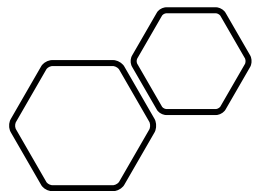# SNP Effect Size on Educational Attainment Comparison Between Movers and Stayers

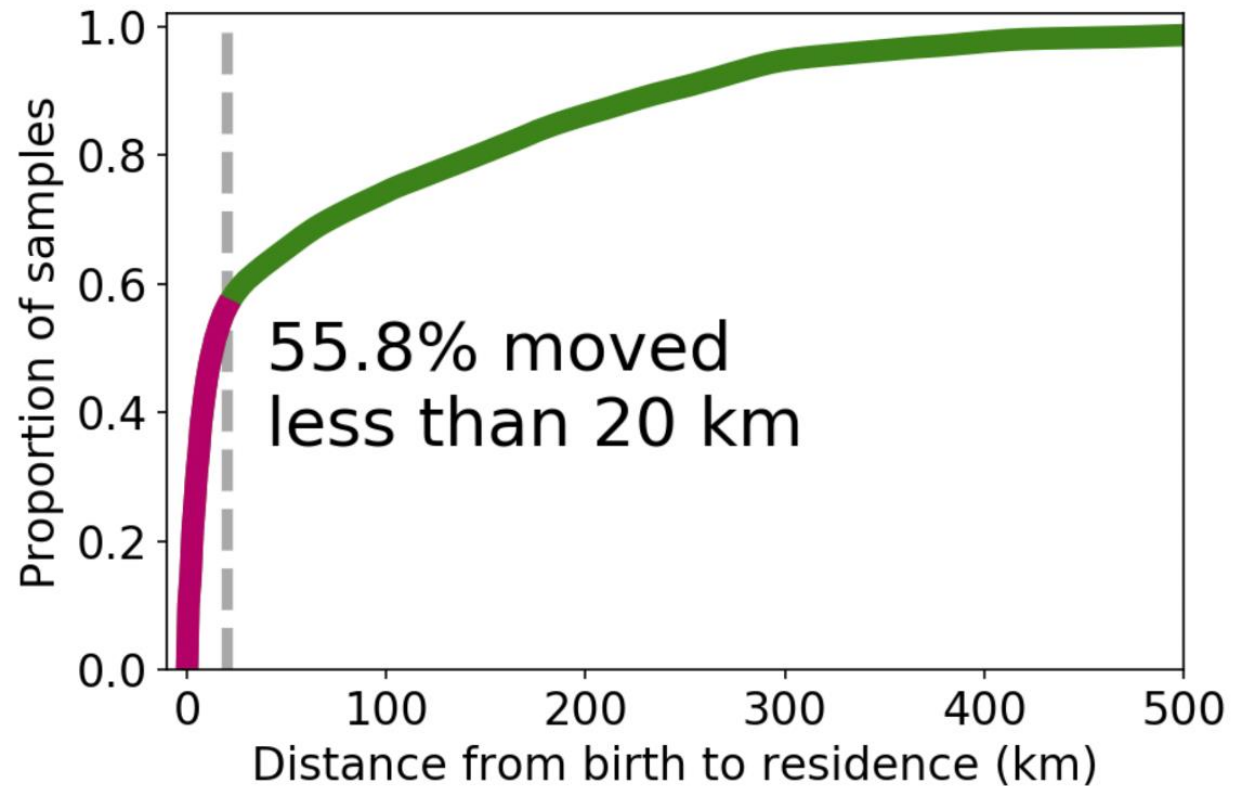Presented by Amber Day

Educational Attainment (EA)

