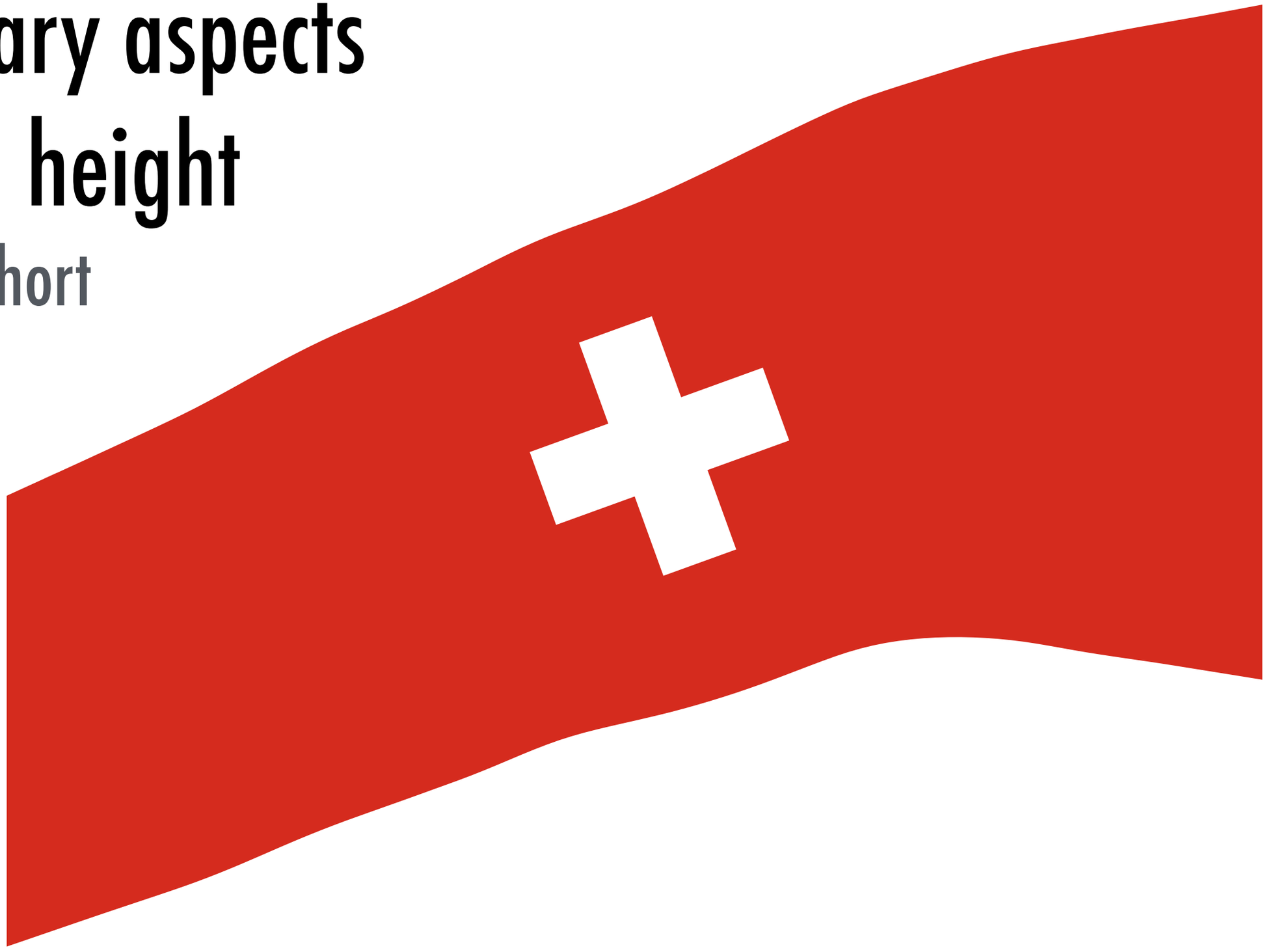
Evolutionary aspects of human height

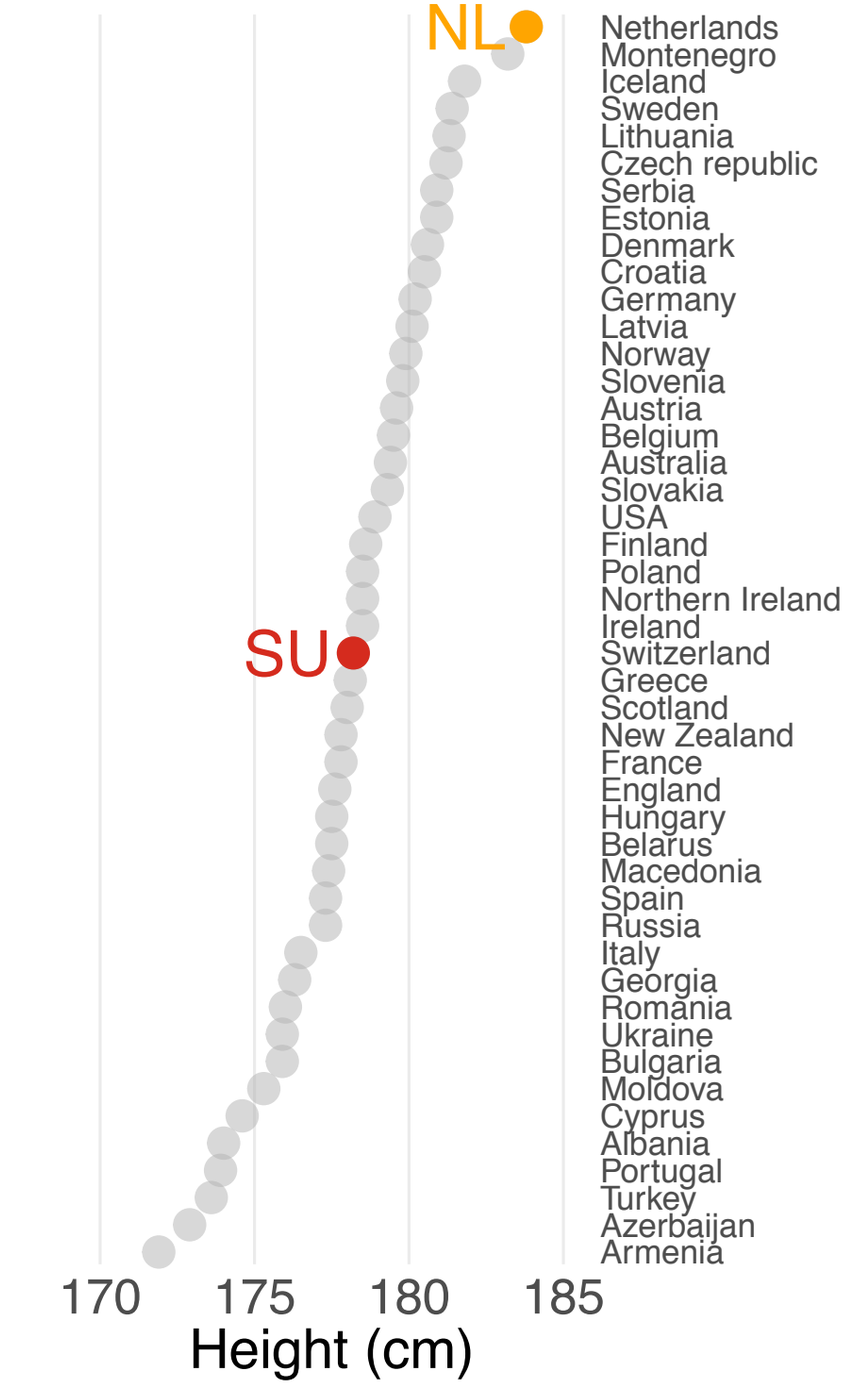
a long story short



gert stulp
g.stulp@rug.nl
www.gertstulp.com

university of groningen / faculty of behavioural and social sciences / sociology

NWO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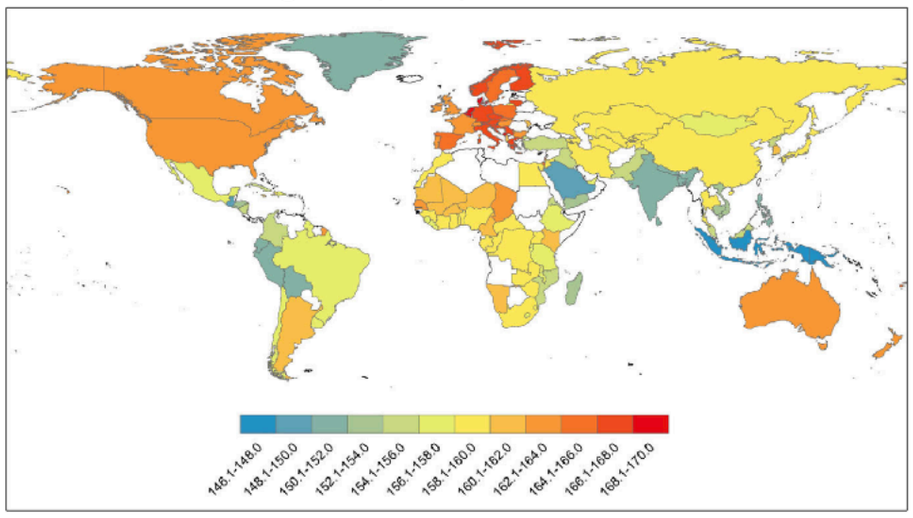
Height (cm)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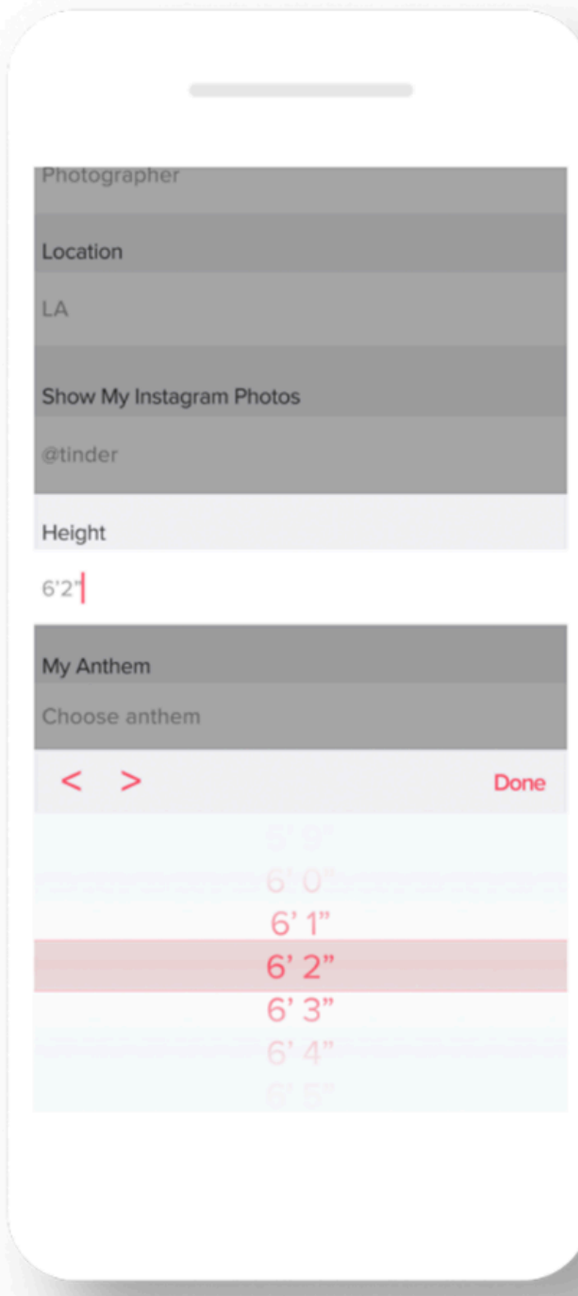
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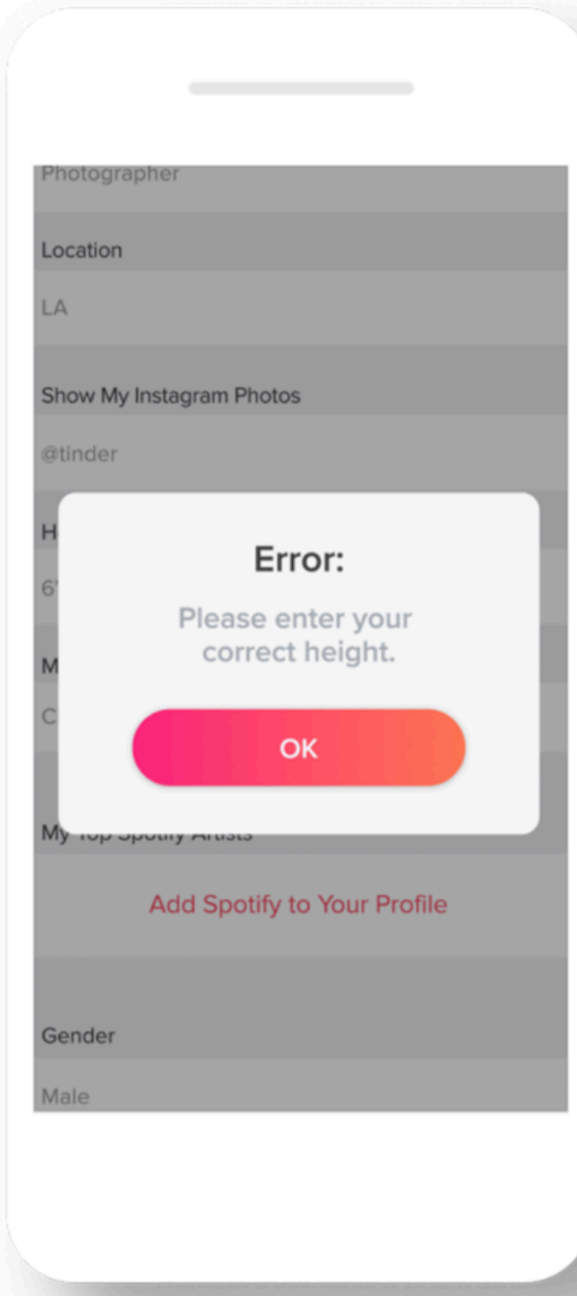
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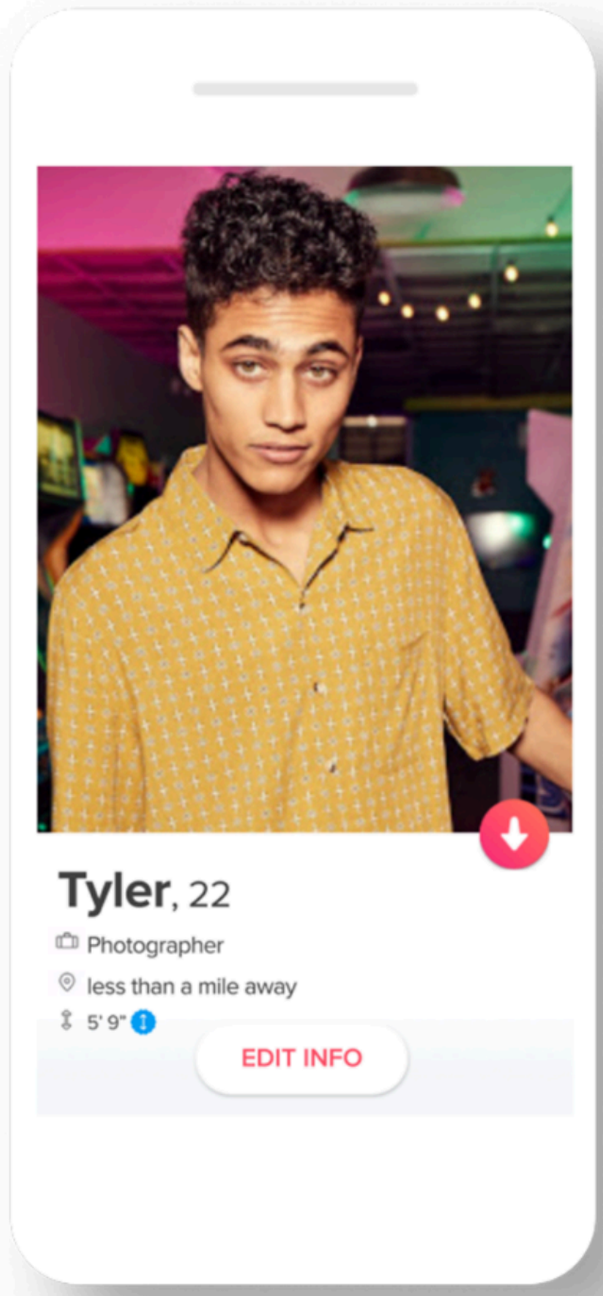
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less than a mile away
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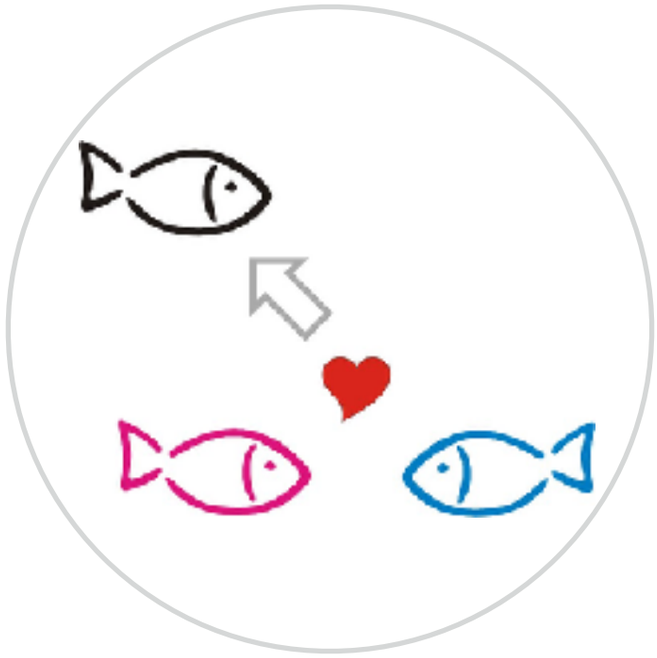


