Additional analysis - $G \times E$ paper

February 17, 2021

Main differences from estimates in paper on overleaf:

- These include a YoB1992 dummy
- These include interactions a la Keller

1 Predictive power of different PGSs

Table 1: Comparison of predictive power from PGSs

	PLINK	UKB	23&me
	(1)	(2)	(3)
PGS	0.290***	0.319***	0.285***
	(0.015)	(0.015)	(0.015)
R2	0.089	0.109	0.086
Observations	3610	3610	3610

Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

2 MoB analysis with different PGSs

Table 2: Entry Assessment (age 4) test; using Plink-based PGS

	(1)	(2)
Treated	1.054***	0.859***
	(0.074)	(0.065)
Treated*PGS		-0.280***
		(0.048)
Treated*MoB	0.058	0.083
	(0.049)	(0.056)
MoB*PGS		-0.084***
		(0.010)
MoB*PGS*Treated		0.162***
		(0.019)
MoB	-0.144**	-0.156**
	(0.050)	(0.049)
PGS	0.164***	0.193***
	(0.037)	(0.029)
R2	0.248	0.264
Observations	1094	1094

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Key Stage tests; using Plink-based PGS

	Key Stage 1		Key Stage 2		Key Stage 3		Key Stage 4	
Treated	0.590***	0.626***	0.211***	0.159***	0.142	0.159**	0.193***	0.223***
	(0.016)	(0.052)	(0.017)	(0.037)	(0.081)	(0.058)	(0.032)	(0.034)
Treated*PGS		-0.084**		-0.061*		-0.090***		-0.015
		(0.030)		(0.026)		(0.019)		(0.014)
Treated*MoB	0.070***	0.068***	0.109***	0.110***	0.044	0.048	0.048**	0.046**
	(0.011)	(0.011)	(0.013)	(0.012)	(0.030)	(0.031)	(0.015)	(0.016)
MoB*PGS		0.013		0.007		0.033***		0.045***
		(0.006)		(0.009)		(0.006)		(0.009)
MoB*PGS*Treated		0.014		0.014		0.013		-0.036**
		(0.009)		(0.012)		(0.008)		(0.010)
MoB	-0.090***	-0.085***	-0.099***	-0.102***	-0.028	-0.026	-0.042**	-0.042**
	(0.010)	(0.011)	(0.012)	(0.010)	(0.015)	(0.014)	(0.012)	(0.012)
PGS	0.237***	0.229***	0.293***	0.301***	0.316***	0.312***	0.276***	0.283***
	(0.010)	(0.026)	(0.009)	(0.015)	(0.017)	(0.023)	(0.012)	(0.029)
R2	0.162	0.167	0.111	0.114	0.116	0.119	0.115	0.120
Observations	3436	3436	3610	3610	3073	3073	3579	3579

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

3 LDpred-based PGS using UKB sum stats

Table 4: Entry Assessment (age 4) test; using LDpred-based PGS with UKB sum stats

	(1)	(2)
Treated	1.055***	0.889***
	(0.080)	(0.084)
Treated*PGS		-0.090
		(0.078)
Treated*MoB	0.057	0.066
	(0.047)	(0.049)
MoB*PGS		-0.066***
		(0.015)
MoB*PGS*Treated		0.106**
		(0.030)
MoB	-0.146**	-0.145**
	(0.046)	(0.043)
PGS	0.161***	0.161**
	(0.024)	(0.059)
R2	0.247	0.260
Observations	1094	1094

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Key Stage tests; using LDpred-based PGS with UKB sum stats

	Key Stage 1		Key Stage 2		Key Stage 3		Key Stage 4	
Treated	0.619***	0.658***	0.249***	0.189***	0.177*	0.211**	0.232***	0.257***
	(0.018)	(0.056)	(0.012)	(0.040)	(0.078)	(0.054)	(0.026)	(0.033)
Treated*PGS		0.007		-0.023		-0.034		0.014
		(0.036)		(0.047)		(0.071)		(0.013)
Treated*MoB	0.067***	0.061***	0.101***	0.102***	0.033	0.034	0.038**	0.037**
	(0.012)	(0.013)	(0.012)	(0.010)	(0.029)	(0.033)	(0.013)	(0.011)
MoB*PGS		0.043***		0.028		-0.012		0.025***
		(0.006)		(0.015)		(0.014)		(0.003)
MoB*PGS*Treated		-0.037**		-0.015		0.038		-0.027**
		(0.012)		(0.019)		(0.021)		(0.007)
MoB	-0.097***	-0.091***	-0.107***	-0.107***	-0.031*	-0.030*	-0.046***	-0.046***
	(0.012)	(0.013)	(0.010)	(0.009)	(0.013)	(0.014)	(0.011)	(0.011)
PGS	0.257***	0.232***	0.320***	0.308***	0.331***	0.315***	0.293***	0.291***
	(0.015)	(0.021)	(0.013)	(0.038)	(0.016)	(0.053)	(0.007)	(0.023)
R2	0.173	0.183	0.129	0.136	0.126	0.130	0.126	0.129
Observations	3436	3436	3610	3610	3073	3073	3579	3579