- Education is moderately heritable and an important correlate of many social, economic, and health outcomes. (Lee, 2018)
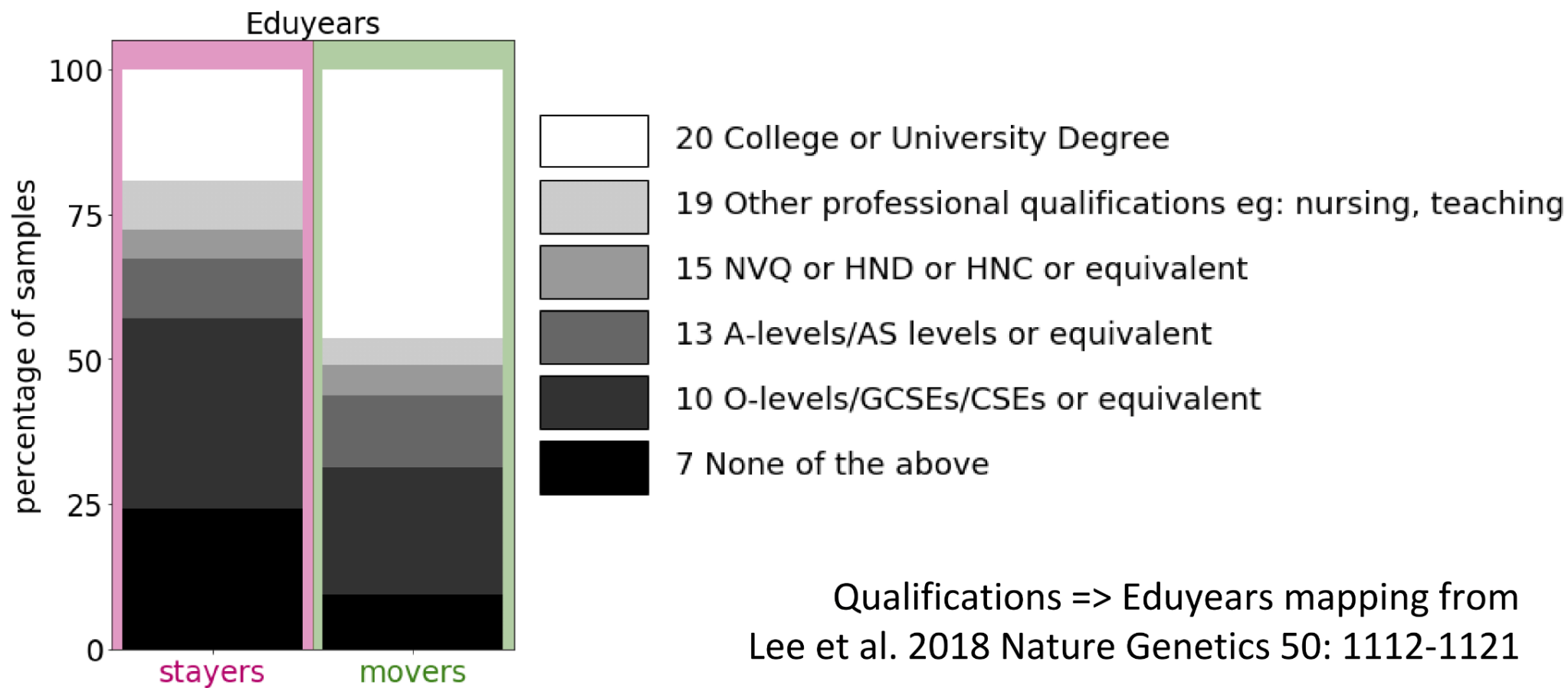
UK Biobank

Stayers $n = 177,519$

Movers $n = 152,227$

55.8% moved less than 20 km

Ian G. Woods, James G. Booth, Amy L. Williams, ASHG 2019

Movers Have Higher Educational Attainment (EA)

Eduyears

20 College or University Degree

19 Other professional qualifications eg: nursing, teaching

15 NVQ or HND or HNC or equivalent

13 A-levels/AS levels or equivalent

10 O-levels/GCSEs/CSEs or equivalent

7 None of the above

Qualifications => Eduyears mapping from Lee et al. 2018 Nature Genetics 50: 1112-1121

Ian G. Woods, James G. Booth, Amy L. Williams, ASHG 2019

Gene discovery and polygenic prediction from a genome-wide association study of educational attainment in 1.1 million individuals

James J. Lee[1,58], Robbee Wedow[2,3,4,58], Aysu Okbay[5,6,58*], Edward Kong[7], Omeed Maghzian[7],

GWAS of Educational Attainment (EA3)

