

Sex differences in spatial ability

Overview: Do males and females think differently?

Some interesting differences:

- sex differences in spatial ability
- sex differences in navigation
- sex differences in range size
- Relationships between range size and spatial ability

Explanations:

- Evolutionary hypotheses: Hunting, mating, parenting
- Psychological mediators: Risk and Harm avoidance

Framing issues

An evolutionary perspective suggests:

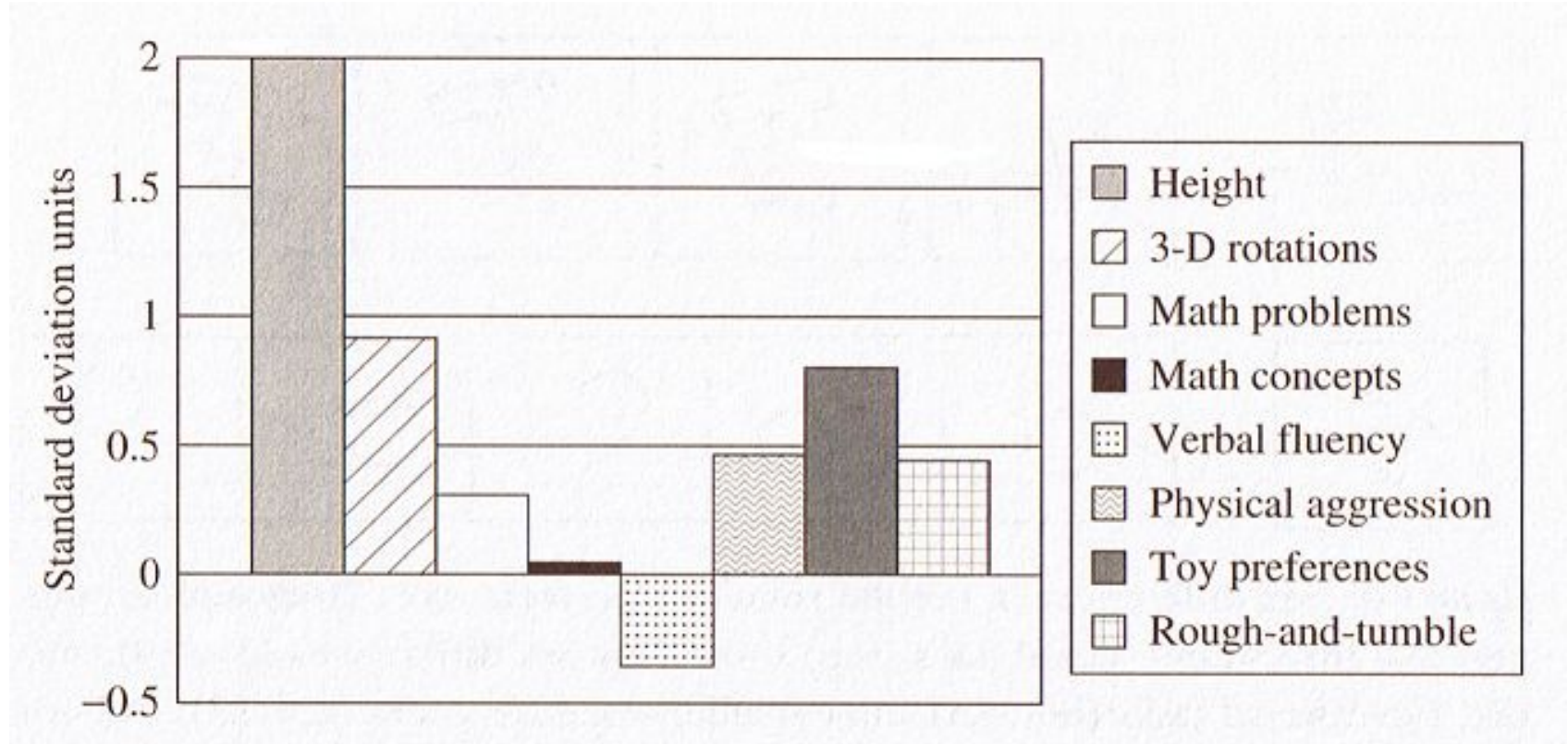
Different balance of selective pressures → different optima

Value judgments don't come from evolution

But implicit value judgments in the literature:

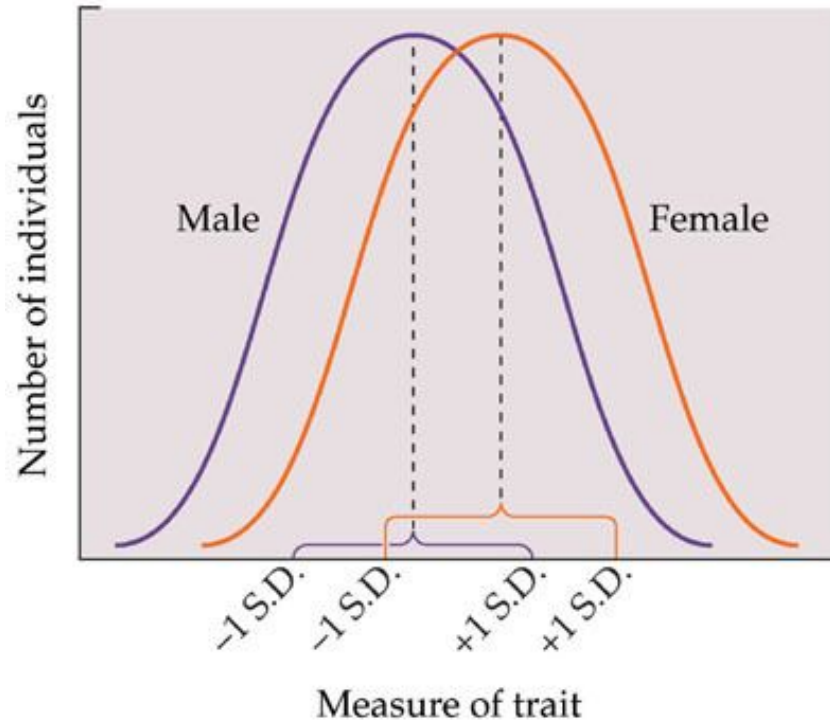
- How behavior is characterized (infants at the barrier: Goldberg & Lewis)
- What is tested, What counts as correct (speed of assessing relevant info)
- What is the null case (males as the 'default' ?)