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4 LDpred-based PGS using 23&me sum stats

Table 6: Entry Assessment (age 4) test; using LDpred-based PGS with 23&me sum stats

	(1)	(2)
Treated	1.052***	0.882***
	(0.064)	(0.057)
Treated*PGS		-0.145**
		(0.051)
Treated*MoB	0.054	0.077
	(0.045)	(0.047)
MoB*PGS		-0.047**
		(0.015)
MoB*PGS*Treated		0.106***
		(0.025)
MoB	-0.141**	-0.158**
	(0.046)	(0.043)
PGS	0.119***	0.126***
	(0.025)	(0.024)
R2	0.237	0.251
Observations	1094	1094

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Key Stage tests; using LDpred-based PGS with 23&me sum stats

	Key Stage 1		Key Stage 2		Key Stage 3		Key Stage 4	
Treated	0.620***	0.658***	0.262***	0.202***	0.188	0.243**	0.241***	0.263***
	(0.019)	(0.046)	(0.031)	(0.031)	(0.098)	(0.083)	(0.043)	(0.041)
Treated*PGS		-0.112**		-0.069***		-0.049**		-0.041
		(0.038)		(0.008)		(0.016)		(0.025)
Treated*MoB	0.056***	0.052**	0.082***	0.081***	0.015	0.009	0.023	0.021
	(0.012)	(0.014)	(0.016)	(0.015)	(0.036)	(0.036)	(0.018)	(0.018)
MoB*PGS		0.048***		0.012		0.009		0.022***
		(0.012)		(0.010)		(0.007)		(0.003)
MoB*PGS*Treated		-0.006		0.012		0.037***		-0.003
		(0.015)		(0.009)		(0.005)		(0.011)
MoB	-0.087***	-0.083***	-0.091***	-0.092***	-0.016	-0.014	-0.033**	-0.033**
	(0.012)	(0.013)	(0.012)	(0.009)	(0.015)	(0.013)	(0.012)	(0.011)
PGS	0.210***	0.197***	0.287***	0.275***	0.304***	0.253***	0.274***	0.249***
	(0.020)	(0.013)	(0.010)	(0.024)	(0.021)	(0.023)	(0.007)	(0.019)
R2	0.149	0.153	0.106	0.108	0.106	0.110	0.113	0.116
Observations	3436	3436	3610	3610	3073	3073	3579	3579

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5 Parental investments

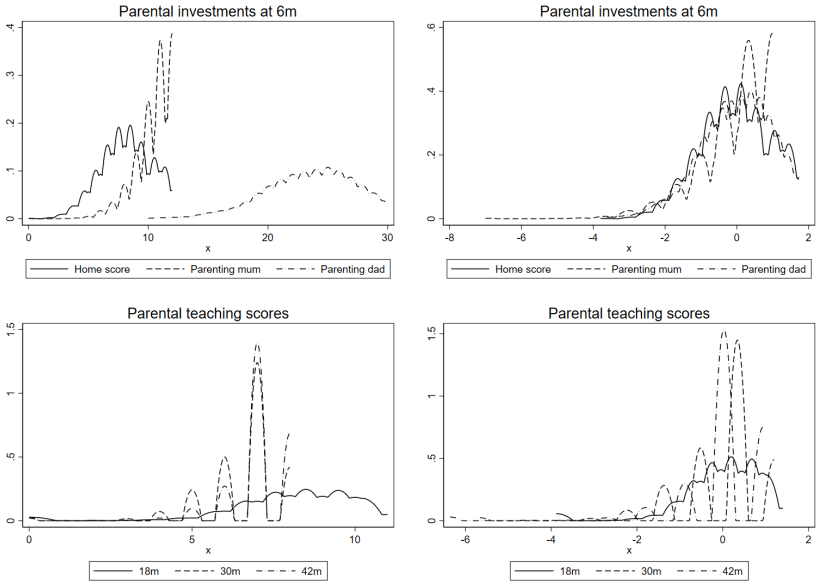

Figure 1: Distribution of the parental investments scores (original and standardized

