table
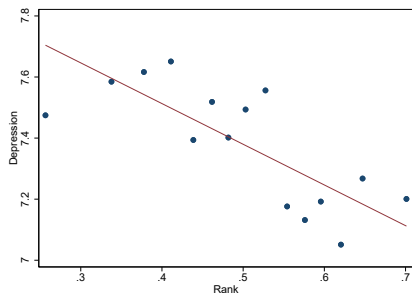
Depression

College Attendance

Roadmap

Conclusion

- Students with the same socioeconomic status, but a higher within-cohort rank have better outcomes in terms of depression, cognitive ability, self-esteem and popularity

- The causal effect of relative SES is strongest in cohorts with high degrees of inequality

- Within-cohort rank has long-term effects on mental health and educational outcomes

▸ Mediation

Questions/ Comments?

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Have a look at the paper!

APPENDIX

Data

Outcome Measures

Depression

- Center of Epidemiologic Studies Depression (CES-D) score

- Range: 0 – 57

Cognitive Ability

- Adolescent Health Picture Vocabulary Test (AHPVT)

- Age-specific test: scores standardized within each age group

Data

Outcome Measures

Self-Esteem

▸ Measure: Rosenberg   ▸ Distribution: Rosenberg

- 6 items of the Rosenberg self-esteem scale

- Range: 0 – 24

Popularity

▸ Measure: Bonacich   ▸ Distribution: Popularity

- Leveraging extensive information on friendship network

- Bonacich centrality: weighs ego's friendship ties by the centrality of ego's alters

- Standardized within cohorts

Contemporaneous Rank Effects (1994/95)

	(1)	(2)	(3)	(4)
Panel A: Depression				
CES-D	-0.96***	-0.81***	-0.80***	-0.83***
	(0.19)	(0.19)	(0.20)	(0.20)
Number of observations	13,683	13,683	13,683	13,683
Panel B: Cognitive Ability				
Peabody	2.14***	1.59***	1.69***	1.60***
	(0.33)	(0.30)	(0.31)	(0.31)
Number of observations	13,115	13,115	13,115	13,115
Panel C: Self-esteem				
6-item Rosenberg	0.33***	0.29***	0.30***	0.31***
	(0.09)	(0.09)	(0.09)	(0.10)
Number of observations	13,685	13,685	13,685	13,685
Panel D: Popularity				
Bonacich	0.14***	0.12***	0.12***	0.12***
	(0.02)	(0.02)	(0.03)	(0.03)
Number of observations	12,883	12,883	12,883	12,8830
Level of SES	yes	yes	yes	yes
Individual controls	no	yes	yes	yes
Cohort controls	no	no	yes	no
School and cohort FE	yes	yes	yes	no
School x cohort FE	no	no	no	yes

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Contemporaneous Rank Effects (1994/95)

	(1)	(2)	(3)	(4)
Panel A: Depression			[-0.11]	[-0.11]
CES-D	-0.96***	-0.81***	-0.80***	-0.83***
	(0.19)	(0.19)	(0.20)	(0.20)
Number of observations	13,683	13,683	13,683	13,683
Panel B: Cognitive Ability			[0.12]	[0.11]
Peabody	2.14***	1.59***	1.69***	1.60***
	(0.33)	(0.30)	(0.31)	(0.31)
Number of observations	13,115	13,115	13,115	13,115
Panel C: Self-esteem			[0.08]	[0.09]
6-item Rosenberg	0.33***	0.29***	0.30***	0.31***
	(0.09)	(0.09)	(0.09)	(0.10)
Number of observations	13,685	13,685	13,685	13,685
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Contemporaneous Rank Effects: Size

- Economically meaningful rank effects

  → Swedish compulsory schooling reform: Maternal education ↑ by 1 year leads to childrens' cognitive ability ↑ by 0.1 std. at the age of 18

Contemporaneous Rank Effects: Size

- Economically meaningful rank effects

  → Swedish compulsory schooling reform: Maternal education ↑ by 1 year leads to childrens' cognitive ability ↑ by 0.1 std. at the age of 18

- Compare rank effects to the effects associated with a change in school quality

  → Use school fixed effects as a benchmark for overall school quality

  → Depression: rank ↑ by 25 pp has equivalent effect to school quality ↑ by 0.6 standard deviations

  → Cognitive ability: rank ↑ by 25 pp has equivalent effect to school quality ↑ by 0.5 standard deviations

