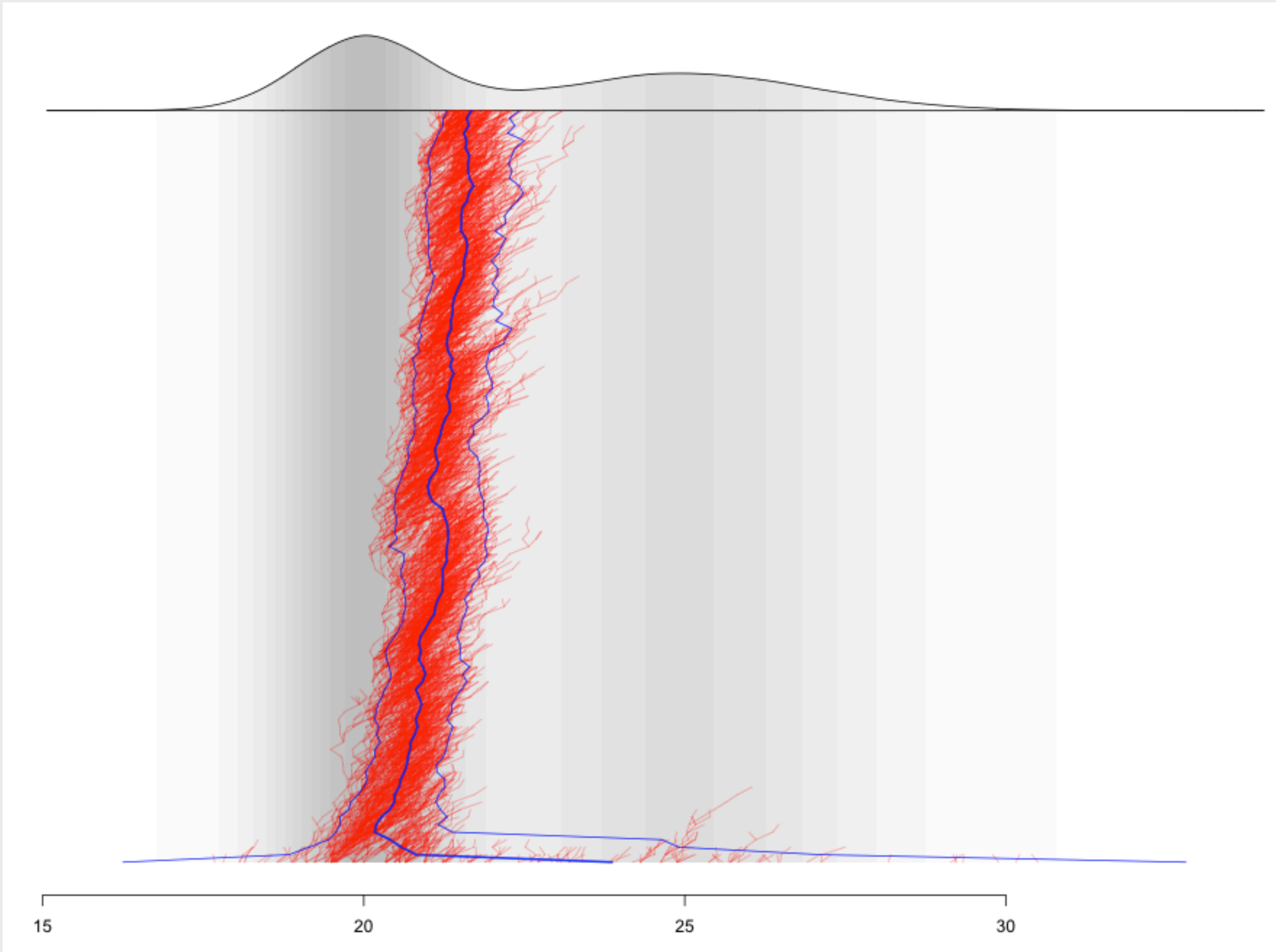
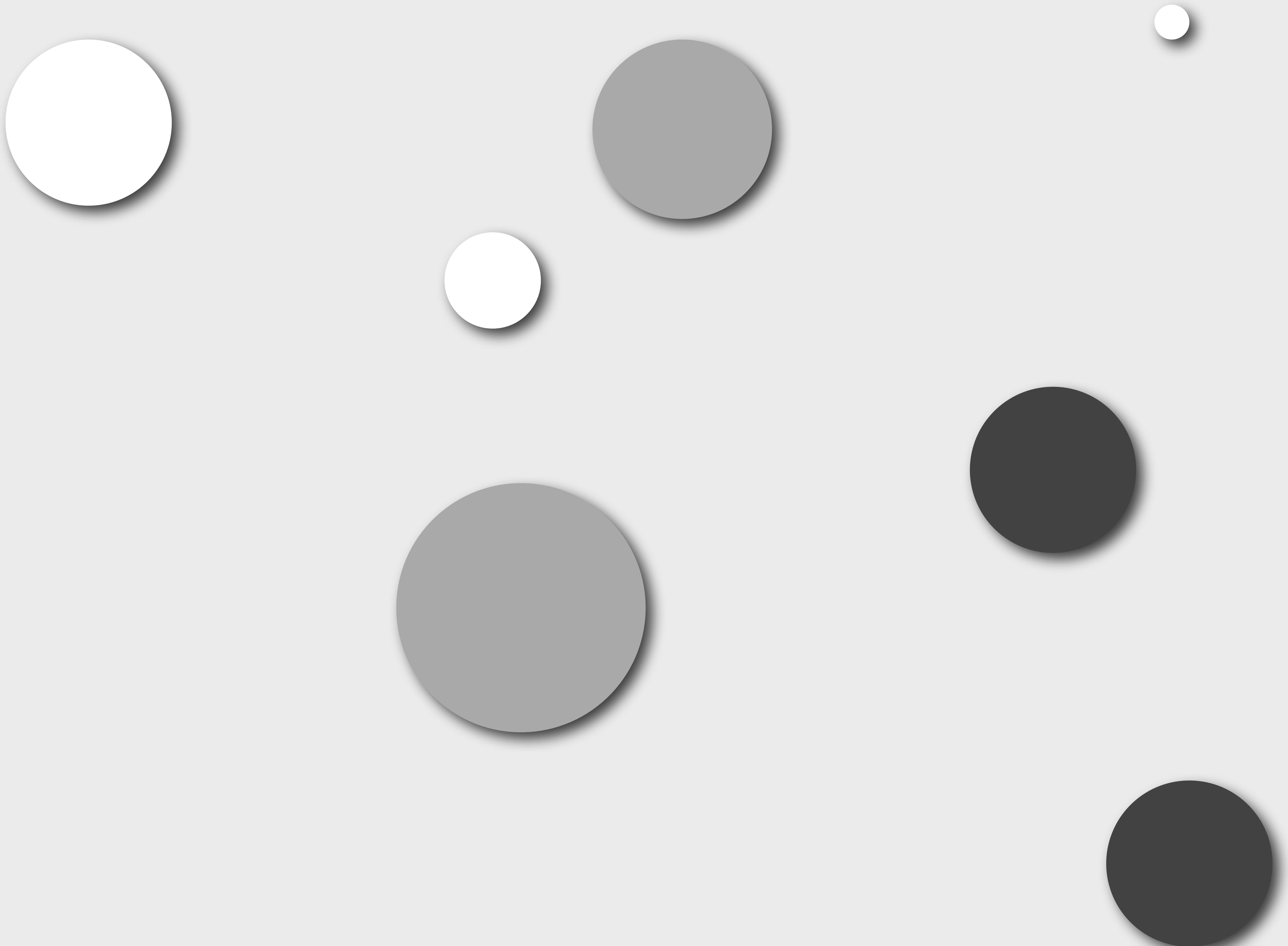
Natural Selection