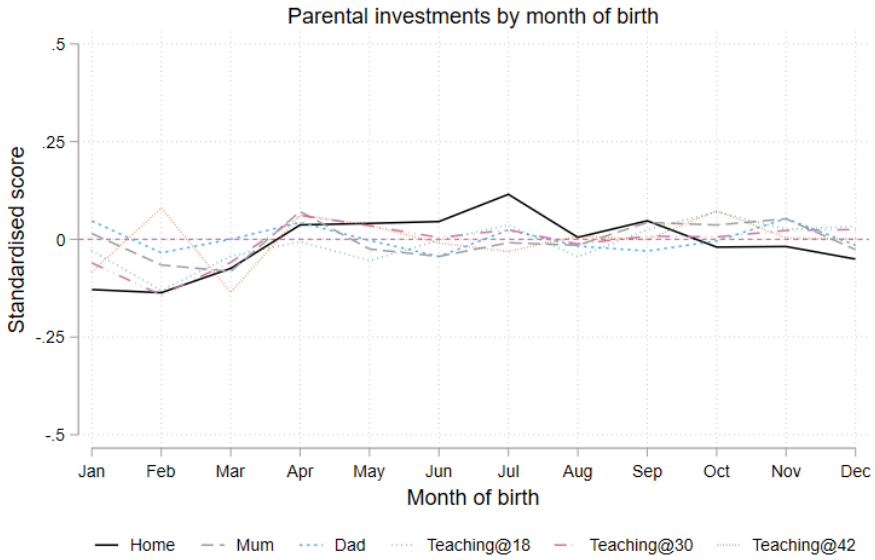

Figure 2: Parental investments by month of birth.

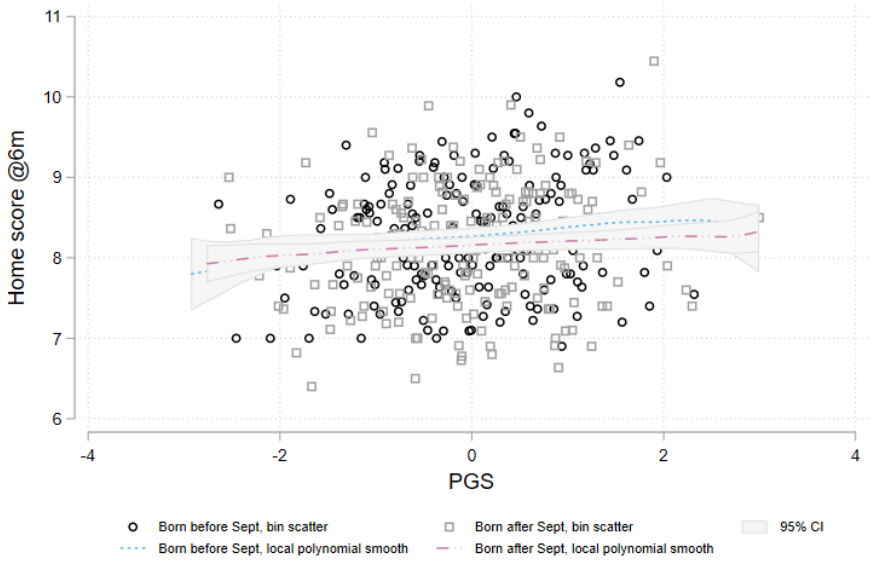

Figure 3: Relationship between PGS and investment (home score) by treated/control.

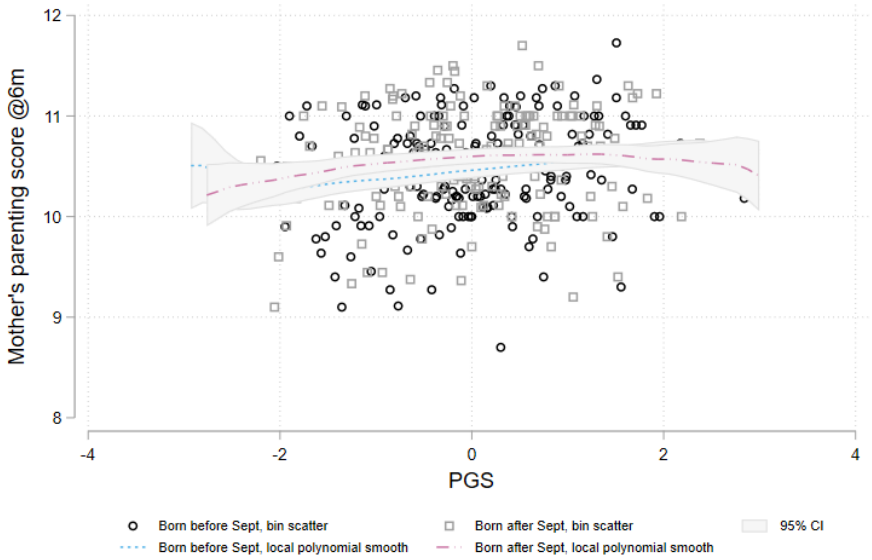

Figure 4: Relationship between PGS and investment (mum parenting score) by treated/control.