Some sex differences in cognition and behavior



Caveat: even with a large sex difference. . .

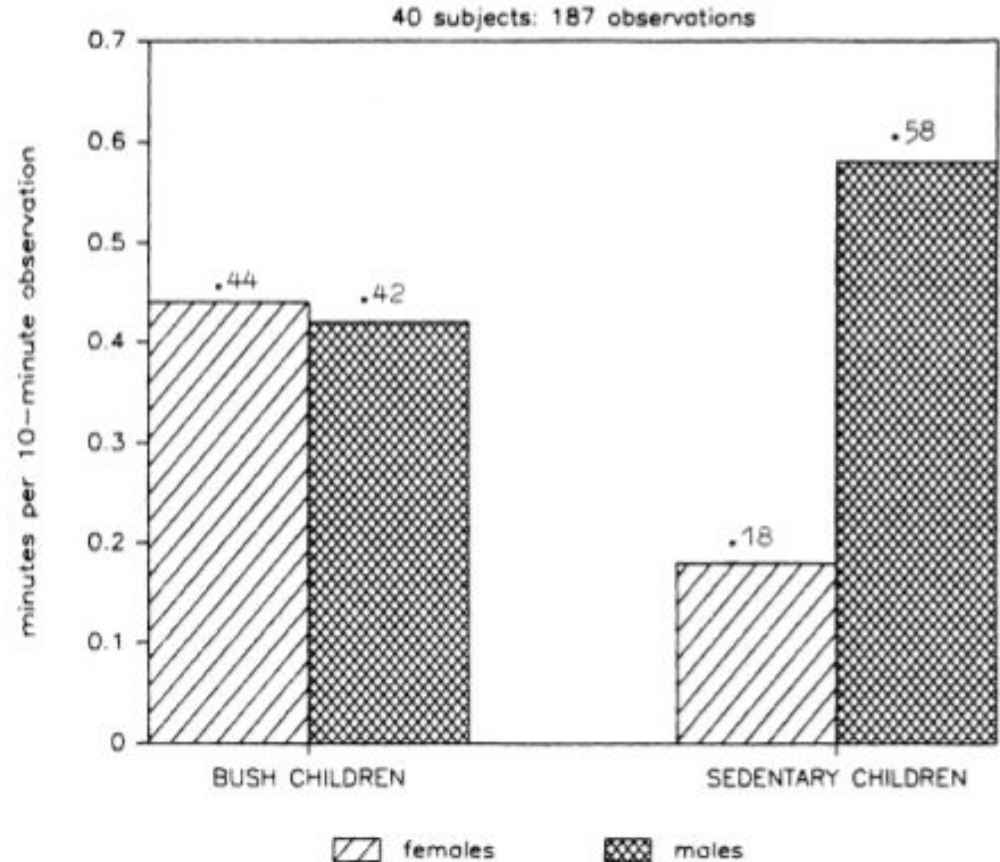
There is a lots of overlap between males and females; but note larger proportional difference in the tails of the distribution



Caveat: nature and nurture interact

Task activity in hunter-gatherer (!Kung) children amplifies sex differences

Figure 3. Rough and Tumble Play

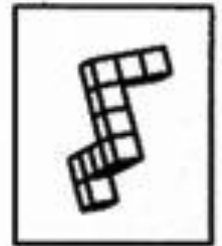
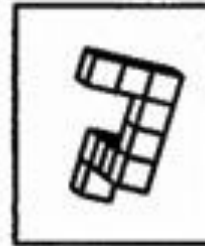
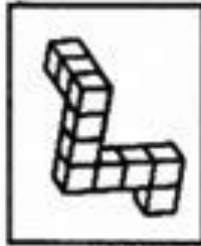


Males usually better at geometric spatial tasks

Now look at this object:



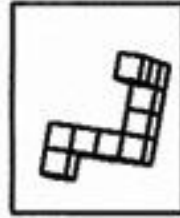
Two of these four drawings show the same object. Can you find the two? Put a big X across them.



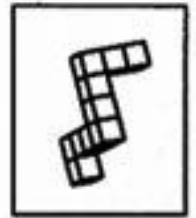
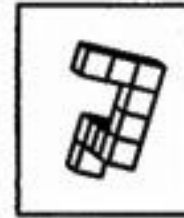
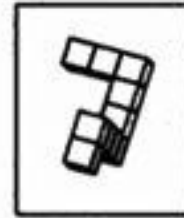
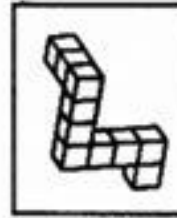
Mental Rotation

Males usually better at geometric spatial tasks

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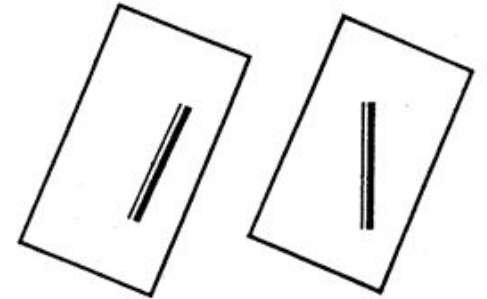
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Mental Rotation

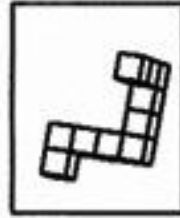
Spatial Perception (rod & frame)

Rod and Frame test—Align a rod within these frames so that the rod is vertical.

