

## When to get married: From individual mate search to population marriage patterns

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## Overview of the talk

- The problem of sequential search
- Sequential search in mate choice
  - One-sided search
  - Mutual search
- Population-level (demographic) implications and test
- Other sources of evidence

## The problem of finding things

Search is required whenever resources are distributed in space or time, e.g.:

- mates
- friends
- habitat
- food
- modern goods: houses, jobs, lightbulbs...

Another better option could always arrive, so the real problem is:

*when to stop search?*

## Choosing a mate

Mate choice involves:

1. Assessing relevant cues of mate quality
2. Processing cues into judgment of mate quality
3. Searching a sequence of prospects and courting on the basis of judged quality

Can be fast and frugal through limited cue use (steps 1, 2), and limited search among alternatives (step 3)

## Features of mate search

No going back: once an alternative is passed, there's little chance of returning to it

No looking forward: upcoming range of possible alternatives is largely unknown

How to decide when to stop?

## A well-studied "mate search" example: the Dowry Problem

A sultan gives his wise man this challenge:

- 100 women with unknown distribution of dowries will be seen
- Women will pass by in sequence and announce their dowry
- Search can be stopped at any time, but no returning to earlier women
- Wise man must pick highest dowry or die

How can the wise man maximize his chances of success and survival?

## Fast and frugal search

Given a search situation with:

- Unknown distribution of alternatives
- No recall (returning to earlier options)
- No switching (once a choice is made)

then it can be appropriate to search using an aspiration level, or *satisfice* (Simon, 1955)

## Satisficing search

Satisficing search operates in two phases:

1. Search through first set of alternatives to gather info and set aspiration level, typically at highest value seen
2. Search through further alternatives and stop when aspiration is exceeded

But how long to search in first phase for setting the aspiration level?

## Solving the Dowry Problem

Goal: Maximize chance of finding best option

Approach: Set aspiration level by sampling a number of options that balances information gathered against risk of missed opportunity

Solution: Sample  $N/e$  ( $= .368*N$ )

In other words, the *37% Rule*...

## Finding a parking place

One-sided parking search:

- Sequence of filled/empty spaces seen one at a time
- Can't tell what's coming up
- Can't turn around in the middle

Differences from one-sided mate search:

- Parking spaces get better as we go along
- Can turn around at very end

## Driving / parking simulator



## The 37% Rule

Search through options in two phases:

Phase 1: Sample / assess first 37% of options, and set aspiration level at highest value seen

Phase 2: Choose first option seen thereafter that has a value above the aspiration level

Cognitive requirements are minimal:  
remember one value and compare to it

## An alternative criterion

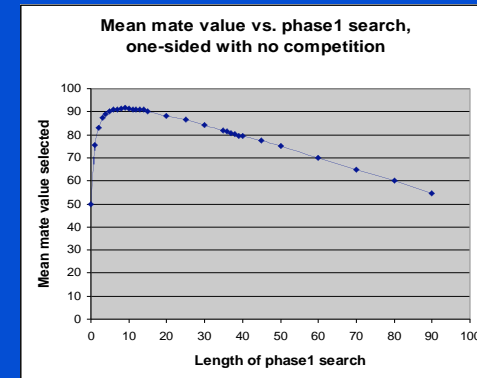
Seeking the optimum takes a long time (mean 74% of population) and doesn't often succeed (mean 37% of times)

Instead, a more reasonable criterion:  
maximize mean value of selected mates

This can be achieved with much less search:  
check 9% of options instead of 37% in Phase 1

Take the Next Best rule: set aspiration after ~12

## Maximizing mean value found



## More realistic mate search: Mutual choice

Problem: Few of us are sultans

Implication:

- Mate choice is typically mutual

Empirical manifestations:

- most people find a mate...
- who is somewhat matched in attractiveness and other qualities...
- after a reasonably short search

## The Matching Game

- Divide a class in half, red and green
- Give each person in each half a number from 1 to N on their forehead
- Tell people to pair up with the highest opposite-color number they can get

### Results:

- rapid pairing
- high correlation of values in each pair

## Modeling mutual search

Kalick & Hamilton (1986): How does matching of mate values occur?