to
choice

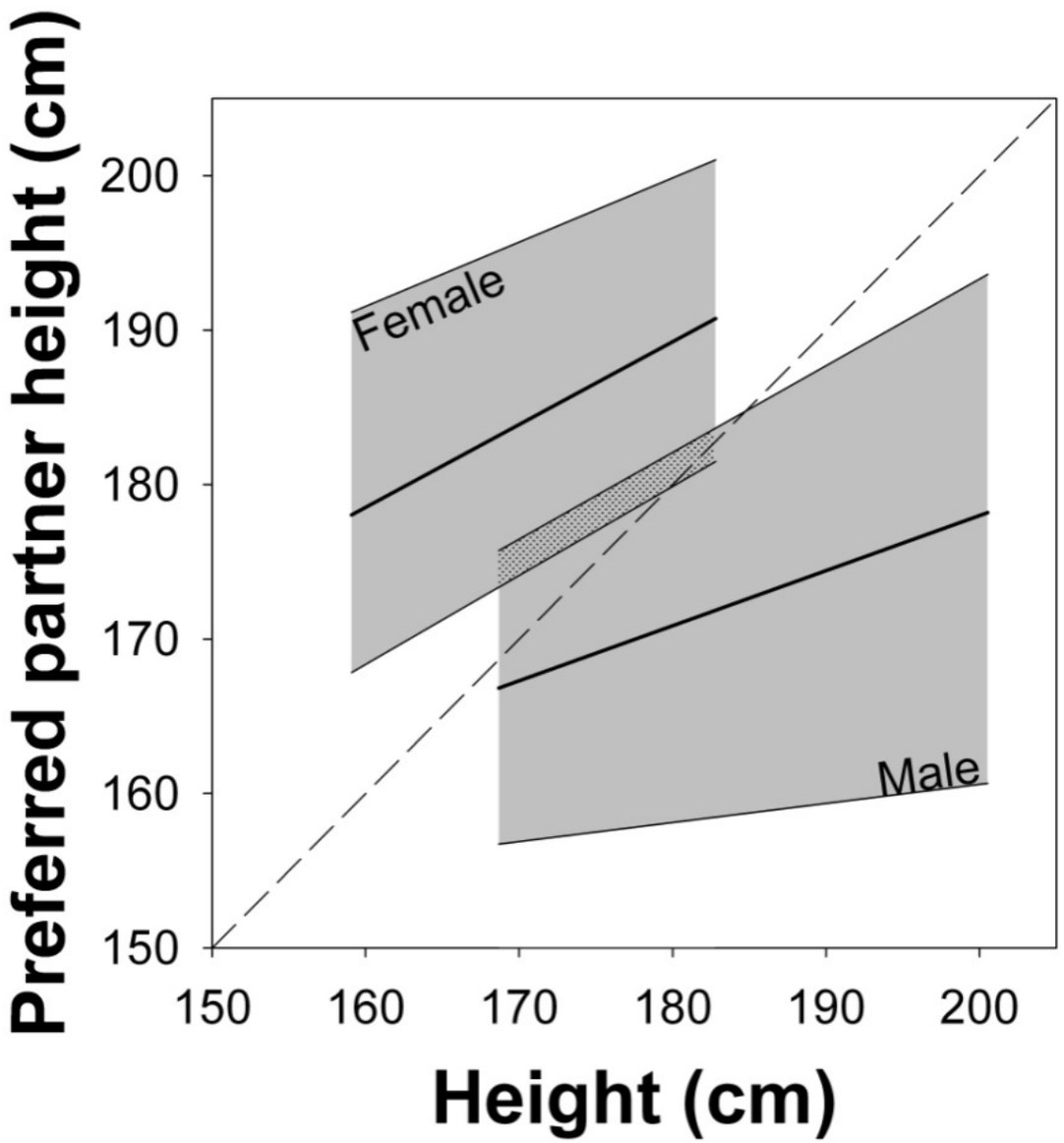
to
pairing

Evolutionary
Psychology

vs

Behavioural
Ecology

PREFERENCES FOR HEIGHT



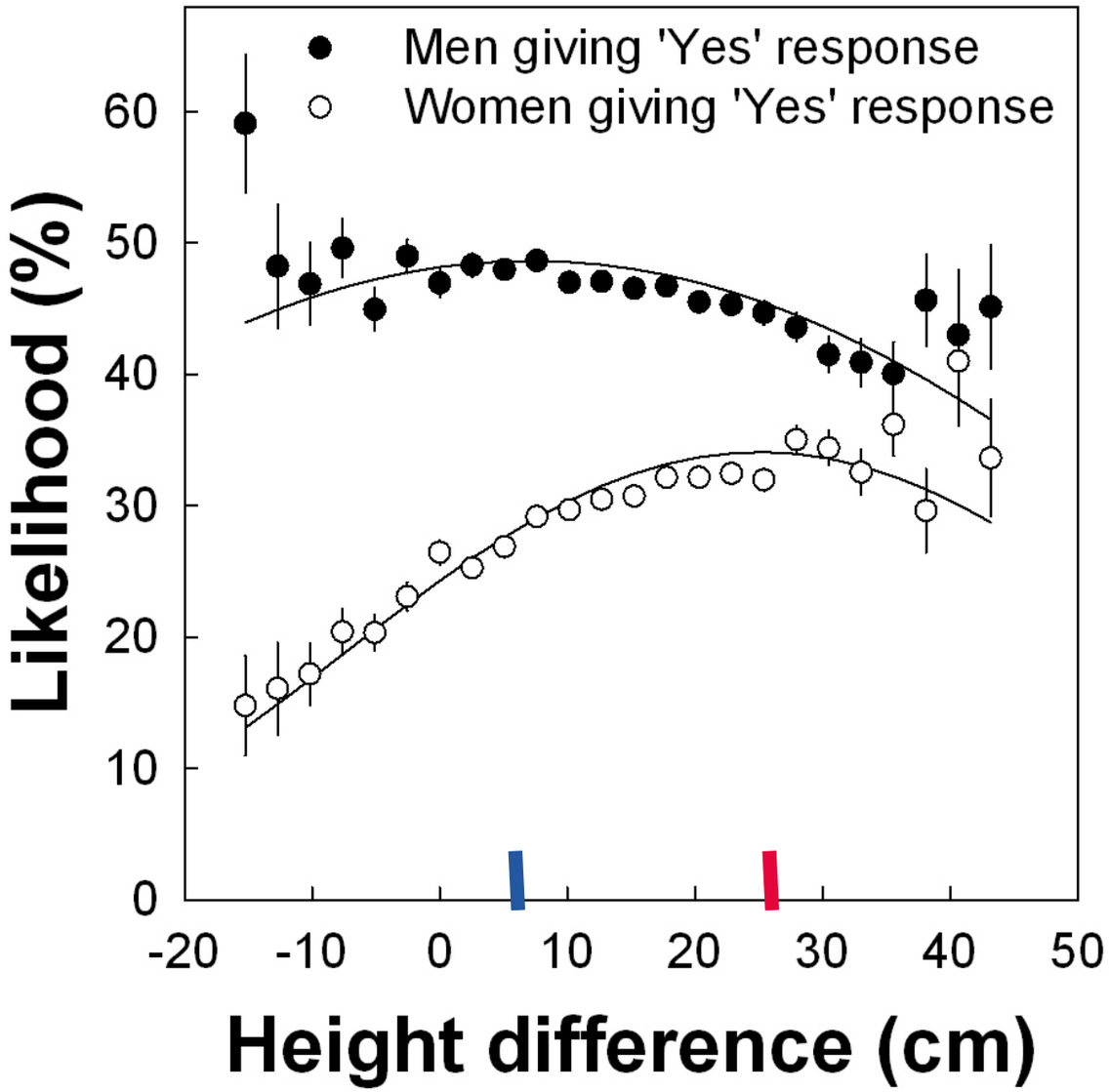
~700 Dutch psychology students
Stulp et al 2013, PAID

consistent findings on preferences for partner height:

1. assortative preference
2. male-taller preference
3. male-not-too tall preference

weak preference:
minimally and maximally 'accepted' height range very large

CHOICE FOR HEIGHT

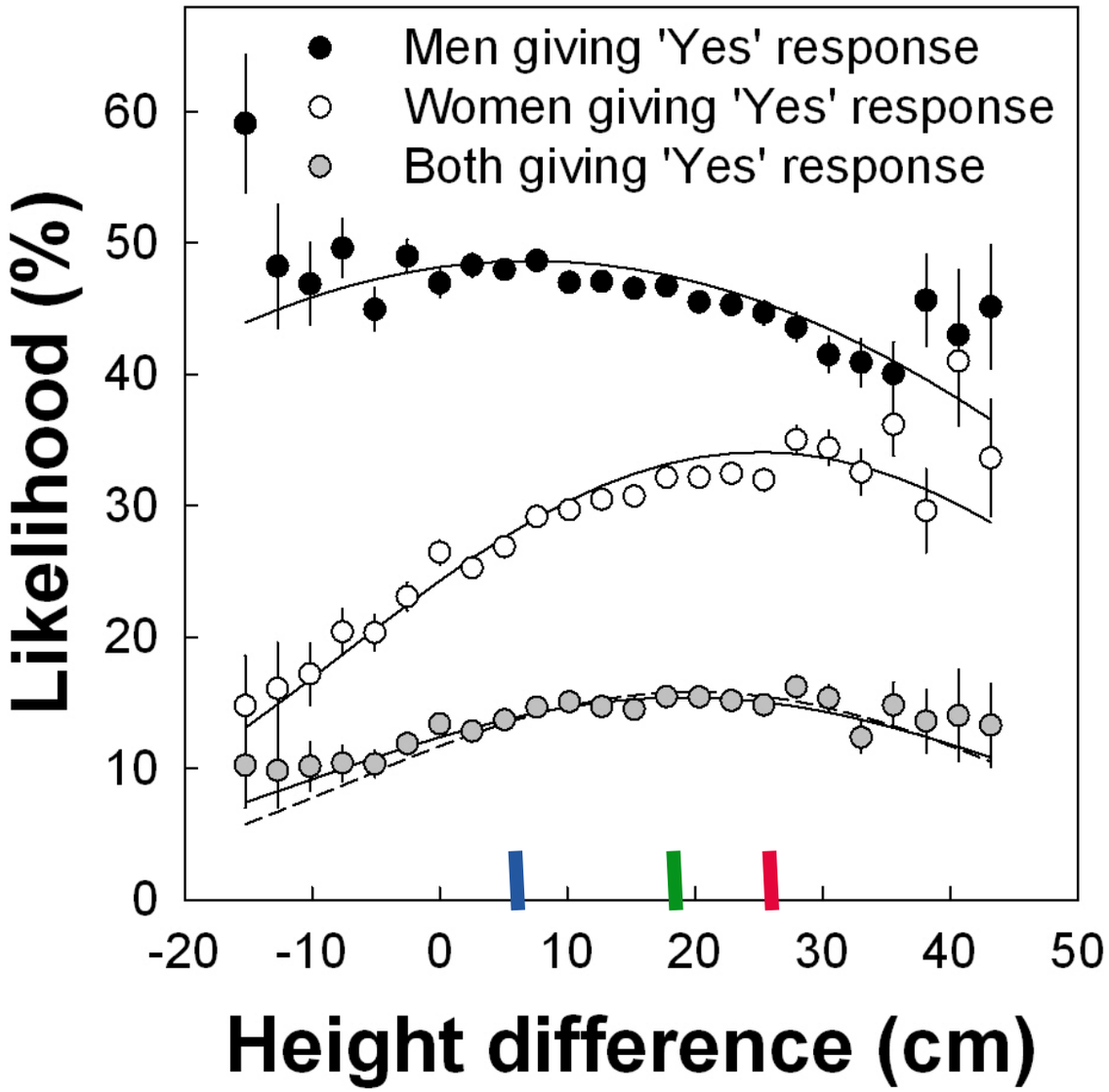


~5000 US speeddaters
Stulp et al 2013, AB

in speeddating:

- women were most likely to say ‘yes’ to men who was 25.3 cm taller
- men were most likely to say ‘yes’ to women who was 6.6 cm shorter
- mate choice conflict!

PAIRING FOR HEIGHT



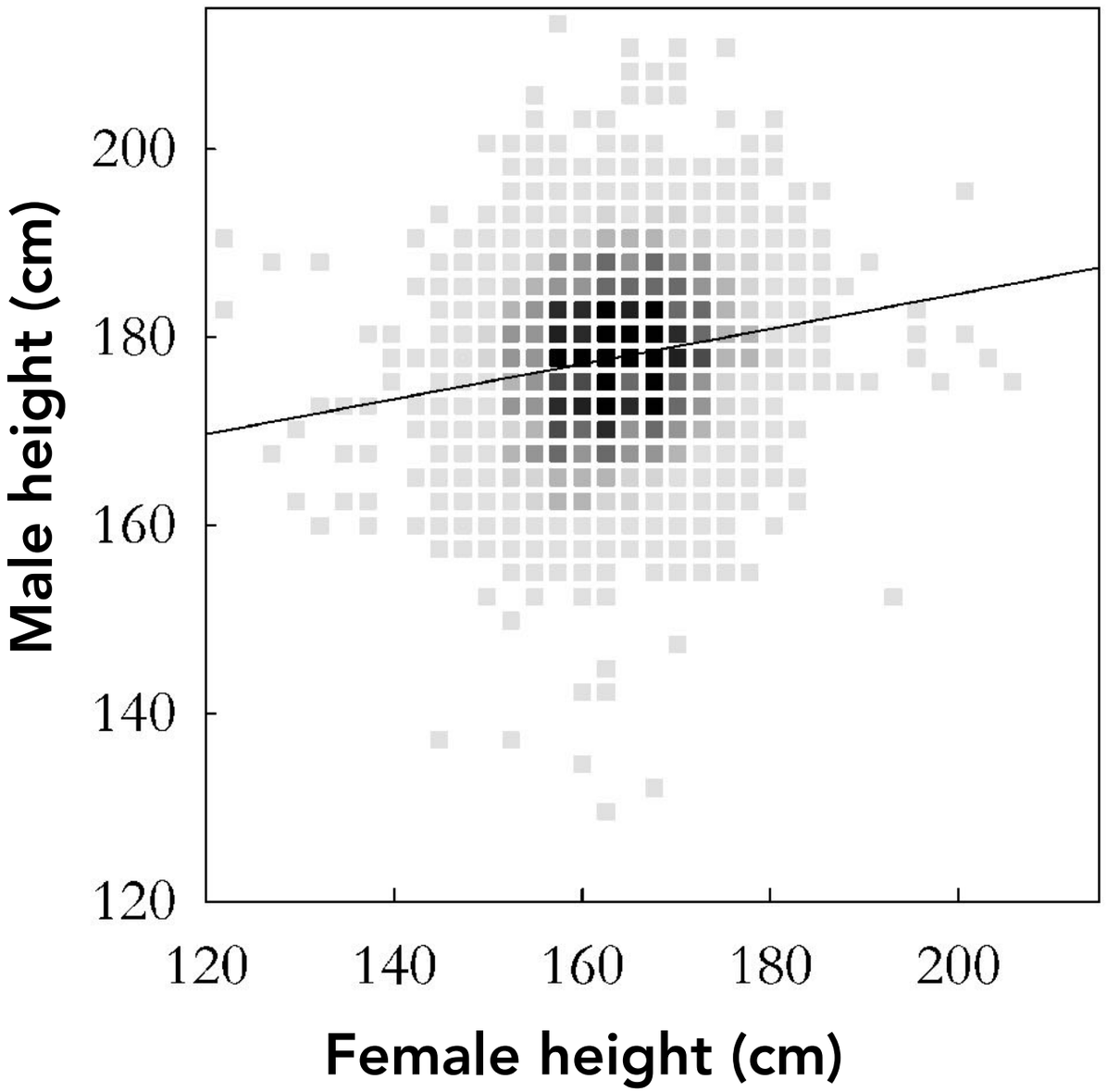
~5000 US speeddaters
Stulp et al 2013, AB

in speeddating:

- women were most likely to say ‘yes’ to men who was 25.3 cm taller
- men were most likely to say ‘yes’ to women who was 6.6 cm shorter
- mate choice conflict!

- pairing (both ‘yes’) most likely when the men was 19.6 cm taller
  suboptimal for both sexes

PAIRING FOR HEIGHT



12,502 British parents, MCS
Stulp et al 2013, PLOS

in couples:

1. assortative mating (r = 0.2)
   weaker than preferences
   need not be because of preferences
2. male-taller norm
   7.5% vs 10.2%
3. male-not-too tall norm
   13.9% vs 15.7% >25cm difference

- preferences align with pairing, but effects are weak

IS HEIGHT IMPORTANT IN MATE CHOICE?

YES

- people have specific preferences
- women's preferences a bit stronger
- preferences lead to choice lead to pairings
- height is associated with partnerships

NO

- preferences are weak
- height is weakly associated with partnerships
- preference studies and speeddating artifical settings
- you can put a number on it

IS HEIGHT IMPORTANT IN MATE CHOICE?

