

# Trivers-Willard and Biased Parental Investment

- When conditions are good, males are expected to out reproduce females because of the availability of polygyny; and when conditions are poor females are likely to outreproduce males.

“Natural selection of parental ability to vary the sex ration of offspring” *Science* (1973)

# Predictions from Trivers-Willard: investment bias

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- When parental condition good or environment good, then raise boys or invest heavily in boys and little in girls.
- If environmental conditions poor or parental condition poor, then heavily invest in girls and invest little in boys

# Predictions from Trivers-Willard: Sex ratio

- **High status families should produce a greater number of males. Why?**
  - Male fetuses are more quickly aborted in utero when conditions are bad
  - Males are more costly to bear than females
  - If conditions are good then mothers have superior health leading to a higher production of males

# Condition for Trivers-Willard

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- 1. Resources are unequally distributed or controlled in a population**
- 2. Wealth is a stronger determinant of male reproductive performance than female reproductive performance**
- 3. The socioeconomic status of parents can be conferred upon offspring and will endure into the offspring's adulthood**

# Tests of Trivers-Willard (I)

- **Betzig and Turke (1986). “Parental investment by sex on Ifaluk.”**  
*Ethology & Sociobiology* 7: 29-37  
show that high status fathers spent more time interacting with their sons than did low status males and also high status mothers spent more time with sons than daughters than did low status mothers

# Inheritance is distributed as Trivers-Willard model would predict (II)

|              | Proportion of wealth to sons | Proportion of wealth to daughters |
|--------------|------------------------------|-----------------------------------|
| Wealthy      | 26.0                         | 19.9                              |
| Less wealthy | 12.3                         | 19.0                              |

- **Kish et al. (*Ethology and Sociobiology*) show that sons receive more of the inheritance in large estates (\$110,850) than in small estates (\$20,000) in a sample of 1,000 wills.**

# Prediction holds when sample is divided into quartiles

| high to low in \$ | Value of estate       | Sample size | Proportion to sons | Proportion to daughters | Greatest proportion to: |
|-------------------|-----------------------|-------------|--------------------|-------------------------|-------------------------|
|                   | >\$20,350             | 250         | 9.9                | 19.4                    | Daughters               |
|                   | \$20,350 to \$52,900  | 250         | 14.6               | 18.6                    | No difference           |
|                   | \$52,900 to \$110,850 | 250         | 21.9               | 24.6                    | No difference           |
|                   | >110,850              | 250         | 30.2               | 15.1                    | Sons                    |

# Tests of Trivers-Willard (III-IV)

- Voland, E. (1984). “Human sex-ratio manipulation: historical data from a German parish.” *Journal of Human Evolution* 13(1): 99-107. In German peasants from 1720 to 1869 show that girls in elite families had a mortality rate of 13.6% and boys 12.6% while in the low status laboring class male mortality was 20.8% and female mortality was 14.6%
- Boone: high status Portuguese nobility invest more in males for estate inheritance while low status nobility invest more in dowry for daughters.

# Tests of Trivers-Willard (V)

- **Cronk, L. Mukogudo (low class and former hunter-gatherers) invest more in girls than boys as shown by**
  - low sex ratio (67:100)
  - clear evidence (health records) of greater investment in girls than boys
  - much higher than expected boy mortality rates
  - more care given to girls
  - girls had better growth and development measures