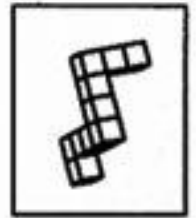
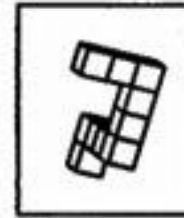
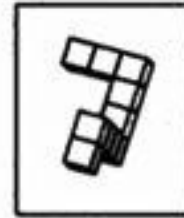
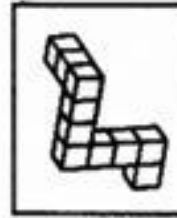


Males usually better at geometric spatial tasks

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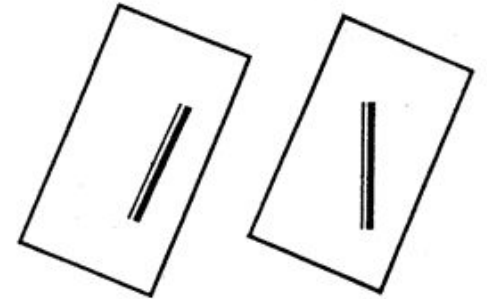
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Targeting (hitting & Intercepting moving objects)

Line angle accuracy

Women often better at remembering relative (not absolute) position of objects

Stimulus Figure



Test Figure (some objects changed places)



Sex differences in navigation

Men attend more to geocentric cues, like N,S,E,W

- indicate absolute distance and direction
- example: “go north 4 miles”
- enables short-cuts
- probably related to skill at geometric spatial tasks

Women may attend more to egocentric cues:

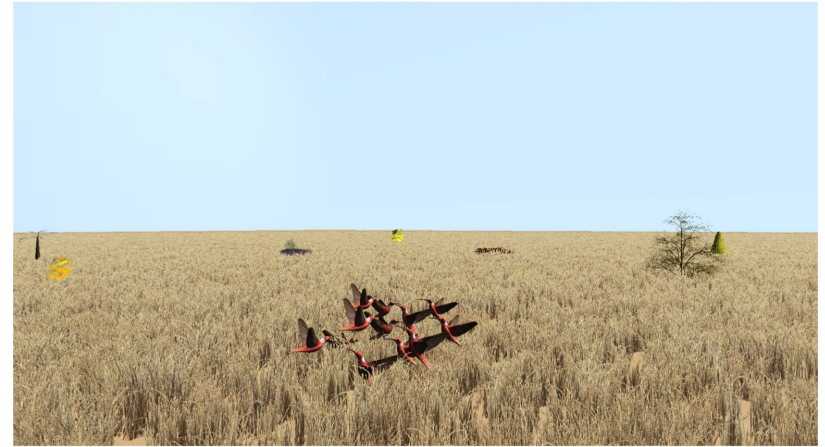
- note local landmark’s position in reference to self (“ego”)
- example: “turn left at the church”
- can use to retrace route, no shortcuts
- (no evidence yet that this is related to object location memory)

Near vs. Far Landmarks

Learning Phase: **DISTAL**

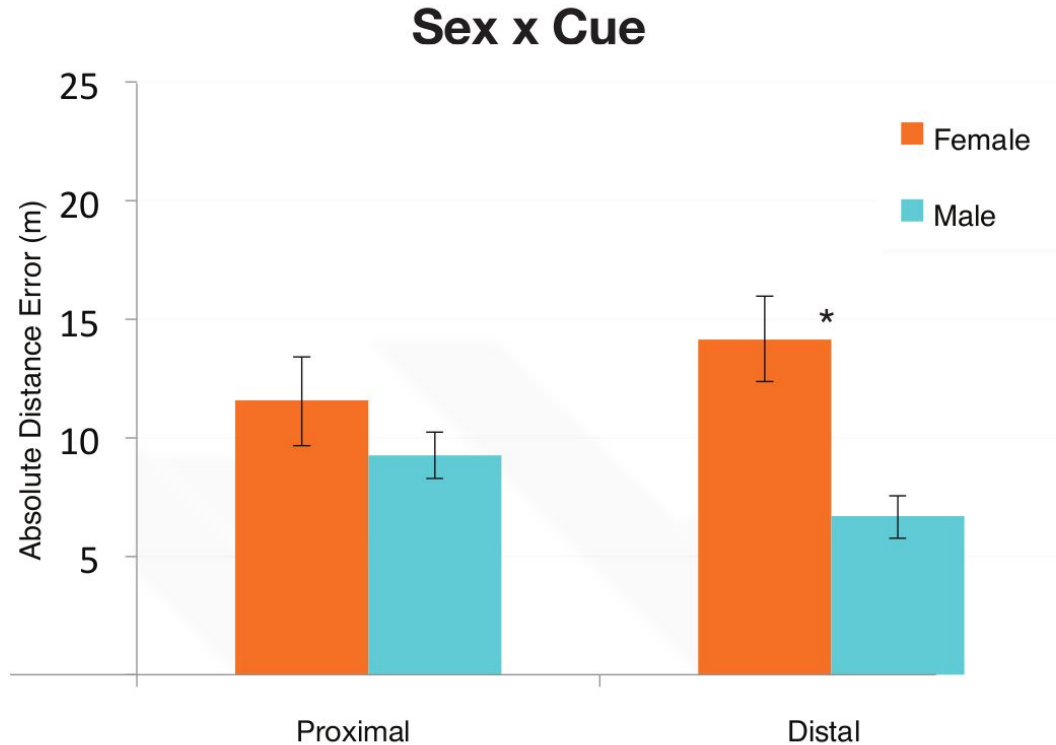


Learning Phase: **PROXIMAL**



Testing Phase: participants were asked to return to the location of the birds, which were no longer visible, on 6 trials from different starting positions. After each trial feedback was given.