- $n = 1{,}131{,}881$ total sample size
- $n = 694{,}894$ UK Biobank and 23andMe
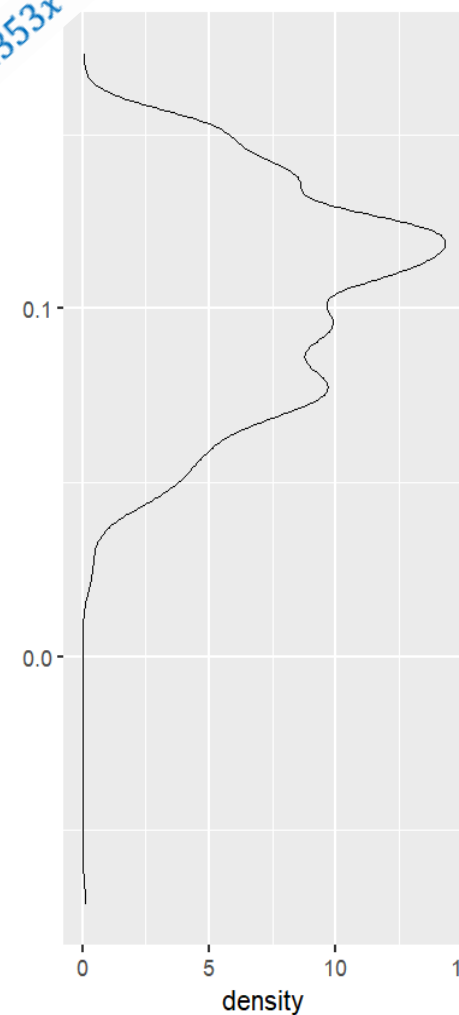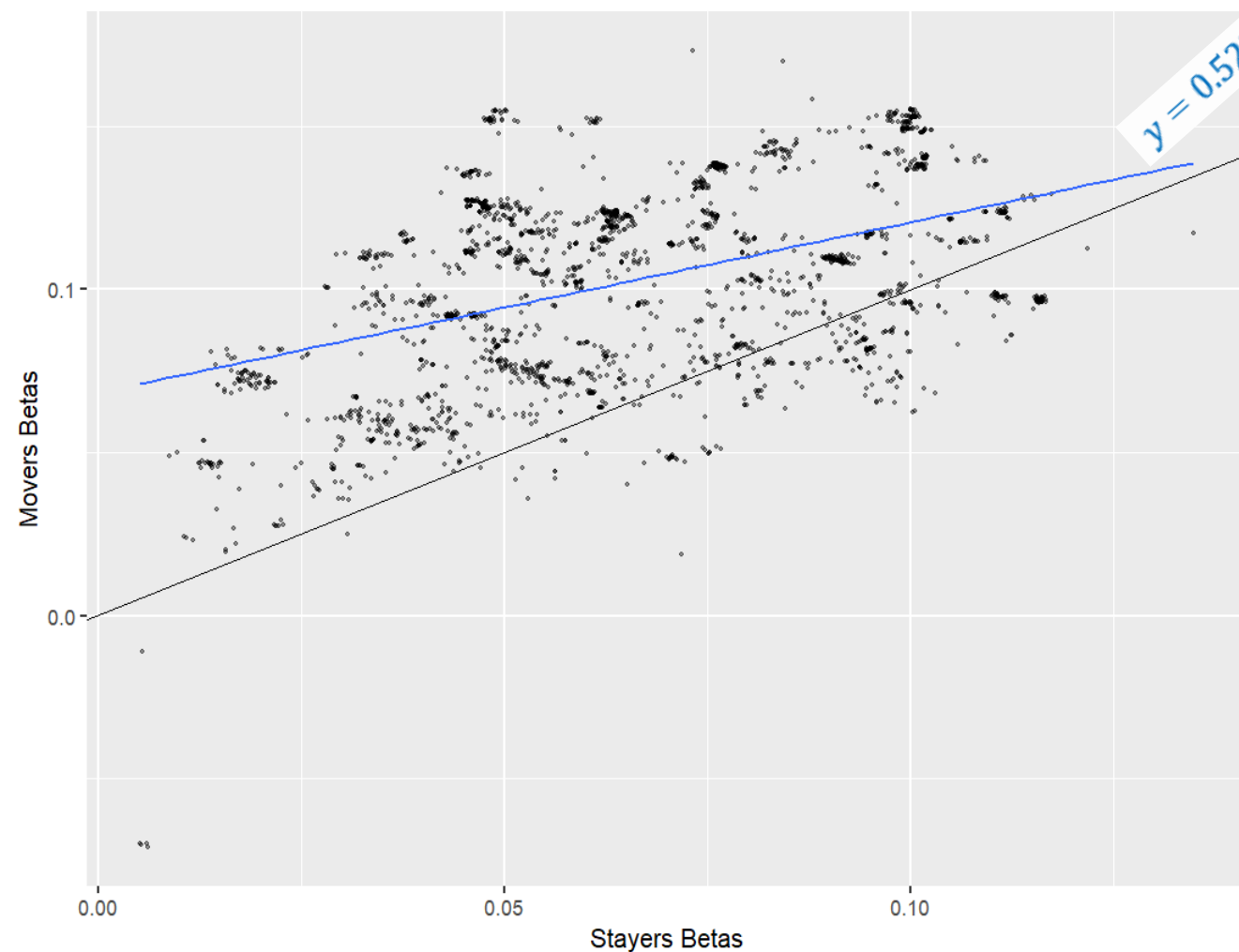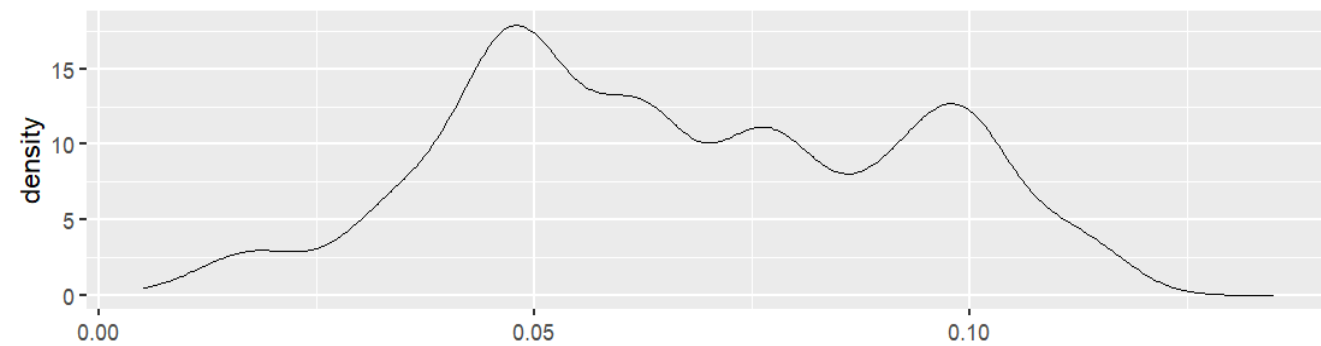- $n = 436{,}987$ EA3 excluding UK Biobank and 23andMe

