

# How many wives do men want? On the evolution of polygyny rates

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# Economics is about resource allocation

## The Question: are resources allocated efficiently?

Goods, services



Labor, natural  
resources

Intermediate goods,  
labor

# **Answer #1: The First Theorem of Welfare Economics**

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If:

- (i) there is a market for every good,
- (ii) all actors know everything about everything,
- and (iii) no single firm has market power,

then:

a decentralized market delivers an efficient resource allocation,  
even if all individuals are selfish.

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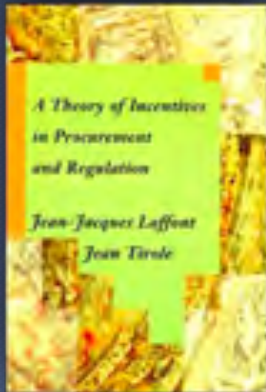
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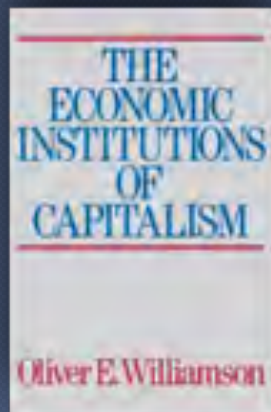


# Answer #2: Institutions Mitigate Market Imperfections



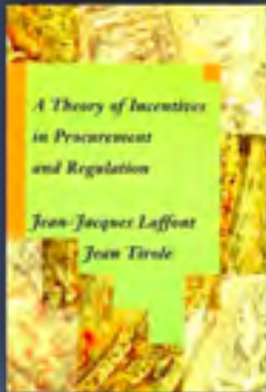
Regulation by governments

Rules and contracts in organizations



Auto-regulation by communities

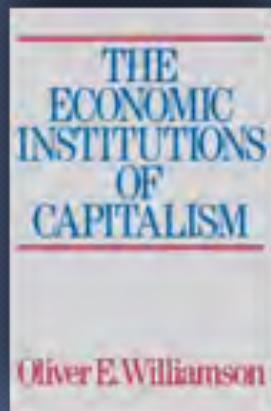
# Answer #2: Institutions Mitigate Market Imperfections



Regulation by governments

Reign of selfish  
*homo oeconomicus*

Rules and contracts  
in organizations



Auto-regulation  
by communities

# Answer #3: Preferences Matter

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Altruism (G. Becker)

Warm glow (J. Andreoni)

Fairness/inequity aversion (M. Rabin, E. Fehr and K. Schmidt)

Conditional altruism (D. Levine)

Conformity (D. Bernheim)

Desire to avoid social stigma (A. Lindbeck, S. Nyberg, and J. Weibull)

Identity concerns (G. Akerlof and R. Kranton)

Efficiency concerns (G. Charness and M. Rabin)

Image concerns (R. Bénabou and J. Tirole, T. Ellingsen and M. Johannesson)

Honesty concerns (I. Alger and R. Renault)

# Answer #4: Preferences are Endogenous

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Models on the long-term evolution of preferences in strategic interactions:

Frank (1987)

Güth and Yaari (1992)

Bester and Güth (1998)

Ok and Vega-Redondo (2001)

Dekel, Ely and Yilankaya (2007)

Heifetz, Shannon and Spiegel (2007a,b)

Alger and Weibull (2013, 2016, *Annual Review of Economics* 2019)

Models on the cultural transmission of preferences:

Bisin and Verdier (2001)

Hauk and Saéz-Martí (2002)



# Answer #4: Preferences are Endogenous

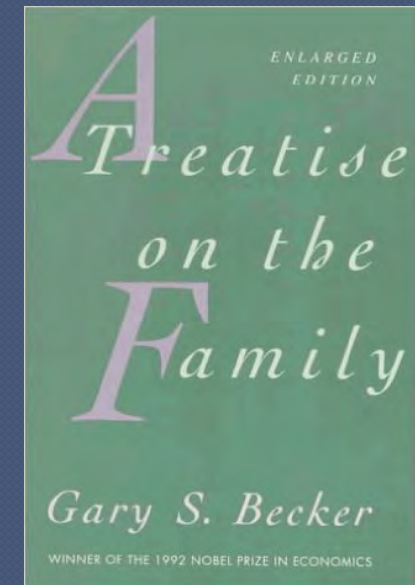
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Evolutionary forces should be particularly pronounced for preferences guiding family-related behavior