With only far landmarks, women made more errors

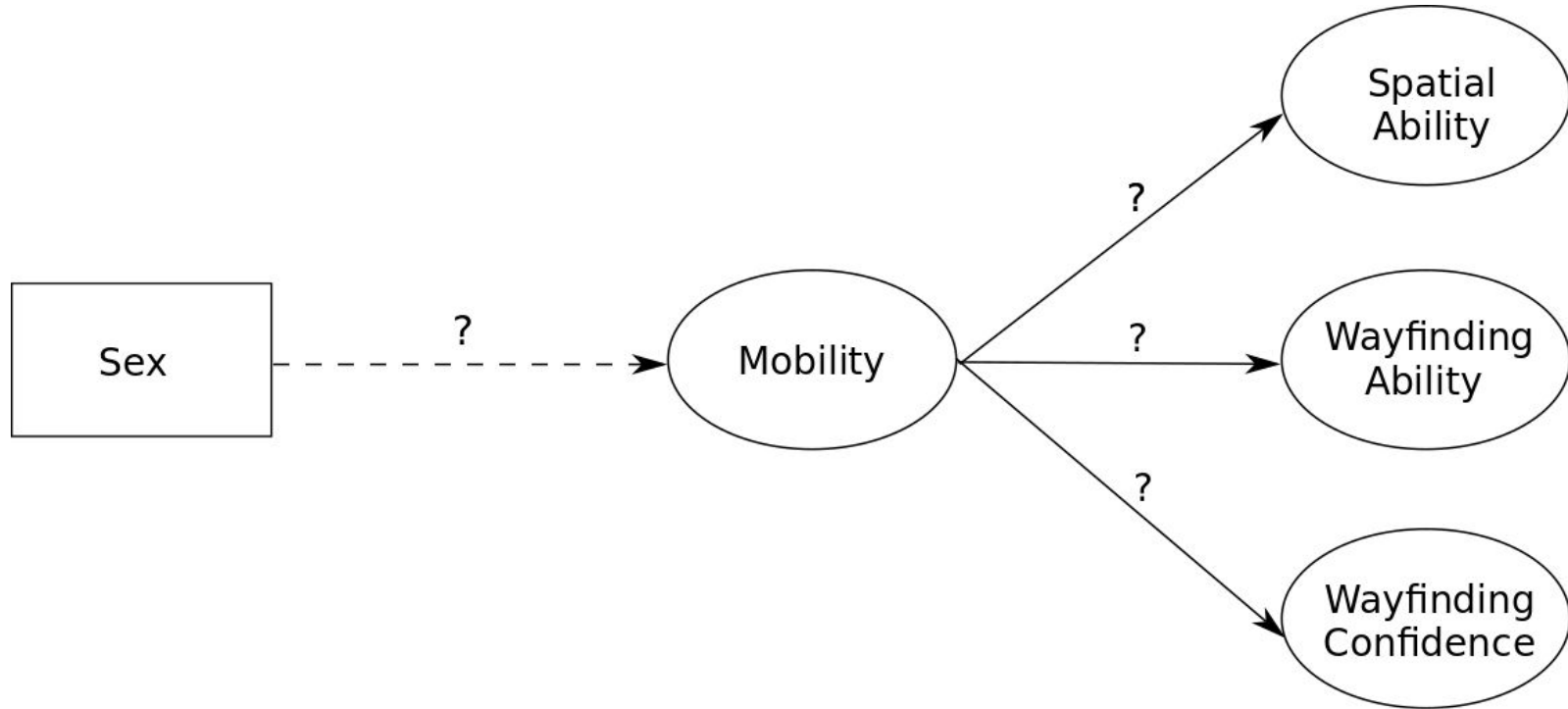


Male advantage looks like an evolved adaptation

- Not an evolutionary novelty (vs. math, etc).
- Is found in some other non-monogamous species
- Magnitude of sex differences are not trivial (vs. math etc).
- Is found cross-culturally
- Is affected by fetal androgens

In other spp, is related to sex differences in range size and navigation

The Spatial Cognition & Navigation Project



The Fieldsites:

HADZA



The Fieldsites:

TWE

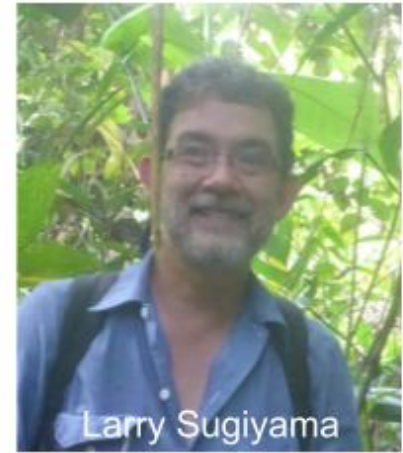


The Fieldsites:
TSIMANE

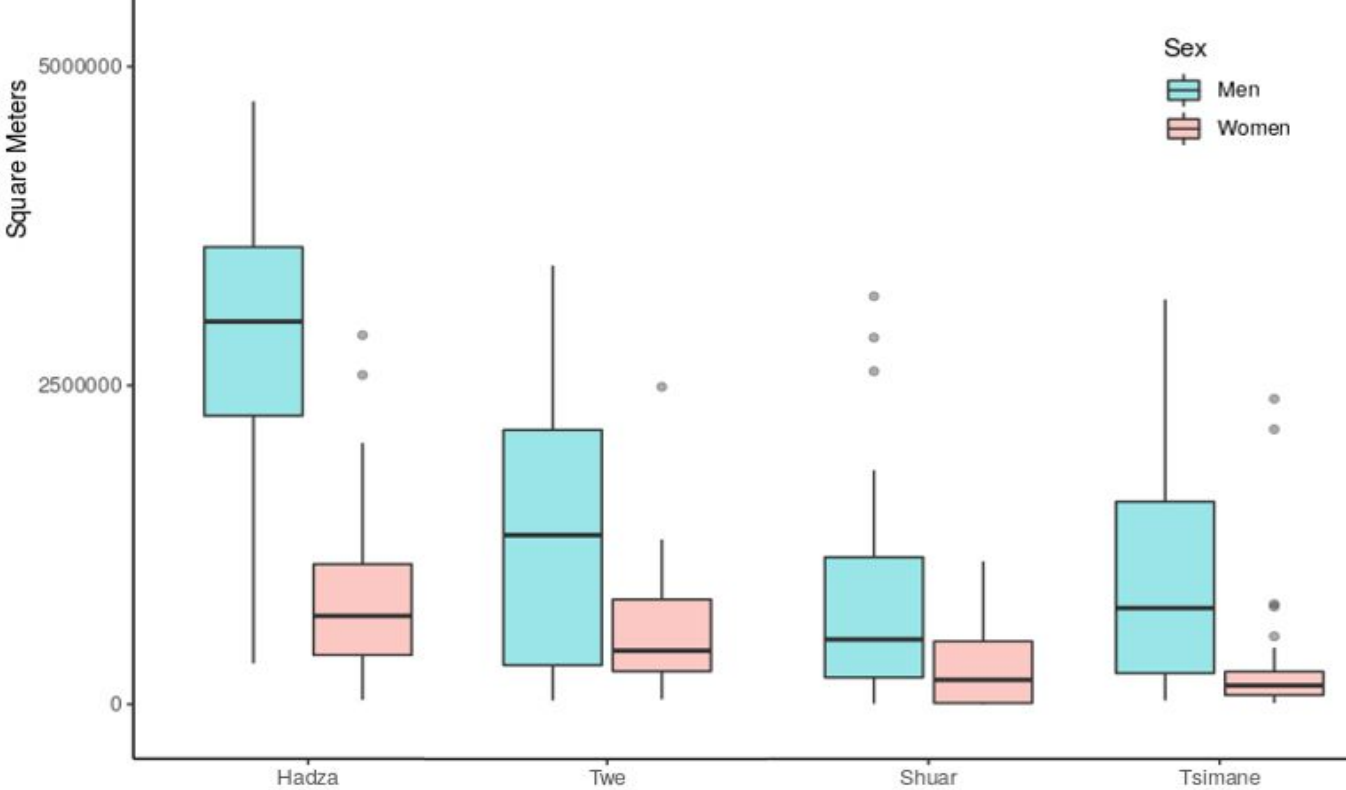


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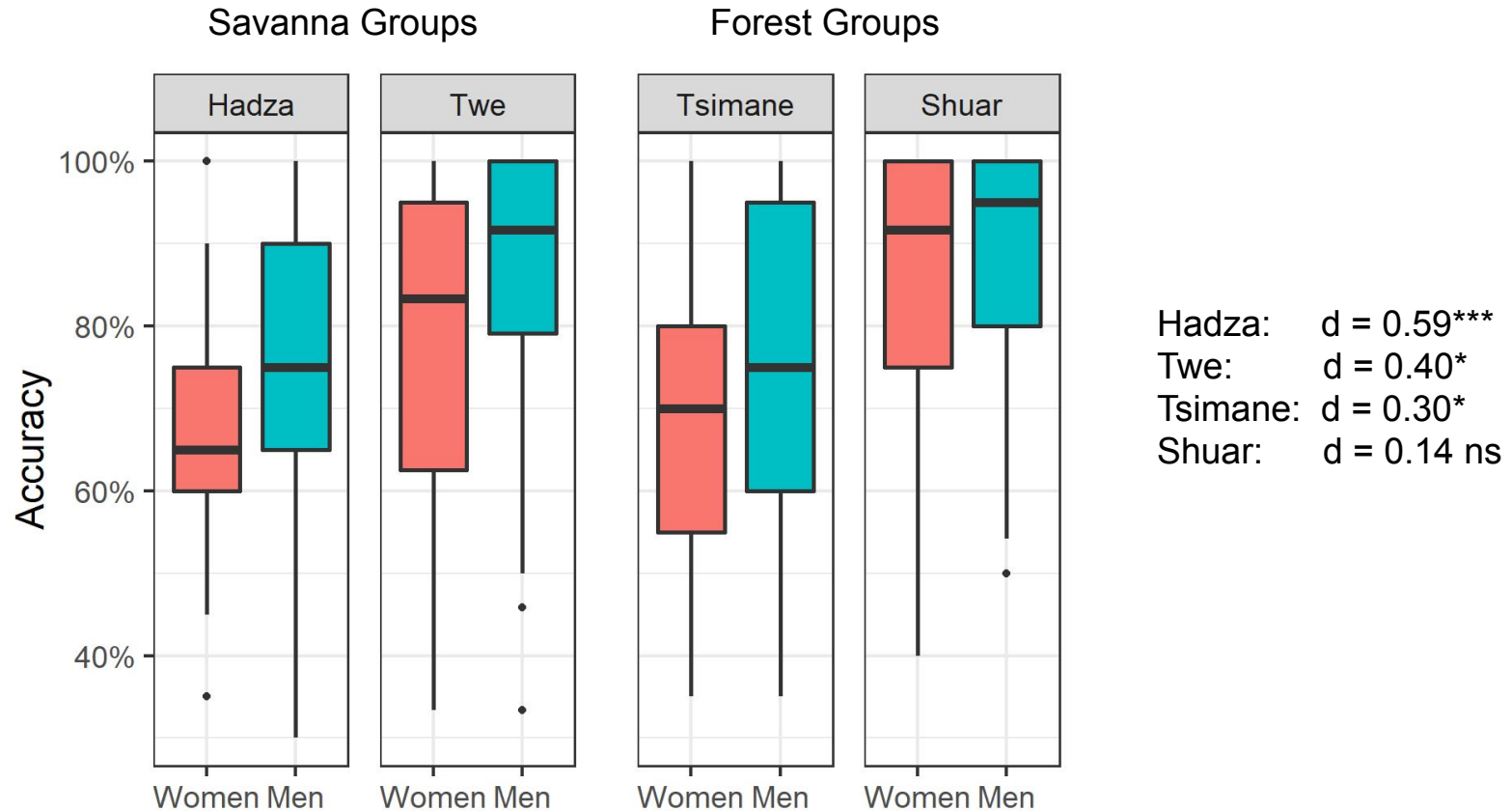
SHUAR



Daily range size (GPS)



Spatial ability; mental rotation



Evolutionary hypotheses: Hunting, mating, parenting

In other species, sex differences in spatial ability reflect different navigational demands on males and females (cowbirds, voles, guppies...)

