Cultural evolution

Using evolutionary principles to make sense of
word origins,
problem solving, and
the growth of Wikipedia articles.

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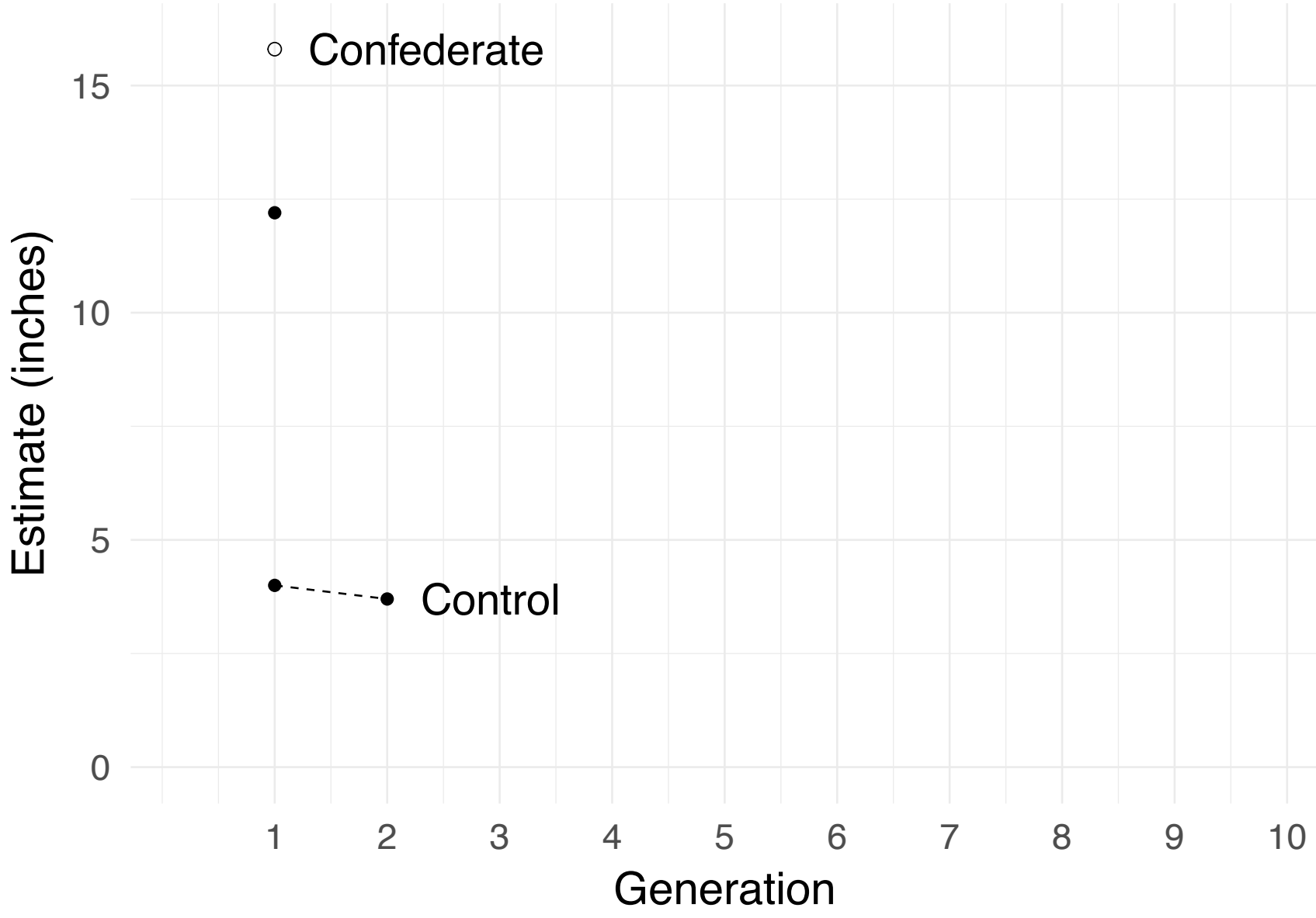
Unifying theme

- **Iteration** is "the repetition of a process or utterance."
- When can iteration be trusted?

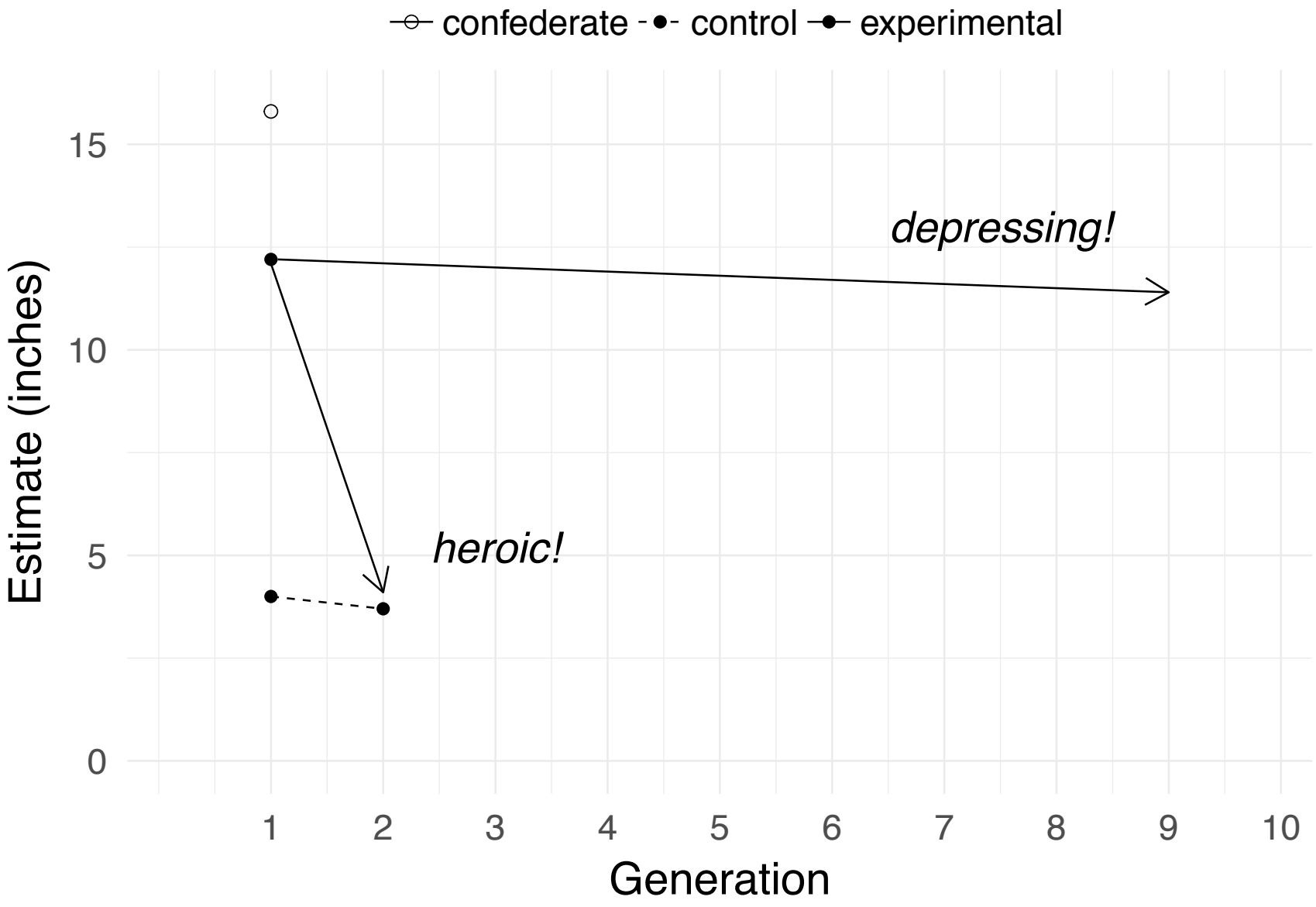
Evolution in the psychology department

Jacobs & Campbell. (1961). *J Abnorm Soc Psychol*.
The perpetuation of an arbitrary tradition through several generations of a laboratory microculture.

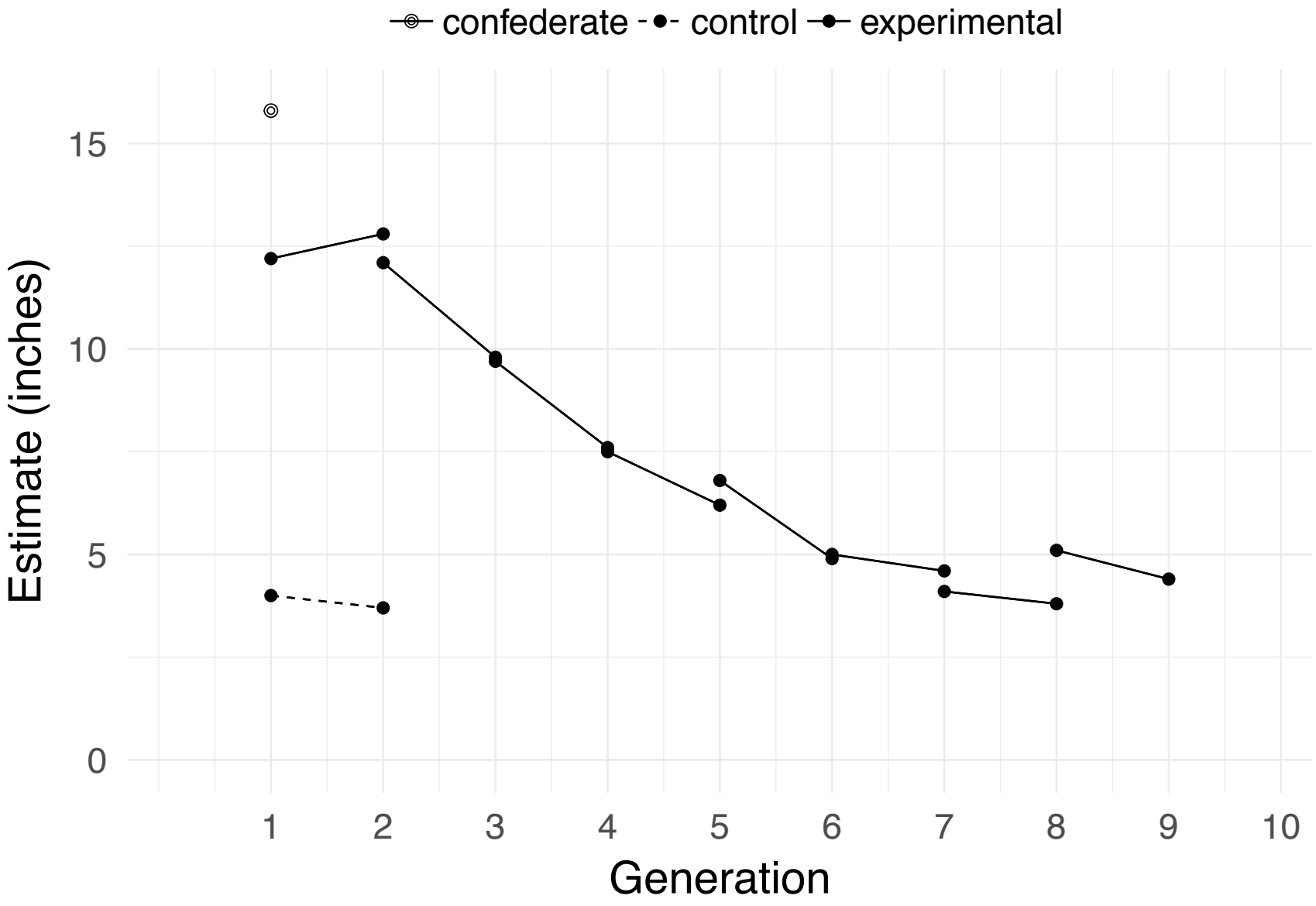
Iterated conformity (Jacobs & Campbell, 1961)