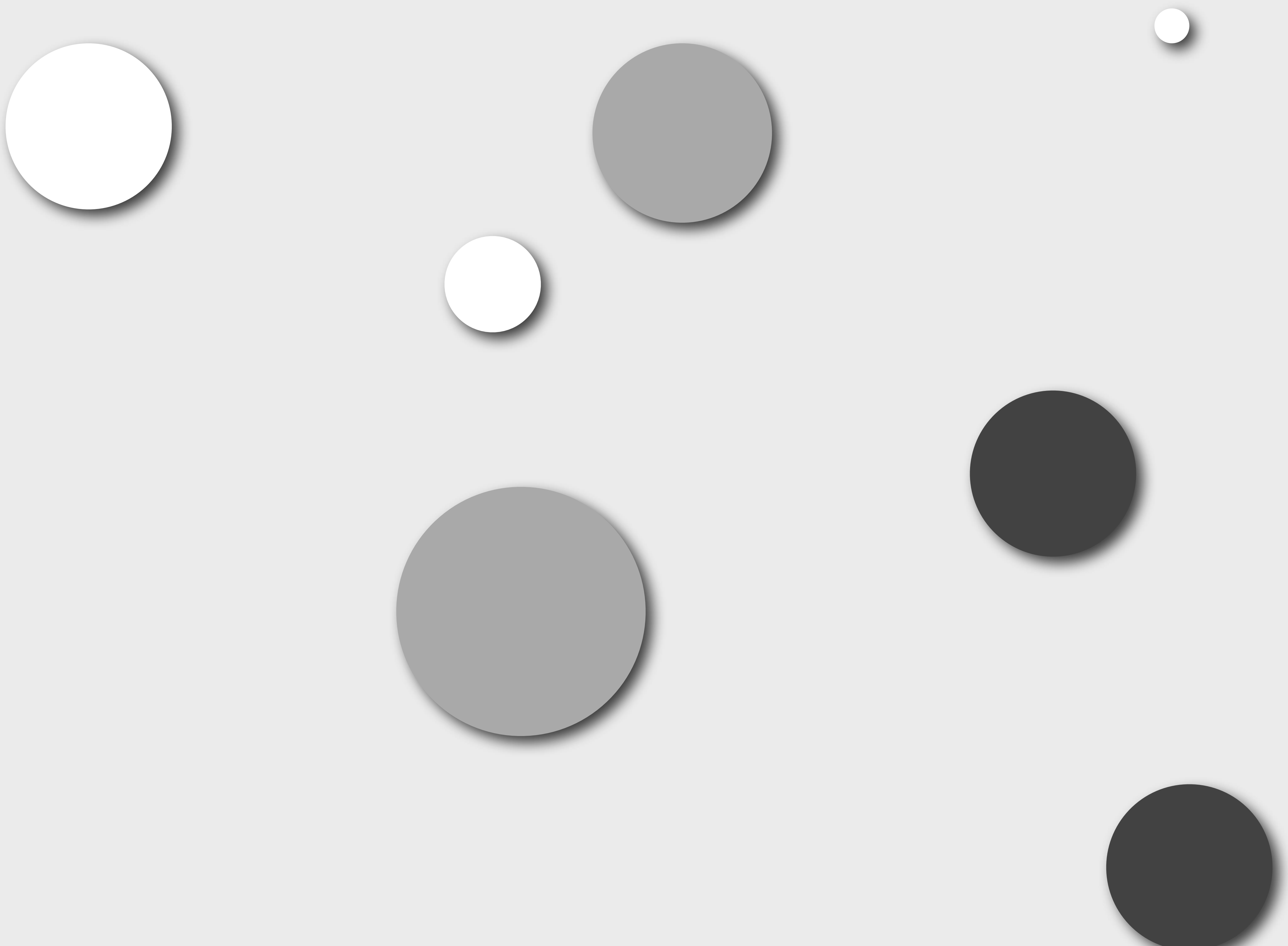
Brian O'Meara

EEB464 Fall 2011

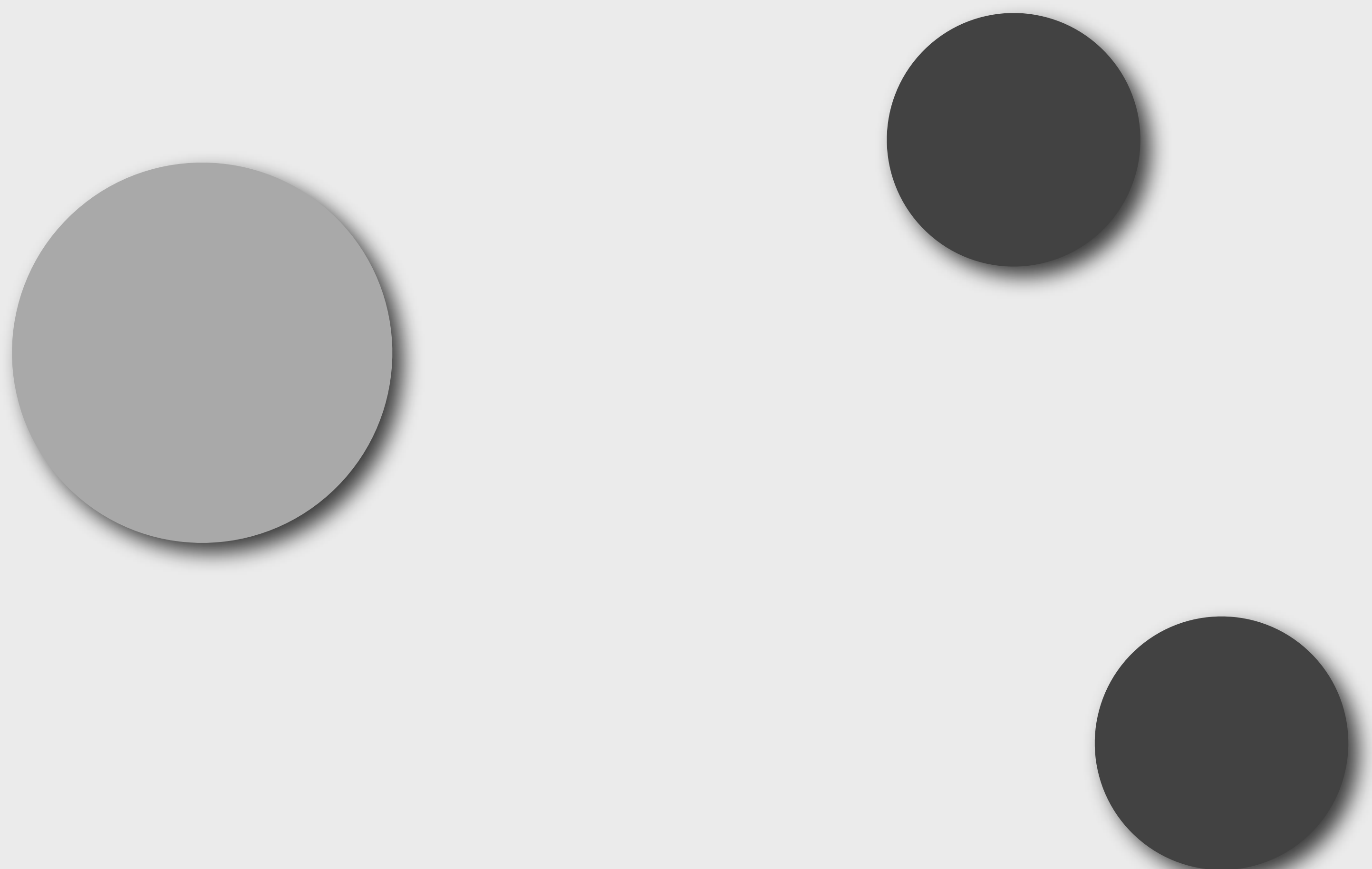
Variation

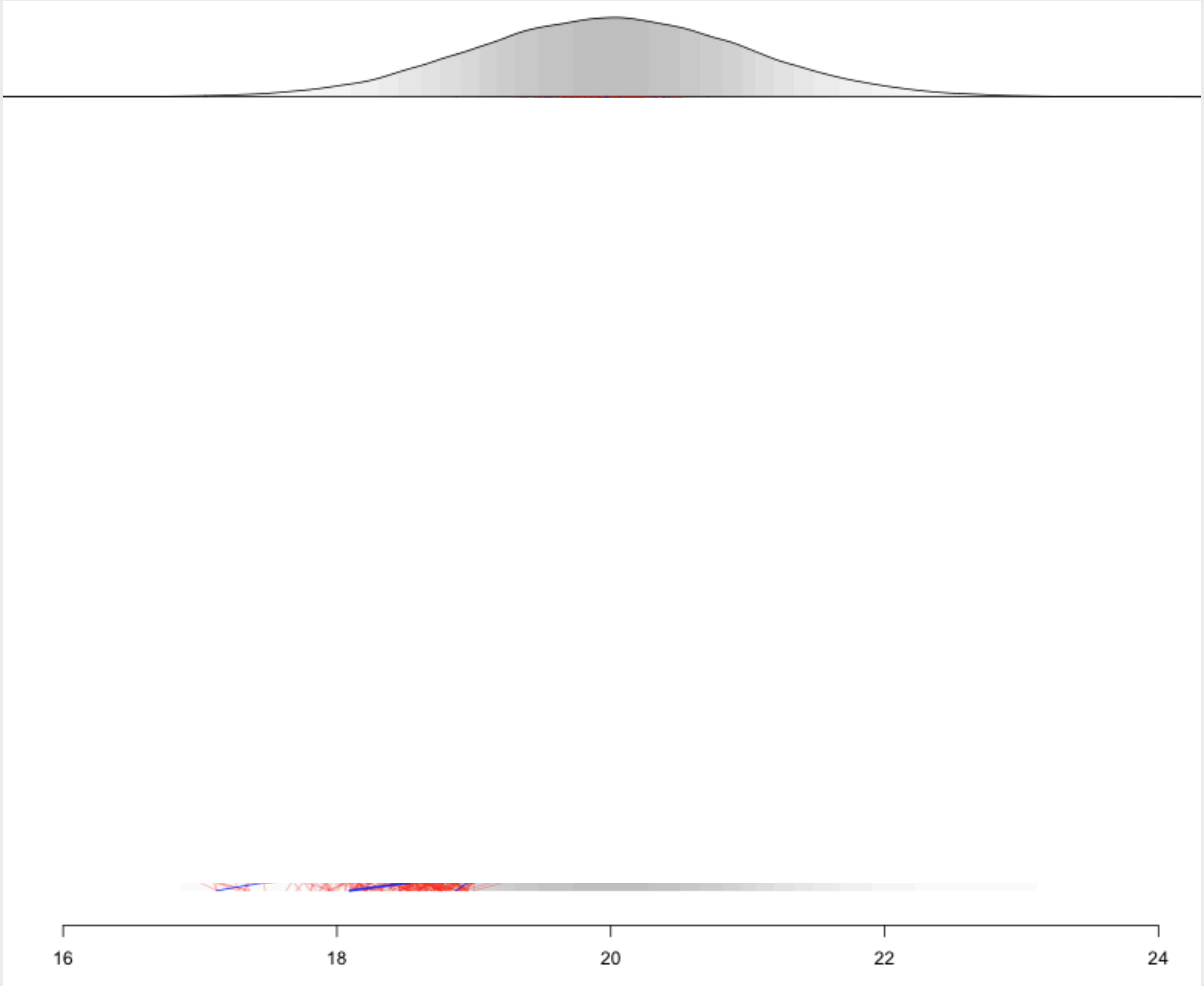


