Extending communication games to more players

Veronica Boyce

LangCog Lab Meeting

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Stanford University
Human-Centered
Artificial Intelligence

Communication occurs in many contexts

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Ranging from one-on-one to small group
to large group to broadcast

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In all cases, need to efficiently establish reference.

Clark & Wilkes-Gibbs 1986: Efficient Reference

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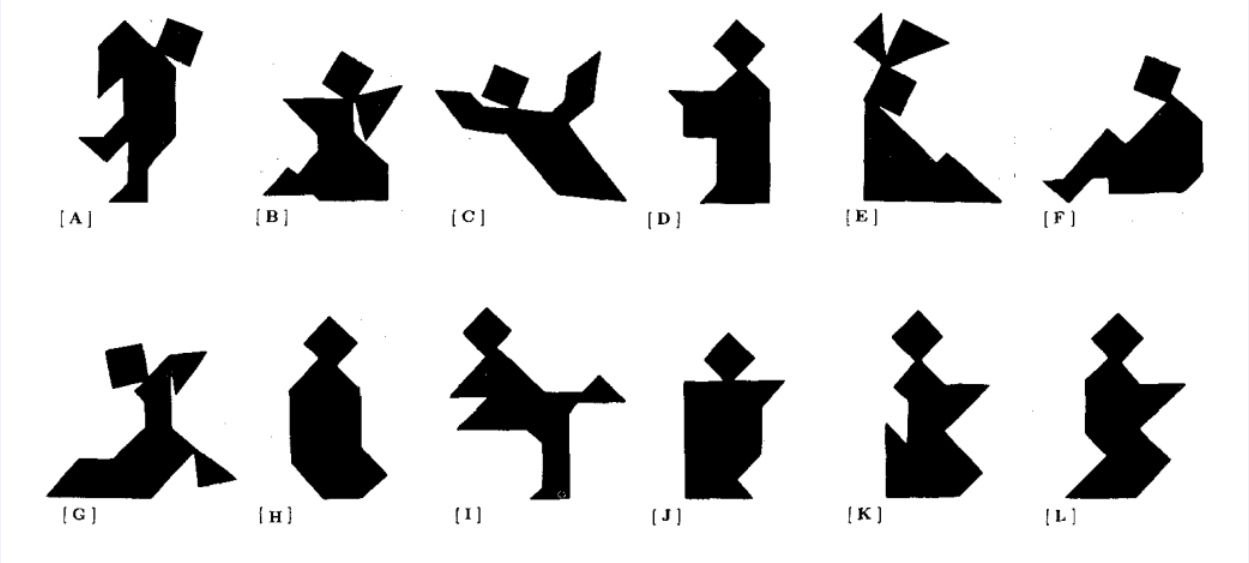

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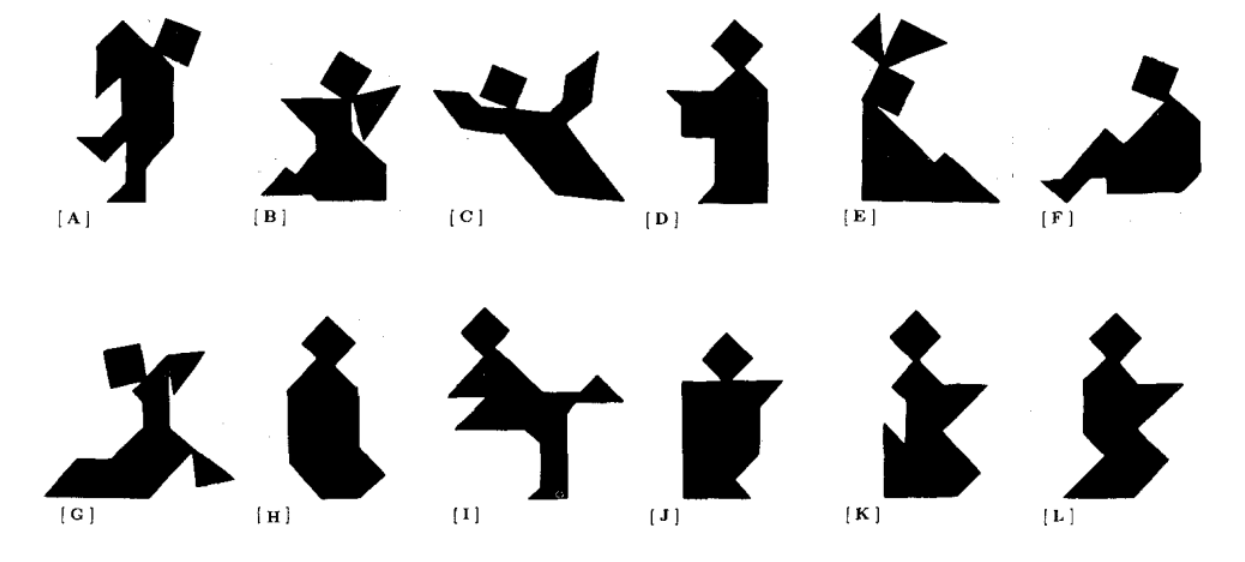