# Tests of Trivers-Willard (VI)

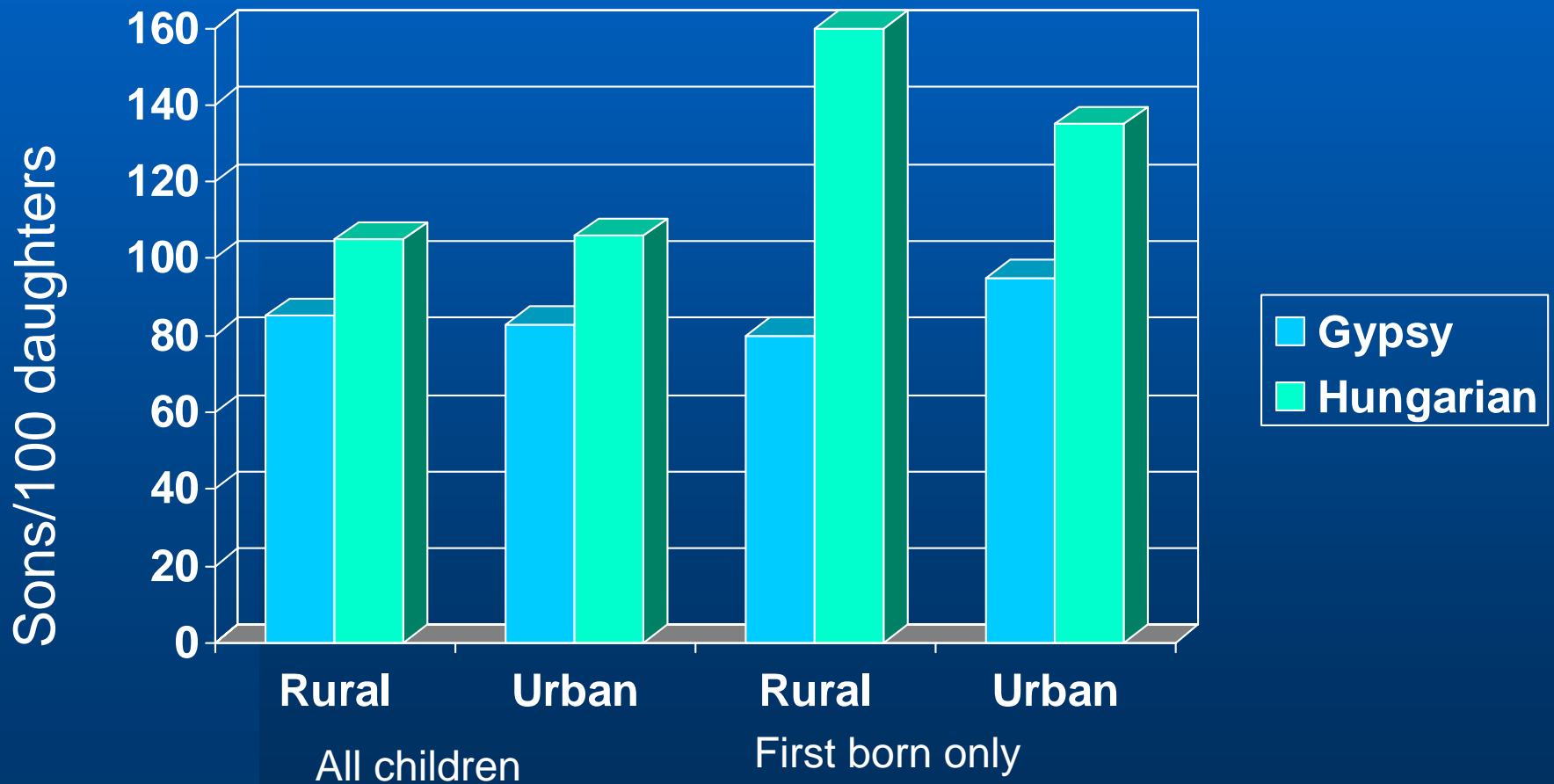
**Gaulin's study of high (>\$60K) and low (>\$60K) income families:**

- **Women more likely to nurse sons in high income households and more likely to nurse daughters in low income households**
- **Daughters were heavier in low income households while boys were heavier in high income households**
- **Interbirth intervals were great for boys in high status households than in low status households**

# Gypsies compared to Hungarians (VII)

- **Gypsies are at the socioeconomic bottom**
- **Gypsy girls can marry up, sons can't**
- **Gypsy girls who marry Hungarians:**
  - More children
  - Higher birth weights
  - Lower child mortality rates
  - Lower rates of birth defects