EA3 excluding UK Biobank and 23andMe

- Ascertainment $n = 436{,}987$

- Stayers $n = 177{,}519$

- Movers $n = 152{,}227$

- $n = 2{,}525$ lead SNPs

- $p = 10^{-8}$ cut off value

- 1 extreme value was excluded
  (magnitude of effect size in Movers was > 3 and in Stayers was > 0.5)

rsID	Chr	BP	EA	OA	EAF	N	Z_unadj	P_unadj	Z	P	BETA	beta_movers_abs	beta_stayers_abs
rs3843954	13	58548511	C	G	0.299	303821	-7.14	9.362e-13	-6.911	4.819e-12	-0.0200069	3.18111	0.519066

Effect sizes larger in Movers than Stayers for EA3* SNPs
*excluding UK Biobank and 23andMe
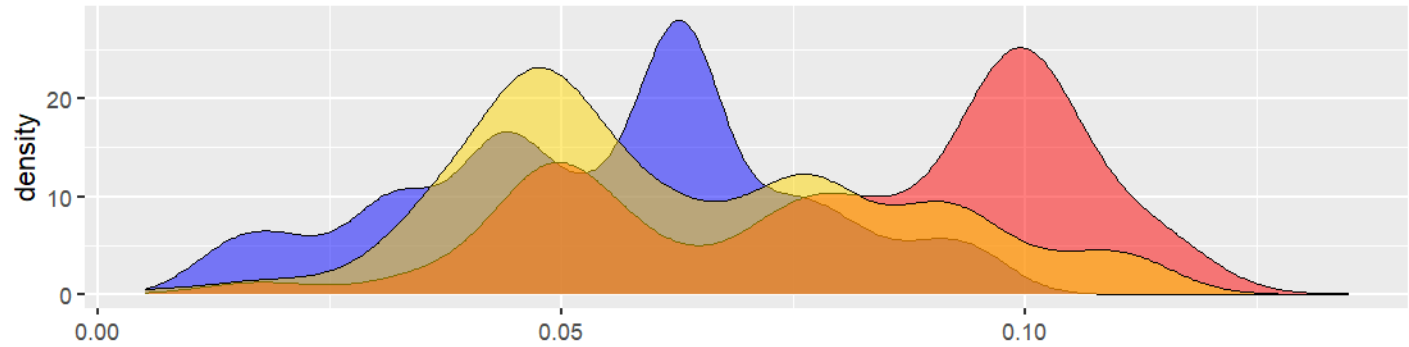
$y = 0.52353x + 0.06833$

Call:
lm(formula = beta_movers_sm ~ beta_stayers_abs, data = EA3_filter)

Residuals:
      Min   1Q   Median   3Q   Max
-0.142502 -0.023798 0.000322 0.022053 0.066548
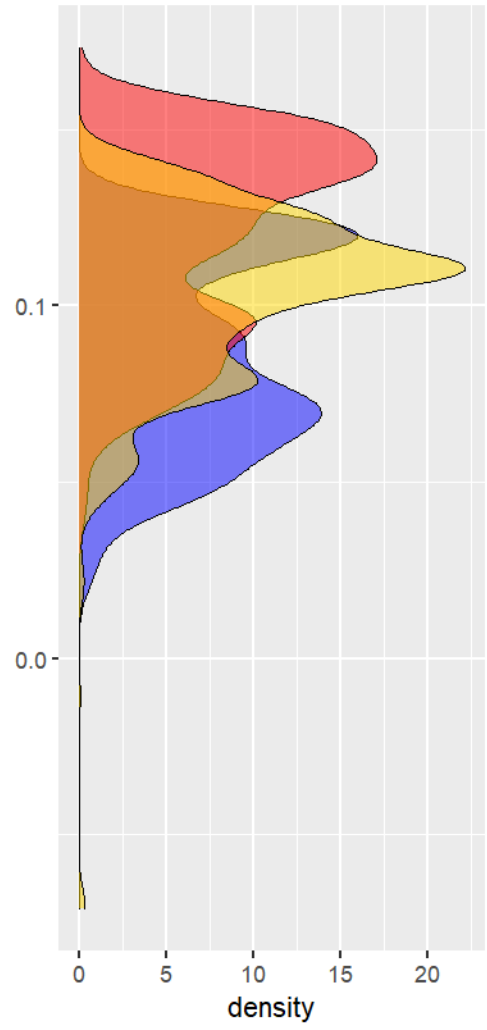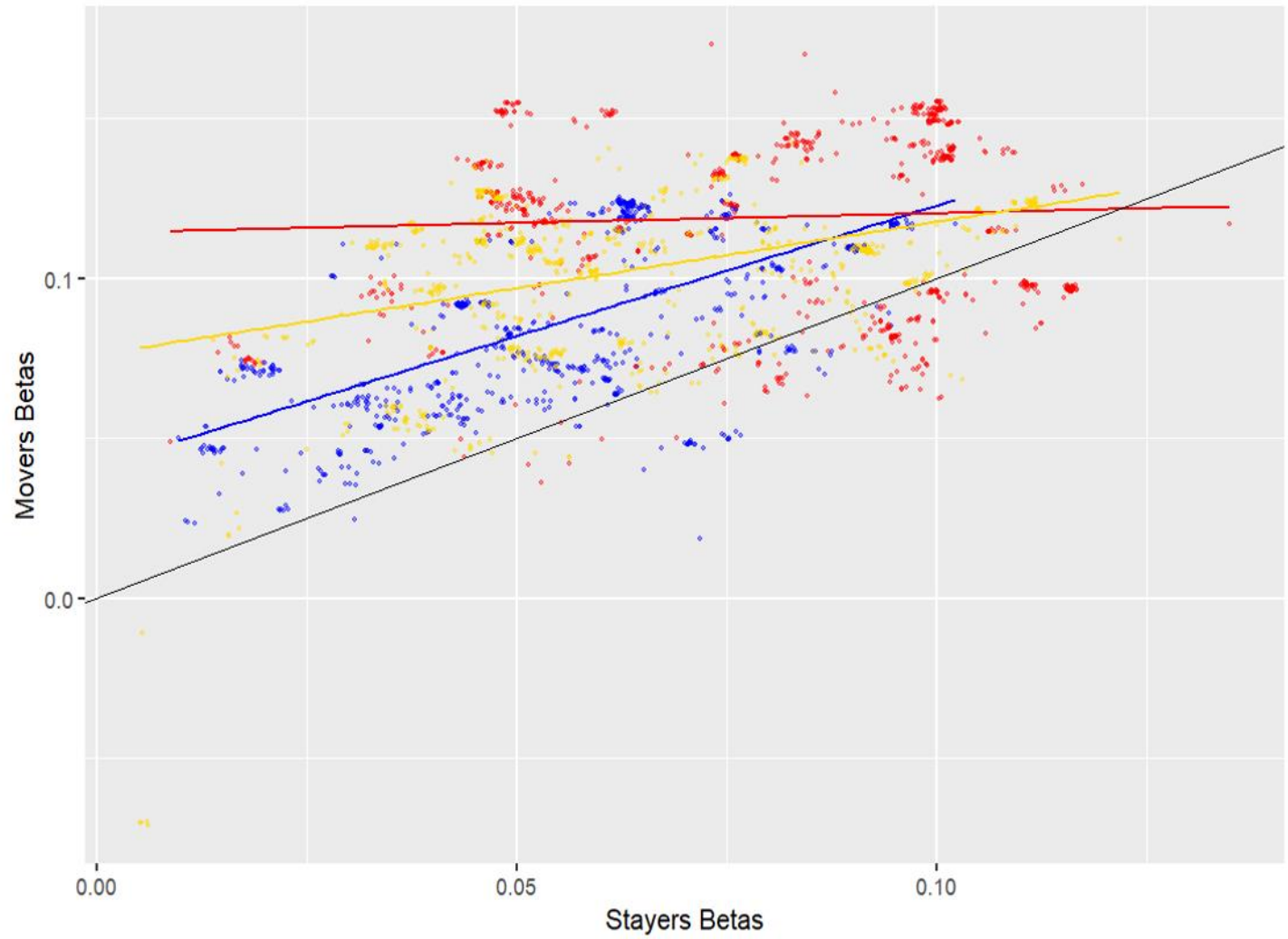
Coefficients:
                 Estimate Std. Error t value
(Intercept)   0.06833   0.00152   44.96
beta_stayers_abs 0.52353   0.02126   24.62
                 Pr(>|t|)
(Intercept)   <2e-16 ***
beta_stayers_abs <2e-16 ***

Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.02712 on 2523 degrees of freedom
Multiple R-squared: 0.1937,   Adjusted R-squared: 0.1934
F-statistic: 606.1 on 1 and 2523 DF, p-value: < 2.2e-16

Color	EA3 β value
Red	$0.02 < \beta < 0.035$
Yellow	$0.0165 < \beta < 0.02$
Blue	$\beta < 0.0165$

Movers population appears to be more similar to EA3* population.

*excluding UK Biobank and 23andMe

Further Investigations

- *Since the Stayers population in the UK Biobank is more distinct from the EA3 population, using significant SNPs from Stayers could aid in uncovering a broader set of loci associated with educational attainment.*
-Ian

- *Hidden stratification exists within the "homogeneous" white British ancestry population within the UKB, and that one way to reveal that stratification is by partitioning into movers and stayers.*
-Ian

- *Beyond stratification, another mechanism for ascertainment bias here that comes to mind is genetic associations with EA being highly contingent on environment, through GxE or rGE or GxExExGxE; and that the environment of movers (e.g. parental SES) is more similar to EA3 individuals.*
-Arbel

- *Further investigate ways to compare the similarities between EA3 and Movers data (more partitions for marginal densities, compare marginal densities of effect sizes for a larger cut off than 10^{-8}).*
-Amber