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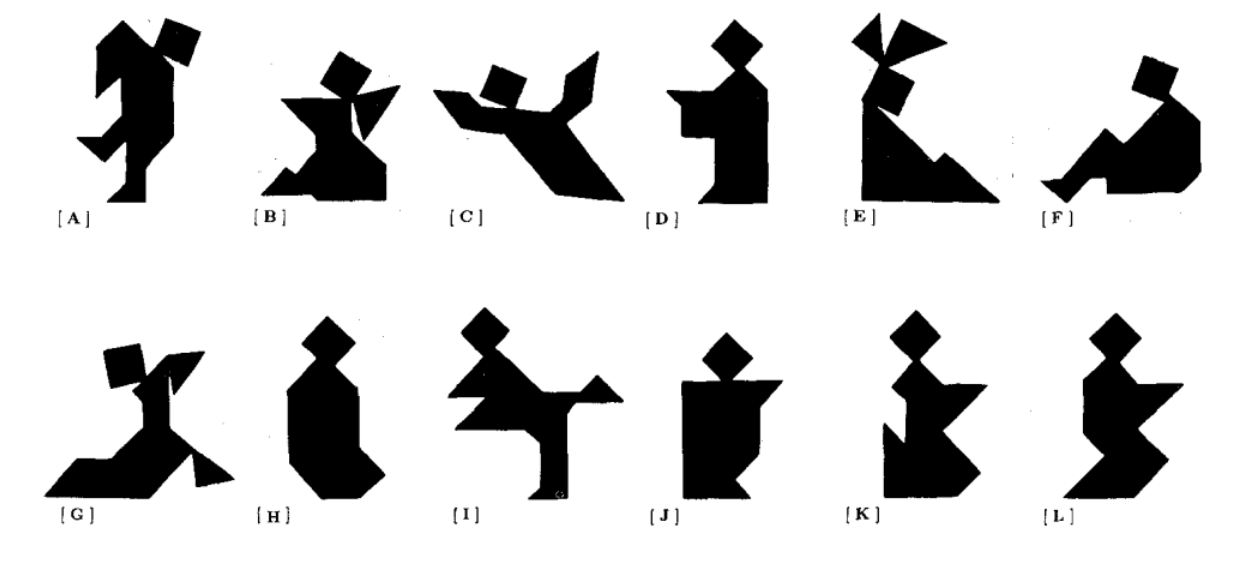

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2. Um, the next one's the person ice skating that has two arms?