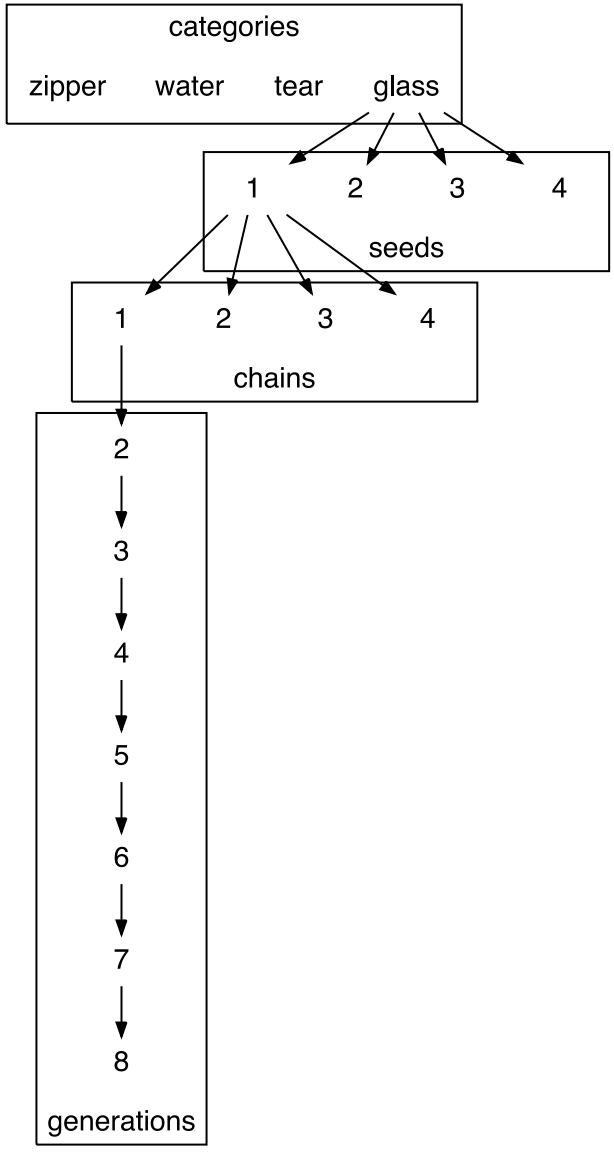
Iterated conformity (Jacobs & Campbell, 1961)



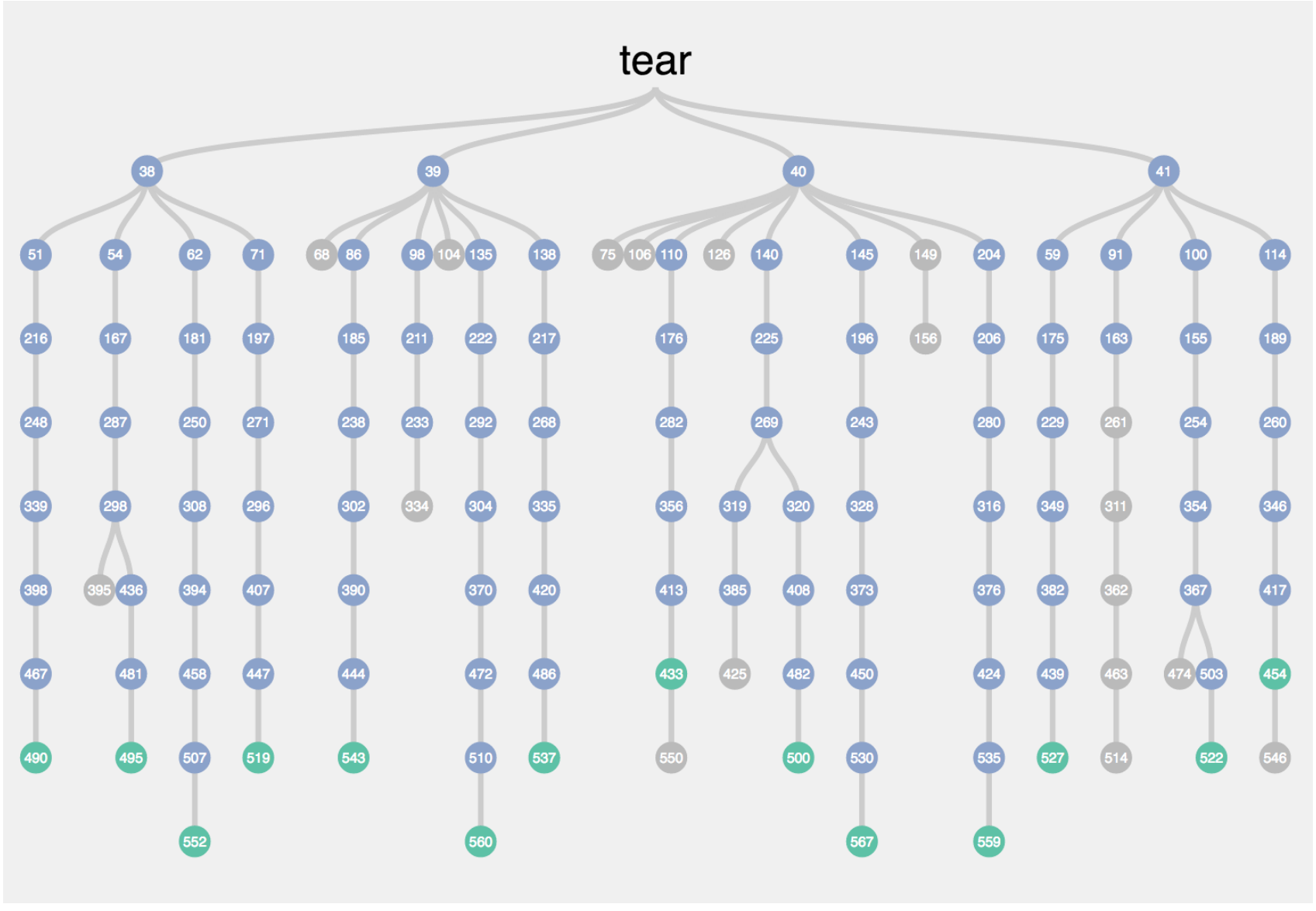
Iterated conformity (Jacobs & Campbell, 1961)



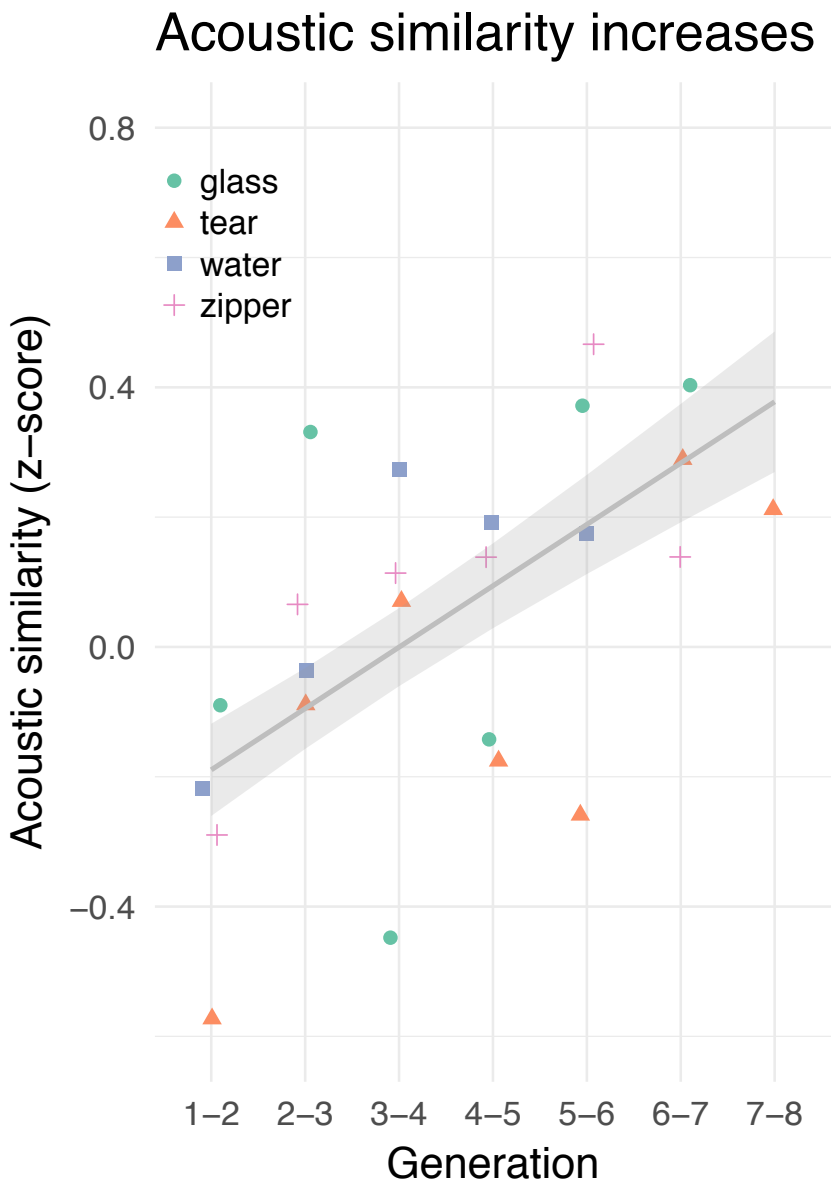
Creating words from iterated vocal imitation