NO

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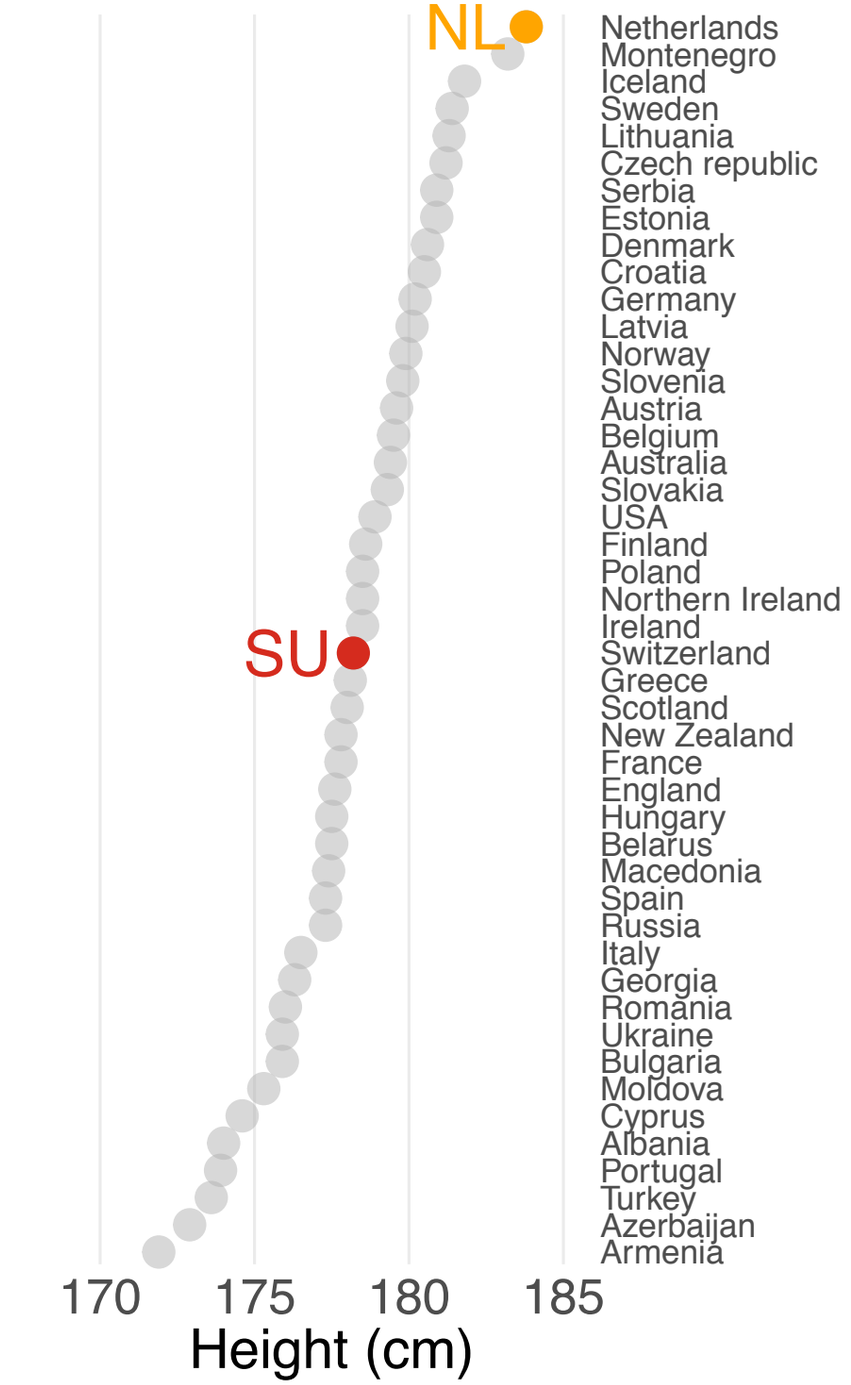
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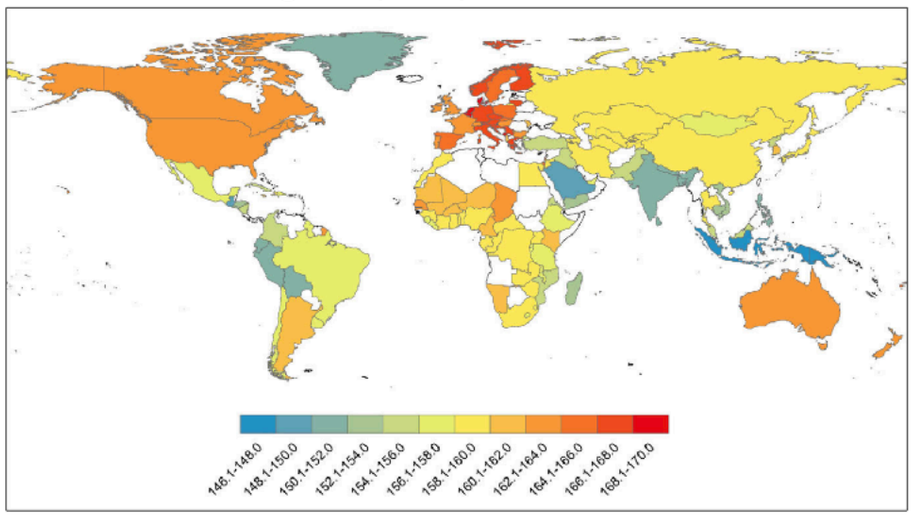
Height (cm)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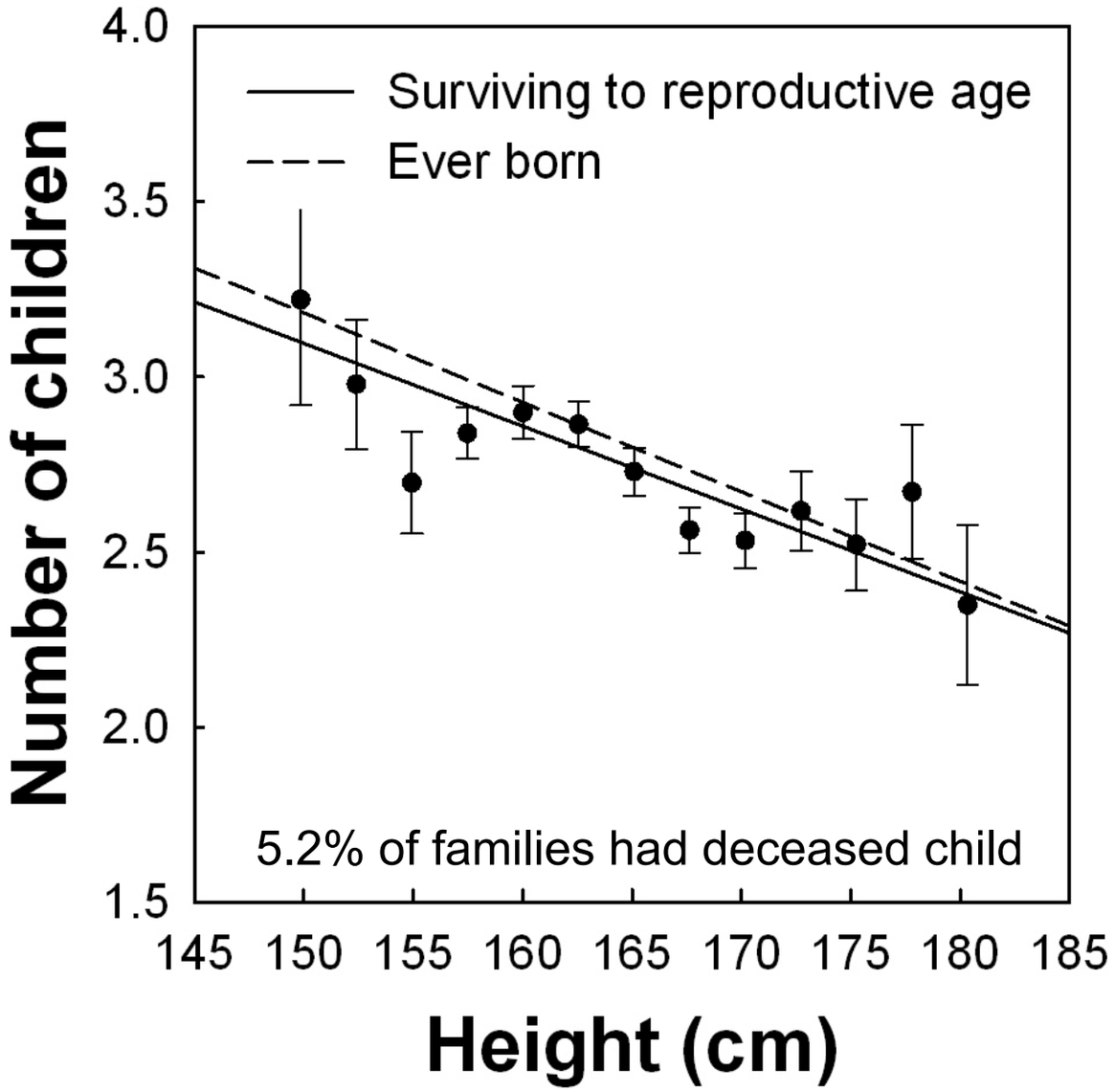
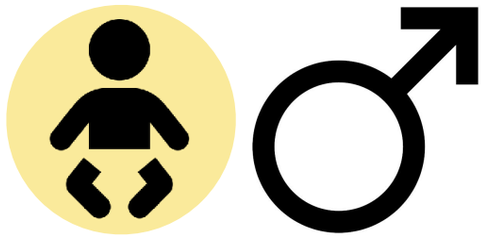
SELECTION ON FEMALE HEIGHT



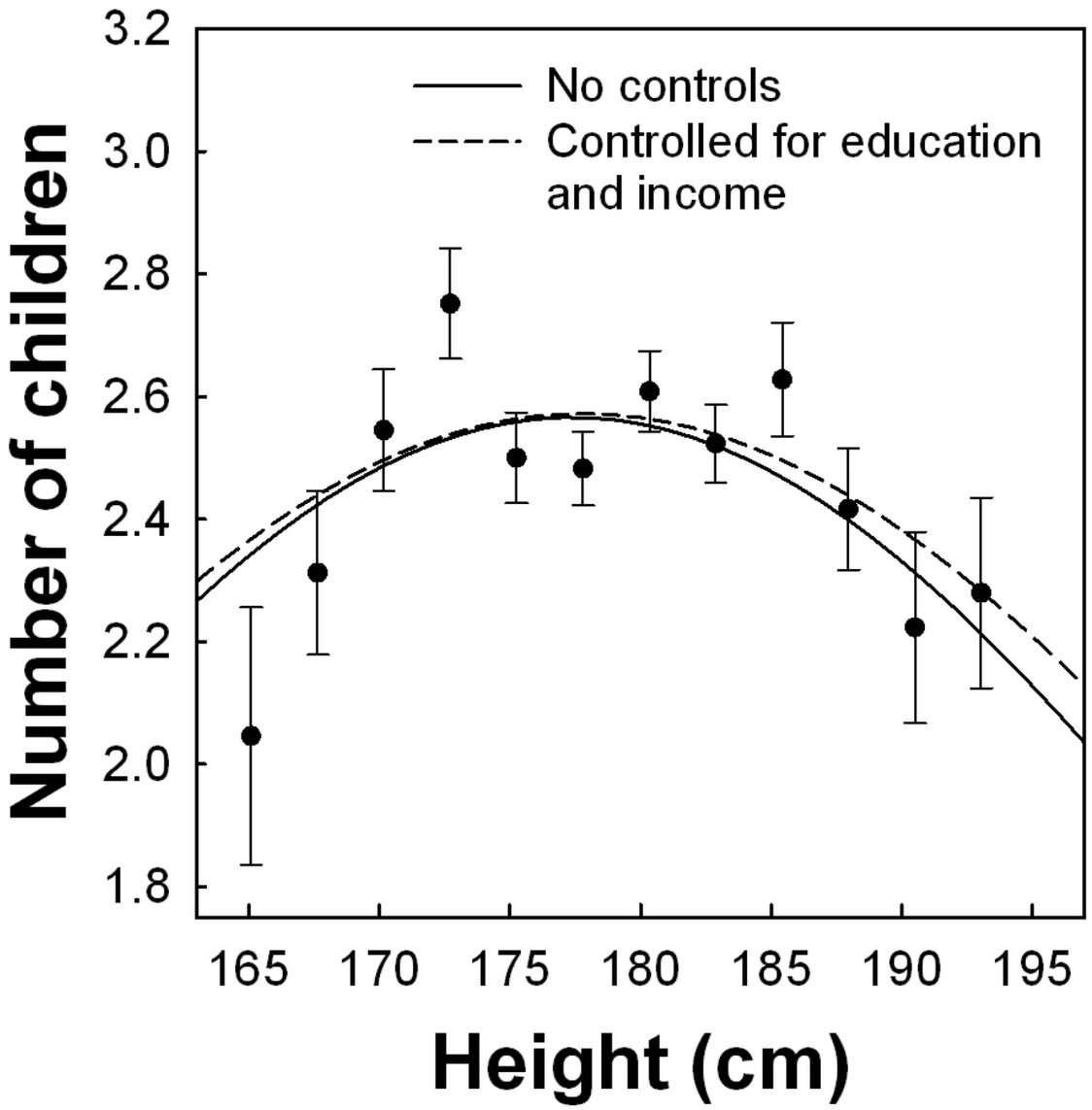
- shorter women
  - had more children, despite higher child mortality
  - had their first child sooner
  - were more likely to have parter
- weak effects ($R^2 < 1\%$)
- results replicated in US
  Byars et al 2010

10 3 2 7

4,059 Americans, WLS
Stulp et al 2012, AHJB



SELECTION ON MALE HEIGHT

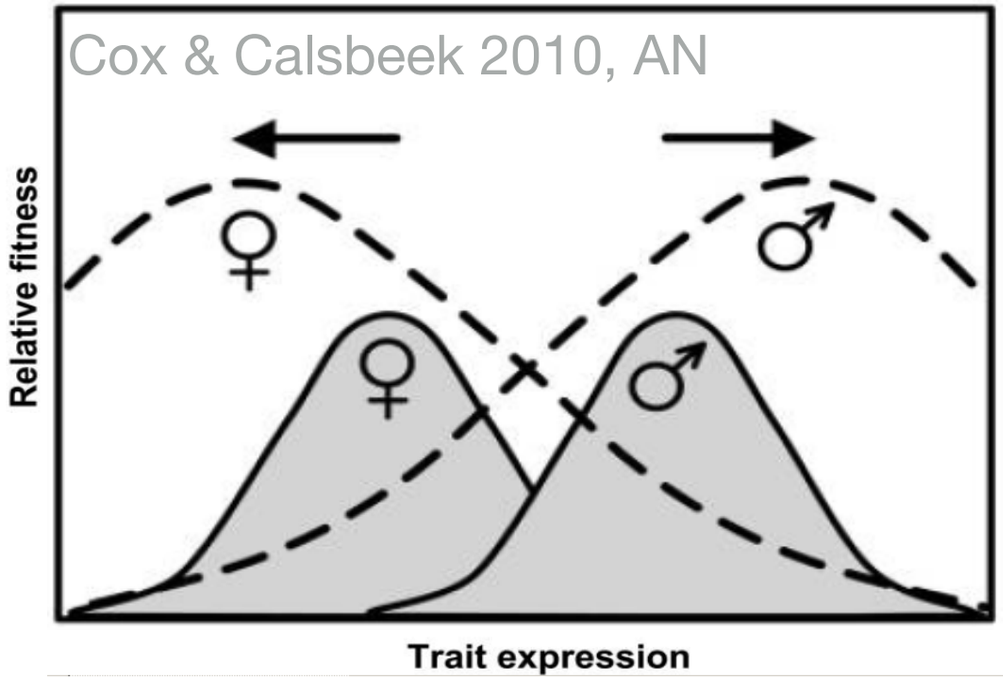


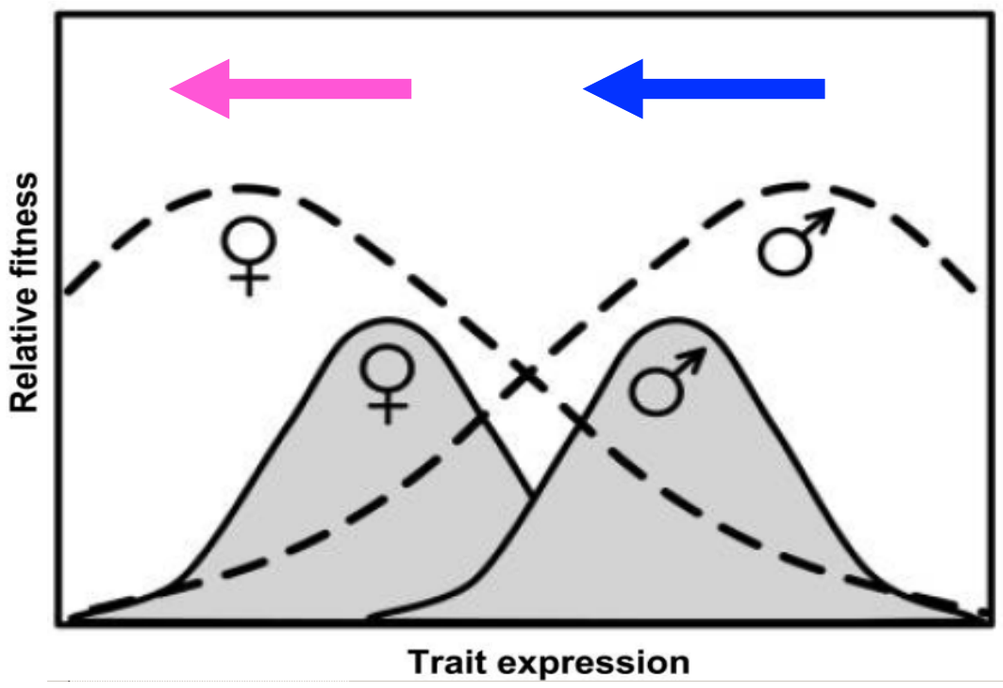
- average height men
  - had more children
  - had their first child sooner
  - married sooner
- weak effects ($R^2 < 1\%$)
- results replicated in US
  Byars et al 2010