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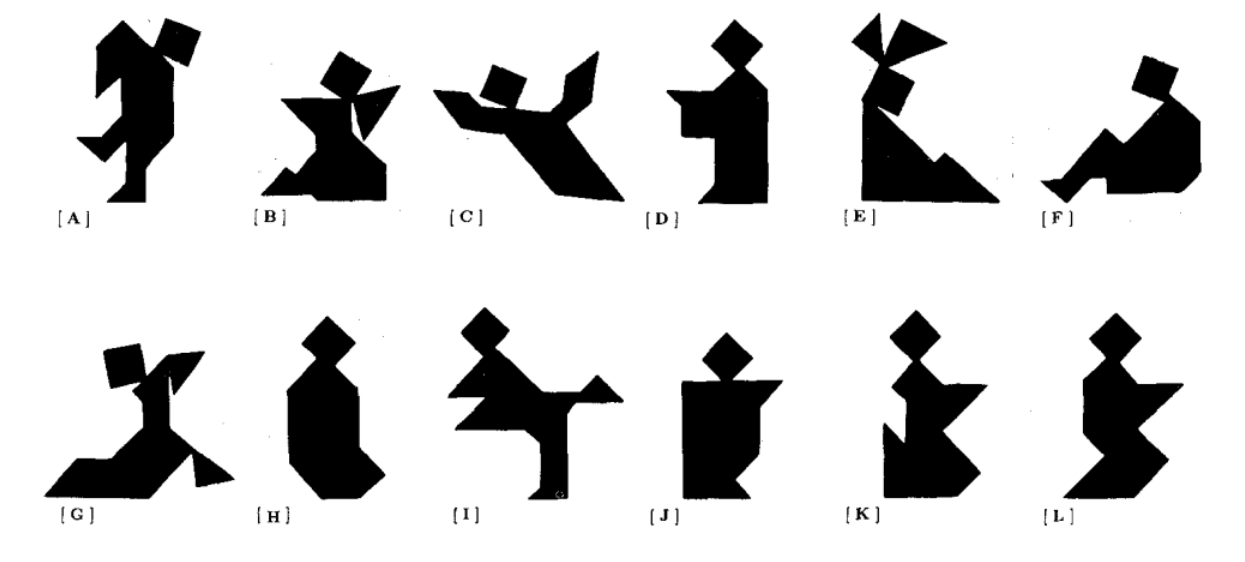

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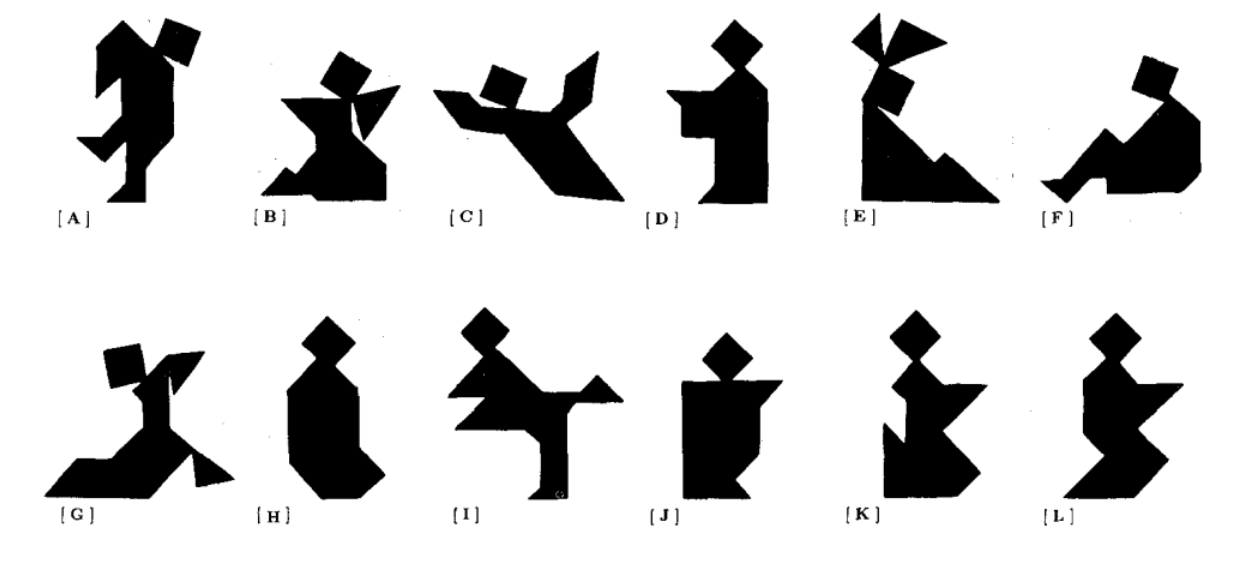