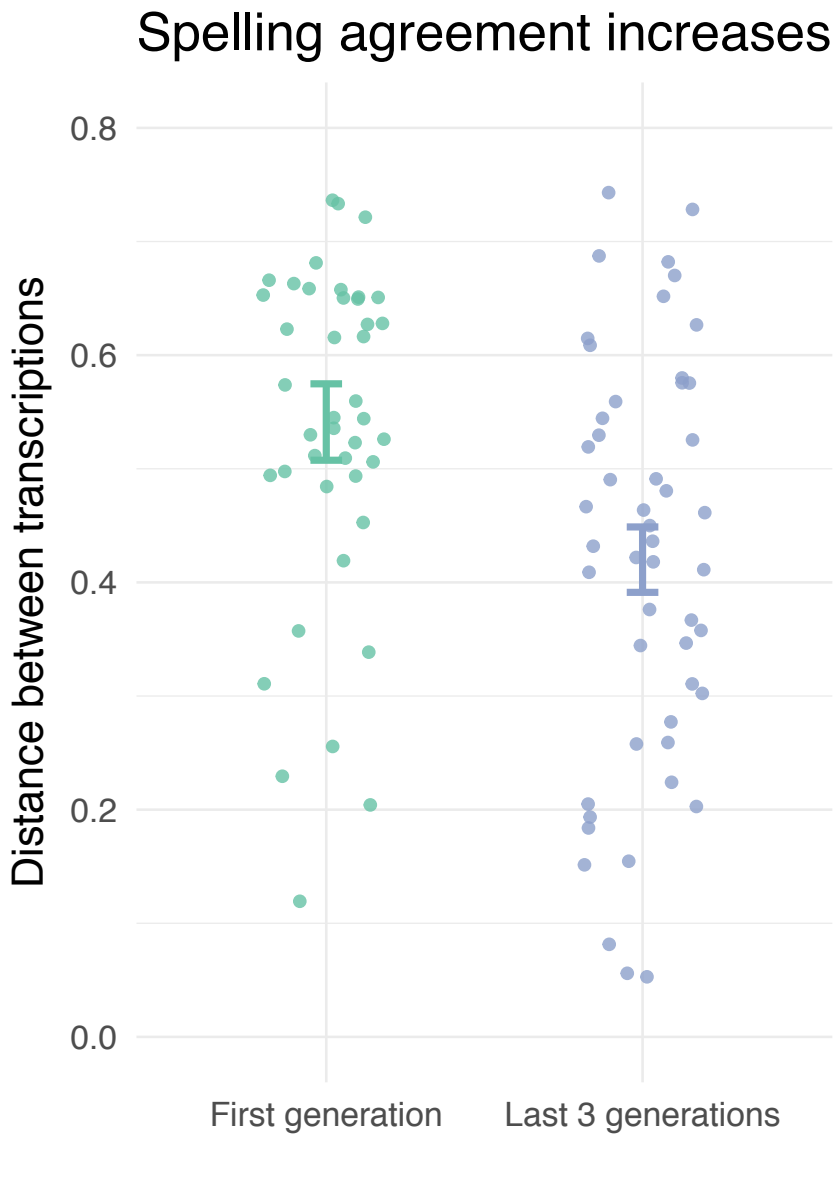


Telephone app

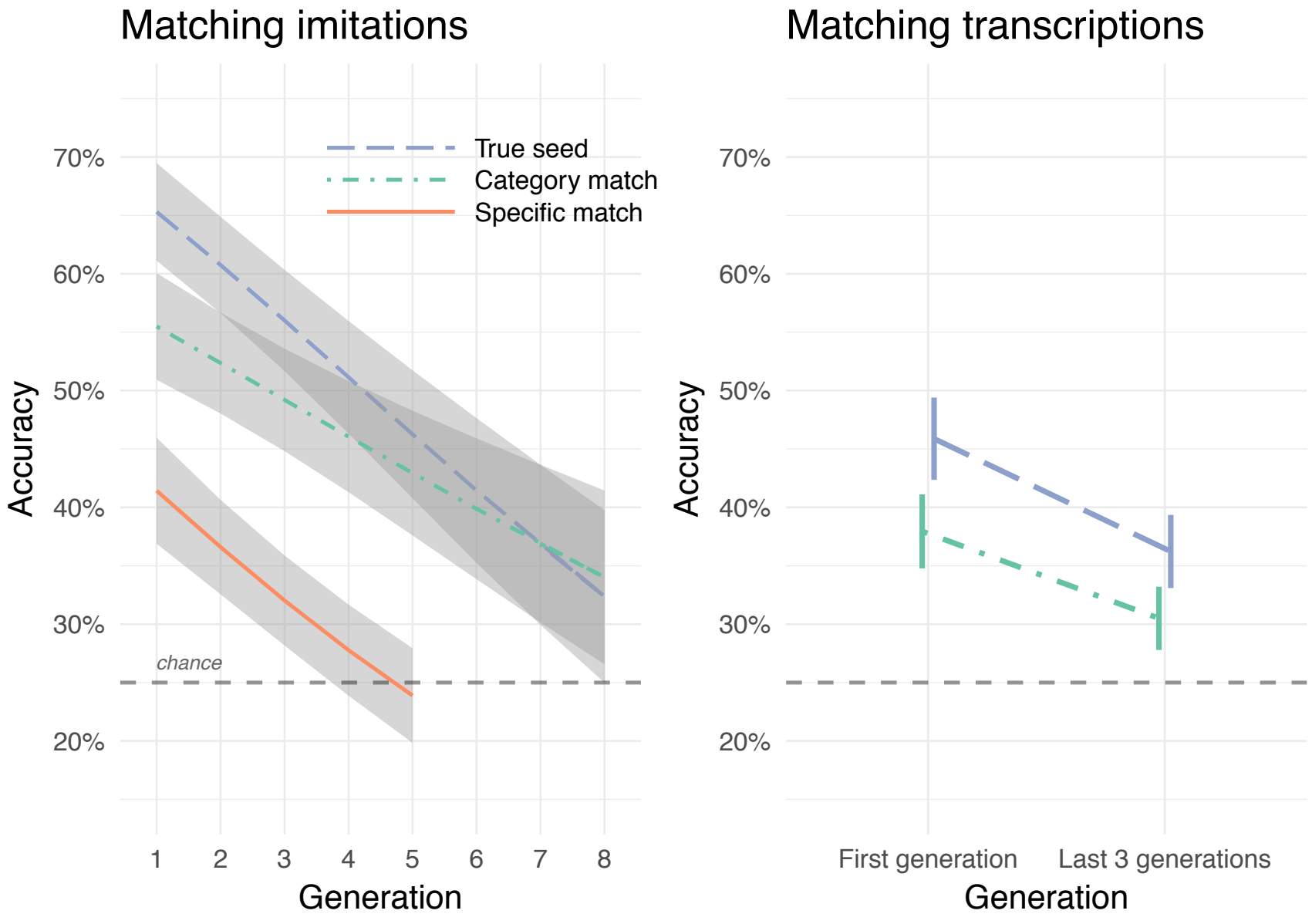


Imitations stabilize over generations

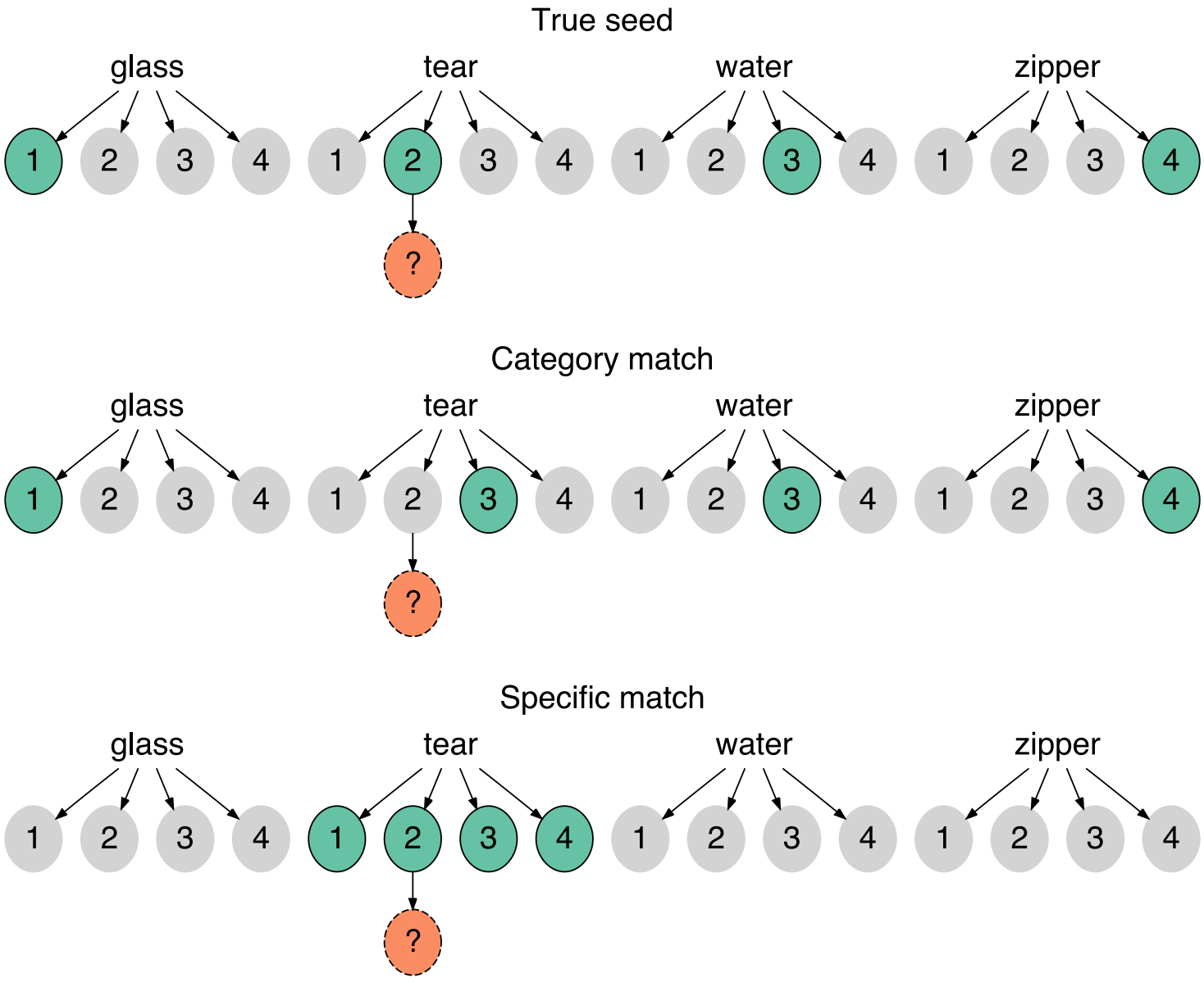




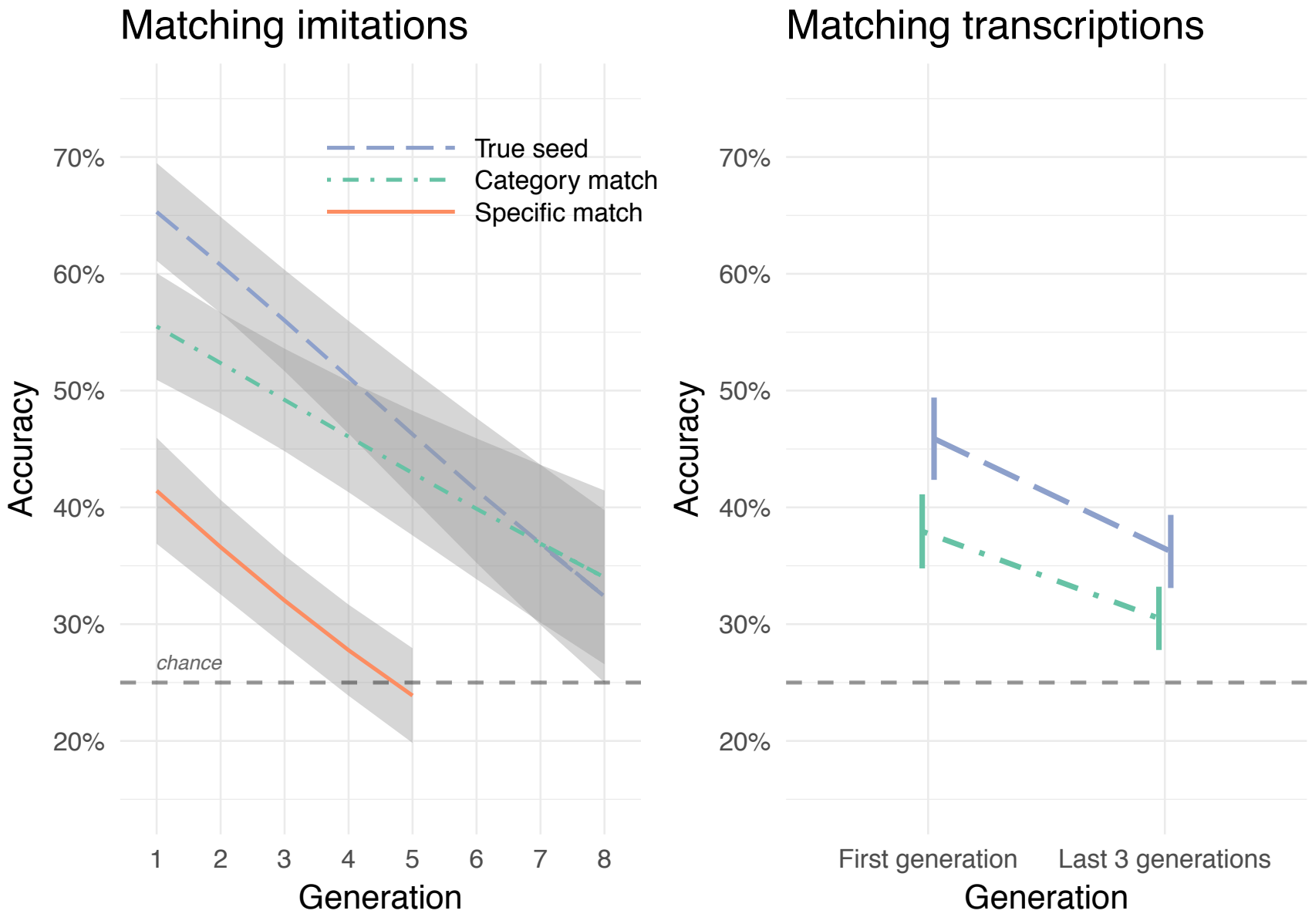
Guess the seed game



Question types



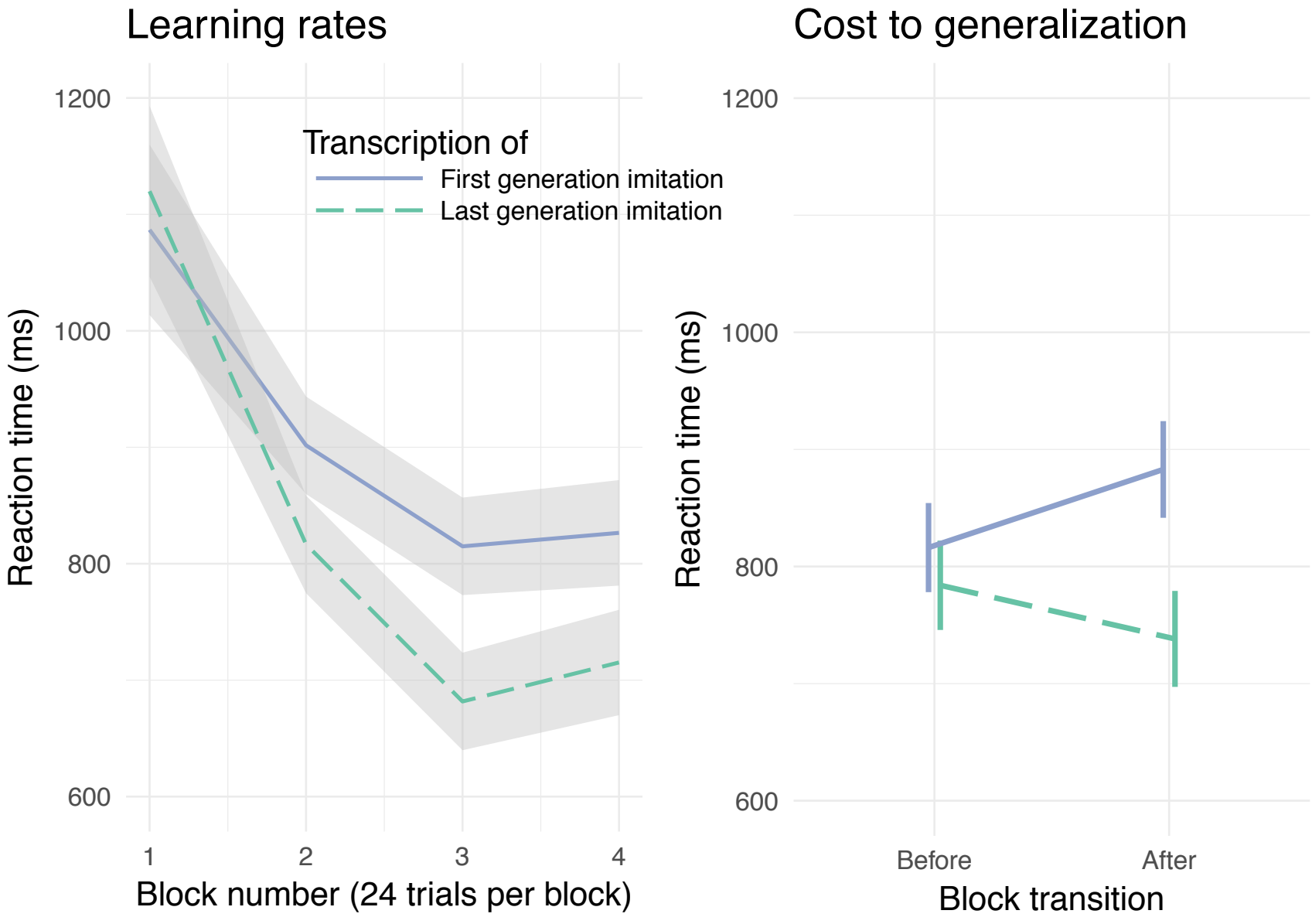
Guess the seed



Invented words

Category	Seed	First generation	Last generation
glass	1	tingtingting	dundunduh
glass	2	chirck	correcto
glass	3	dirrng	wayew
glass	4	boonk	baroke
tear	1	scheeept	cheecheea
tear	2	feeshefee	cheeoooo
tear	3	hhhweerrr	chhhhhhewwwe
tear	4	ccccchhhhyeaahh	shhhhh
water	1	boococucuwich	eeverlusha
