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

Melissa Hines, *Brain Gender*. 2003
Caveat: even with a large sex difference. . .

There is a lot 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
Males usually better at geometric spatial tasks

Mental Rotation
Males usually better at geometric spatial tasks

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

Mental Rotation

Spatial Perception (rod & frame)

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.

Padilla et al. *Psychon Bull Rev* 2017
With only far landmarks, women made more errors

Padilla et al. Psychon Bull Rev 2017
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
The Fieldsites: SHUAR

Larry Sugiyama
Daily range size (GPS)
Spatial ability; mental rotation

Hadza: $d = 0.59^{* * *}$
Twe: $d = 0.40^{*}$
Tsimane: $d = 0.30^{*}$
Shuar: $d = 0.14 \text{ ns}$
Evolutionary hypotheses: Hunting, mating, parenting

In other species, sex differences in spatial ability reflect different navigational demands on males and females (cowbirds, voles, guppies...).
Evolutionary hypotheses: Hunting, mating, parenting

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

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)

Pine vole: Monogamous
Meadow vole: Polygynous

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

Gaulin & Fitzgerald
J. Mammalogy 1988
Anim. Beh 1989
Range size and mating competition? The Tsimane

Miner et al. Proc. B. 2014
Twe study

Extra-marital affairs are common and accepted in this population
Sex differences in range size (Twe)
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 Twe 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:

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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Men with lovers</td>
<td>6.3</td>
</tr>
<tr>
<td>Men without lovers</td>
<td>2.8</td>
</tr>
<tr>
<td>Women</td>
<td>2.3</td>
</tr>
</tbody>
</table>
Do larger ranges confer a fitness advantage? (Yes)

More mobile Twe 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?

<table>
<thead>
<tr>
<th></th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily range size</td>
<td>0.61</td>
<td>1.83**</td>
</tr>
<tr>
<td>Yearly overnights visits</td>
<td>1.05*</td>
<td>1.44**</td>
</tr>
<tr>
<td>Lifetime # places visited</td>
<td>0.56</td>
<td>1.53*</td>
</tr>
</tbody>
</table>

* p < .05, ** p < .01 (controlling for age)
Is range size related to spatial ability in Twe men? (maybe)

Vashro et al. (2016) *Human Nature*

Vashro & Cashdan (2014) *EHB*
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

Style of travel explains why men did better at:
- Pointing to the objects from another location
- Returning to objects they found earlier

Cautious exploration style
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).