Persistent Rank Effects

	(1)	(2)	(3)	(4)
Panel A: Long-run Depression				
CES-D (10 items)	-0.28***	-0.25**	-0.28**	-0.28**
	(0.10)	(0.11)	(0.11)	(0.11)
Number of observations	10,901	10,901	10,901	10,901
Panel B: College				
Attending college	0.08***	0.06***	0.07***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
Completing college	0.07***	0.06***	0.06***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
Number of observations	10,911	10,911	10,911	10,911
Level of SES	yes	yes	yes	yes
Individual controls	no	yes	yes	yes
Cohort controls	no	no	yes	no
School and cohort FE	yes	yes	yes	no
School x cohort FE	no	no	no	yes

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Depression

Measure	During the past week...	Scale
CES-D	You were bothered by things that don't usually bother you.*	Never 0 – 3 most/all of the time
	You didn't feel like eating, your appetite was poor.	
	You felt that you could not shake off the blues, even with help from your family and your friends.*	
	You felt you were just as good as other people. (reverse coded)*	
	You had trouble keeping your mind on what you were doing.*	
	You felt depressed.*	
	You felt that you were too tired to do things.*	
	You felt hopeful about the future. (reverse coded)	
	You thought your life had been a failure.	
	You felt fearful.	
	You were happy. (reverse coded)*	
	You talked less than usual.	
	You felt lonely.	
	People were unfriendly to you.	
	You enjoyed life. (reverse coded)*	
	You felt sad.*	
	You felt that people disliked you.*	
	It was hard to get started doing things.	
	You felt life was not worth living.	

Distribution of Depression Score
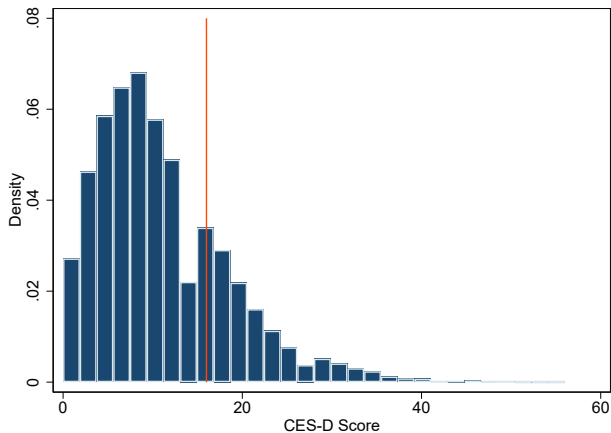
Distribution of Cognitive Ability Score
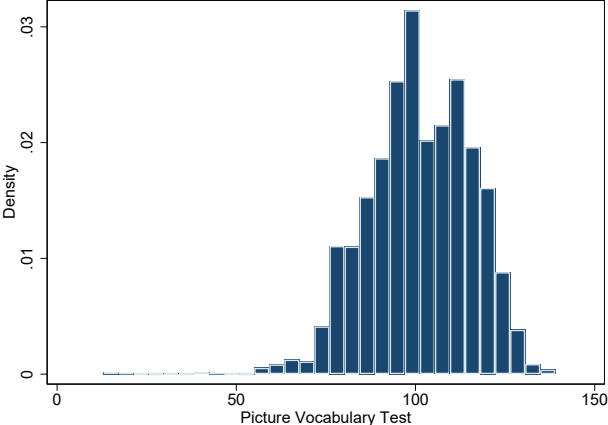
Rosenberg Self-Esteem Scale

Measure	Do you agree or disagree that you...	Scale
RSE	have many good qualities	Strongly disagree 0 - 4 Strongly agree
	have a lot to be proud of	
	like yourself just the way you are	
	feel you are doing things just about right	
	feel socially accepted	
	feel loved and wanted	

Distribution of Self-Esteem Scale
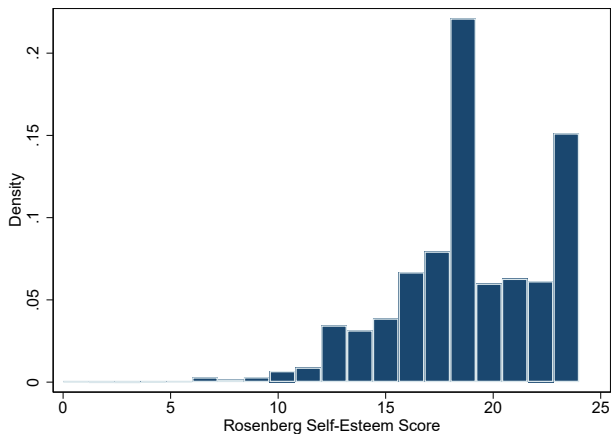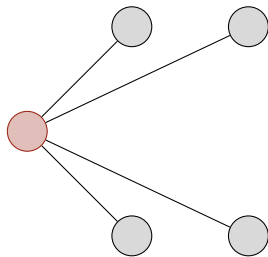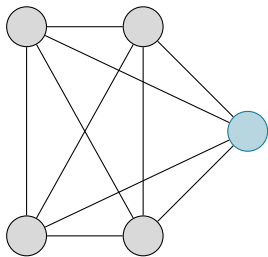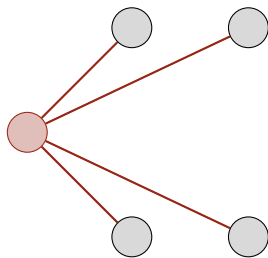
Popularity