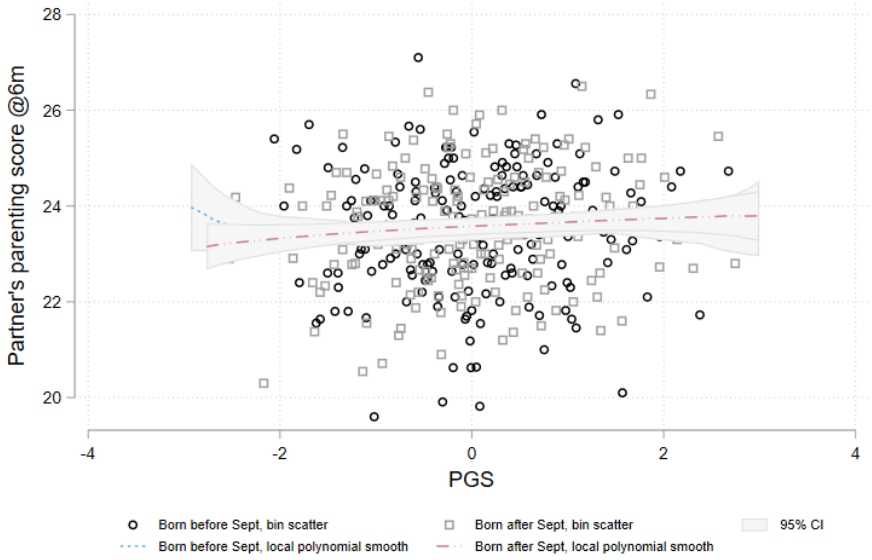

Figure 5: Relationship between PGS and investment (dad parenting score) by treated/control.

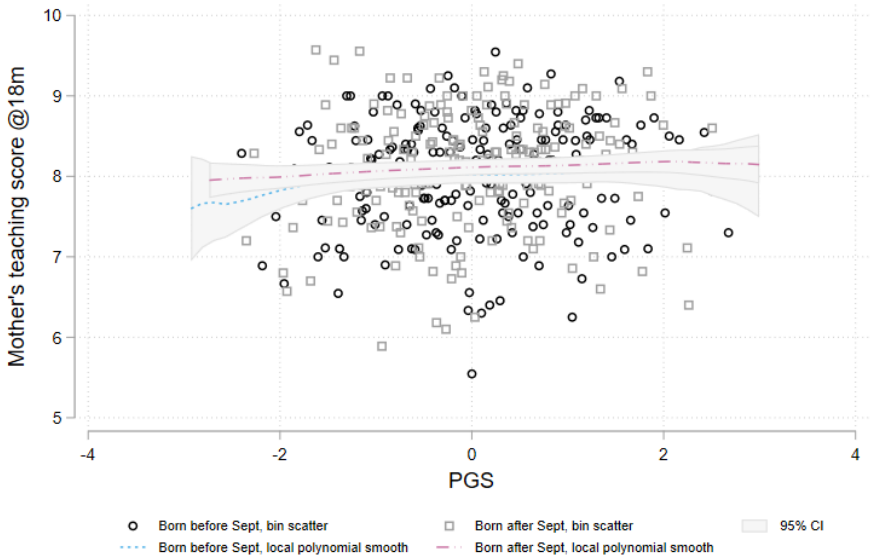

Figure 6: Relationship between PGS and investment (teaching score 18m) by treated/control.

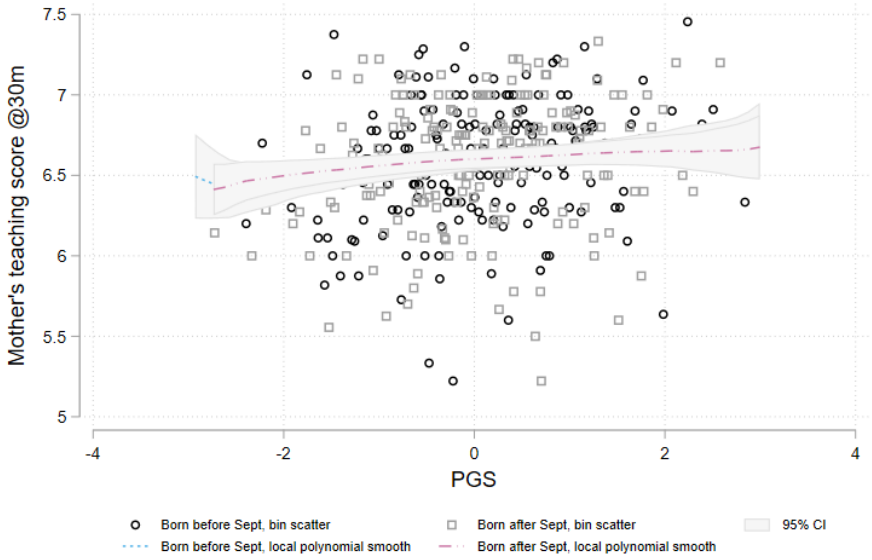

Figure 7: Relationship between PGS and investment (teaching score 30m) by treated/control.