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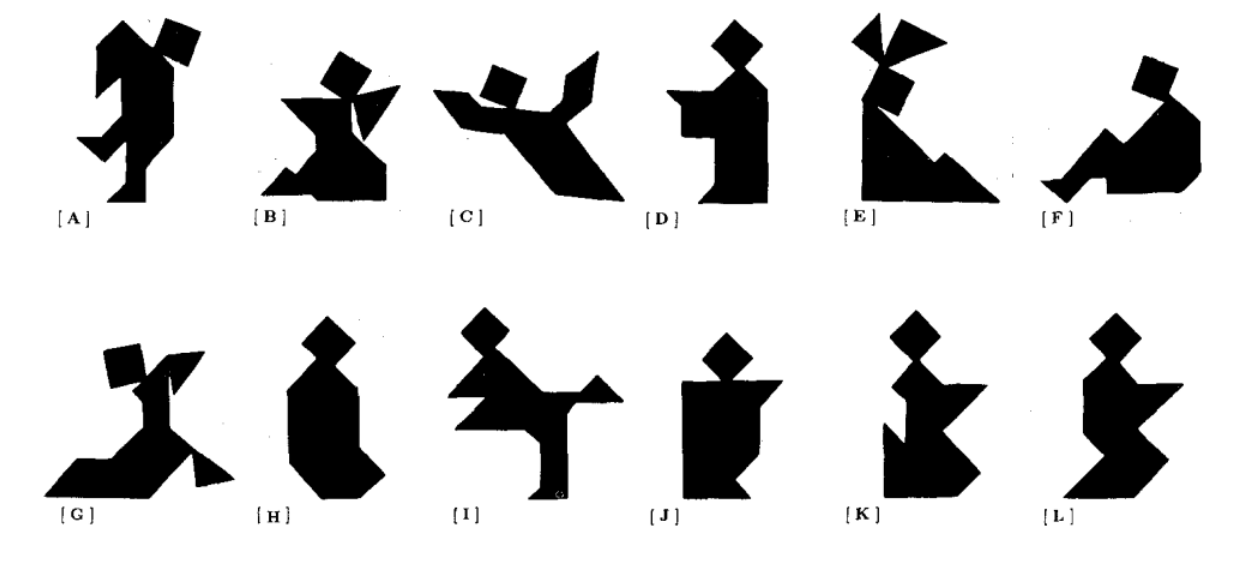

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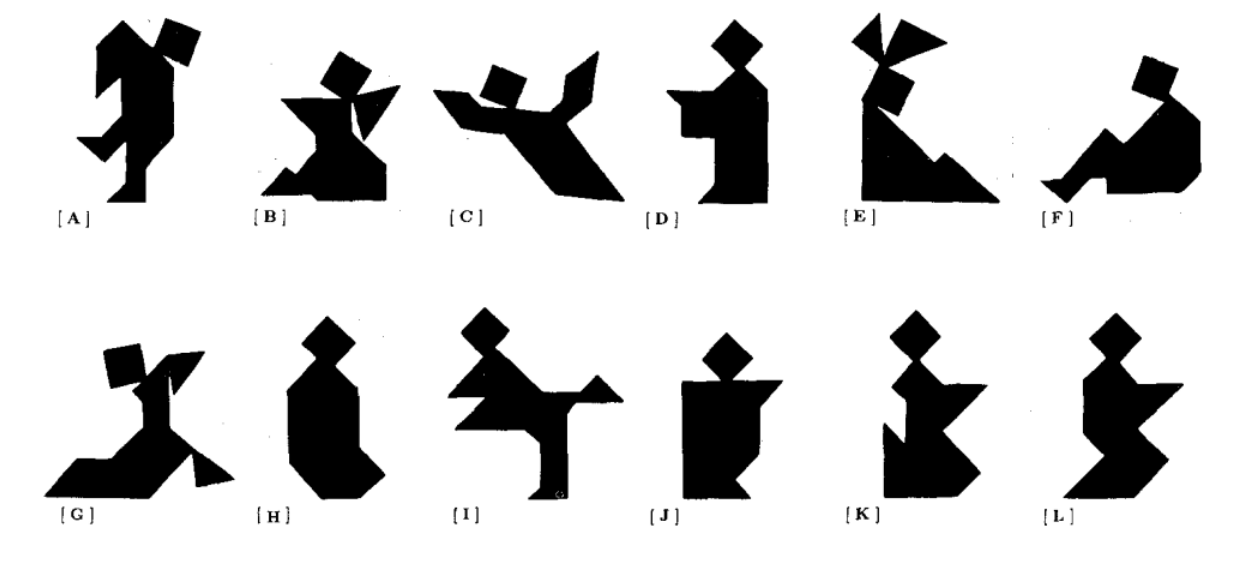