water	2	chwoochwooochwooo	cheiopshpshcheiopsh
water	3	atoadelchoo	mowah
water	4	awakawush	galonggalong
zipper	1	euah	izoo
zipper	2	zoop	veeeep
zipper	3	arrgt	owww
zipper	4	bzzzzup	izzip

Category learning



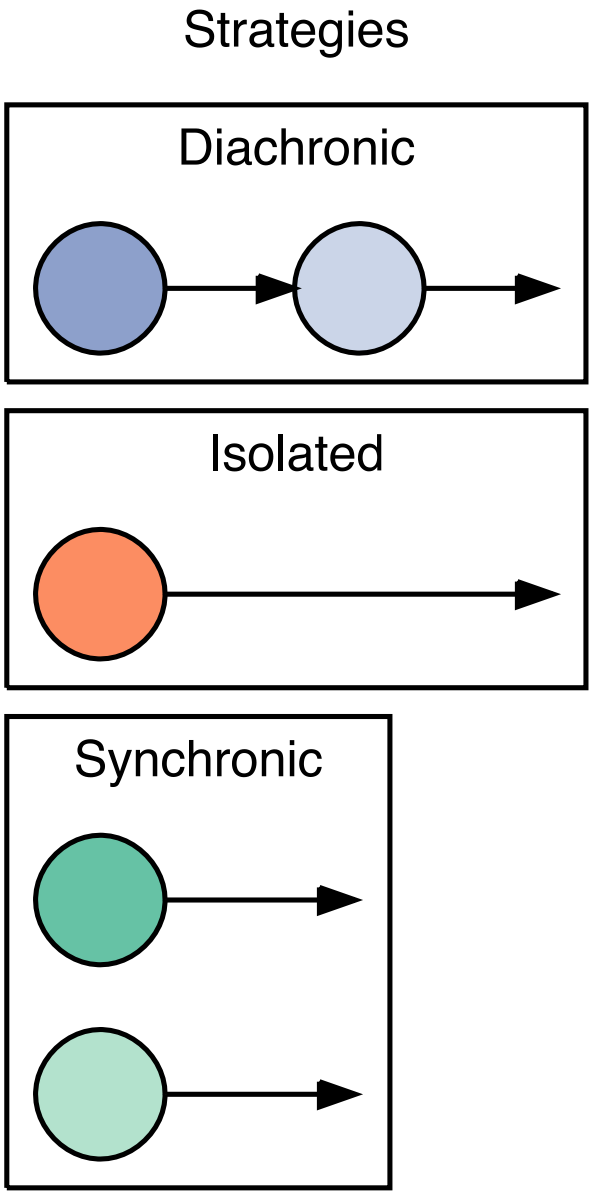
Summary

Unguided repetition of nonverbal imitations makes them more word-like.

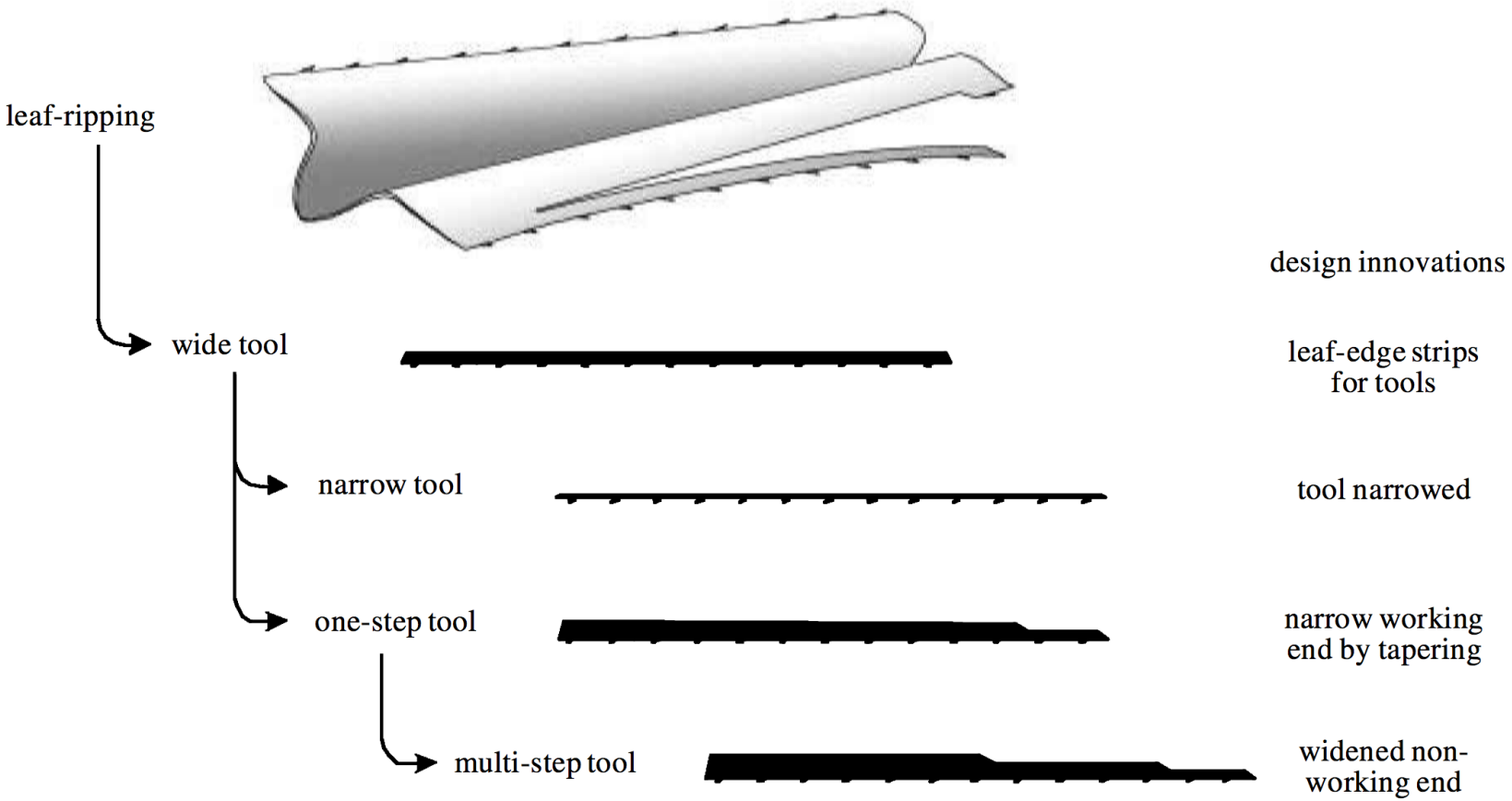
- Acoustic form becomes more repeatable and easier to spell.
- Imitations and transcriptions gradually lose resemblance to source.
- As imitations transition into words they become more categorical.

Supports theories of language evolution that value human imitative abilities.