Observed matching phenomenon need not come from matching process:

- model agents seeking best possible mate also produced value matching within mated pairs
- however, they took much longer to find mates than did agents seeking mates with values near their own

## Knowing one's own value

Some knowledge of one's own mate value can speed up search

But how to determine one's own value in a fast and frugal way?

Answer: learn one's own value during an initial "dating" period and use this as aspiration level, as in to Phase 1 of satisficing search

## Mutual search learning strategies

Methods for learning aspiration near own mate value, decreasingly self-centered:

- *Ignorant* strategy: ignore own value and just go for best (one-sided search)
- *Vain* strategy: adjust aspiration up with every offer, down with every rejection
- *Realistic* strategy: adjust up with every higher offer, down with lower rejections
- *Clever* strategy: adjust halfway up to every higher offer, halfway down to lower rejects

## Modeling mutual sequential mate search

- Simulation with 100 males, 100 females
- Mate values 1-100, perceived only by other sex
- Each individual sequentially assesses the opposite-sex population in two phases:
  - Initial adolescent phase (making proposals/rejections to set aspiration level)
  - Choice phase (making real proposals/rejections)
- Mutual proposals during choice phase pair up (mate) and are removed

How do different aspiration-setting rules operate, using info of mate values and offers?

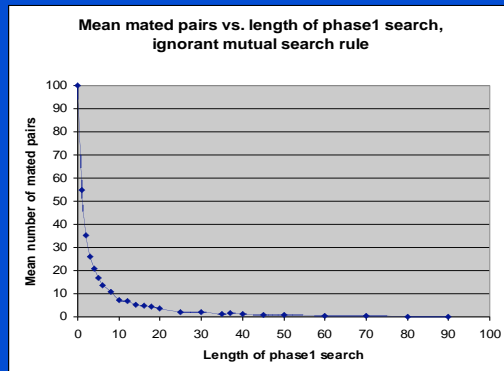
## “Ignorant” aspiration-setting rule

Ignore proposals/rejections from others-- just set aspiration level to highest value seen in adolescent phase

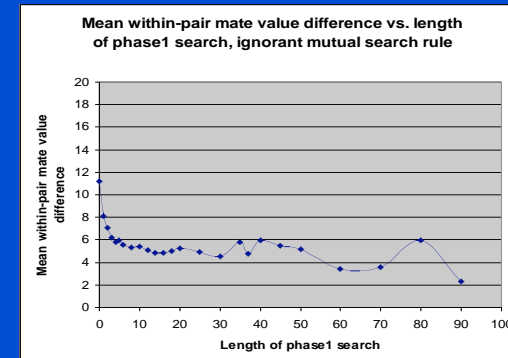
Equivalent to one-sided search rule used in a two-sided search setting

Everyone quickly gets very high aspirations, so few find mates...

## Ignorant rule's mating rate



## Ignorant rule's matching ability



## A better aspiration-setting rule

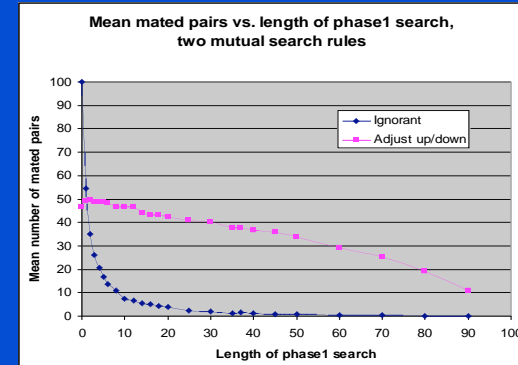
Idea: use other's proposals/rejections as indications of one's own attractiveness, and hence where one should aim

Adjust up/down rule:

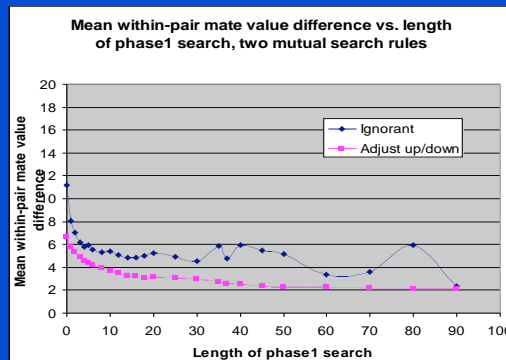
For each proposal from more-attractive individual, set aspiration up to their value

For each rejection from less-attractive individual, set aspiration down to their value

## Adjust up/down rule's mating rate



## Adjust up/down rule's matching



## Comparing search learning rules

Ignorant (one-sided) strategy forms unfeasibly high aspiration levels and consequently few mated pairs

Adjust up/down strategy learns reasonable aspirations, so much of the population finds others with similar values

(But still too few pairs are made, so other strategies should be explored)

## Summary so far—How others' choices change mate search

Solo mate search: set aspiration to highest value seen in small initial sample

[Add indirect competition: decrease size of initial sample]

Add mutual choice: set aspiration using values of proposers and rejecters in small sample

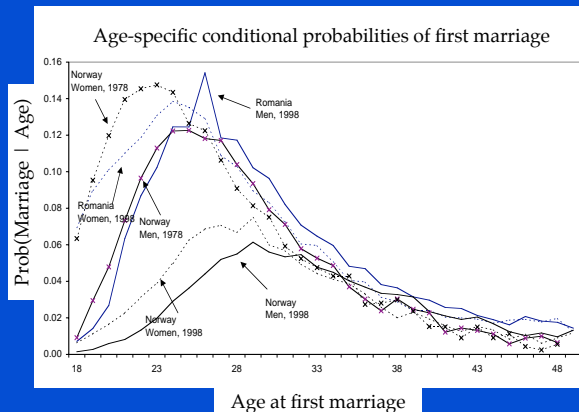
## Testing search rules empirically

Difficult to observe individual sequential mate search processes “in nature”

But we *can* see the population-level outcomes of these individual processes: the distribution of ages at which people get married

Can we use this demographic data to constrain our models?

## Real age-at-marriage patterns



## Explaining age at marriage

Age-at-marriage patterns are surprisingly stable across cultures and eras (Coale)

How to explain this regularity?

- Latent-state models: people pass through states of differing marriageability
- Diffusion models: people “catch the marriage bug” from other married people around them (cf. networks)

Both can account for the observed data...

## Psychologically plausible accounts of age at marriage

...but neither latent-state nor diffusion models are particularly psychological

Third type: search models

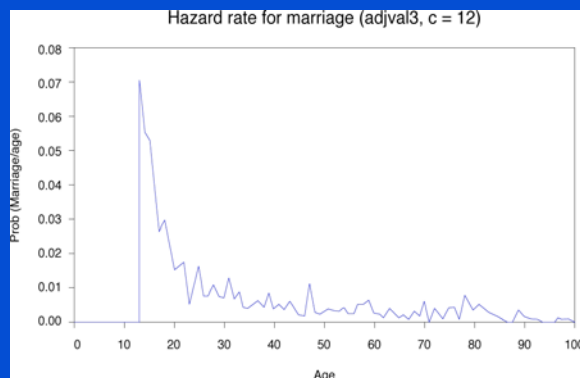
- from psychology: bounded rational models using more plausible satisficing and aspiration-level-learning heuristics

## Mutual search with learning

Does mutual search create the expected population-level outcome?

- individuals start out with medium self-assessment and aspirations
- individuals learn using “clever” rule, adjusting their aspiration partway up or down to mate value of offerer or rejecter

## Marriage pattern, mutual model



## Can one-sided search be fixed?

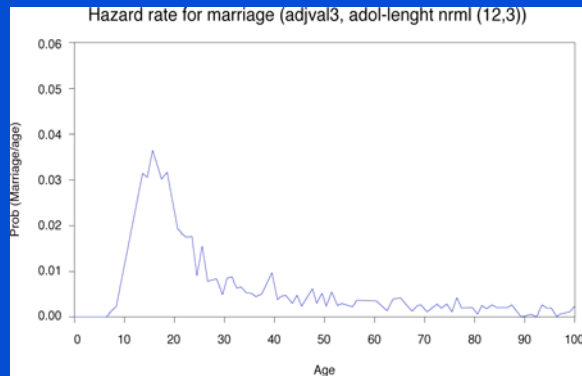
Monotonically-decreasing age-at-marriage distribution is unrealistic

How can it be modified?