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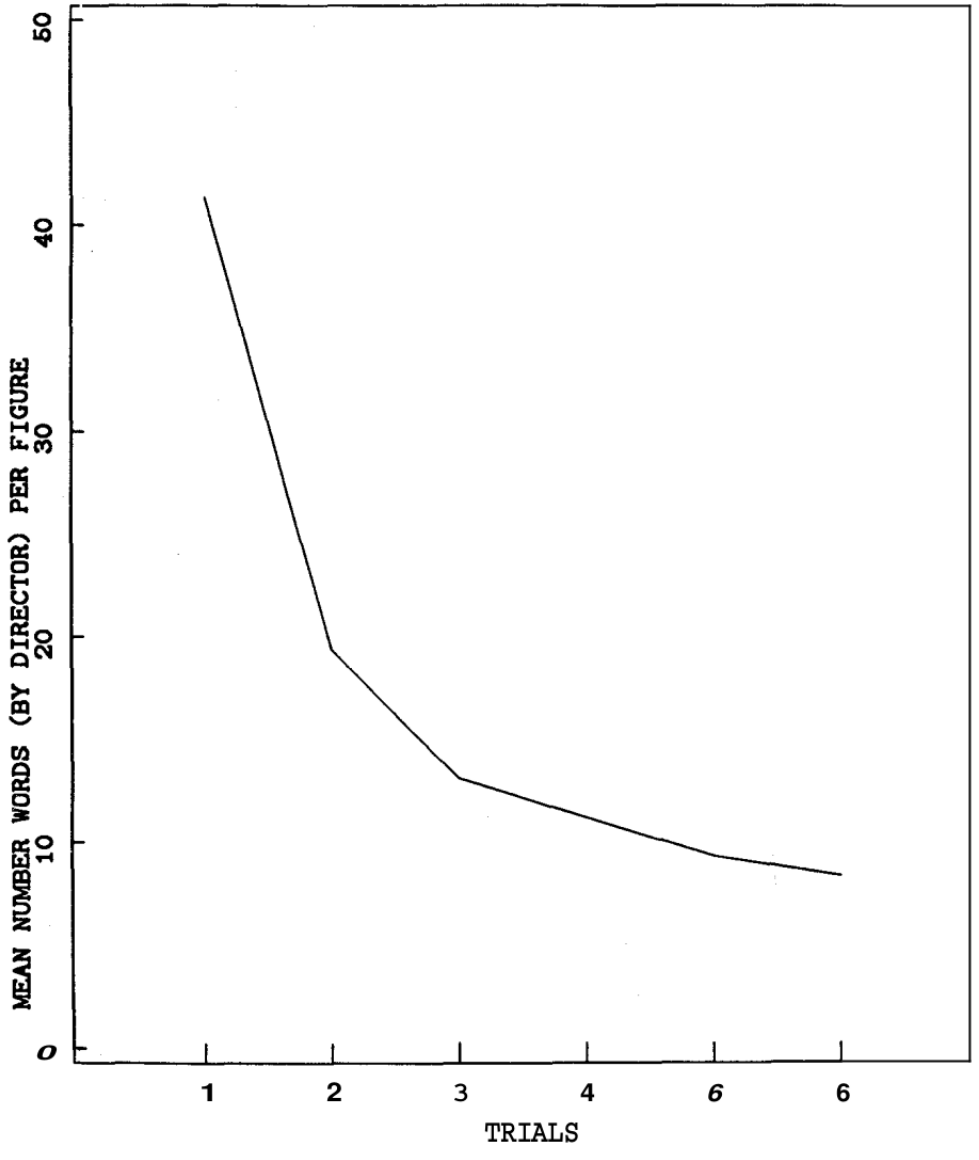
6. The ice skater.