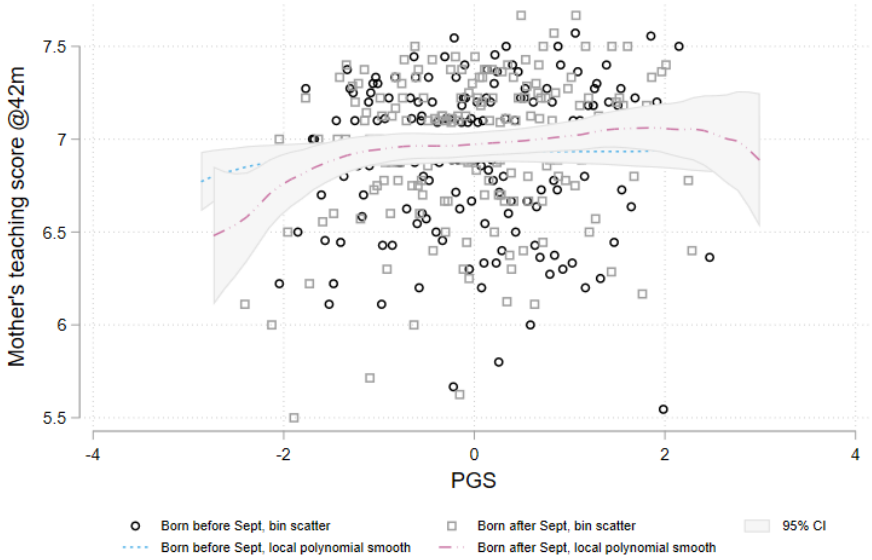

Figure 8: Relationship between PGS and investment (teaching score 42m) by treated/control.

6 Parental investments at 6 months

All tables here on EA sample - results generally similar on larger (KS2) sample, esp for teaching scores (estimates for 6m home/parenting scores are more variable)

Table 8: Investments at 6m; using Plink-based PGS (EA sample)

	Home score @6m	Parenting Mum @6m	Parenting Dad @6m
	(1)	(2)	(3)
Treated	-0.047	0.032	-0.215
	(0.087)	(0.052)	(0.127)
Treated*PGS	-0.233***	-0.067	0.066
	(0.041)	(0.055)	(0.098)
Treated*MoB	0.041	-0.030	-0.086
	(0.022)	(0.018)	(0.044)
MoB*PGS	-0.029*	0.022	0.028
	(0.015)	(0.018)	(0.036)
MoB*PGS*Treated	0.065**	-0.014	-0.067
	(0.017)	(0.028)	(0.053)
MoB	-0.039**	0.008	0.106*
	(0.012)	(0.010)	(0.042)
PGS	0.031	-0.031	0.050
	(0.035)	(0.025)	(0.060)
R2	0.031	0.021	0.042
Observations	1021	1020	995

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Investments at 6m; using LDpred-based PGS with UKB sum stats (EA sample)

	Home score @6m	Parenting Mum @6m	Parenting Dad @6m
	(1)	(2)	(3)
Treated	-0.021	0.053	-0.166
	(0.092)	(0.055)	(0.123)
Treated*PGS	-0.060	0.059	0.267***
	(0.063)	(0.144)	(0.040)
Treated*MoB	0.031	-0.043	-0.092
	(0.028)	(0.023)	(0.048)
MoB*PGS	-0.039	0.020	0.027
	(0.033)	(0.023)	(0.036)
MoB*PGS*Treated	0.020	-0.076	-0.112**
	(0.036)	(0.044)	(0.036)
MoB	-0.029	0.012	0.101*
	(0.019)	(0.014)	(0.045)
PGS	0.053	0.006	0.078**
	(0.040)	(0.025)	(0.022)
R2	0.025	0.021	0.039
Observations	1021	1020	995

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Investments at 6m; using LDpred-based PGS with 23&me sum stats (EA sample)

	Home score @6m	Parenting Mum @6m	Parenting Dad @6m
	(1)	(2)	(3)
Treated	0.019	0.075	-0.213
	(0.109)	(0.056)	(0.116)
Treated*PGS	-0.051	-0.007	0.014
	(0.039)	(0.142)	(0.037)
Treated*MoB	0.024	-0.054**	-0.083
	(0.023)	(0.020)	(0.049)
MoB*PGS	-0.075***	-0.028	0.047*
	(0.018)	(0.030)	(0.023)
MoB*PGS*Treated	0.059*	-0.012	-0.060*
	(0.026)	(0.056)	(0.029)
MoB	-0.034**	0.019	0.102*
	(0.011)	(0.011)	(0.047)
PGS	0.056	0.104***	0.004
	(0.038)	(0.025)	(0.036)
R2	0.032	0.031	0.047
Observations	1021	1020	995