2 3 6 8

3,578 Americans, WLS
Stulp et al 2012, BES

SEXUALLY ANTAGONISTIC SELECTION





Because the sexes share a common genetic machinery, selection pressures that differ for males and females can lead to **intralocus sexual conflict**, when reaching the fitness optimum for one sex is constrained by that of the other

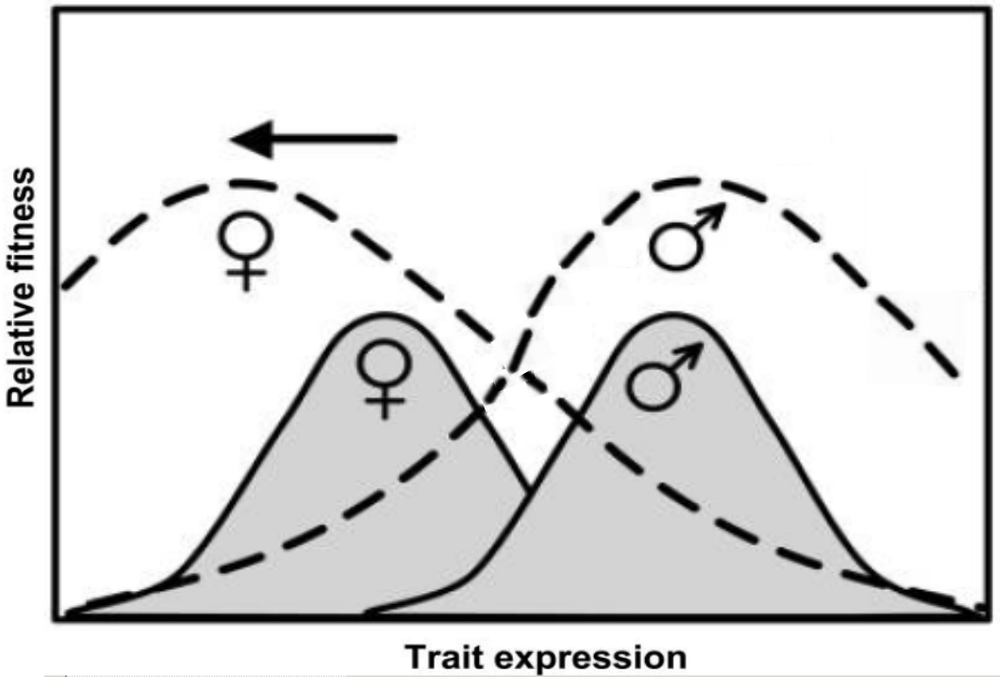
INTRALOCUS SEXUAL CONFLICT

evidence for intralocus sexual conflict

- sexually antagonistic selection and genetic constraints for shared traits
  some heritable traits are 'better' for one sex than the other

- negative intersexual genetic correlation for fitness
  genotypes that confer high female fitness tend to confer low male fitness

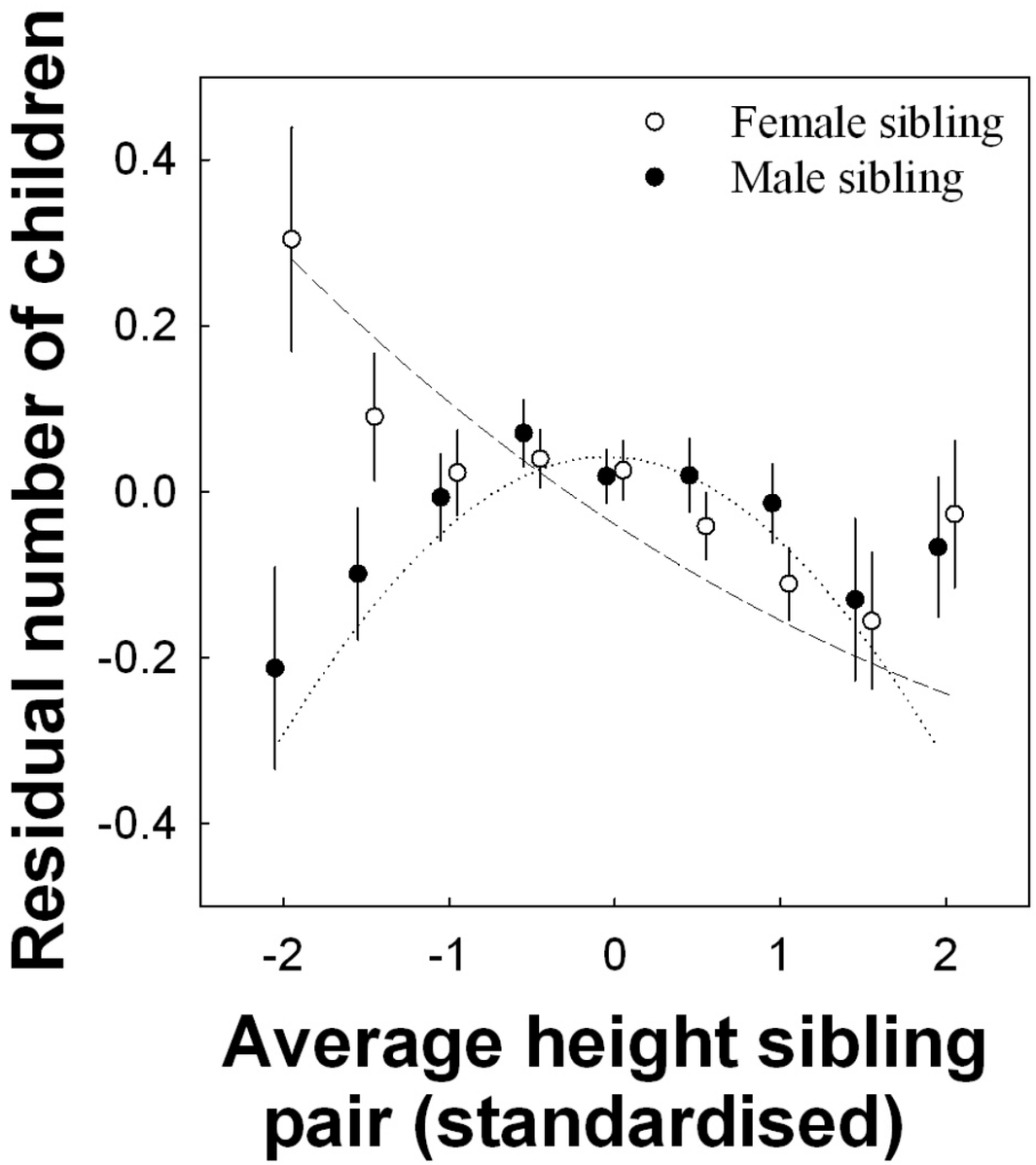
selection for height in US



- selection pressures on height differ for men and women
- height is highly heritable

- do shorter families have more success through daughters?

INTRALOCUS SEXUAL CONFLICT

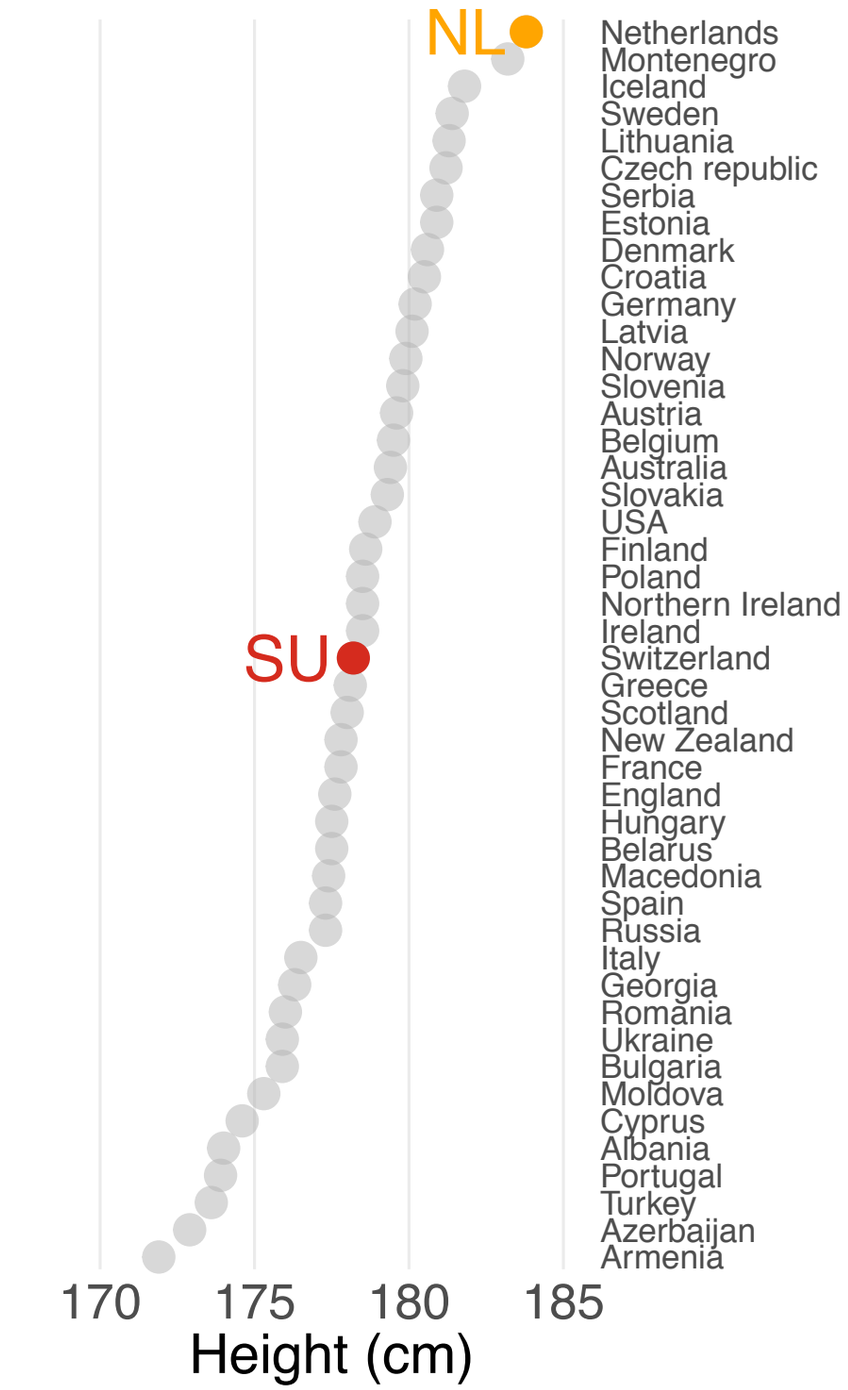


3,140 American sibling pairs, WLS
Stulp et al 2012, BL

intralocus sexual conflict!