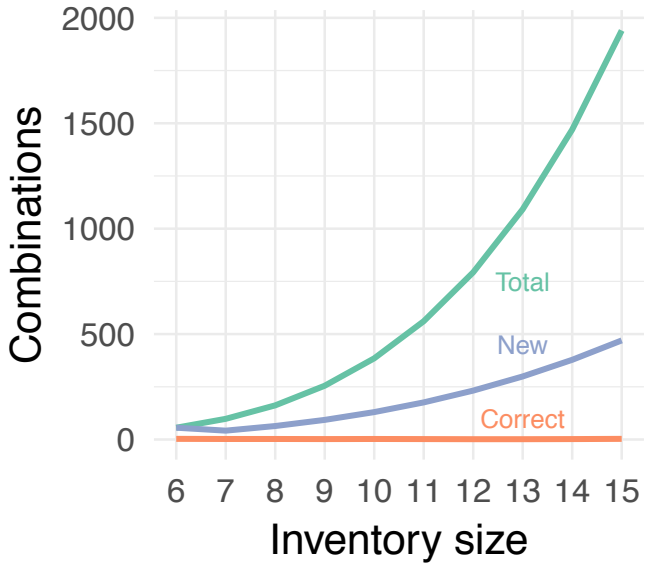
Problem solving

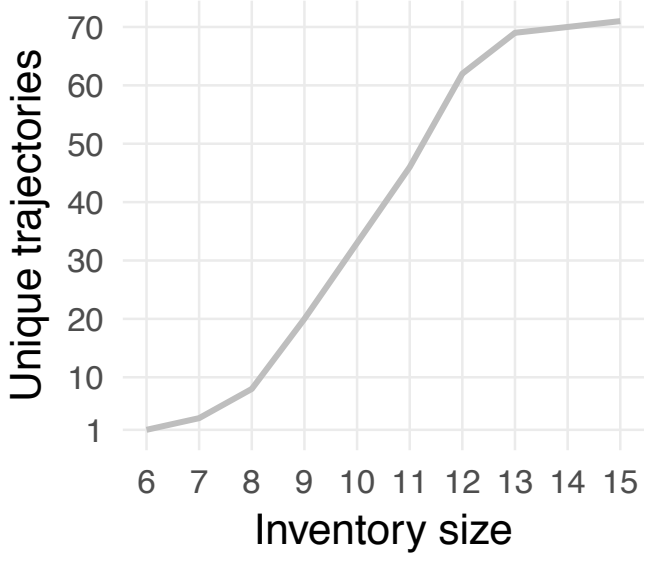


Technological evolution (Hunt & Gray, 2003)

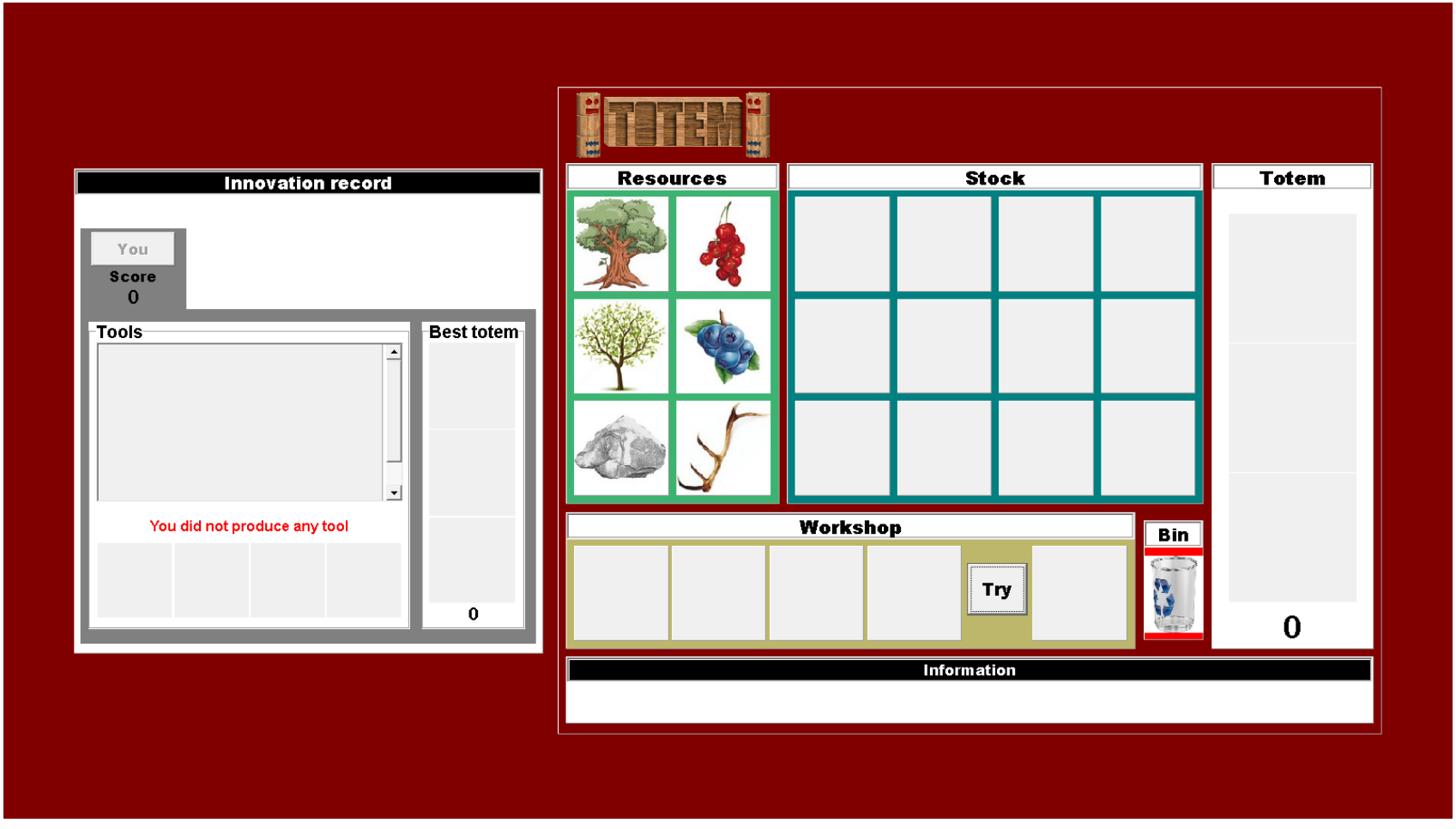


Innovation landscape

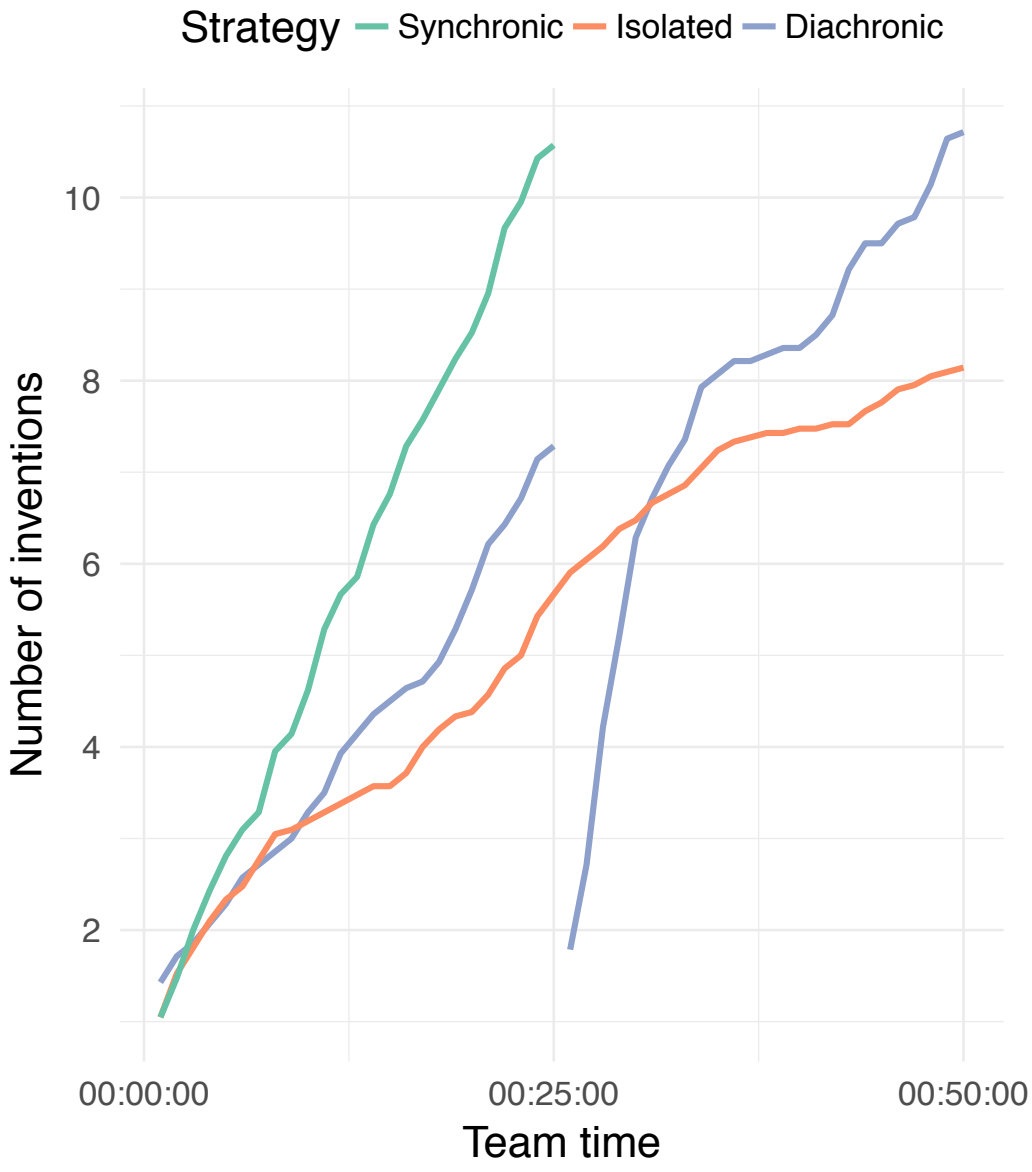


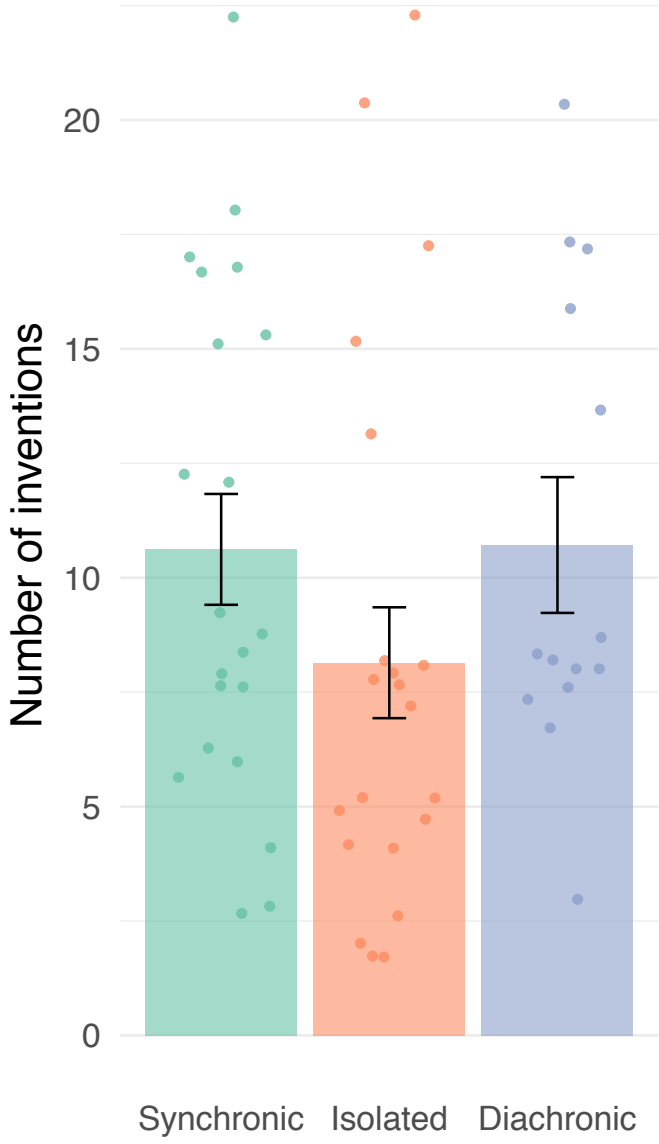


Totems game


Innovation record
You
Score
0
Tools
You did not produce any tool
Best totem
0
TOTEM
Resources
Stock
Totem
0
Workshop
Try
Bin
Information