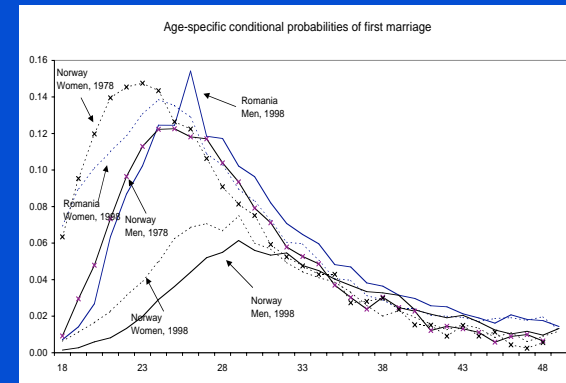
Billari introduced two types of variation in learning period among individuals:

- positively age-skewed (unrealistic?)
- normally distributed around 12

## Adding learning-time variability



## Real age-at-marriage patterns



## Constraining search models with population-level data

By comparing aggregate model outcomes with observed population-level data, we found:

- mutual search with aspiration learning alone was not able to produce realistic age-at-marriage patterns
- adding individual variation in learning/ adolescence times did produce realistic patterns
- other forms of variation (e.g., initial starting aspiration, distribution of mate values) did not help

## Another empirical approach

Is there some way to observe the ongoing mate choice process on an individual basis?

Mate choice in microcosm...

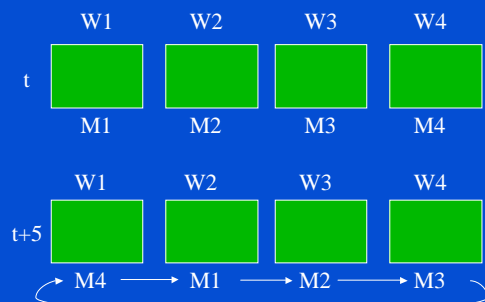
## SpeedDating®



## How does SpeedDating work?

- ~20 men and ~20 women gather in one room (after paying \$30)
- Women sit at tables, men move in circle
- Each woman talks with each man for 5 min.
- Both mark a card saying whether they want to meet the other ever again
- Men shift to the next woman and repeat

## The rotation scheme



## What happens next...

- Men's/women's "offers" are compared
- Every mutual offer gets notified by email, with other's contact info
- After that, it's up to the pairs to decide what to do....

## What we can observe

Data we can get:

offers made and received  
order in which people are met  
matches made

--so (almost) like sequential search...

(except for some fore-knowledge of distribution,  
and no control over when offers are actually made)

So next summer we'll run our own session:

men and women kept separate, making decisions  
immediately after each meeting, and giving us full  
data about their traits and preferences

## New mate search models

Individual variation in learning time is necessary  
But is a fixed period of learning followed by  
"real" search/offers very realistic?

Newer model with Jorge Simão produces  
emergent variation:

- Search using aspiration levels
- Courtship occurs over extended period
- Maintain a network of contacts and switch to better partners (if they agree)

Can look at marriage age vs. mate value,  
distribution of ages, effect of sex ratio....

## Conclusions

Sequential search heuristics use aspiration levels  
set in simple ways to stop search, trading off  
exploration against time/missed opportunities

People use such heuristics in some domains, and  
may use them in mate choice

Populations of simulated individuals searching for  
mates using simple search heuristics get married  
at times corresponding to the distribution of  
human marriages

Empirical data supporting search heuristic use at  
the individual level is still needed (Fast-Dating)

## For more information...

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