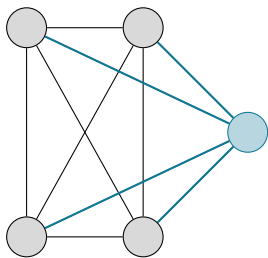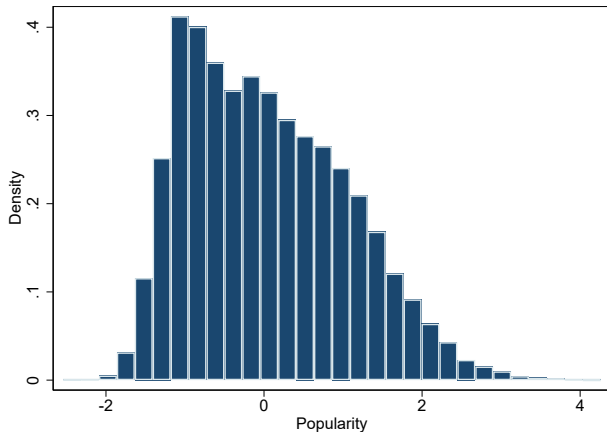# Distribution of Popularity

Mediation Analysis

To what extent are these long-run effects mediated by the observed short-run effects?

Mediation Analysis

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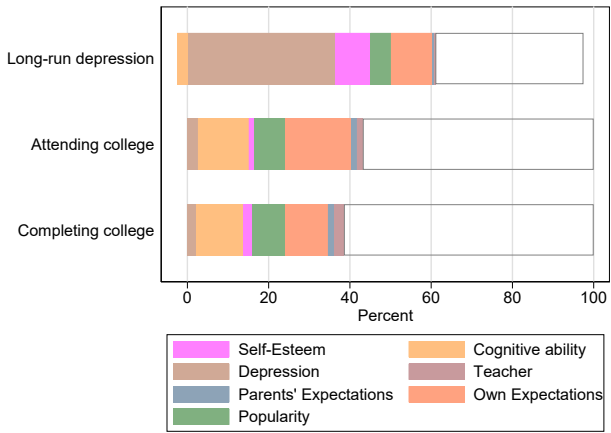
Balancing Test

	(1)	(2)
Polygenic Scores for Education		
Educational attainment (2016)	0.01	0.00
	(0.04)	(0.04)
Educational attainment (2018)	0.01	0.00
	(0.04)	(0.04)
Polygenic Scores for Mental Health Disorders		
Attention-Deficit/Hyperactivity Disorder (2010)	-0.02	-0.03
	(0.05)	(0.05)
Attention-Deficit/Hyperactivity Disorder (2017)	-0.01	-0.01
	(0.04)	(0.04)
Bipolar Disorder (2011)	0.01	0.02
	(0.04)	(0.04)
Major Depressive Disorder (2013)	0.04	0.03
	(0.04)	(0.04)
Major Depressive Disorder (2018)	-0.04	-0.04
	(0.04)	(0.04)
Schizophrenia (2014)	-0.01	-0.01
	(0.03)	(0.03)
Mental Health Cross Disorder (2013)	-0.03	-0.03
	(0.04)	(0.04)
Number of observations	3,975	3,961

Robustness: Strategic Delay

Restrict sample to age bands of 1 std. around the mean

	Depression	Cognitive ability	Self-esteem	Popularity
Rank Coefficient	-1.07***	1.78***	0.31***	0.13***
	(0.23)	(0.34)	(0.10)	(0.03)
Number of observations	9,733	9,358	8,736	9,183

Standard errors clustered at school level in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Robustness: Attrition

Short-run effects estimated on long-run sample

	Depression	Cognitive ability	Self-esteem	Popularity
Rank	-0.70***	1.45***	0.27***	0.13***
	(0.21)	(0.33)	(0.09)	(0.03)
Number of observations	10,875	10,430	10,881	10,238

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Robustness: Attrition

Regression of attrition status

	Attrition status	Attrition status
Rank	0.01	0.01
	(0.01)	(0.01)
Number of observations	13,736	13,736
Level of SES	yes	yes
Individual controls	yes	yes
Cohort controls	yes	no
School and cohort FE	yes	no
School x cohort FE	no	yes