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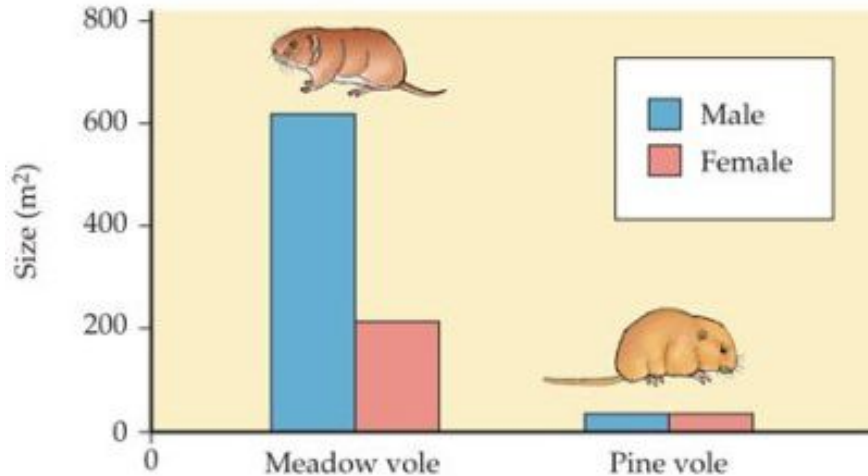
Three evolutionary hypotheses:

1. Men hunt mobile prey > larger and more unpredictable ranges
2. Males travel farther in search of mates
3. Females have smaller ranges due to parenting constraints/risks

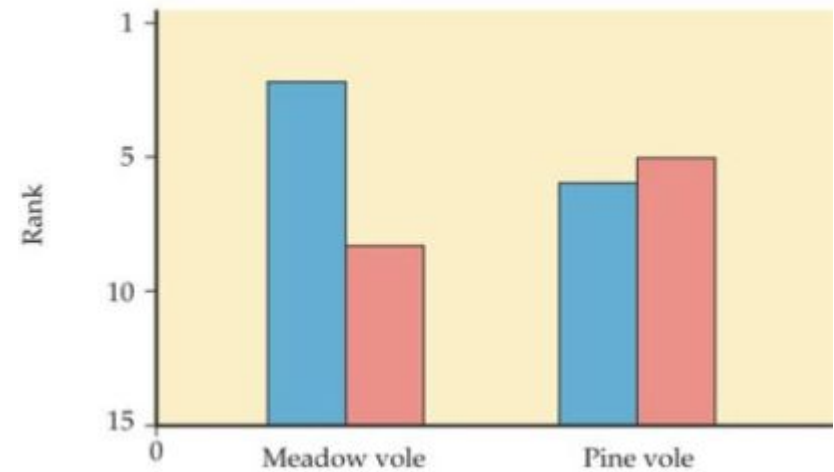
(these are not mutually exclusive, or exhaustive)

Mating, ranging & spatial ability in voles (Gaulin)