- 'shorter' families had more reproducive success through their daughters
- no evidence of sex-ratio biasing

- limitation: only phenotypic association, but replicated by Stearns et al 2012 using pedigree data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Switzerland
Greece
Scotland
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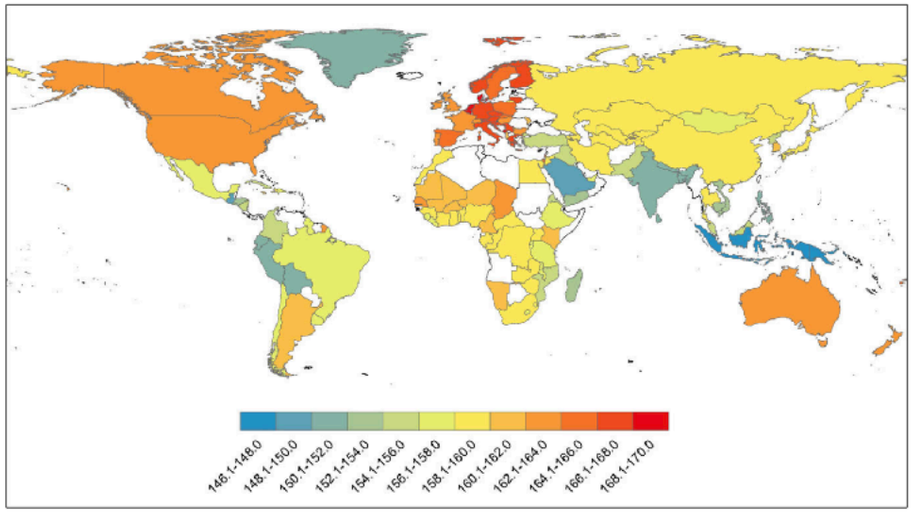
Height (cm)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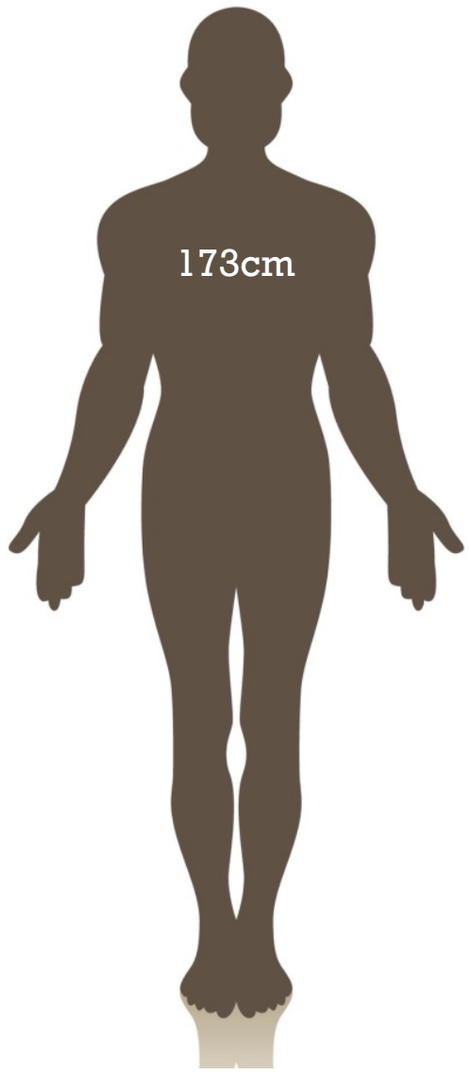
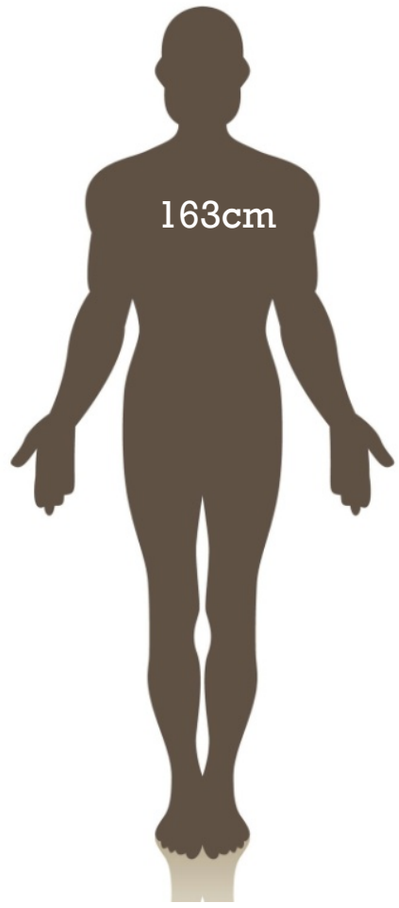
1850 rank: 1/12

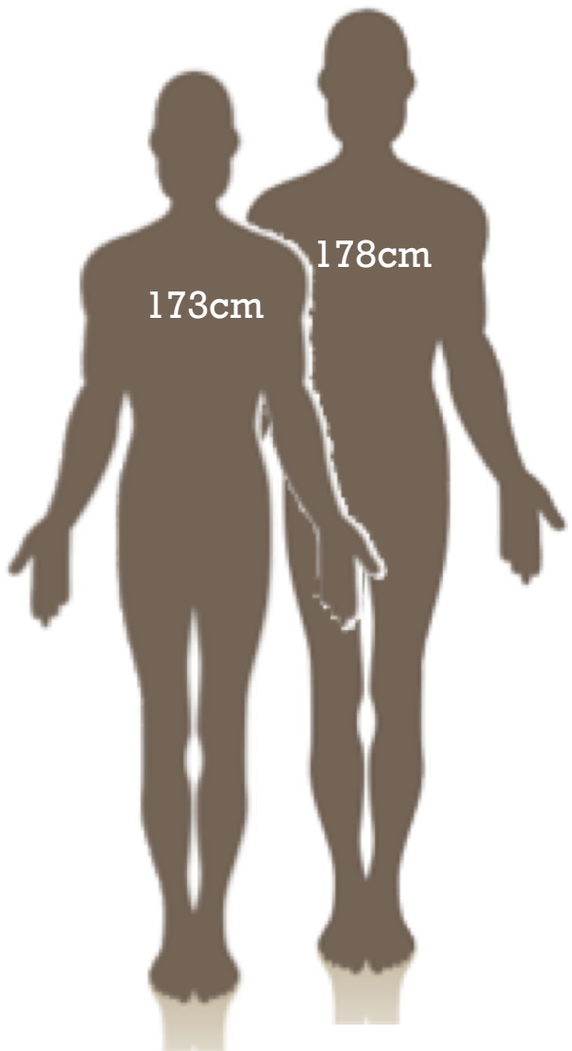
1850 rank: 11/12

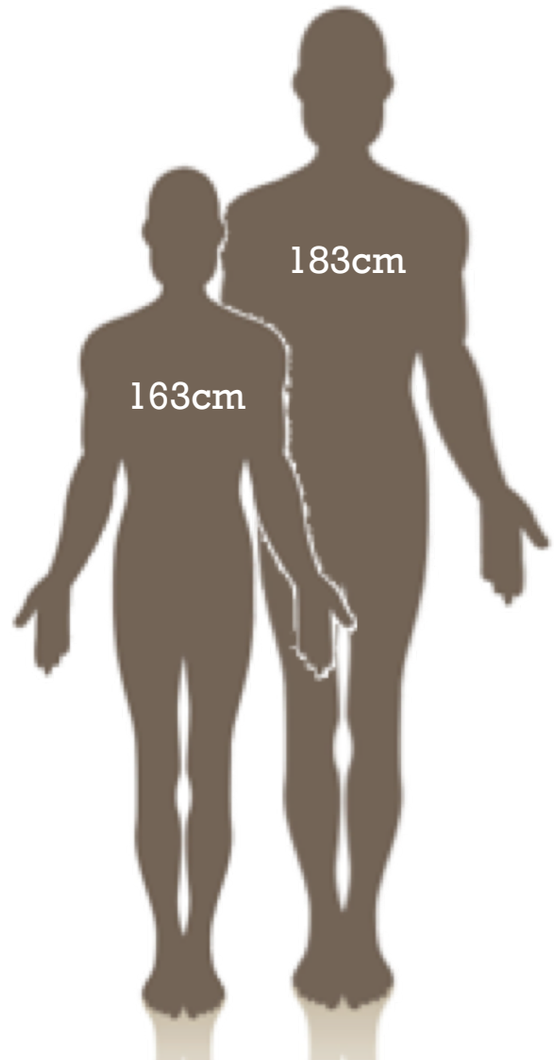




1850 rank: 1/12
2000 rank: 9/12

1850 rank: 11/12
2000 rank: 1/12



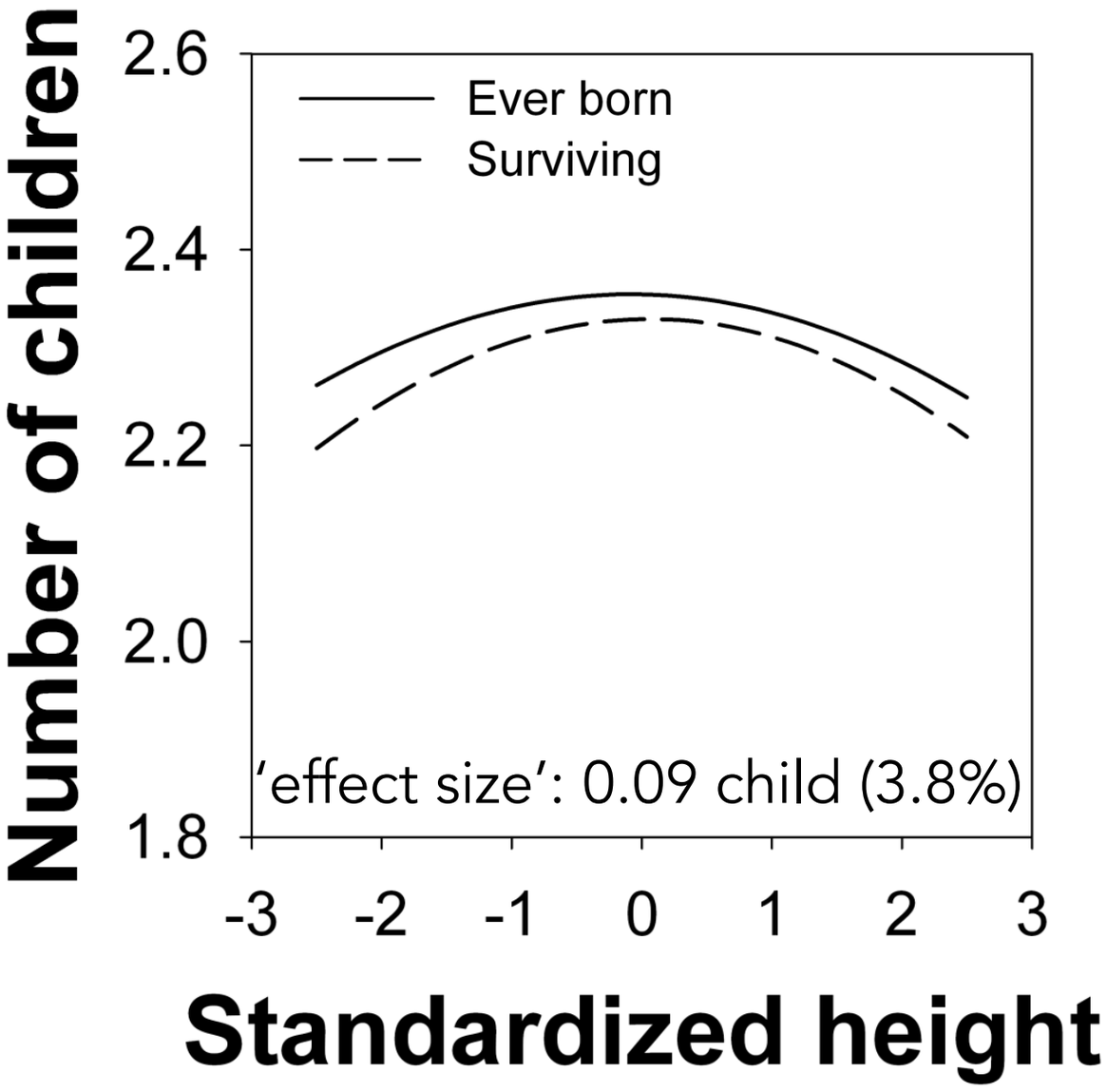


why are the Dutch so tall?

low levels of inequality
diet full of dairy
pre- and postnatal care
part-time work culture

natural selection?

SELECTION ON FEMALE HEIGHT

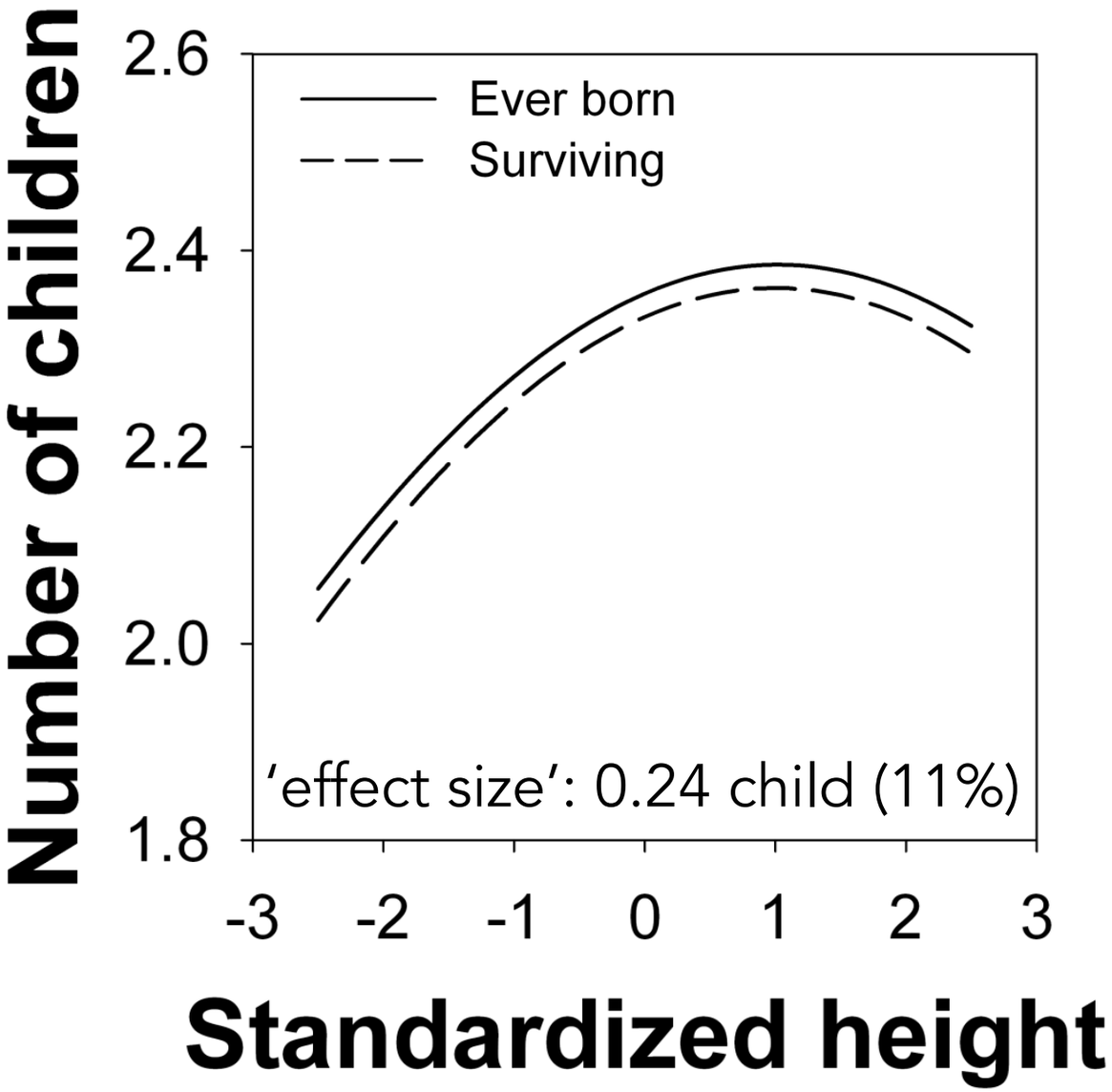


average height women had:
- higher fertility
- higher likelihood of partner

taller women had:
- later age start relationship
- later age first birth
- higher fertility in partnership