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Robustness: SES-Bins and Functional Form

	4 SES bins (Baseline)	3 SES bins	linear SES	quadratic SES
Panel A: Depression				
CES-D	-0.80***	-0.72***	-0.64***	-0.76***
	(0.20)	(0.18)	(0.24)	(0.25)
Number of observations	13,683	13,683	13,683	13,683
Panel B: Cognitive Ability				
Peabody	1.69***	1.76***	0.76*	1.03***
	(0.31)	(0.29)	(0.40)	(0.39)
Number of observations	13,115	13,115	13,115	13,115
Panel C: Self-esteem				
6-item Rosenberg	0.33***	0.31***	0.07	0.10
	(0.09)	(0.11)	(0.13)	(0.13)
Number of observations	13,685	13,685	13,685	13,685
Panel D: Popularity				
Bonacich	0.12***	0.11***	0.05*	0.06**
	(0.03)	(0.02)	(0.03)	(0.03)
Number of observations	12,883	12,883	12,883	12,883

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Robustness: Way to Break Ties

	Average (Baseline)	Lower	Higher
Panel A: Depression			
CES-D	-0.80***	-0.83***	-0.63***
	(0.20)	(0.20)	(0.16)
Number of observations	13,683	13,683	13,683
Panel B: Cognitive Ability			
Peabody	1.69***	1.71***	1.35**
	(0.31)	(0.35)	(0.24)
Number of observations	13,115	13,115	13,115
Panel C: Self-esteem			
6-item Rosenberg	0.33***	0.27***	0.25***
	(0.09)	(0.10)	(0.08)
Number of observations	13,685	13,685	13,685
Panel D: Popularity			
Bonacich	0.12***	0.12***	0.10***
	(0.03)	(0.03)	(0.02)
Number of observations	12,883	12,883	12,883

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Robustness: Definition of SES

	Average (Baseline)	Father's Education	Mother's Education	Highest Educatio
Panel A: Depression				
CES-D	-0.80***	-0.96***	-0.83***	-0.93***
	(0.20)	(0.22)	(0.22)	(0.26)
Number of observations	13,683	13,683	13,683	13,683
Panel B: Cognitive Ability				
Peabody	1.69***	1.87***	2.17***	2.31***
	(0.31)	(0.34)	(0.34)	(0.42)
Number of observations	13,115	13,115	13,115	13,115
Panel C: Self-esteem				
6-item Rosenberg	0.33***	0.31***	0.32***	0.23*
	(0.09)	(0.09)	(0.11)	(0.12)
Number of observations	13,685	13,685	13,685	13,685
Panel D: Popularity				
Bonacich	0.12***	0.10***	0.11***	0.08***
	(0.03)	(0.02)	(0.03)	(0.03)
Number of observations	12,883	12,883	12,883	12,883

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Robustness: Definition of SES

	Education (Baseline)	Family Income	Education (Baseline)
Panel A: Depression			
CES-D	-0.96***	-0.35**	-0.49**
	(0.22)	(0.14)	(0.20)
Number of observations	13,683	10,010	10,010
Panel B: Cognitive Ability			
Peabody	1.87***	1.58***	0.67**
	(0.34)	(0.24)	(0.29)
Number of observations	13,115	9,640	9,640
Panel C: Self-esteem			
6-item Rosenberg	0.33***	0.13	0.19*
	(0.09)	(0.08)	(0.11)
Number of observations	13,685	10,008	10,008
Panel D: Popularity			
Bonacich	0.12***	0.06***	0.11***
	(0.03)	(0.02)	(0.03)
Number of observations	12,883	9,390	9,390

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4 Factors of CES-D

Depressed Affect	Positive Affect	Somatic	Interpersonal Problems
bothered	good	mind	unfriendly
no appetite	hopeful	tired	disliked
blues	happy	start doing	
depressed	enjoy		
failure			
fearful			
lonely			
sad			
not worth living			

4-Factor Model of Depression

	Positive affect	Depressed affect	Somatic symptoms	Interpersonal problems
Rank coefficient	-0.07***	-0.04***	-0.02	-0.04**
	(0.02)	(0.01)	(0.02)	(0.02)
Number of observations	13,683	13,683	13,683	13,683
Level of SES	yes	yes	yes	yes
Individual controls	yes	yes	yes	yes
Cohort controls	yes	yes	yes	yes
School and cohort FE	yes	yes	yes	yes

Standard errors clustered at school level in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

$\rightarrow$ Rank effect on depression not driven by a single factor