Number of inventions

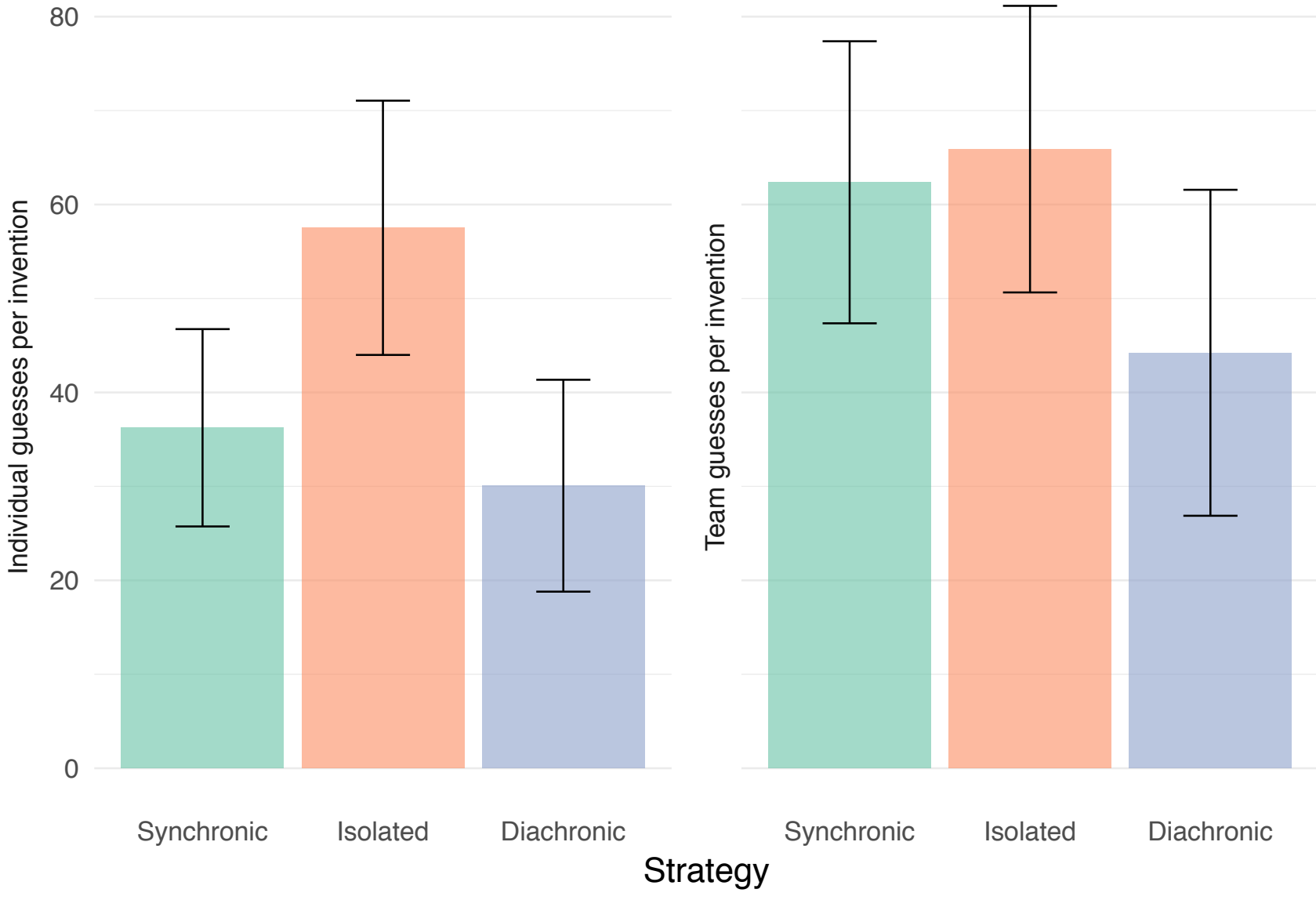




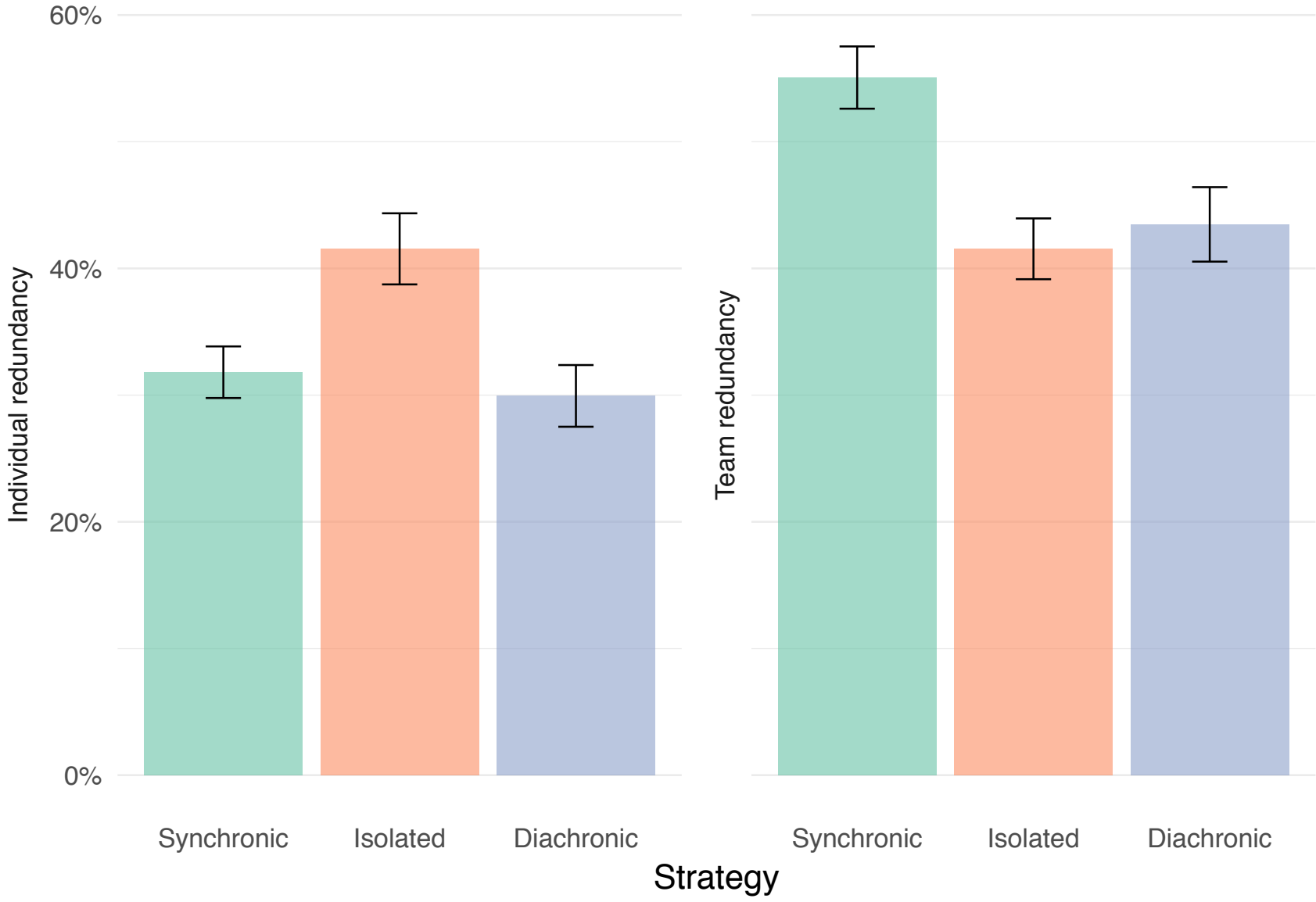
Measuring differences in problem solving

- Effectiveness (guesses per invention)
- Redundancy (non-unique guesses)
- Trajectories (unique paths)