Bergstrom (1994, 1995, 1996)

Alger and Weibull (2010, 2012)

Alger and Cox (*REHO* 2013)



# Answer #4: Preferences are Endogenous

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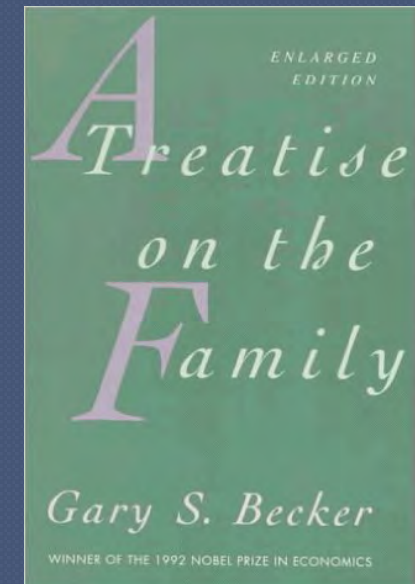
Evolutionary forces should be particularly pronounced for preferences guiding family-related behavior

Today's topic:

“How many wives do men want?

On the evolution of polygyny rates”

Alger (WP 2016)



# Some human societies are more monogamous than others

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Murdock's *Atlas of World Cultures* (1981):  
almost 80 % of the societies permit polygyny

Code of Hammurabi (1700's BC):  
restrictions on number of wives

Old testament: not against polygyny

New testament: pro-monogamy

Ancient Rome: marriage was monogamous

# What explains polygyny rates?

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- Male heterogeneity

Bateman (1948), Orians (1969), Emlen and Oring (1977)

Becker (1974), Grossbard (1980), Bergstrom (1994), Lagerlöf (2005)

- Female heterogeneity

Gould, Moav, and Simhon (2008)

- Females may trade faithfulness for a lower polygyny rate

Kokko and Morrell (2005), Fortunato and Archetti (2010)

Gavrilets (2012)

- Competition between groups

Henrich, Boyd, and Richerson (2012)

# The question

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- ⊙ But male heterogeneity is endogenous
- ⊙ I argue that a key driver of male heterogeneity is the desire to secure mates



# The question

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- ⊙ But male heterogeneity is endogenous
- ⊙ I argue that a key driver of male heterogeneity is the desire to secure mates
- ⊙ I propose a theoretical model to study this question
  - All the women are identical
  - All the men are identical prior to adolescence: they seek to outcompete each other only if they would benefit from having more than one wife

# Model ingredients

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- ❑ A population with overlapping generations in which each individual lives for at most three periods:
  - (childhood: children receive care and food)
  - adolescence: men may compete against each other for women
  - adulthood: households with one man and his wives raise children

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- ❑ A population with overlapping generations in which each individual lives for at most three periods:
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# Model ingredients

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- ❑ A population with overlapping generations in which each individual lives for at most three periods:
  - (childhood: children receive care and food)
  - adolescence: men may compete against each other for women
  - **adulthood: households with one man and his wives raise children**
- ❑ Key step of the analysis:
  - Determine how a man's reproductive success (MRS)  
(the expected number of offspring  
who survive to sexual maturity)  
depends on the number of wives

# Key findings

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- ❑ Depending on the environment in which the population evolves, MRS is either: increasing, U-shaped, or decreasing in the number of wives
- ❑ I show that this implies that in certain environments, monogamy emerges as a consequence of natural selection



# Adulthood: Model

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- ❑ In the adult life stage, each man lives in a household with his wives
- ❑ Total time budget of each adult: 1
- ❑ Time allocated to food production and child care
- ❑ The number of children is endogenous

# Adulthood: Model

The man's problem in adulthood consists in choosing  $(\mathbf{x}, y, n) \in [0, 1]^{k+1} \times [1, +\infty)$  to maximize:

$$\sum_{j=1}^k n \cdot \max\{0, 1 - bn\} \cdot \left(\frac{1-y}{k \cdot n^\alpha}\right)^\lambda \cdot \left(\frac{1-\phi x_j}{n^\beta}\right)^\sigma \cdot \left(\frac{\rho \gamma x_j}{n} + \frac{\theta y}{kn}\right)^\tau$$