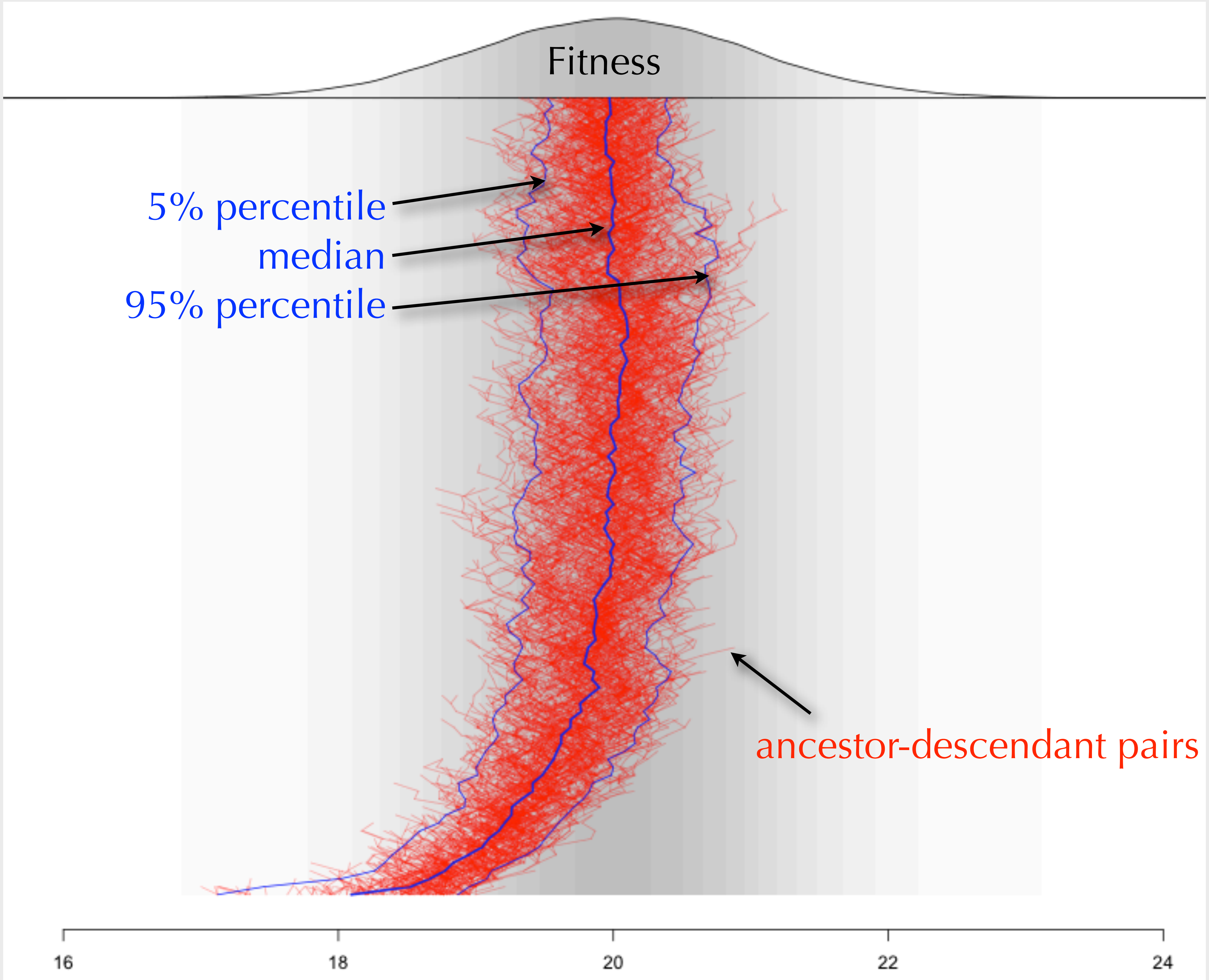
Selection

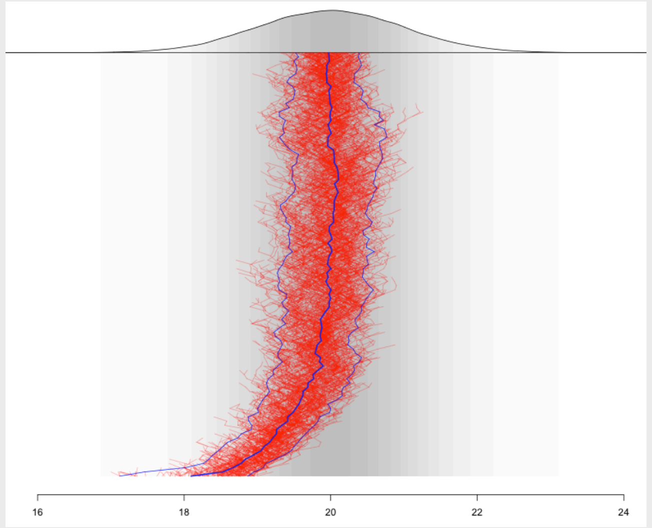


Reproduction
(with heritable traits, and some variation)




16
18
20
22
24


Fitness
5% percentile
median
95% percentile
ancestor-descendant pairs
16
18
20
22
24



Try giving parameters to model:

- Mutation selection balance
- Multiple optima
- Drift only
- Etc.