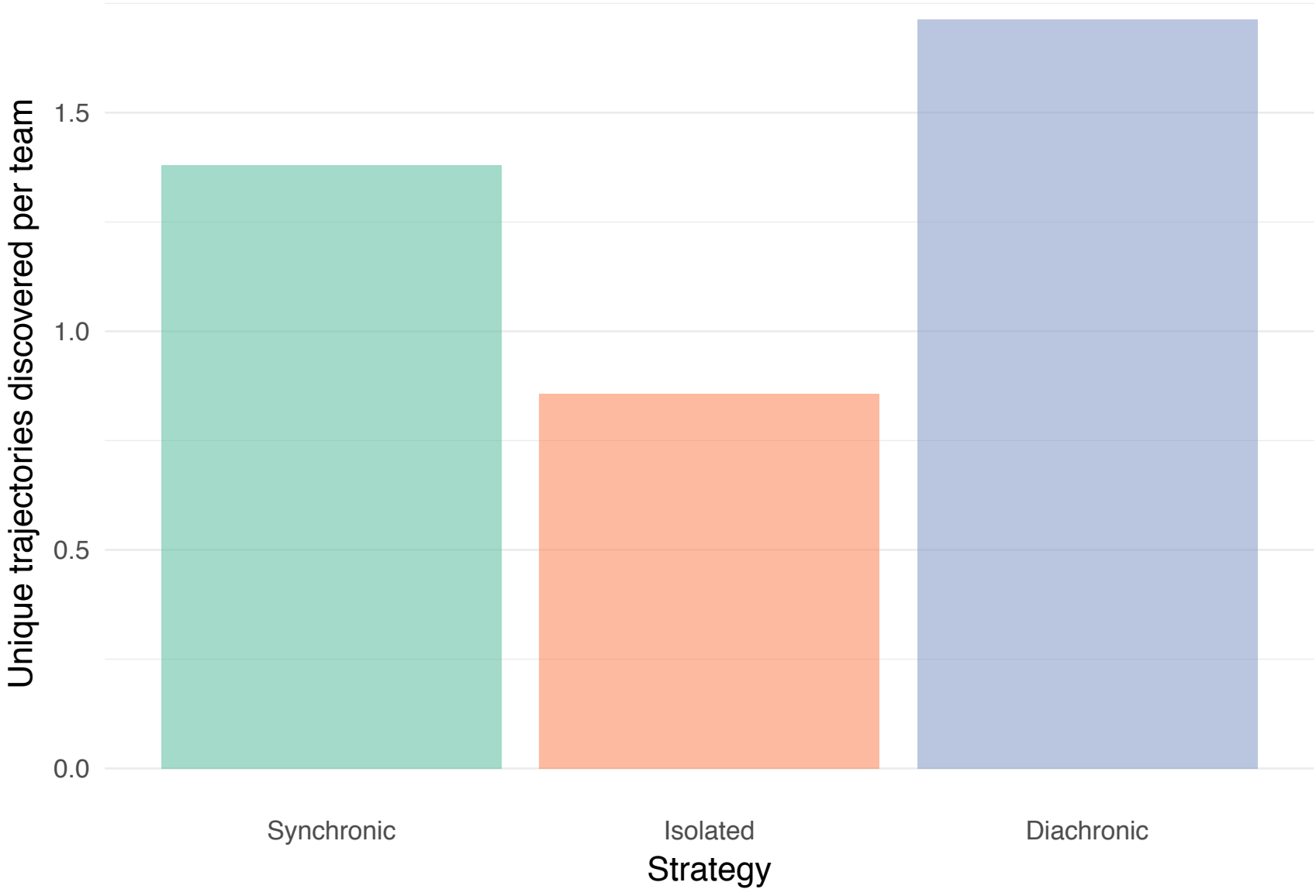
Effectiveness: Guesses per invention



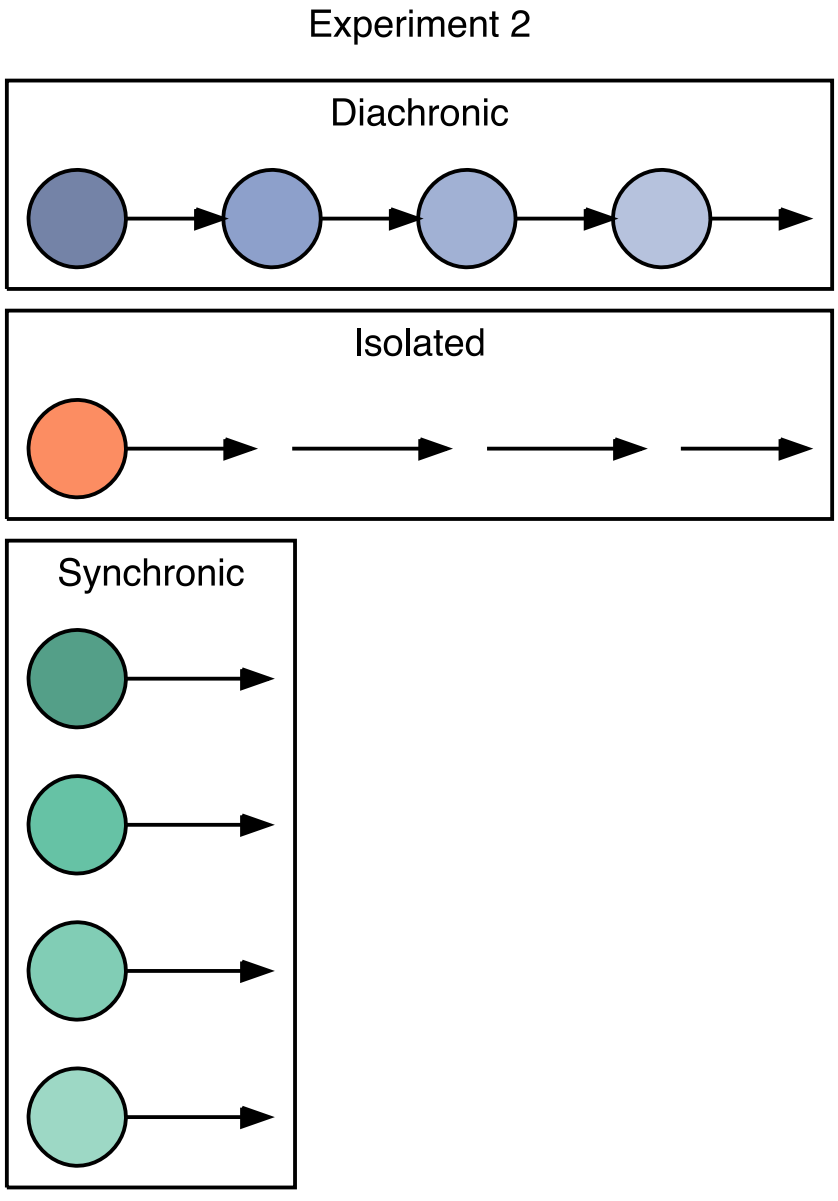
Redundancy: Non-unique guesses



Trajectories: Exploration of landscape



Prediction



Is Wikipedia getting better?

My favorite way of checking this is to "click random article" on 10 articles, and go back and look at them a year ago, 5 years ago, 10 years ago. Every time I have tried, it's unambiguous: Wikipedia is getting better by this test. – Jimbo Wales

Wikipedia is hard to measure

- **Size.** Over 5 million articles in English.
- **Expertise.** e.g., Hurricane Claudette.
- **Always changing.** Articles are never considered complete.

Wikipedia is alive

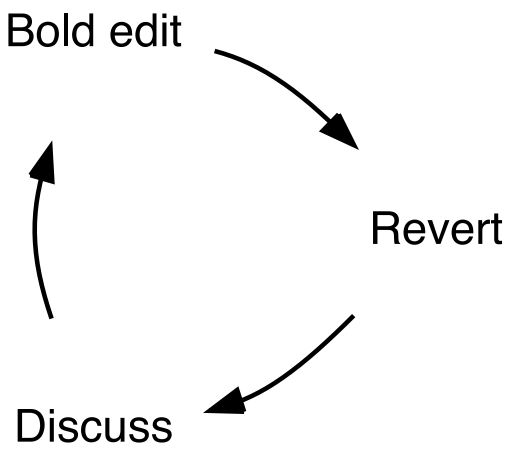
- 7th most popular website in the world.
- 6-10 edits per second.
- 700 new articles per day.

Wikipedians

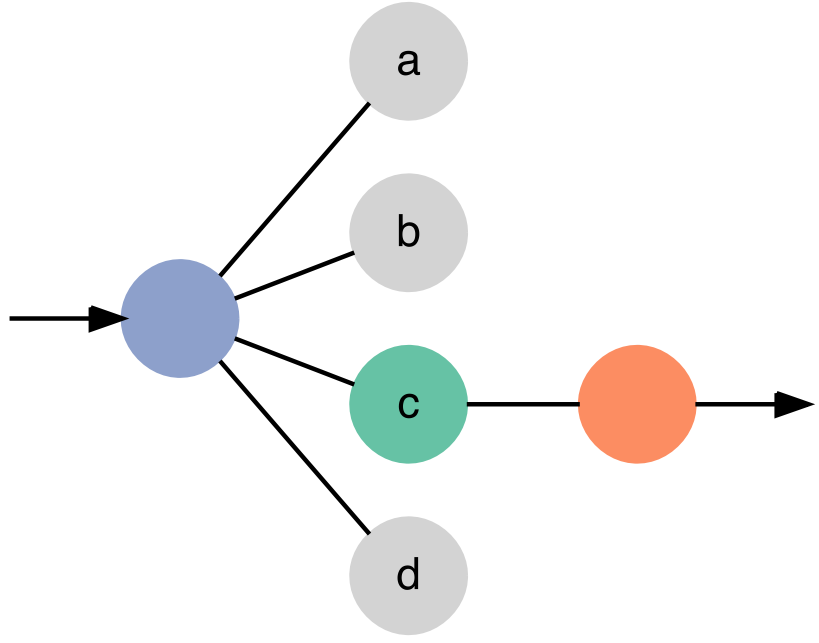
- 140,000 active users ($<$ 30 days).
- Vandalism detection is highly automated.
- New editors do not like getting reverted.
- All editors are protective of their own edits.
- Chance of being reverted doesn't change.