Mother's  
"fatigue"

Father's  
care

Mother's  
care

Food

Each child's survival probability

The vector  $\xi = (\alpha, \beta, \gamma, \theta, \lambda, \rho, \sigma, \tau, \phi)$  is the *ecology*

# Adulthood: Model

- ⊙ For each  $k$  there is a unique solution  $(x^*(k), y^*(k), n^*(k))$

$$\tilde{M}(k) = k \cdot n^*(k) \cdot a(n^*(k)) \cdot s(x^*(k), y^*(k), n^*(k), k)$$

$$\frac{d\tilde{M}(k)}{dk} = s(x^*(k), y^*(k), n^*(k), k) + k \cdot \frac{\partial s(x^*(k), y^*(k), n^*(k), k)}{\partial k}$$

# Adulthood: Results

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- ◉ Male involvement in food production is key:
  - Food is a private good: the benefit from increasing  $k$  depends on how much time the man devotes to food production
  - This in turn depends on the ecology and on  $k$
  - It is decreasing in  $k$

# Adulthood: Results

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- Male involvement in food production is key:
  - Food is a private good: the benefit from increasing  $k$  depends on how much time the man devotes to food production
  - Result:
    - In generous ecologies: MRS is increasing in  $k$
    - In harsh ecologies: MRS is U-shaped
    - In very harsh ecologies: MRS is decreasing in  $k$



# Adolescence: Model

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- ◉ In adolescence males may compete against each other
- ◉ Modeled as an evolutionary game in which:
  - males are matched to interact
  - each male has a strategy (inherited from his father) which dictates the number of rounds he is willing to compete (WTC)

# Adolescence: Model

Sequence of events:

- ① The generation at hand enters adolescence with a balanced sex ratio and couples form randomly
- ② Men are matched randomly into pairs to interact. Two pure strategies in this interaction: *Fight* and *Peace*

	Peace	Fight
Peace	One wife	Zero wives
Fight	Two wives	50-50 chance of getting two or zero wives

- 3'. Male pairs in which both played *Peace* settle down. Those who played *Fight* and won are matched randomly into pairs to interact.

	Peace	Fight
Peace	Two wives	Zero wives
Fight	Four wives	50-50 chance of getting four or zero wives