Balancing selection: selection maintaining diversity

Balancing selection: selection maintaining diversity

Heterozygote advantage

Malaria

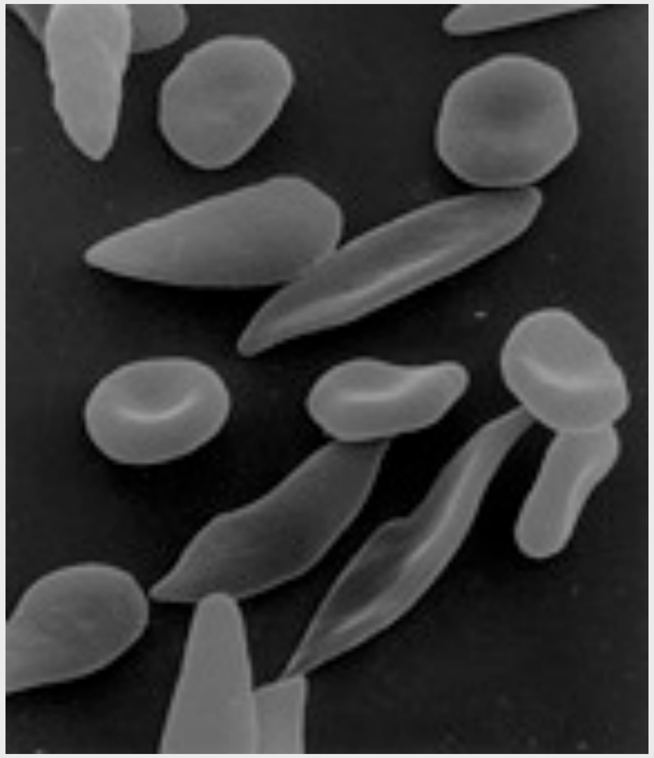
aa

Aa + Aa

Sickle cell anemia

AA

aa Aa Aa AA



Balancing selection: selection maintaining diversity

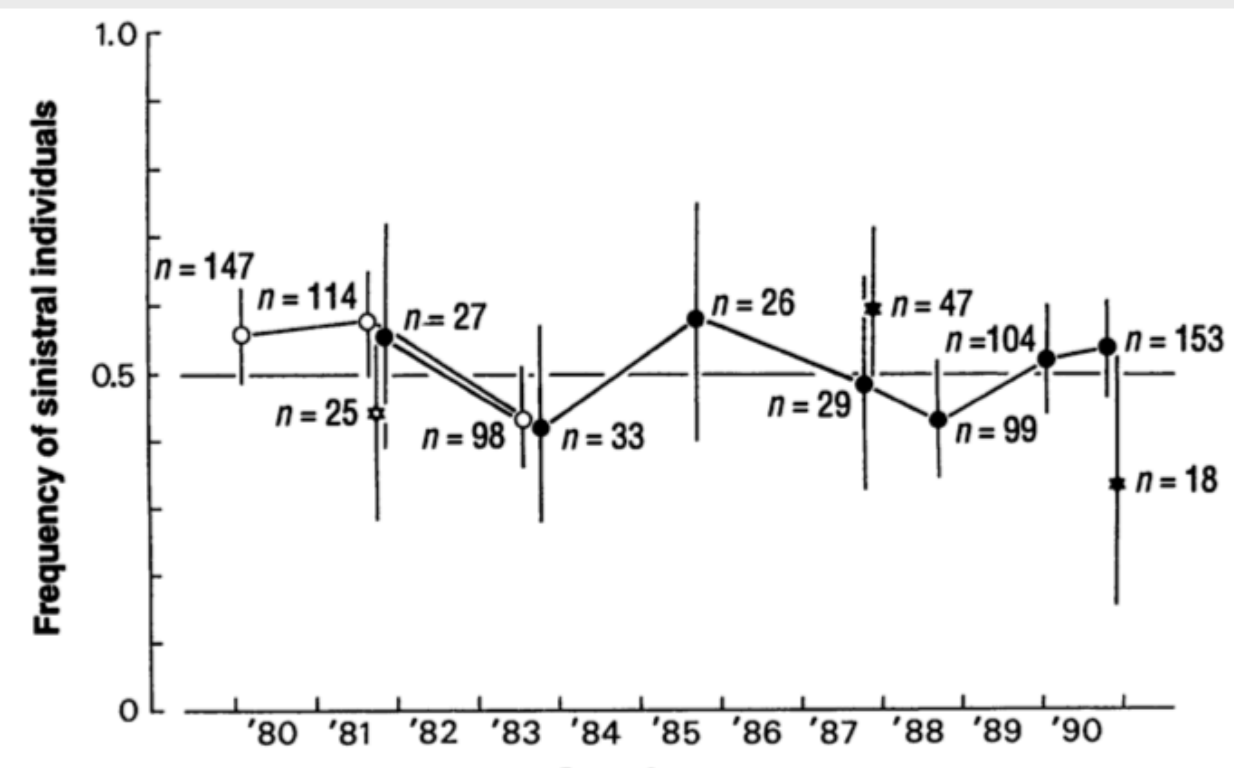
Frequency-dependent selection

Table 1. Correspondence between the handedness of *P. microlepis* and the flank of prey attacked. This experiment was done under natural conditions with adults of *Cyathopharynx furcifer*, an abundant and common prey species of *P. microlepis* (*13*), as lures. Each live *C. furcifer* individual was connected by a hook to a fishing line and allowed to swim; each *P. microlepis* that attacked the lure was caught by gill net.

Handedness of *P. microlepis*	Observations (*n*)	Attacks on flank (*n*)	
		Right	Left
Dextral	4	0	4
Sinistral	9	9	0

Table 2. Occurrence of right and left pored scales in the stomach of *P. microlepis*. The handedness of scales was determined under a binocular microscope on the basis of the shape of the exposed granulated portion and the number of basal ridges in the upper and lower parts separated by the mucous tube. Unknown scales are those misshapen as a result of partial digestion and those of abnormal shape.

Handedness of *P. microlepis*	Fish (*n*)	Pored scales (*n*)		
		Right	Left	Unknown
Dextral	32	0	139	31
Sinistral	24	76	0	23



Hori 1993

Note story is more complex than this: Palmer (2010)