Wikipedia article editing as an evolutionary strategy

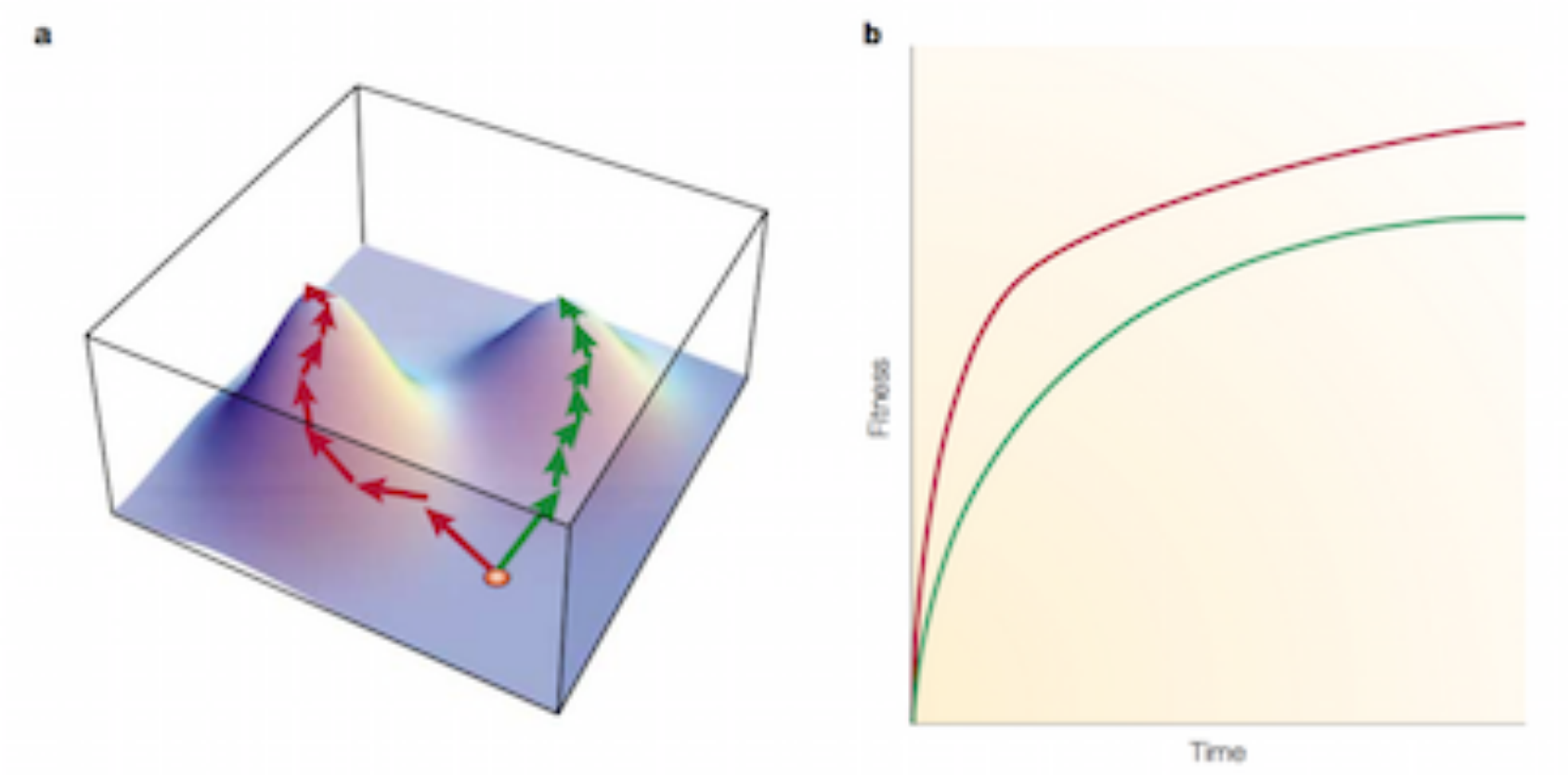
The BRD cycle editing strategy



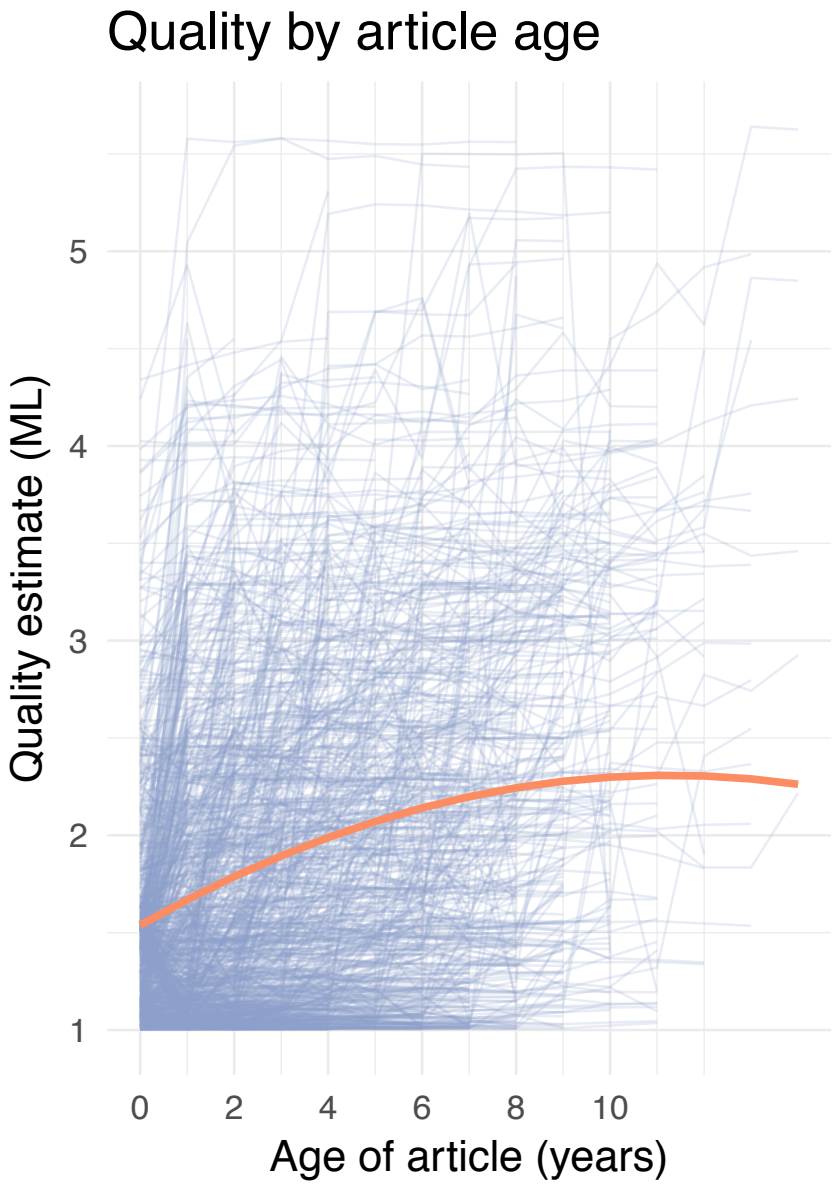
Results of BRD cycle editing

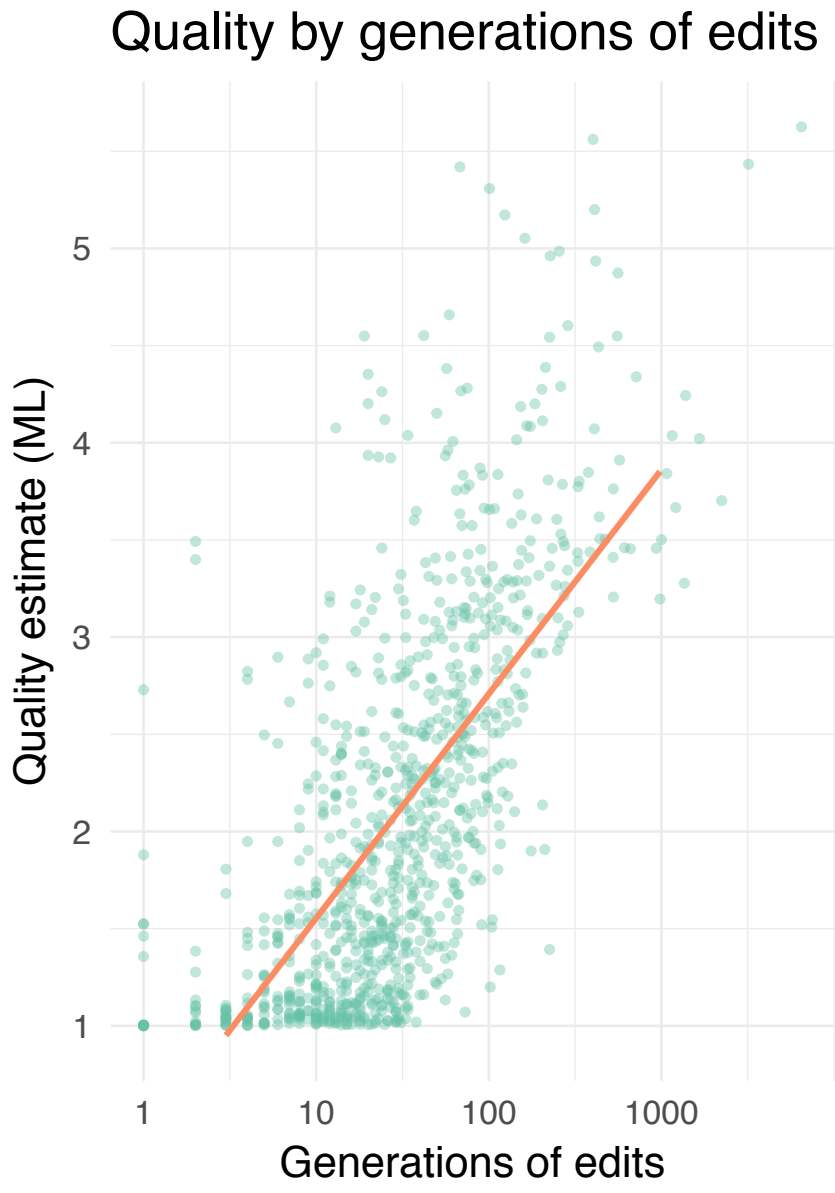


Experimental evolution (Elena & Lenski, 2003)



Wikipedia article quality





Future directions

- Edit quality models (big data!).
- Separate purifying from positive selection.
- Expand to open source software projects.

Discussion question

What do you like/dislike about the Wikipedia/evolution comparison?

Using evolutionary principles to make sense of
word origins,
problem solving, and
the growth of Wikipedia articles.

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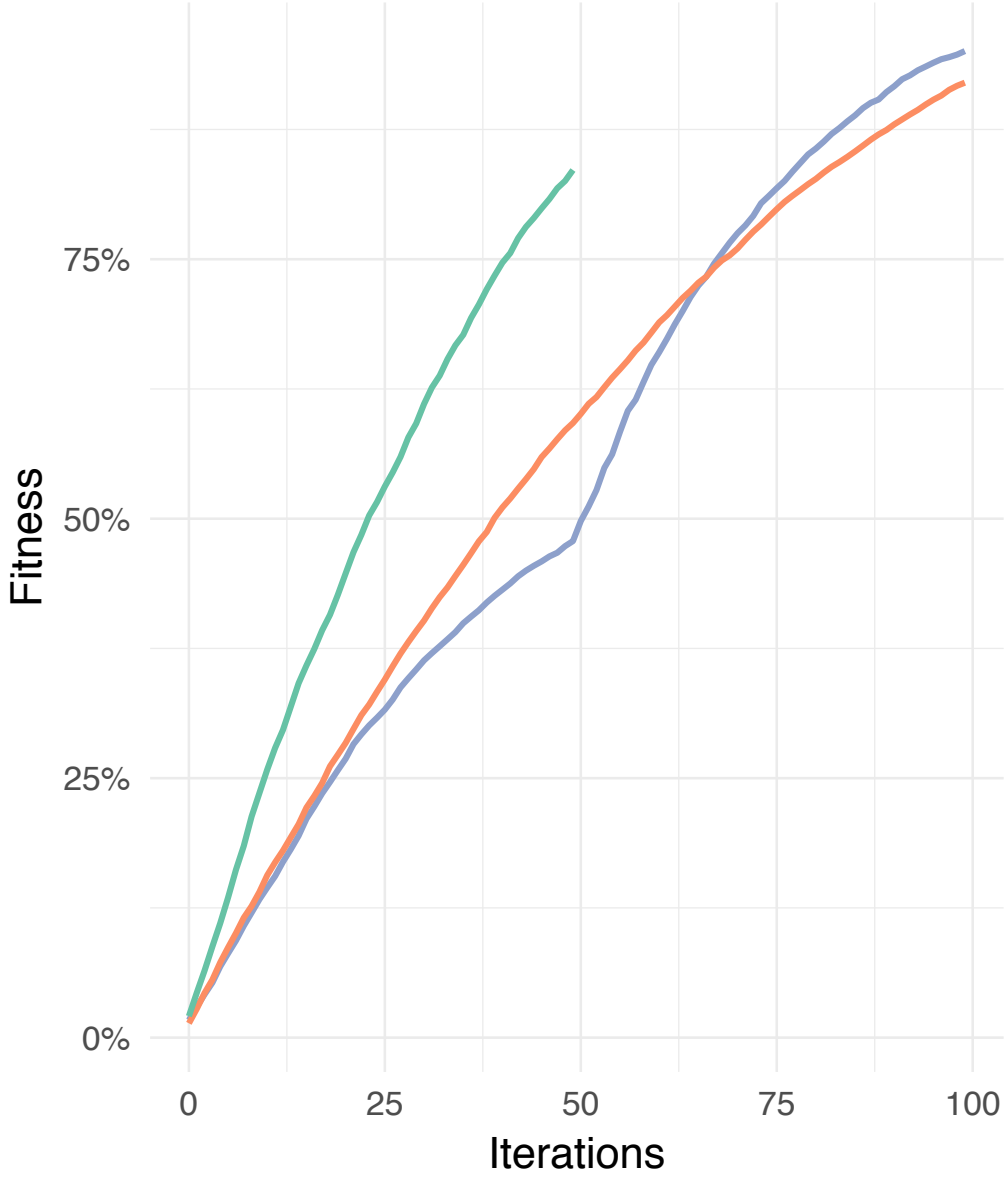
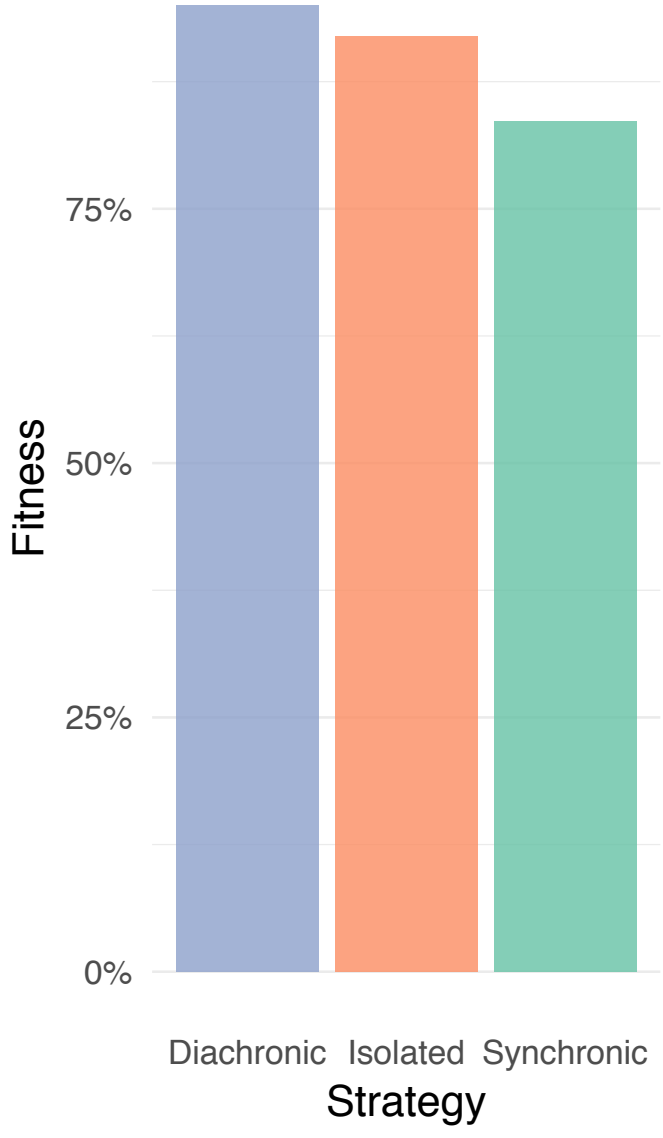
github.com/pedmiston/leaning-on-darwin

Proof of principle





Problem solving as hill climbing