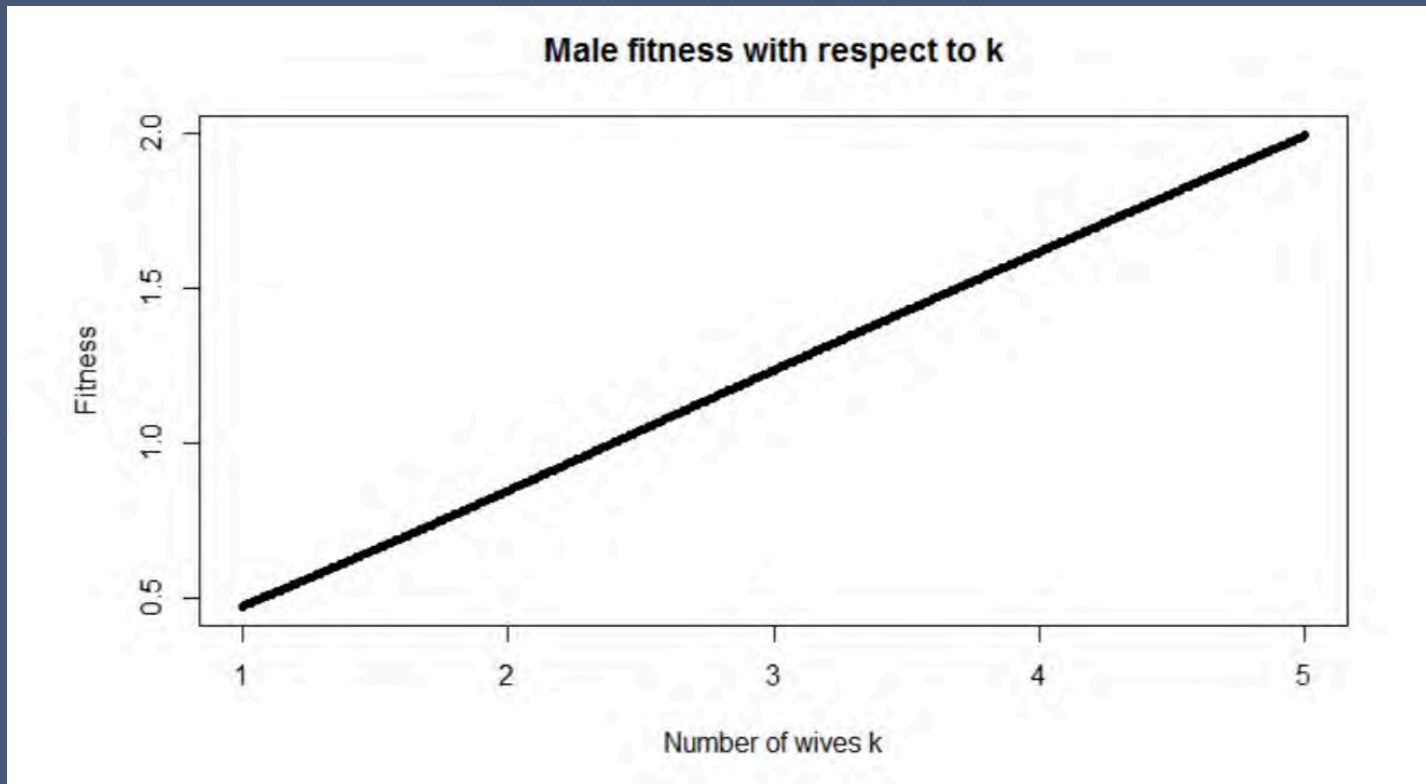
Etc... until no man plays *Fight*

# Adolescence: Model

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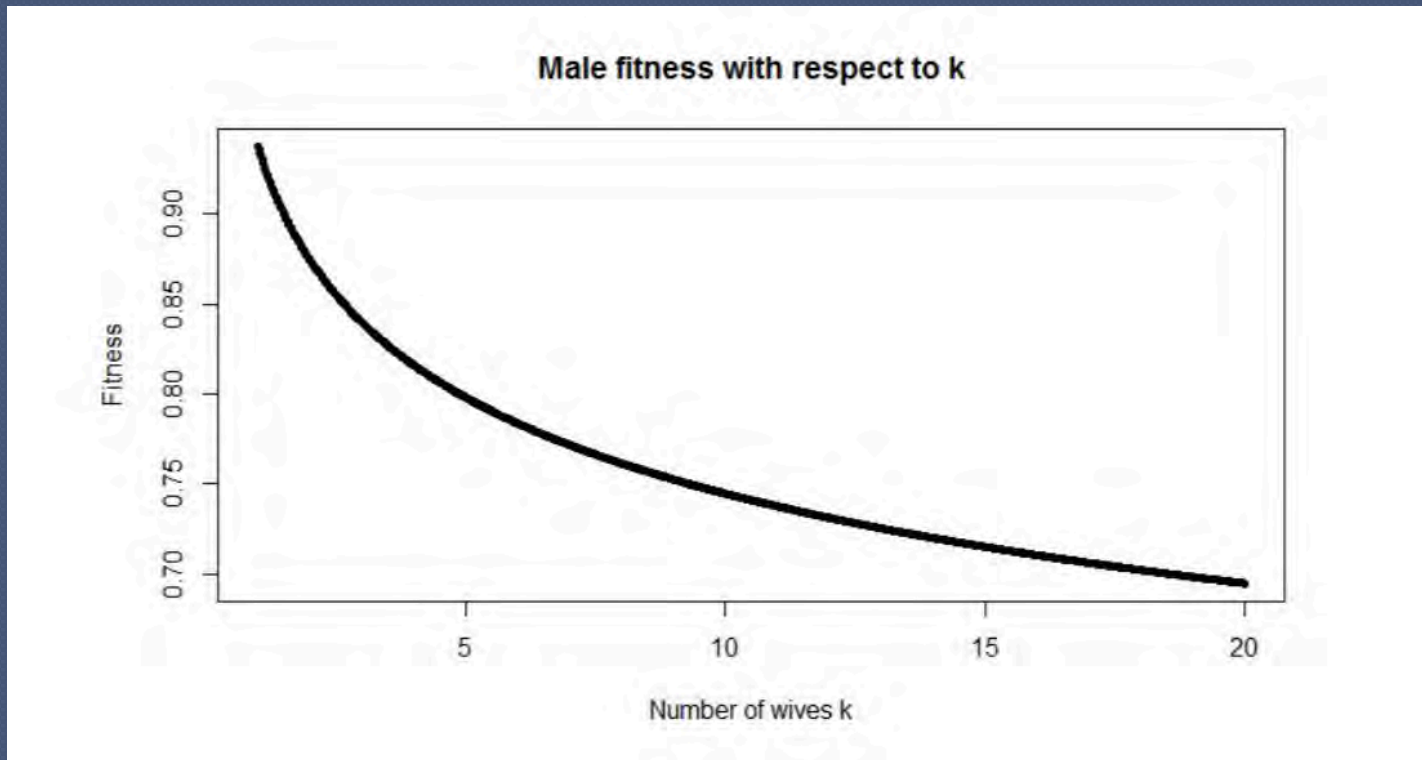
- Solution concept: evolutionarily stable strategies
- Consider some resident WTC
- This WTC is an ESS if there is no other WTC that gives a higher MRS, given that this WTC is present in most men