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7 Parental investments at 18 months

Table 11: Investments at 18m; using Plink-based PGS (EA sample)

	Teaching score @18m	Teaching score @30m	Teaching score @42m
	(1)	(2)	(3)
Treated	0.203	0.025	-0.027
	(0.152)	(0.050)	(0.059)
Treated*PGS	0.106***	0.015	0.098
	(0.020)	(0.059)	(0.057)
Treated*MoB	-0.008	-0.031	0.113***
	(0.047)	(0.027)	(0.010)
MoB*PGS	-0.009	-0.073**	-0.032
	(0.011)	(0.021)	(0.025)
MoB*PGS*Treated	-0.031***	0.068	0.040
	(0.008)	(0.039)	(0.028)
MoB	-0.030	0.043	-0.106***
	(0.035)	(0.024)	(0.009)
PGS	0.077**	0.051*	-0.089
	(0.021)	(0.023)	(0.050)
R2	0.039	0.064	0.065
Observations	889	837	818

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 12: Investments at 18m; using LDpred-based PGS with UKB sum stats (EA sample)

	Teaching score @18m	Teaching score @30m	Teaching score @42m
	(1)	(2)	(3)
Treated	0.204	0.032	-0.048
	(0.144)	(0.063)	(0.081)
Treated*PGS	0.225***	0.230***	0.196
	(0.045)	(0.030)	(0.106)
Treated*MoB	-0.025	-0.055*	0.099***
	(0.045)	(0.025)	(0.020)
MoB*PGS	0.028*	0.021	0.061
	(0.012)	(0.022)	(0.064)
MoB*PGS*Treated	-0.125***	-0.098**	-0.094
	(0.020)	(0.028)	(0.063)
MoB	-0.014	0.062**	-0.092***
	(0.034)	(0.024)	(0.011)
PGS	0.052*	-0.006	-0.141
	(0.022)	(0.041)	(0.076)
R2	0.037	0.062	0.082
Observations	889	837	818

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 13: Investments at 18m; using LDpred-based PGS with 23&me sum stats (EA sample) [interactions no longer significant for larger (KS2) sample]

	Teaching score @18m	Teaching score @30m	Teaching score @42m
	(1)	(2)	(3)
Treated	0.285	0.073	0.008
	(0.150)	(0.075)	(0.082)
Treated*PGS	0.113**	0.136**	0.238**
	(0.044)	(0.048)	(0.066)
Treated*MoB	-0.043	-0.052	0.096***
	(0.056)	(0.035)	(0.016)
MoB*PGS	-0.048	-0.061	0.014
	(0.024)	(0.035)	(0.010)
MoB*PGS*Treated	0.032	0.025	-0.081***
	(0.038)	(0.045)	(0.017)
MoB	-0.017	0.050	-0.099***
	(0.038)	(0.025)	(0.011)
PGS	0.031	0.073	0.015
	(0.049)	(0.057)	(0.025)
R2	0.040	0.054	0.062
Observations	889	837	818

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 14: Investments at 18m; using LDpred-based PGS with 23&me sum stats (KS2 sample)

	Teaching score @18m	Teaching score @30m	Teaching score @42m
	(1)	(2)	(3)
Treated	0.122	-0.010	0.039
	(0.066)	(0.037)	(0.061)
Treated*PGS	-0.048	-0.025	0.049
	(0.048)	(0.025)	(0.031)
Treated*MoB	0.020	0.028***	0.044
	(0.026)	(0.005)	(0.023)
MoB*PGS	-0.038***	0.007	0.017
	(0.007)	(0.016)	(0.020)
MoB*PGS*Treated	0.059**	-0.013	-0.031
	(0.016)	(0.019)	(0.025)
MoB	-0.016	-0.014**	-0.049***
	(0.020)	(0.004)	(0.003)
PGS	0.008	0.067**	0.043
	(0.028)	(0.017)	(0.023)
R2	0.011	0.015	0.017
Observations	3308	3141	3093

Robust standard errors clustered by month of birth in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