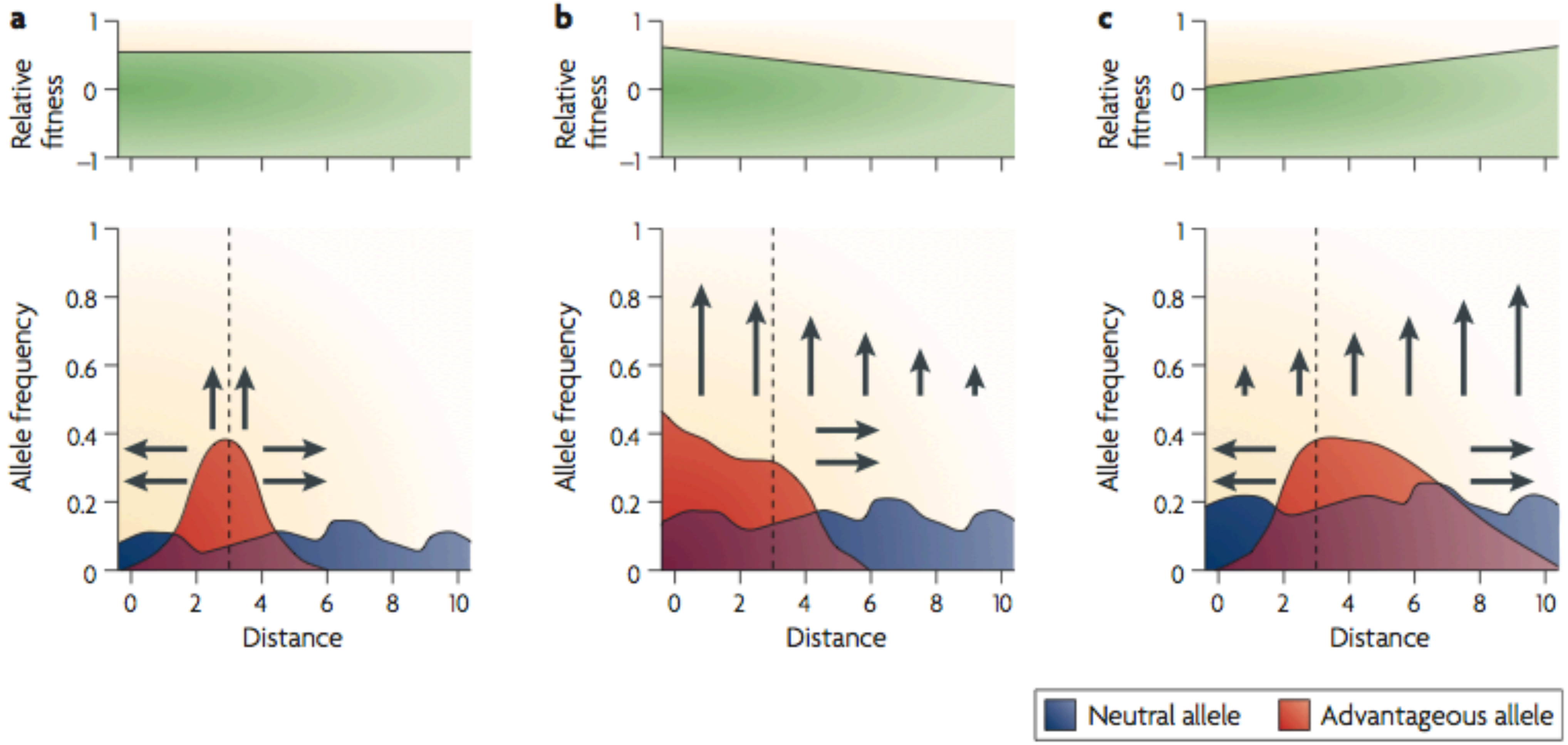


Figure 1 | **The 'wave of advance' spread of a globally advantageous mutation.** Arrows indicate how the allele frequencies of a selected allele (red) are expected to change over time, depending on the pattern of selective advantage of the allele (indicated in green above each graph). Vertical arrows represent the expected magnitude of increase due to selection. Horizontal arrows represent how dispersal homogenizes allele frequencies across space. For every selected allele, a representative neutral allele (blue) of similar average frequency is shown for comparison. In each case the allele arose at location 3 on the x axis (marked with a vertical dashed line); the spread will continue until the selected allele is at frequency 1 across the whole habitat. **a** | Uniform selective advantage across space. If the new variant is identically advantageous everywhere, then as the variant increases in frequency it will become exceptionally concentrated around its geographic origin relative to a neutral variant of the same age. One effect of this is the creation of transiently enhanced levels of divergence among populations and clines in allele frequencies that reflect the geographic origin of the allele. **b**,**c** | Non-uniform advantage across space. In scenario **b**, the novel allele is introduced to the regions in which it is most advantageous and rapidly increases in frequency in those regions. This can lead to transient correlations between allele frequency and the environmental factor that drives