24,580 Dutch, LifeLines
Stulp et al 2015, PRSB

SELECTION ON MALE HEIGHT



taller men had:

- higher fertility
- higher likelihood of partner
- later age start relationship
- later age first birth
- higher fertility in partnership

18,032 Dutch, LifeLines
Stulp et al 2015, PRSB

Does natural selection favour taller stature among the tallest people on earth?

Gert Stulp[1,2], Louise Barrett[3,4], Felix C. Tropf[2] and Melinda Mills[5]

> we do not present direct evidence for natural selection
>
> seems plausible to suggest that natural selection may have acted on the Dutch population
>
> it is important to emphasize again that our effect sizes are very small

EVOLUTION
INTERNATIONAL JOURNAL OF ORGANIC EVOLUTION

Did natural selection make the Dutch taller? A cautionary note on the importance of quantification in understanding evolution

Maja Tarka,[1,2] Geir H. Bolstad,[3] Sebastian Wacker,[4] Katja Räsänen,[5,6] Thomas F. Hansen,[7] and Christophe Pélabon[1]

“

only assessed natural selection in a qualitative manner

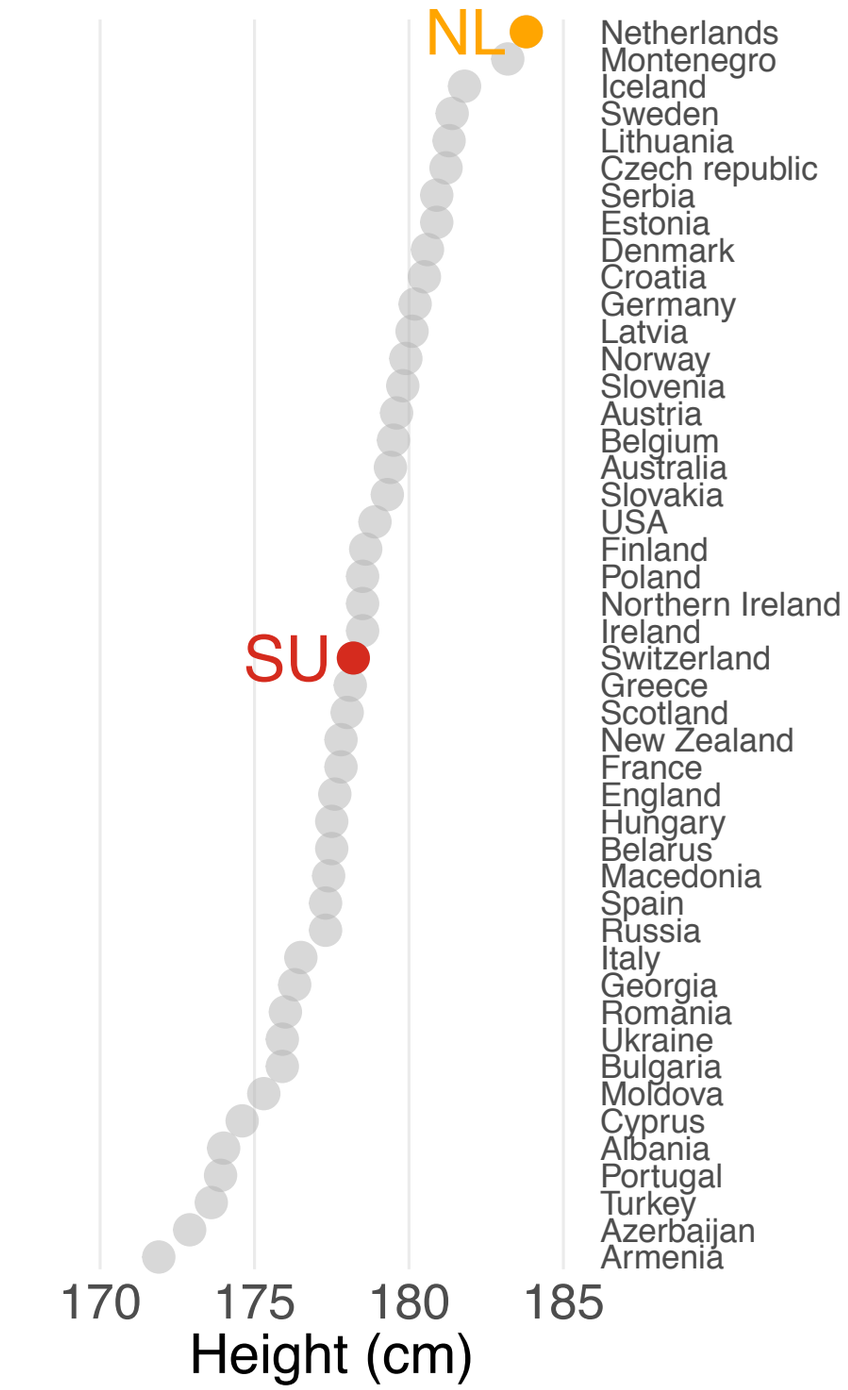
the predicted evolutionary increase in height is 2.28 **mm**

NATURAL SELECTION ON HEIGHT

predicted **increase**
2.28 mm

predicted **decrease**
2.28 mm
(also Byars et al 2012)

- predicted evolutionary difference:
  2 x 2.28 mm ≈ 0.45 cm
- difference between US and NL in 2000 ≈ 5 cm
- (predicted) population-difference in height attributed to natural selection ≈ 10%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Austria
Belgium
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Slovakia
USA
Finland
Poland
Northern Ireland
Ireland
Switzerland
Greece
Scotland
New Zealand
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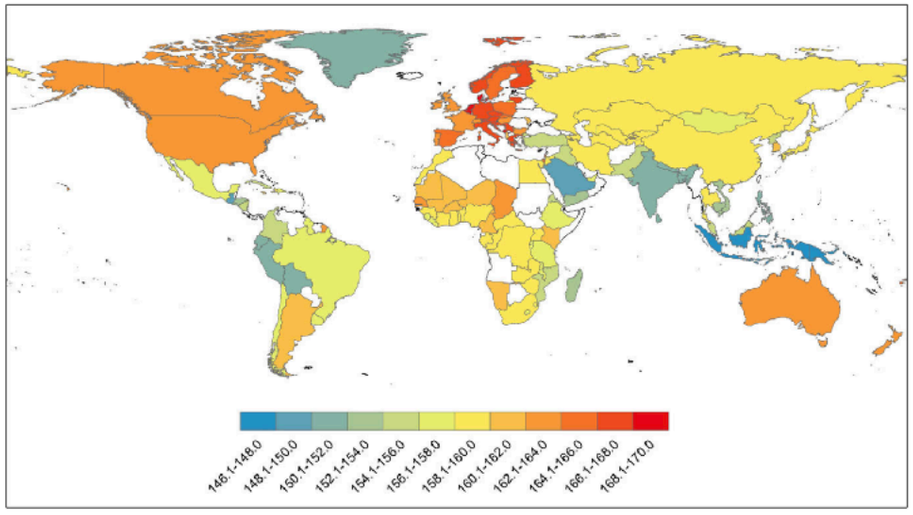
Height (cm)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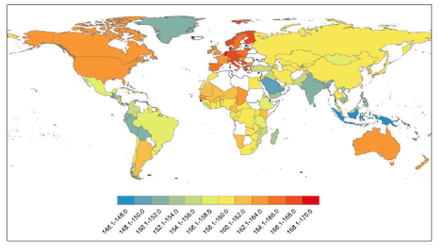


LIMITS TO GROWTH

Contents lists available at ScienceDirect

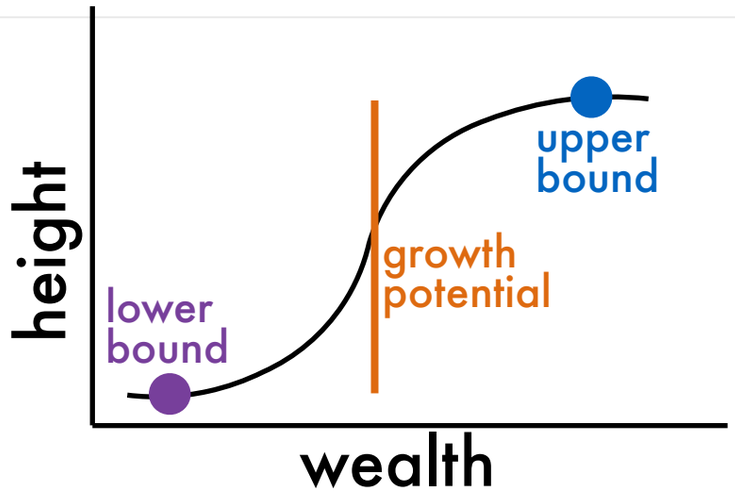
Economics and Human Biology

journal homepage: www.elsevier.com/locate/ehb

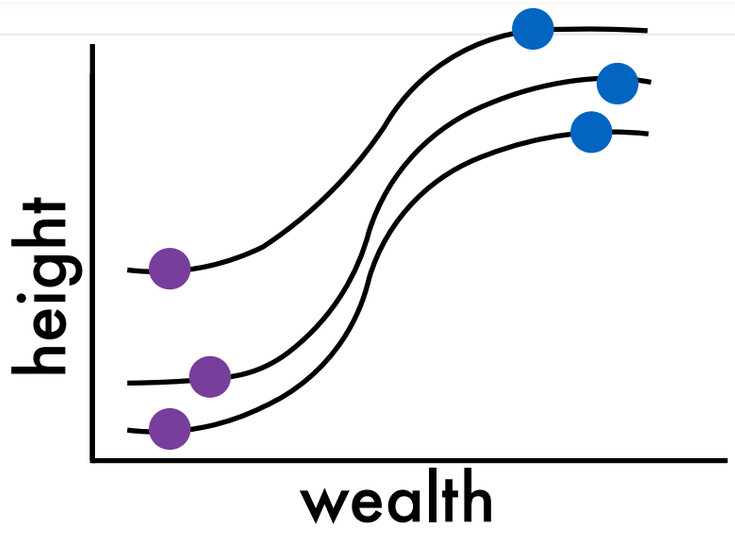
Identifying the limits to socioeconomic influences on human growth

Daniel J. Hruschka[a,*], Joseph V. Hackman[a], Gert Stulp[b]

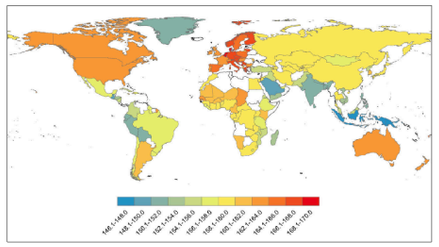
how is height constrained by wealth across countries?



how much variation across populations is (not) explained by health, mortality, wealth, and diet?