# Gypsy Sex Ratio Bias

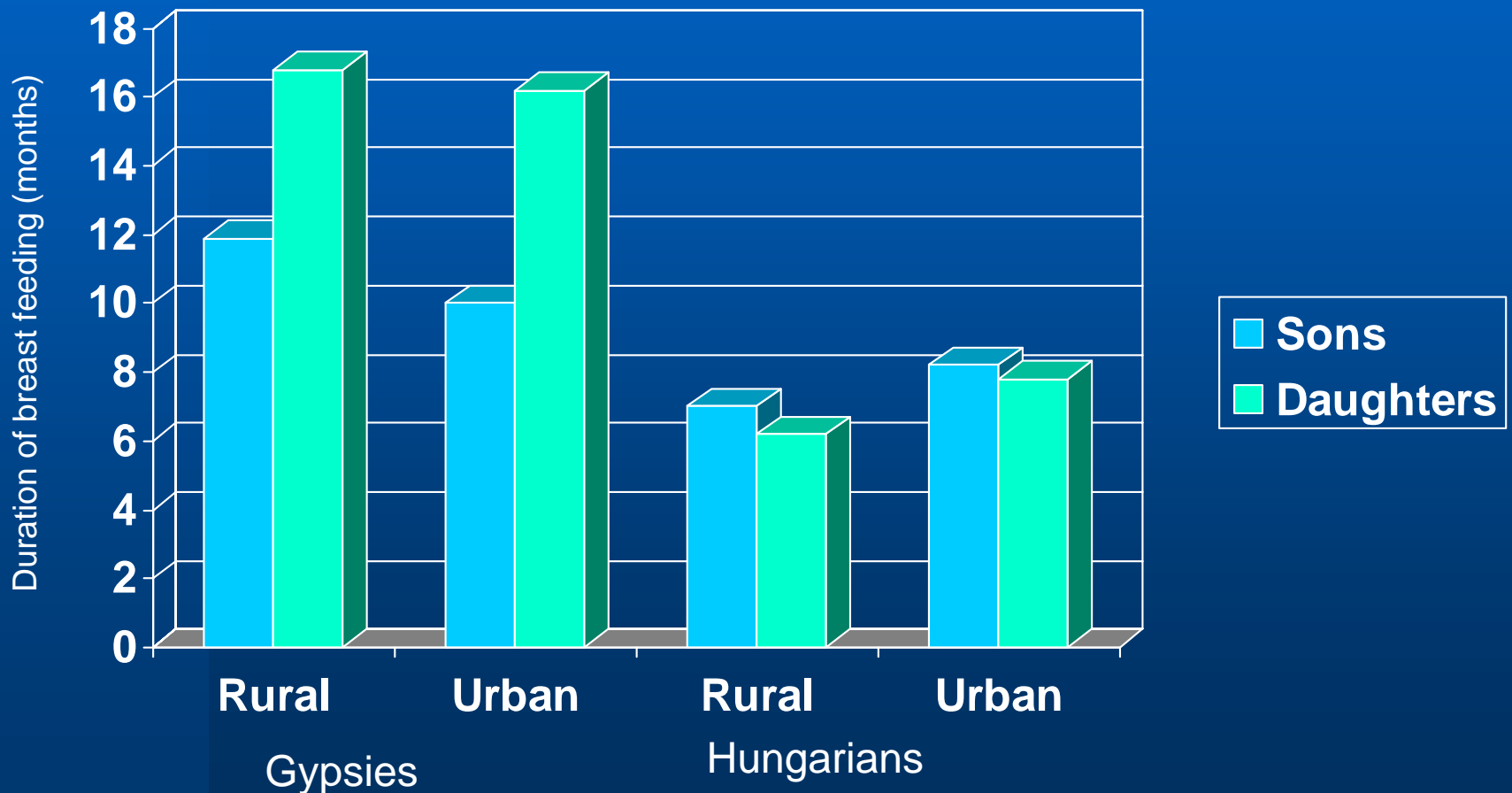


# How is bias achieved

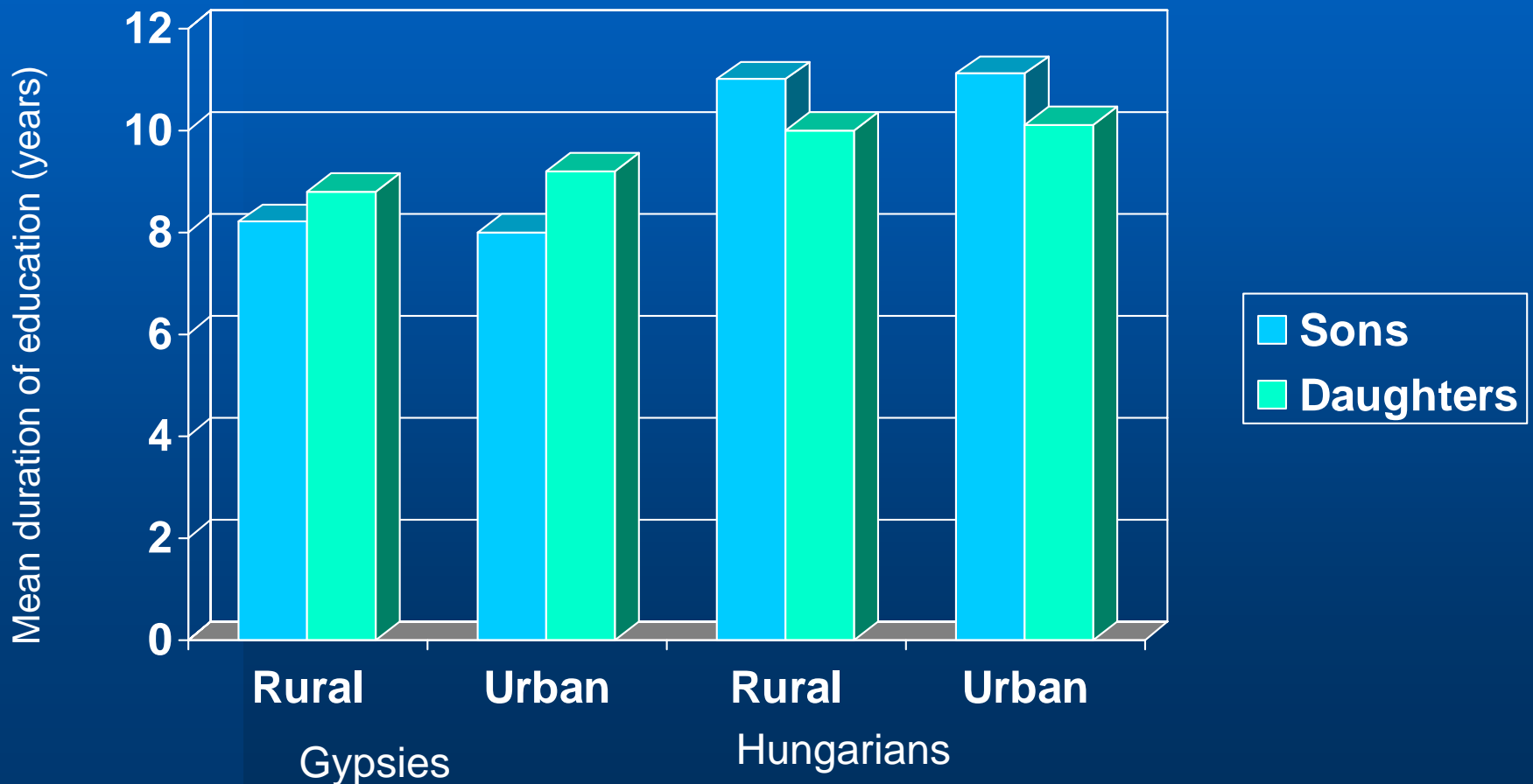
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- **More likely to abort a birth if current child is a girl than a boy**
- **Leads to longer investment in girls**
- **If abortion is near end of reproductive career this will produce a bias**
- **But this fact is probably not sufficient to explain sex ratio skew**