(a) Size of home range



(b) Ranking in spatial learning

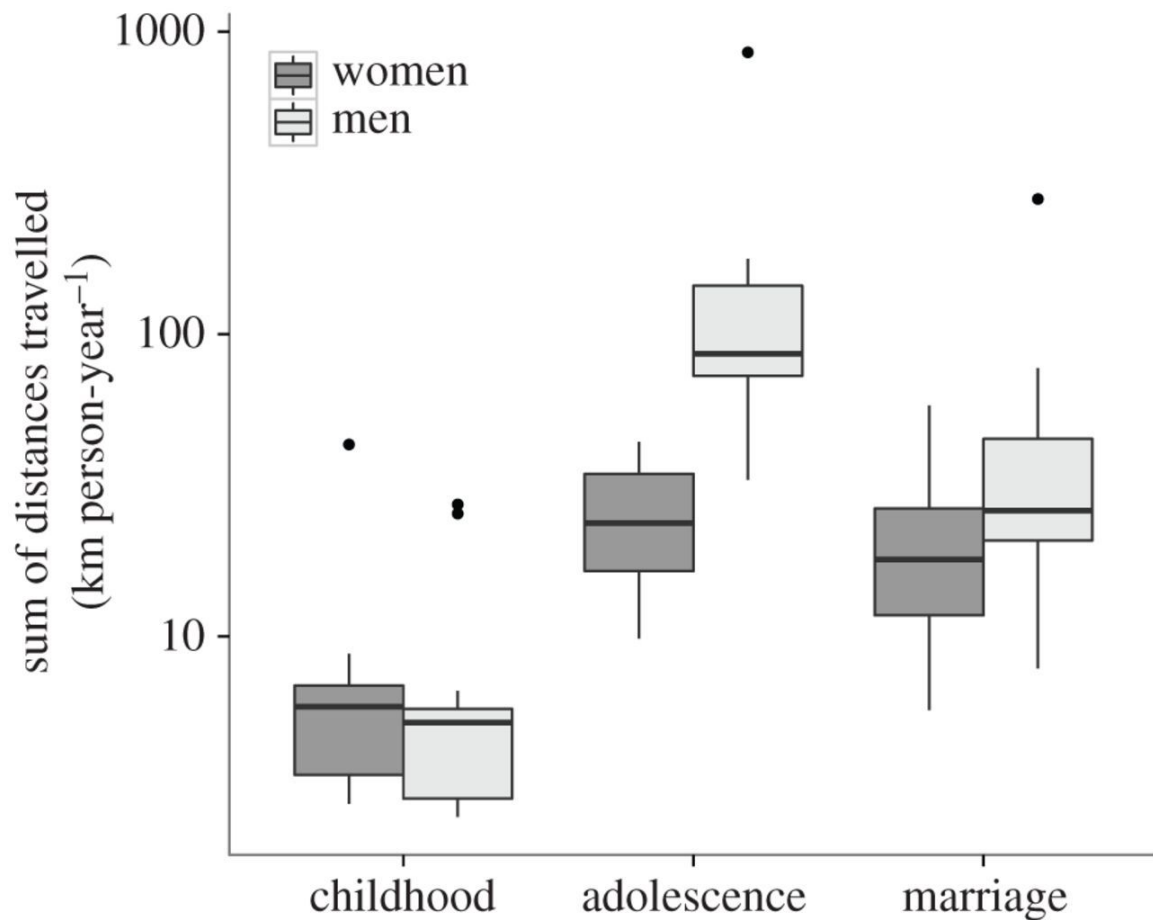


Figures: Gaulin & Fitzgerald, as adapted by Watson and Breedlove 2015

Pine vole: **Monogamous**
Meadow vole: **Polygynous**

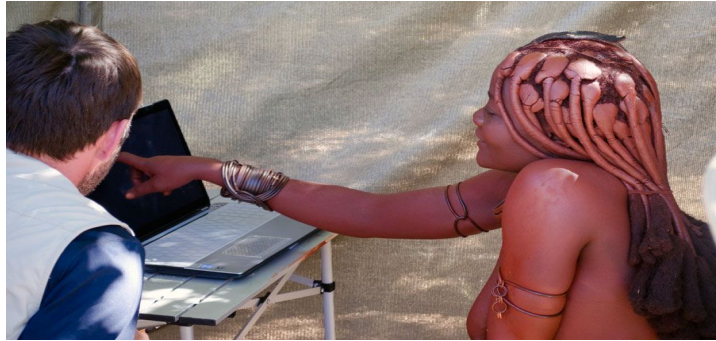
Gaulin & Fitzgerald
J. Mammalogy 1988
Anim. Beh 1989

Range size and mating competition? The Tsimane



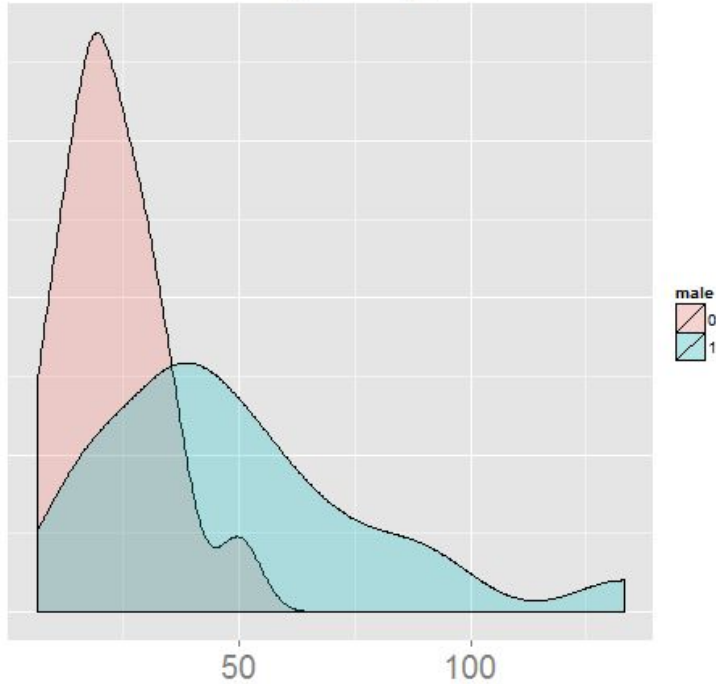
Two study

Extra-marital affairs are common and accepted in this population

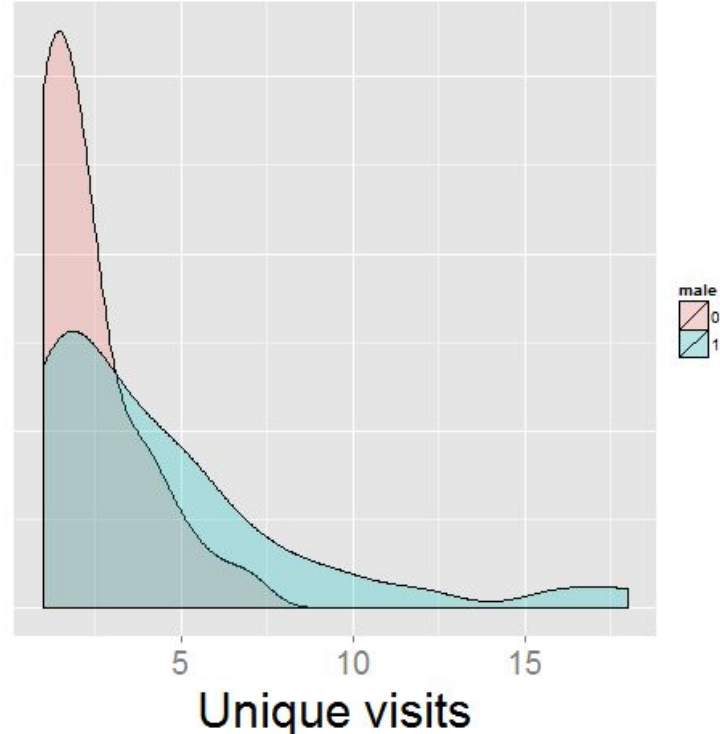


Sex differences in range size (Twe)

Daily range



Annual travel



Is the sex difference related to mate search?

Do men travel to visit mates? :

1. For overnight visits, questionnaire including

Why did you go there? **13% of men said to visit girlfriend**

Do you have a lover there? **24% of places men visited had lovers**

Is the sex difference related to mate search?