- DHS: demographic health studies
- 1,768,962 women
- 207,341 men
- 20–49 years old
- 51 countries
- four world regions: sub-Saharan Africa, South Asia, Latin America, and North Africa and the Middle East
- 1000 fold variation in household wealth
- wealth based on assets Hruschka et al 2015



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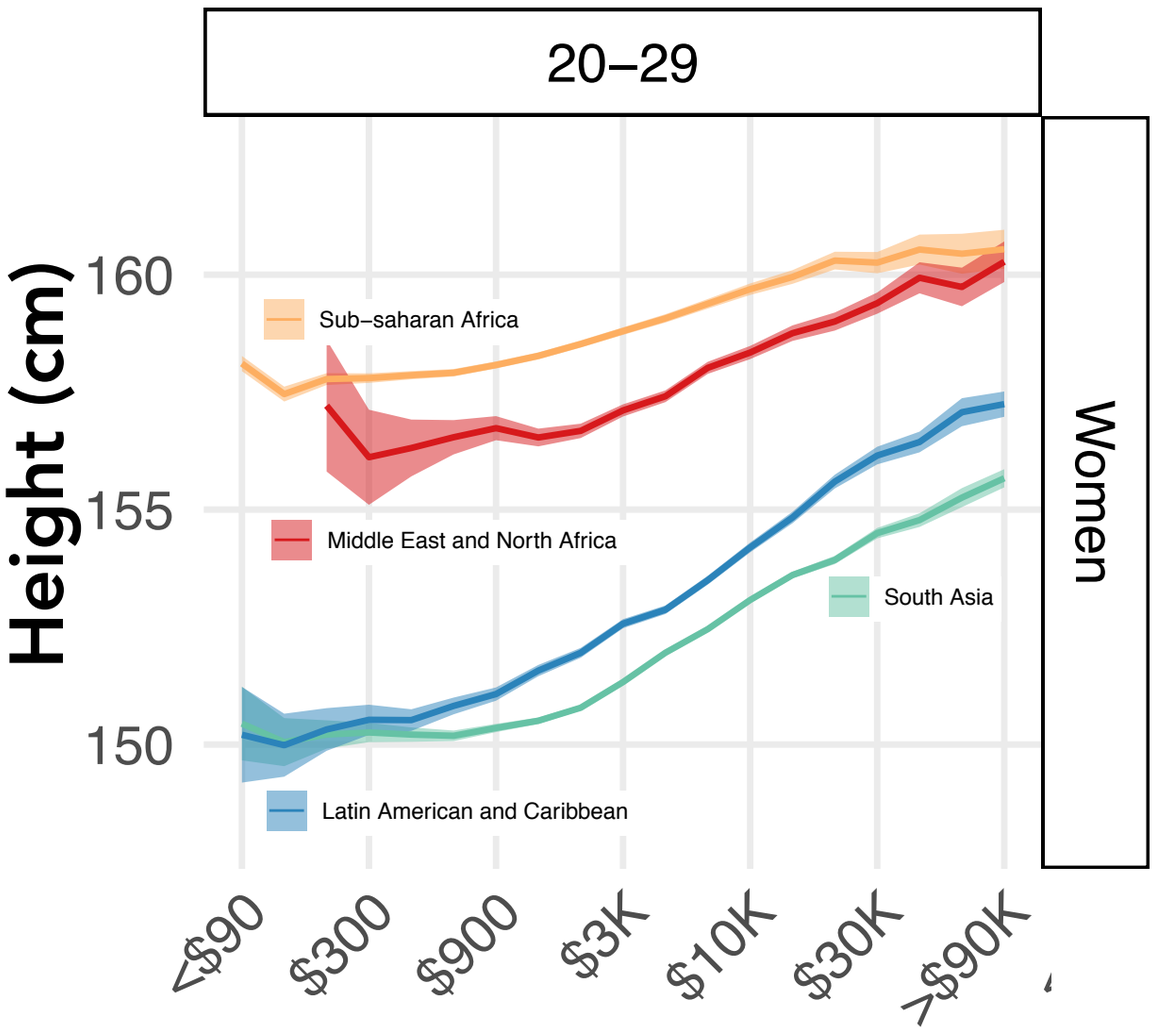


N = 1,976,303, DHS

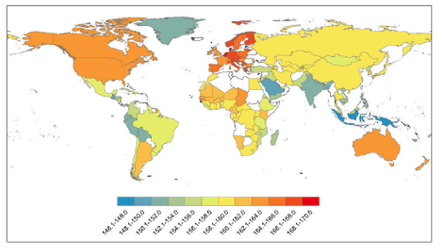
Hruschka et al 2019, EHB

controlling for: household wealth, education, disease, hygiene, calorie-intake from several food sources, urban residence, year

lower bounds:

Sub-saharan Africa	Middle East & North Africa	Latin America & Carribean	South Asia
157.7	154.7	150.1	149.9

substantial variation suggests genetic differences and/or unidentified environmental differences between populations



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Identifying the limits to socioeconomic influences on human growth

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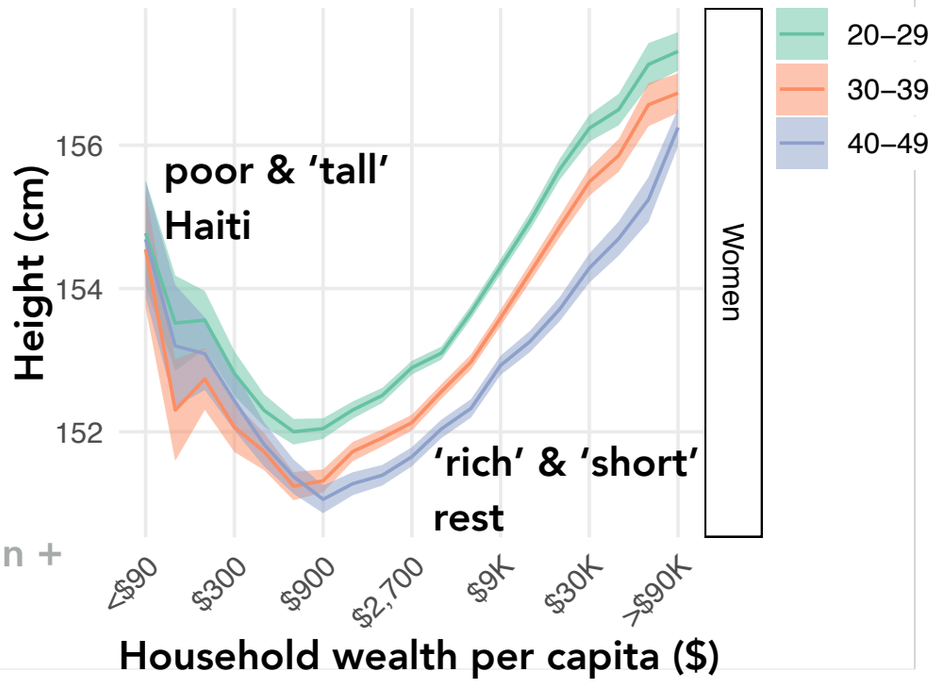
why is this important?

casts doubt on (simplistically) using height as indicator of development

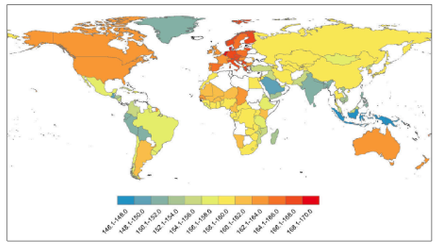
… because the assumption that population differences in height are only due to environmental differences is likely wrong

> Although height is one of the most heritable human traits, crosspopulation differences are believed to be related to non-genetic, environmental factors
>
> NCD Risk Factor Collaboration 2016, eLife

… failing to take into account population differences can give misleading patterns



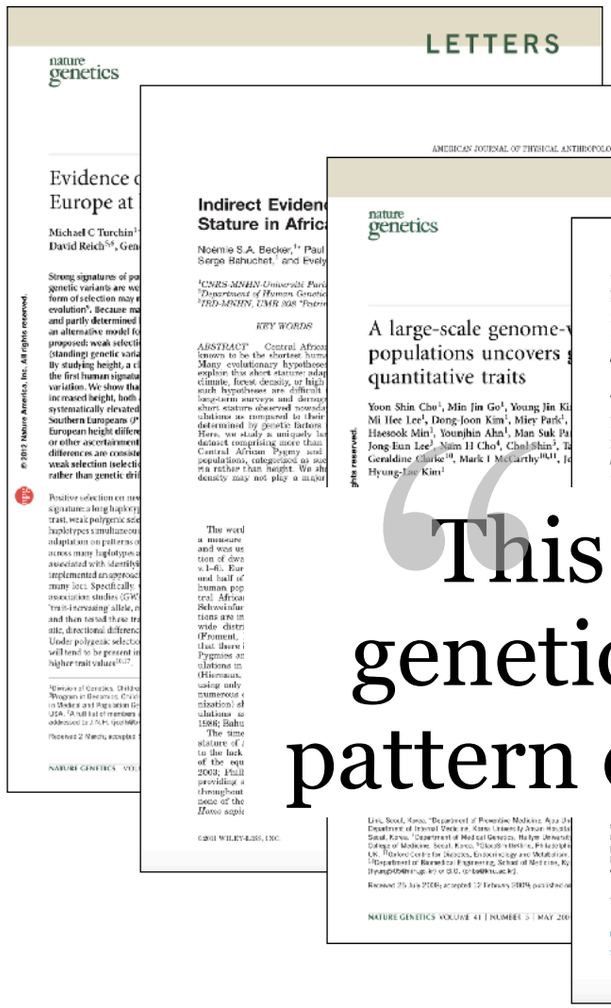
Haiti + Latin American + Carribean countries



POPULATION DIFFERENCES

do genetic differences between populations account for height differences?

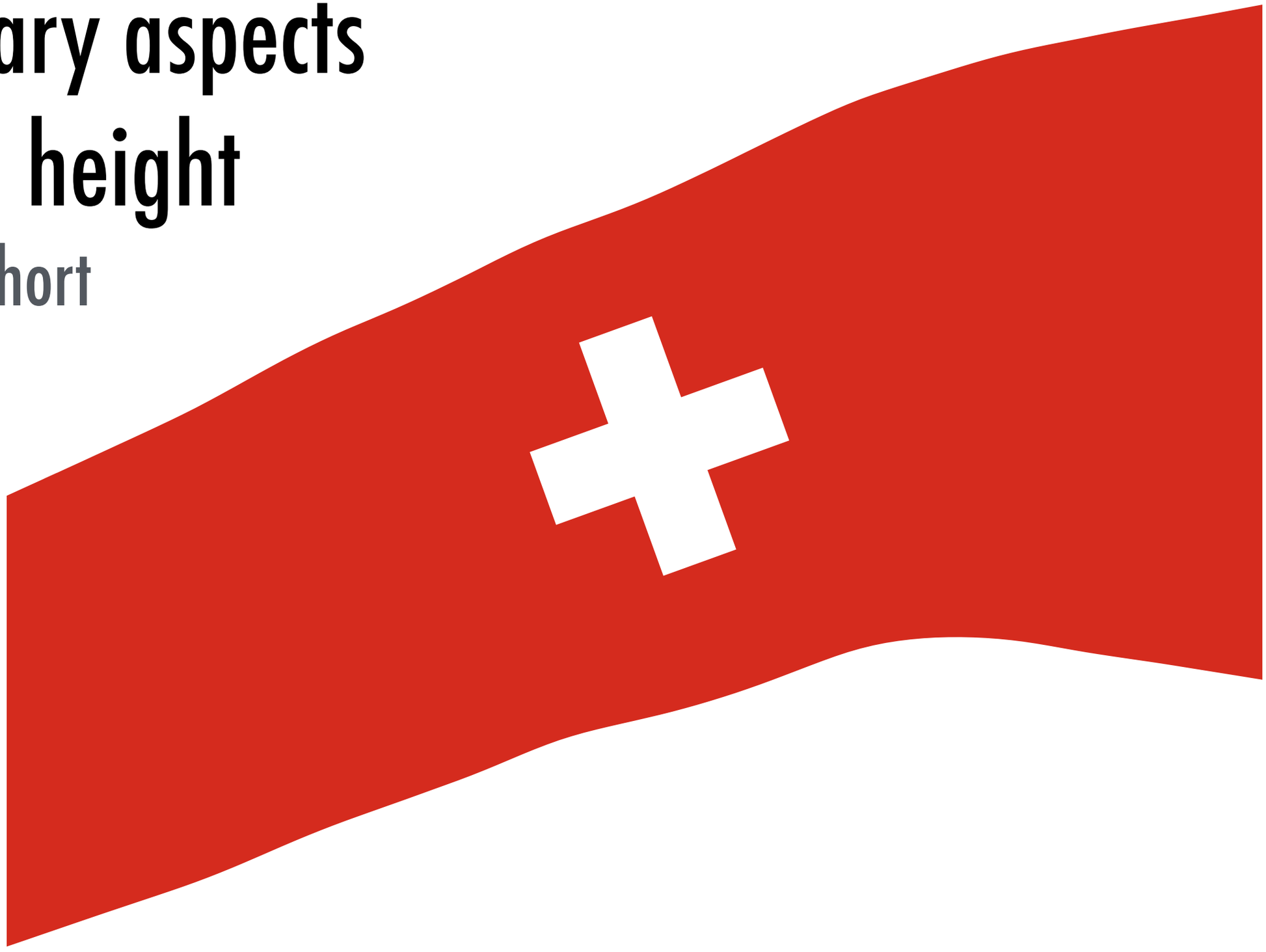
does natural selection explain height differences between populations?



> This means we still do not know whether genetics and selection are responsible for the pattern of height differences seen across Europe

Evolutionary aspects of human height

a long story short



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