# Adolescence: Results



Generous ecologies: only maximal competition is ESS

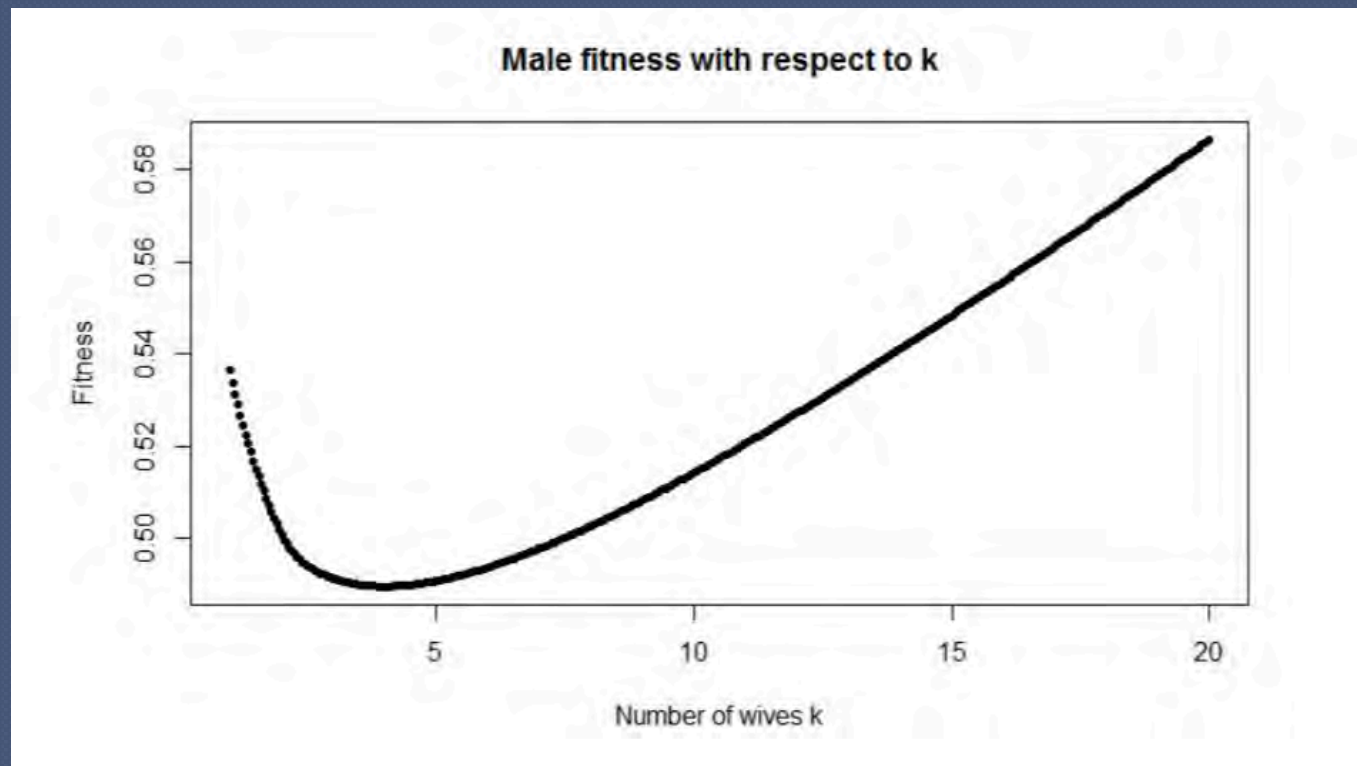
# Adolescence: Results



Very harsh ecologies: only minimal competition is ESS



# Adolescence: Results



Harsh ecologies: maximal and minimal competition are ESS

# Discussion

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- The model so far: a hunter-gatherer society. A winning man does not acquire any productive resources. Monogamy is sustainable through natural selection in harsh enough environments.

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- Neolithic transition: a winning man acquires the loser's reproductive *and* productive resources (land and tools). Monogamy is less likely to be sustainable.

# Discussion

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- The model so far: a hunter-gatherer society. A winning man does not acquire any productive resources. Monogamy is sustainable through natural selection in harsh enough environments.
- Neolithic transition: a winning man acquires the loser's reproductive *and* productive resources (land and tools). Monogamy is less likely to be sustainable.
- This is about life and death: extremely strong incentives for men to develop and produce weapons, or other means to win male-male competitions.

# In sum

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- ◉ A simple model of the evolution of male preferences over polygyny rates
- ◉ In some ecologies, men do not benefit from having more than one wife: institutions are then not needed to sustain monogamy
- ◉ The transition from hunting and gathering to sedentary agricultural societies led to a more severe male-male competition
- ◉ The results survive if :
  - women choose how to allocate their own time
  - women choose their own fertility



# Some species are more monogamous than others

Research on the Aka pygmies by anthropologists Barry and Bonnie Hewlett



Aka pygmy father and his son. They are the best dads in the world. Trevor Davies

<https://kwekudee-tripdownmemorylane.blogspot.com/2013/08/aka-pygmy-people-egalitarian-society.html>



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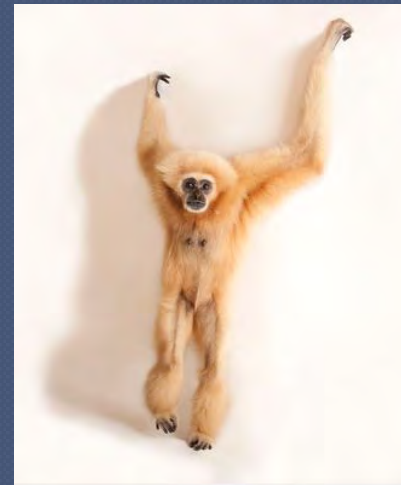
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# What is the mechanism?

Measure	Number of 334 alleles			df	F	P
	0	1	2			
Mean score for the Partner Bonding Scale in the three groups						
Partner Bonding Scale	48.0 (6.50)	46.3 (6.16)	45.5 (6.71)	2, 143	8.40	0.0004
Frequency and column-wise percentage of subjects reporting marital crisis/threat of divorce in the three groups						
Have you experienced marital crisis or threat of divorce during the last year?						
No	469 (85%)	277 (84%)	27 (66%)	2, 143	5.00	0.008
Yes	81 (15%)	51 (16%)	14 (34%)			
Frequency and column-wise percentage of subjects being married or cohabiting in the three groups						
Marital status						
Married	457 (83%)	275 (84%)	28 (68%)	2, 143	4.36	0.01
Cohabiting	96 (17%)	52 (16%)	13 (32%)			
Values for the Partner Bonding Scale are means with standard deviation in brackets.						

Walum et al. (2008)

Allele 334 on avpr1a gene is the human analogue of the AVP receptor gene which has been associated with monogamous behavior in prairie voles [Young et al. 1999]

# Concluding remarks

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- Theoretical work on the evolutionary foundations of human motivation may help us see new patterns and formulate novel hypothesis
- Here, I propose a model to examine whether monogamy is consistent with natural selection
- The model suggests that men got a strong incentive to out-compete other men with the advent of agriculture
- Comparison with other species and tentative work on humans suggests that male preferences for competition may have a genetic basis (which does not rule out that culture matters too!)



# Merci !



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