8 Permutations with different PGSs

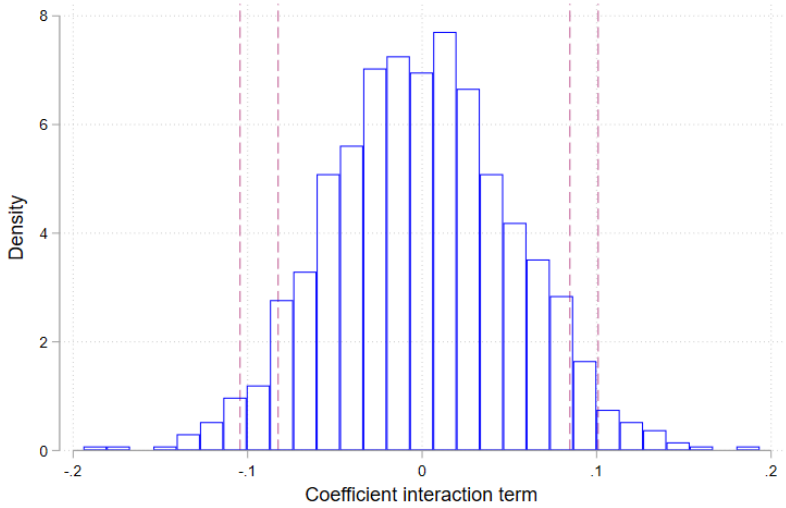

Figure 9: Permutation with Plink-based PGS (coef).

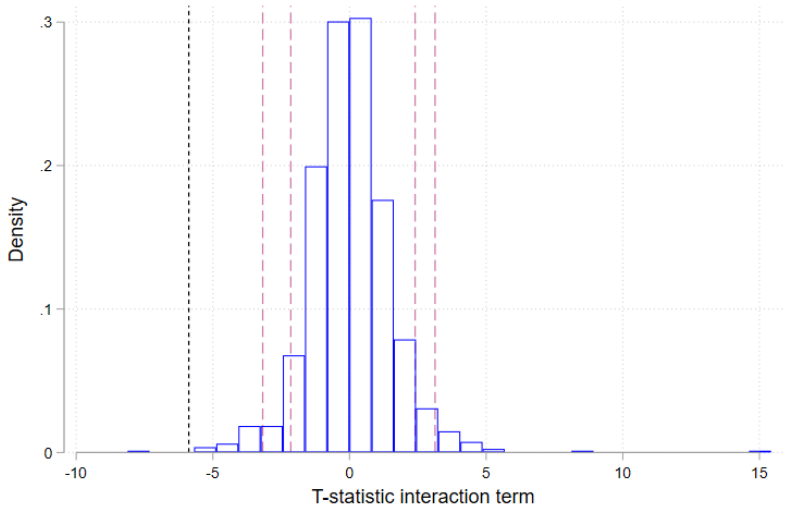

Figure 10: Permutation with Plink-based PGS (t-stat).

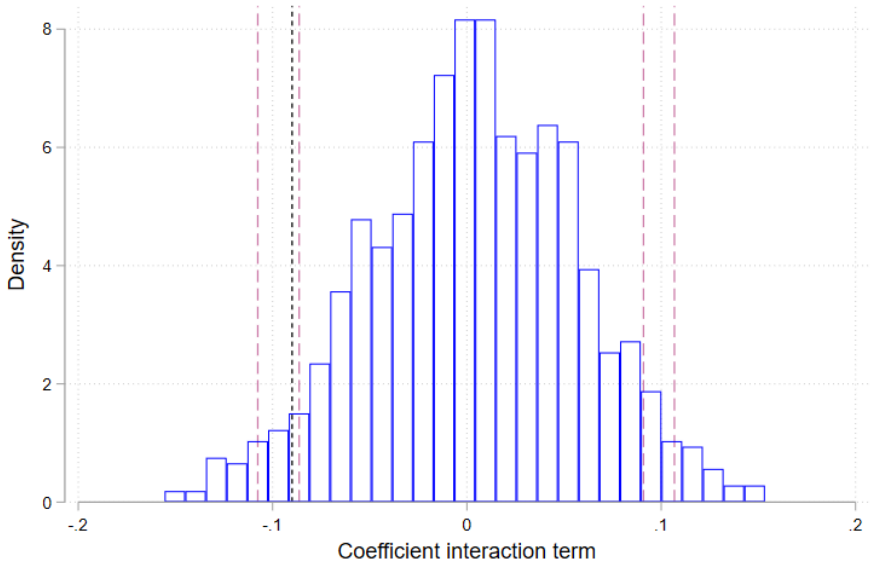

Figure 11: Permutation with LDpred-based PGS - UKB (coef).