# Biased investment: breast feeding



# Biased investment: education



# A National Study on Education and Sex Ratio in the USA (VIII)

- **Findings:**

- **Social status correlates with education**

- Girls born to low status fathers receive more education than boys
- Boys born to high status fathers receive more education than girls

- **Social status correlates with sex ratios**

- High status males have a male biased sex ratio

# A National Study on Education and Sex Bias in the USA

1122 / *Social Forces* 83:3, March 2005

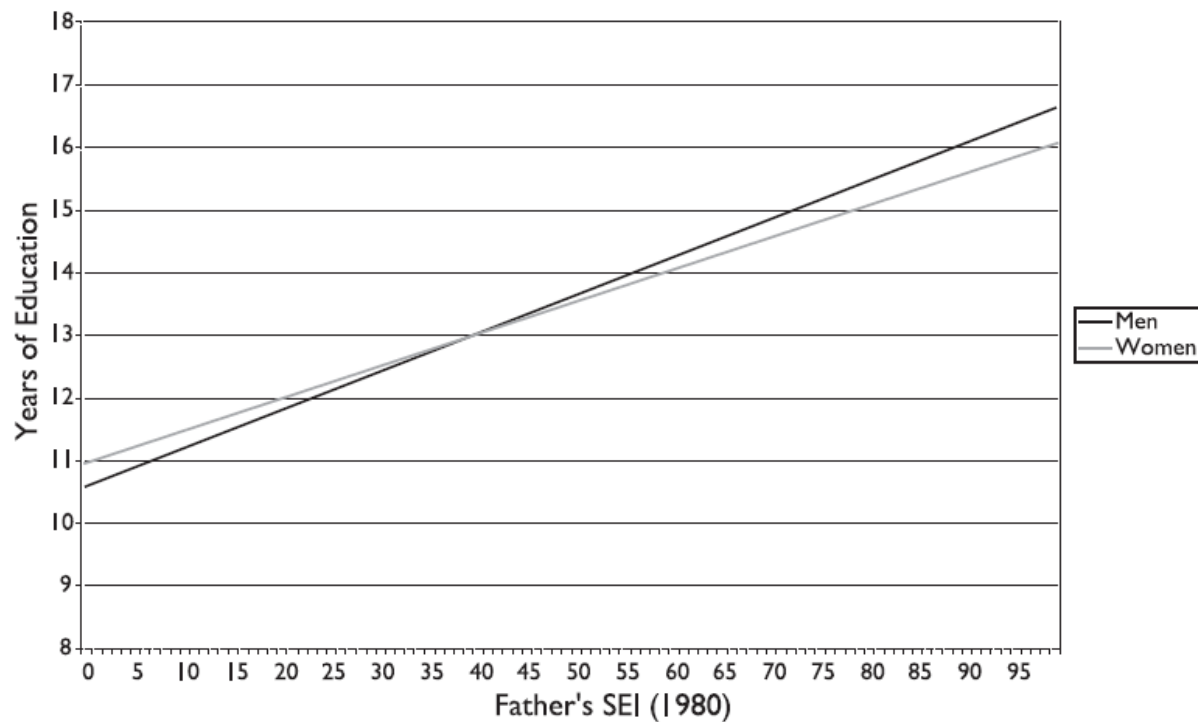
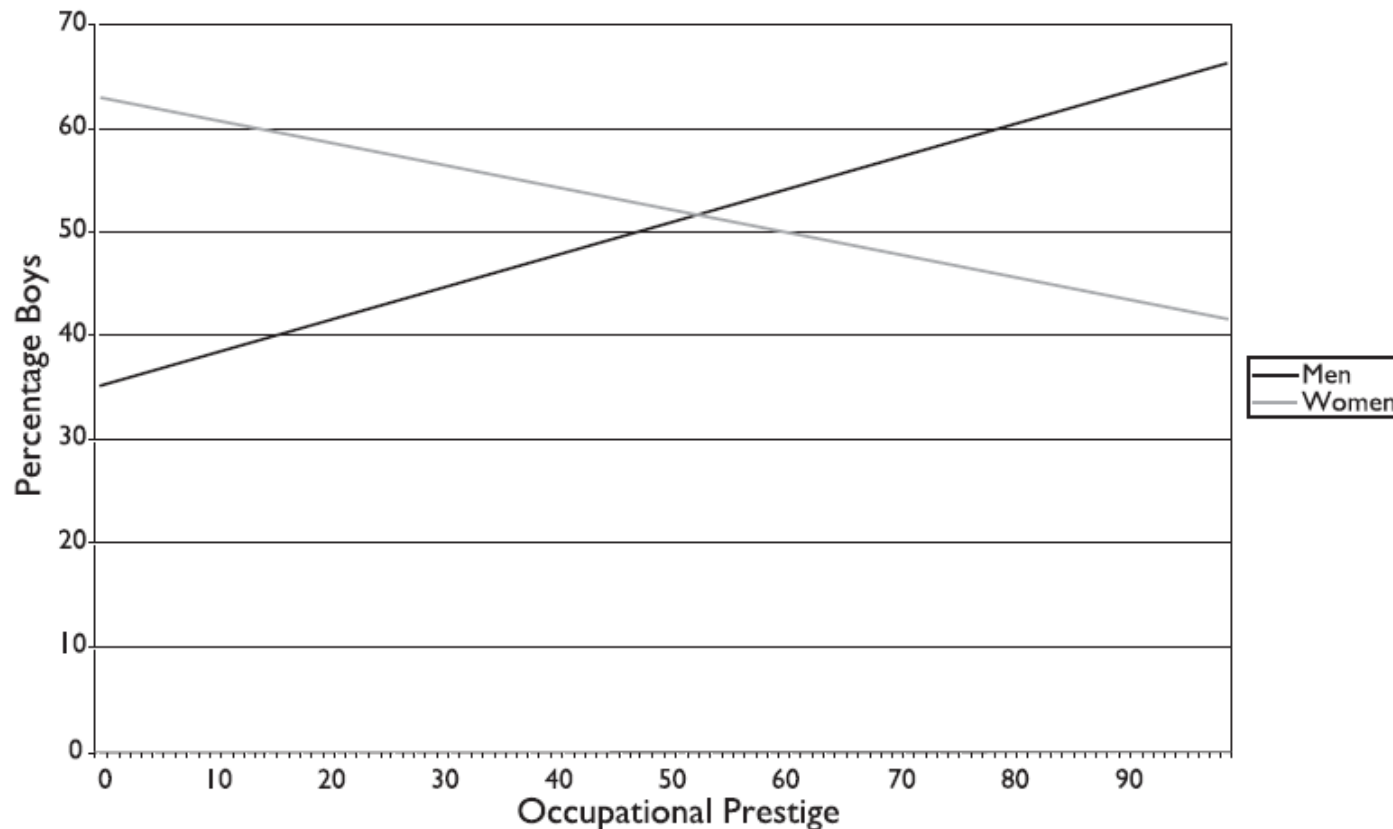


Figure 1. Years of Education by Father's Socioeconomic Status (1980)

Hopcroft, R.  
(2005)  
“Parental  
Status and  
Differential  
Investment in  
Sons and  
Daughters”

# Sex ratio and social status

1128 / *Social Forces* 83:3, March 2005



# Sex ratio and social status – a discrepancy

- Note that pattern is as predicted for males but not for females
- Explanations
  - Measures of social status are accurate for males but less so for females
  - Low status females (education, income) are more likely be married to high status males. Thus, the negative and positive correlations make sense.

# First Application of Trivers-Willard

- In 1979 Mildred Dickemann published on a widespread pattern of infanticide and biased investment in China and parts of northern India
- In high caste Indian and Chinese social groups three to ten times as many boys existed compared to girls
- Lower class groups in these same societies invested much of their wealth in girls through dowry but did little to assist the marriage prospects of their sons.
- Trivers-Willard provided a model to interpret this pattern