Do Two men travel to visit mates? :

1. For overnight visits, questionnaire including

Why did you go there? **13% of men said to visit girlfriend**

Do you have a lover there? **24% of places men visited had lovers**

Do men with lovers visit more places? (yes)

Average number of overnight visit locations per year by:

Men with lovers	6.3
Men without lovers	2.8
Women	2.3

Do larger ranges confer a fitness advantage? (Yes)

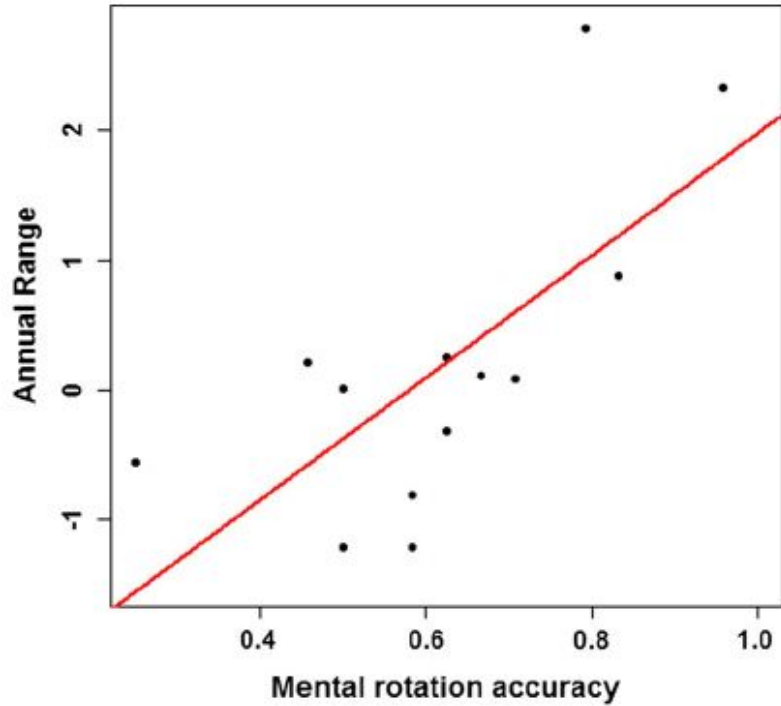
More mobile Two men have more children -- so not just a response to poor mating success at home.

Increasing range size by 1 SD adds how many children?

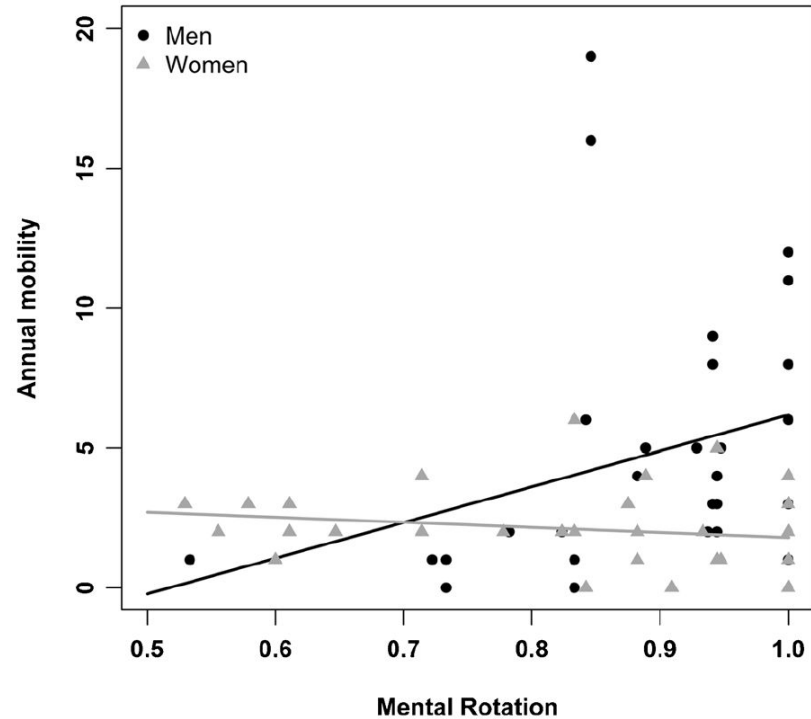
	Women	Men
Daily range size	0.61	1.83**
Yearly overnights visits	1.05*	1.44**
Lifetime # places visited	0.56	1.53*

* $p < .05$, ** $p < .01$
(controlling for age)

Is range size related to spatial ability in Two men? (maybe)



Vashro & Cashdan (2014) *EHB*



Vashro et al. (2016) *Human Nature*

Notes and caveats

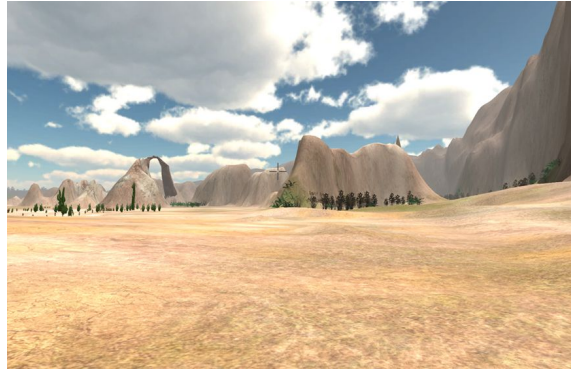
Mating patterns – and mating competition – vary a lot across societies. The sex difference does also.

- Monogamous Maya show little sex difference in range size, & it appears after marriage (male provisioning ?)

No assumption that this is conscious mate-seeking. We think it is mediated by sex differences in risk-seeking and harm-avoidance

- Risk-seeking predicted range size, which predicted navigational strategy and confidence in a Utah sample.

Cautious travel and navigational accuracy in virtual environments



Sex differences in style of exploration (searching for hidden objects):

- Women do more pausing
- Women return to previously explored locations
- Men cover more ground



Cautious exploration style

Style of travel explains why men did better at:

- Pointing to the objects from another location
- returning to objects they found earlier

Summary

Sex differences in spatial cognition and navigation are real, found cross-culturally, but not invariant. Think adaptation, not better/worse.

Data on other species points to sex differences in range size as a selection pressure for sex differences in spatial ability.

Data in humans suggests sex differences in natural mobility also related to sex differences in navigation

Mating competition, division of labor, parenting, among the selection pressures suggested for sex differences in human range size

These selection pressures lead to sex differences in risk-seeking & harm avoidance. We will look at this further in the next section (mating).