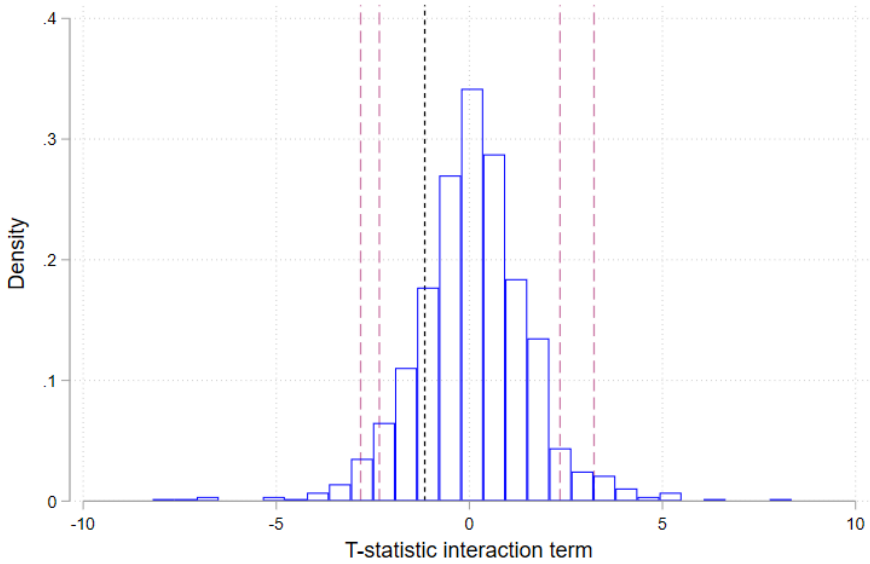

Figure 12: Permutation with LDpred-based PGS - UKB(t-stat).

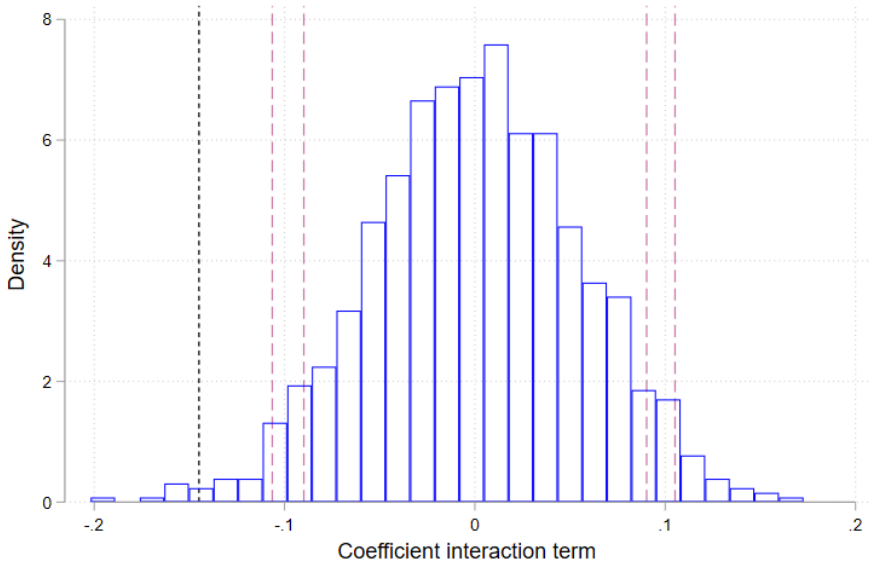

Figure 13: Permutation with LDpred-based PGS - 23me (coef).

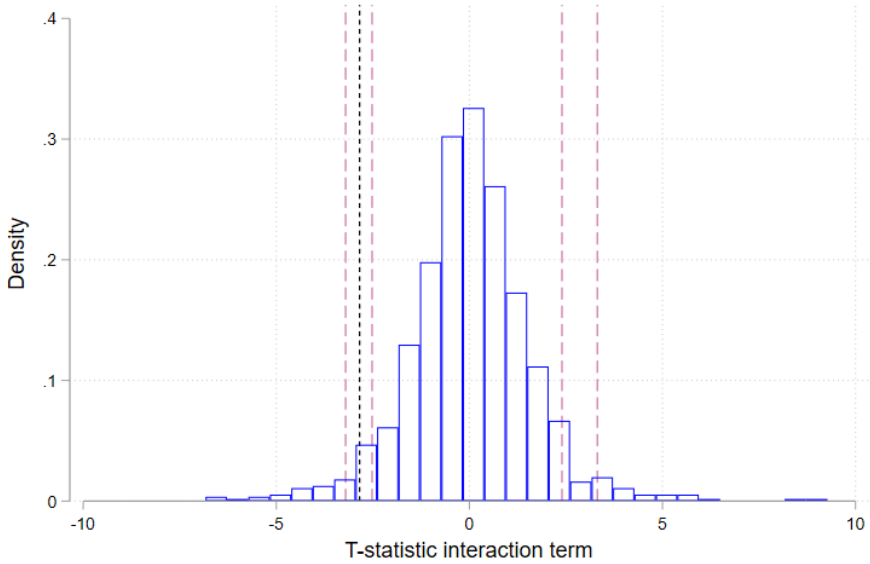

Figure 14: Permutation with LDpred-based PGS - 23me (t-stat).