positive selection. By contrast, in scenario **c**, the novel allele arises in an area distant from where it is most advantageous. It will increase in frequency locally before spreading outwards, and its distribution will carry a strong signature of its geographic origin and be less reflective of spatial variation in selective advantage. These models assume selection acting on new mutations, which may not be the prevailing scenario in humans. Selection on pre-existing variation will complicate these simple scenarios.

Novembre and Rienzo. Spatial patterns of variation due to natural selection in humans. Nature Reviews Genetics (2010) vol. 10 (11) pp. 745-755

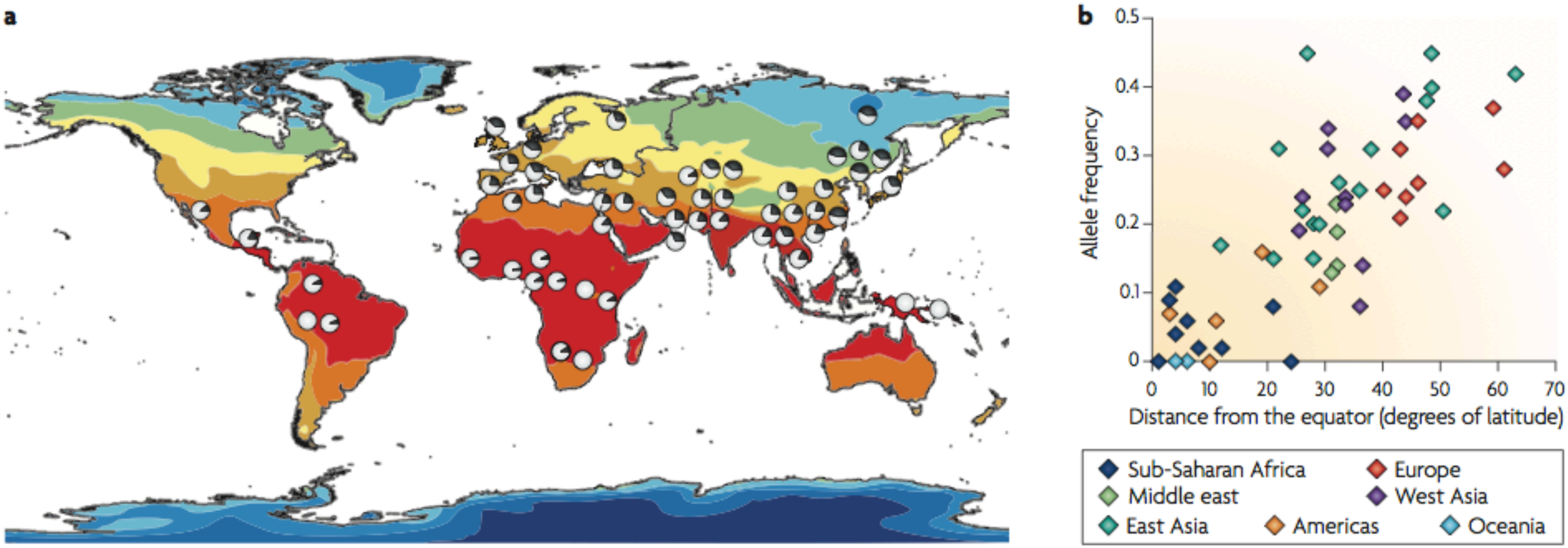


Figure 5 | **Correlation of a SNP in the *RPTOR* gene with environmental variables. a** | Pie charts show the frequency of the derived allele at SNP rs12946049 in the *RPTOR* gene in the Human Genome Diversity Project panel[53]. The colours, ranging from dark blue (cold) to red (hot), represent the maximum temperature in the winter. **b** | Allele frequency at rs12946049 as a function of distance from the equator. Qualitatively, the correlation is convincing for two reasons. First, the variation correlates strongly with an environmental feature in ways that depart from background spatial patterns (for example, distantly related populations in the tropical Americas, Oceania and sub-Saharan Africa share the same environment and have similar allele frequencies). Second, the correlation exists in multiple world regions. Figure is modified from REF. 53.

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Table 1: Linear selection gradients on male wealth or male hunting ability across 11 different human societies

Characteristic, source	Population	Measurement	β	Comment
Male wealth:				
Borgerhoff Mulder 1987	Kipsigis agriculturalists	Land ownership	.68	Weighted mean for two oldest cohorts
Cronk 1991	Mukugodo pastoralists	Livestock	.58	Controlling for age
Røskaft et al. 1992	Norwegian farmers, 1700–1900	Agricultural resources	.32	From table 2
Clark and Hamilton 2006	English testators, 1540–1850	Assets in will	.18	Data (including some not in article) supplied by G. Clark; assets log transformed
Mealey 1985	Nineteenth-century Mormons	Wealth	.23	Middle value from three cohorts reported
Hopcroft 2006	Contemporary United States	Income	.12	Controlling for age
Fieder and Huber 2007	Contemporary Sweden	Income	.17	Number of children square-root transformed
NCDS data (this article)	Contemporary Britain	Income	.10	Income log transformed
Male hunting ability:				
Kaplan and Hill 1985	Aché	Hunting ability (weighed returns)	.31	From data in table 1 controlling for age
Marlowe 1999	Hadza	Hunting ability (ranked by peers)	.36	Controlling for age
Gurven and von Rueden 2006	Tsimane	Amount of meat acquired (kg)	.22	Controlling for age

Nettle and Pollet. Natural selection on male wealth in humans. Am Nat (2008) vol. 172 (5) pp. 658-66

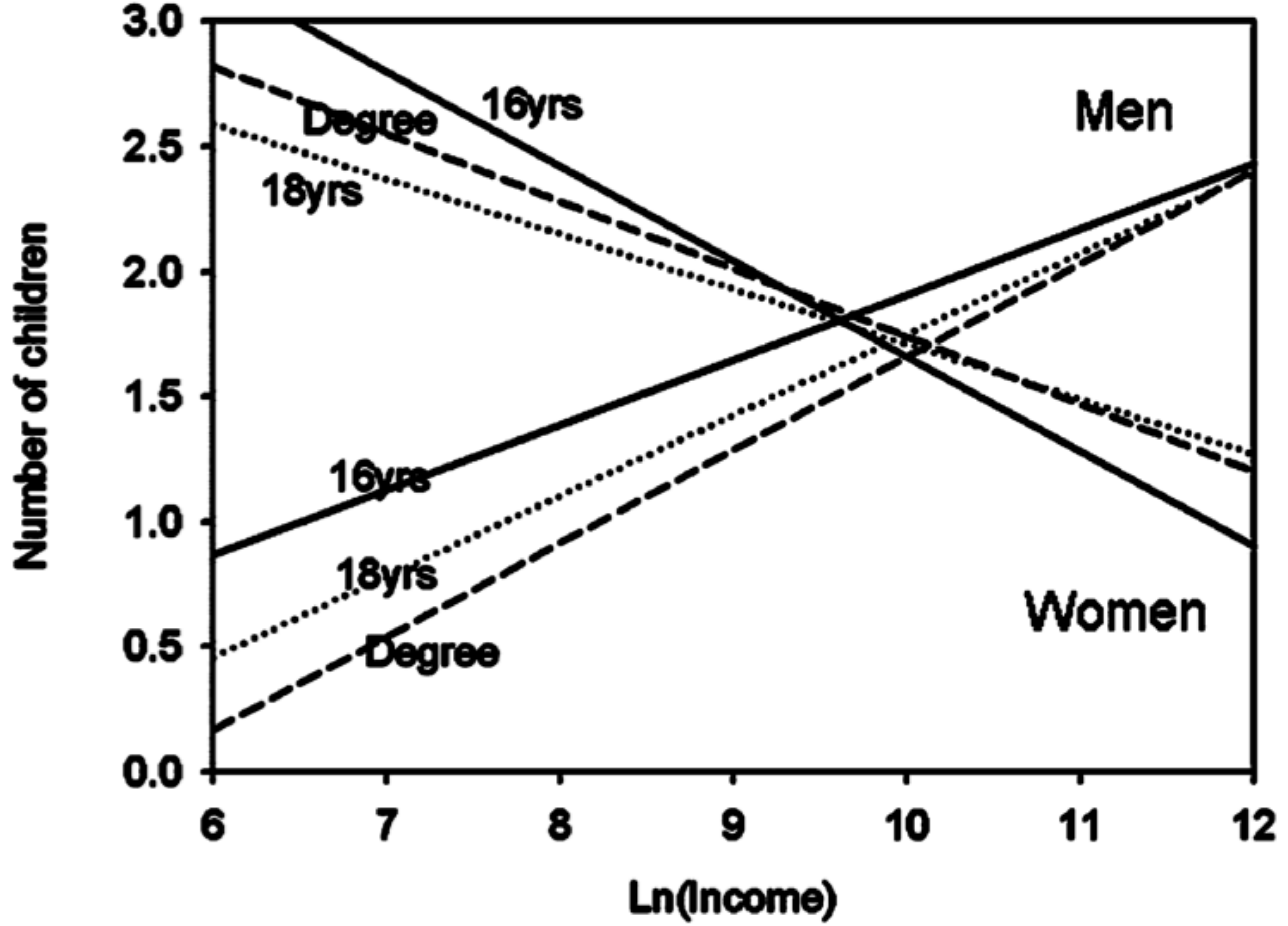

Figure 1: Plot of best-fit linear regression equations of number of children against natural log of income (ln[income]), National Child Development Study data, for men and women of different education groups.

Nettle and Pollet. Natural selection on male wealth in humans. Am Nat (2008) vol. 172 (5) pp. 658-66