Clark & Wilkes-Gibbs 1986: Reduction



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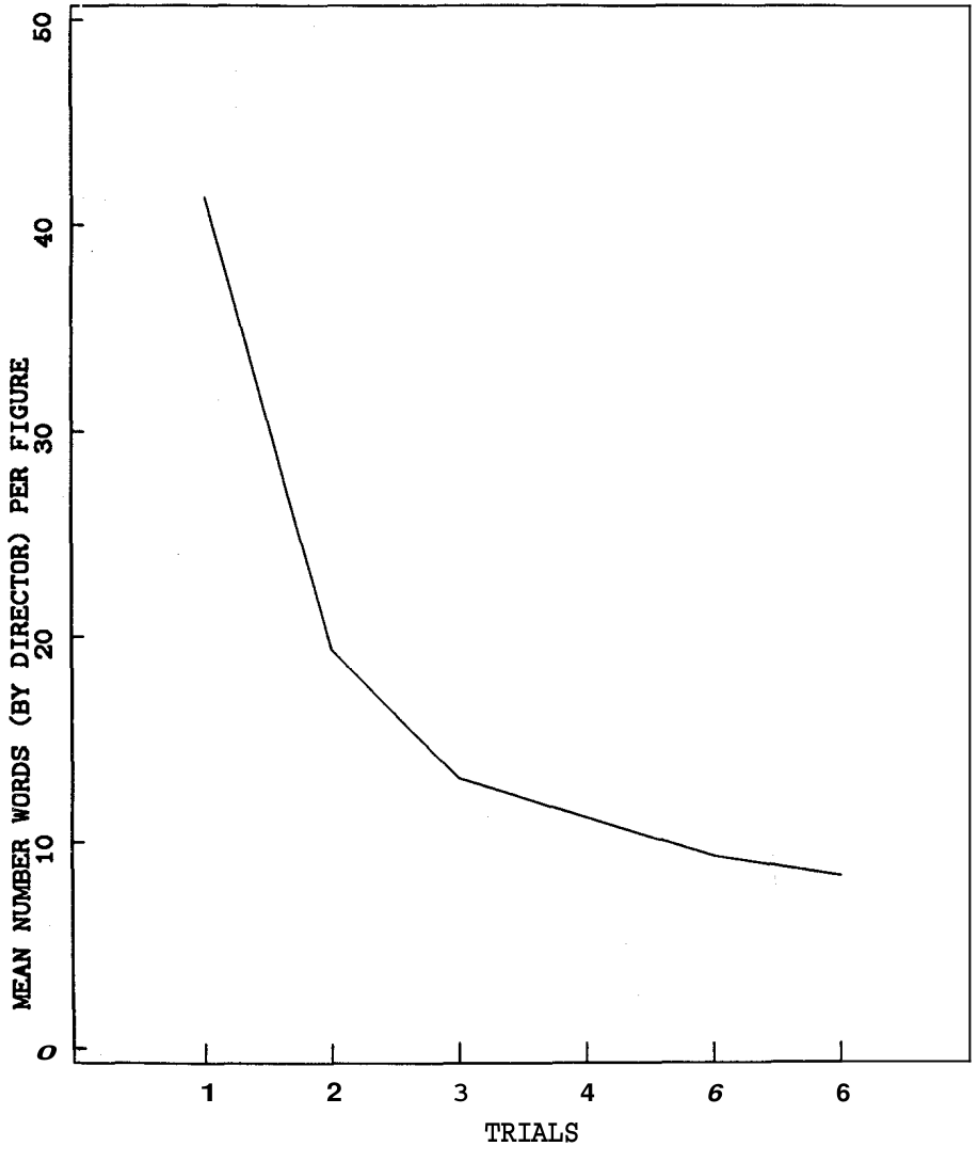


Ubiquitous phenomenon

Many explanations:

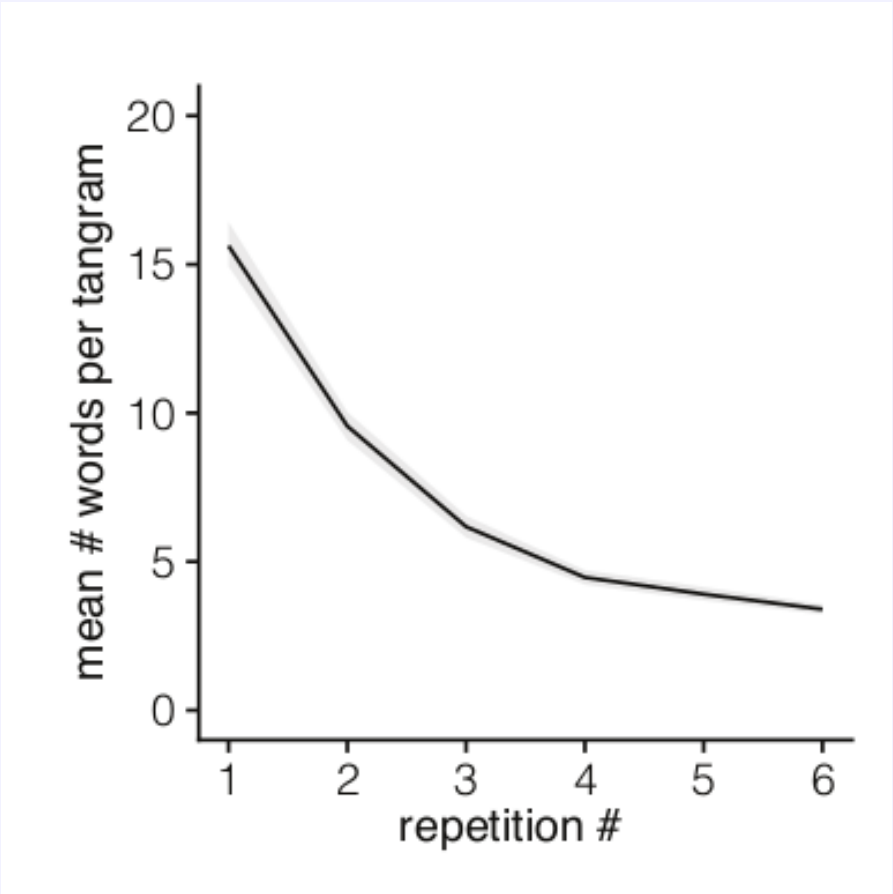
- Common ground (Clark 1996)
- Recursive mentalistic inference (Goodman & Frank 2016)
- Interactive priming (Garrod & Pickering 2009)

(Won't address today)

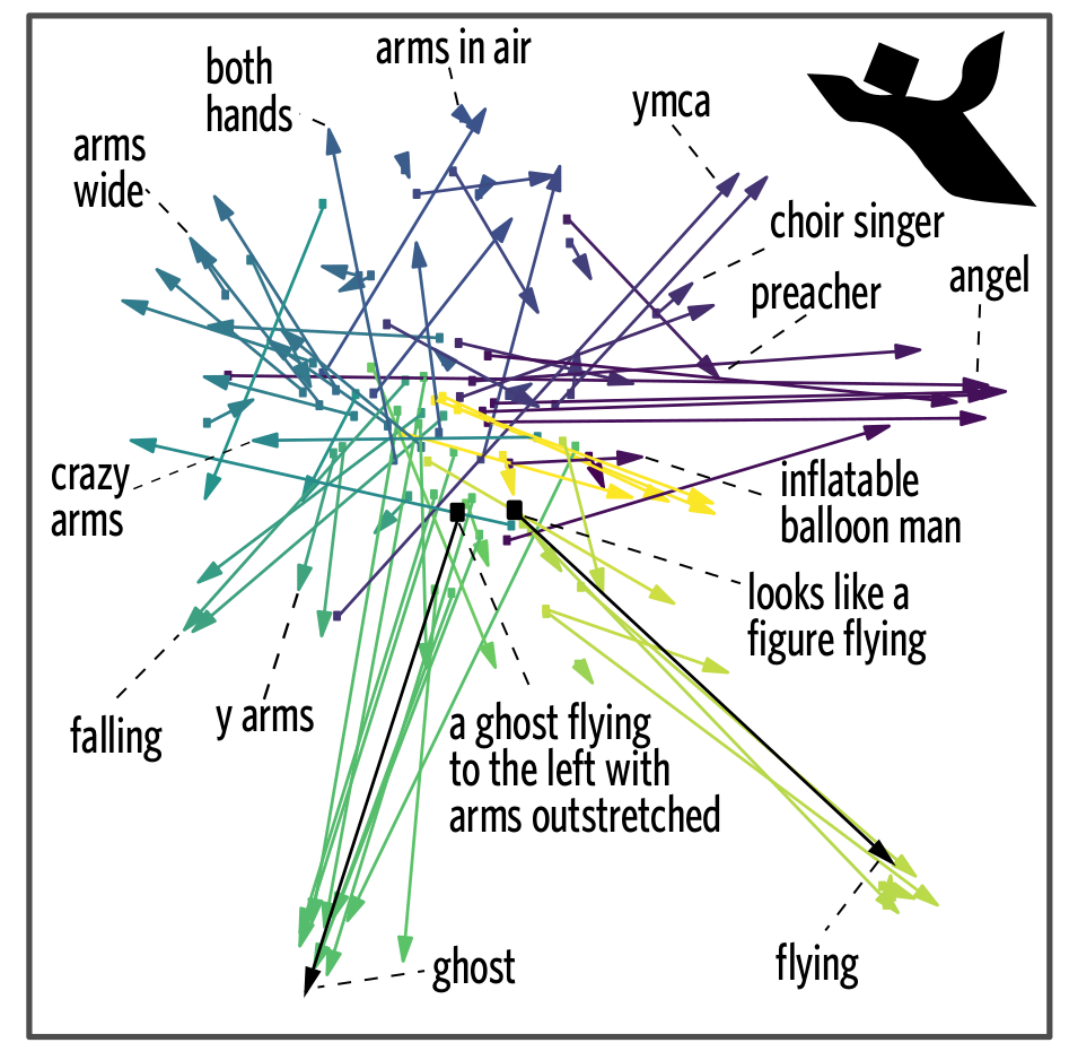
Hawkins, Frank, & Goodman 2020:

Scaling up via web-based experiments

- Cued version with feedback on each trial
- Message with a chat box
- After all exclusions, 83 dyads



Hawkins, Frank, & Goodman 2020: Content Analysis



Semantics converge within and diverge between groups

Dyads are well-studied in this paradigm,...

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but much real-life communication is not dyadic.

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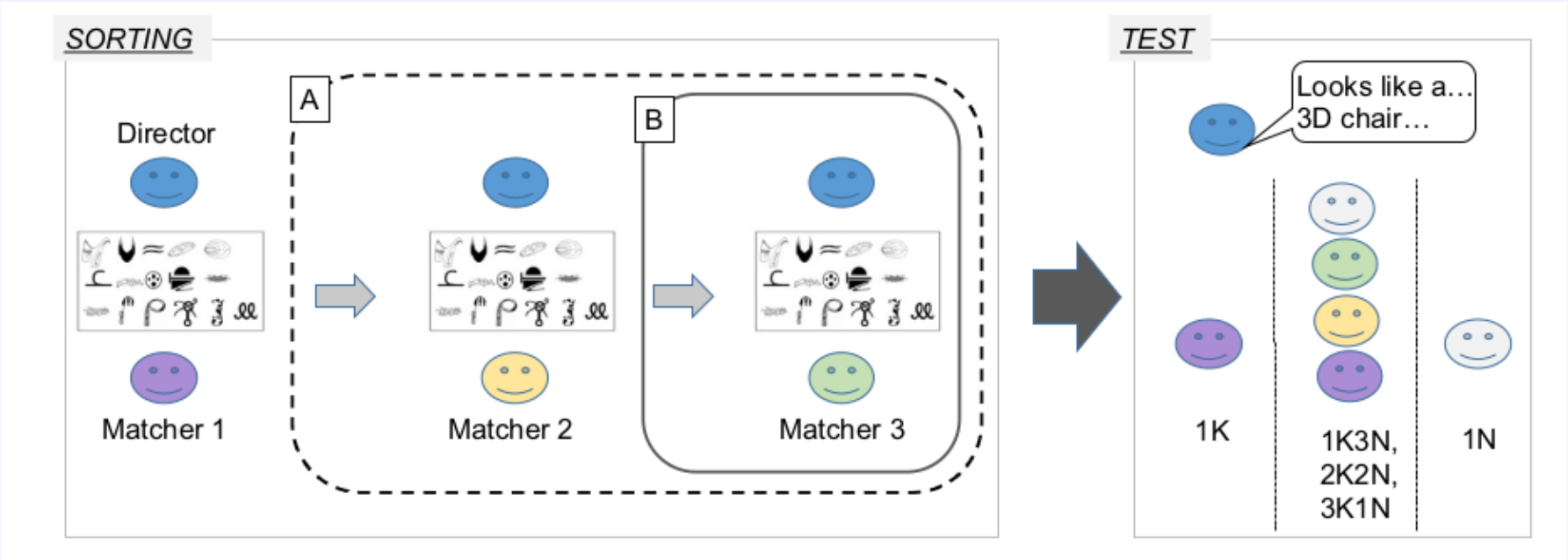
but much real-life communication is not dyadic.

How does efficient reference work in groups?

Yoon & Brown-Schmidt 2019: Audience design

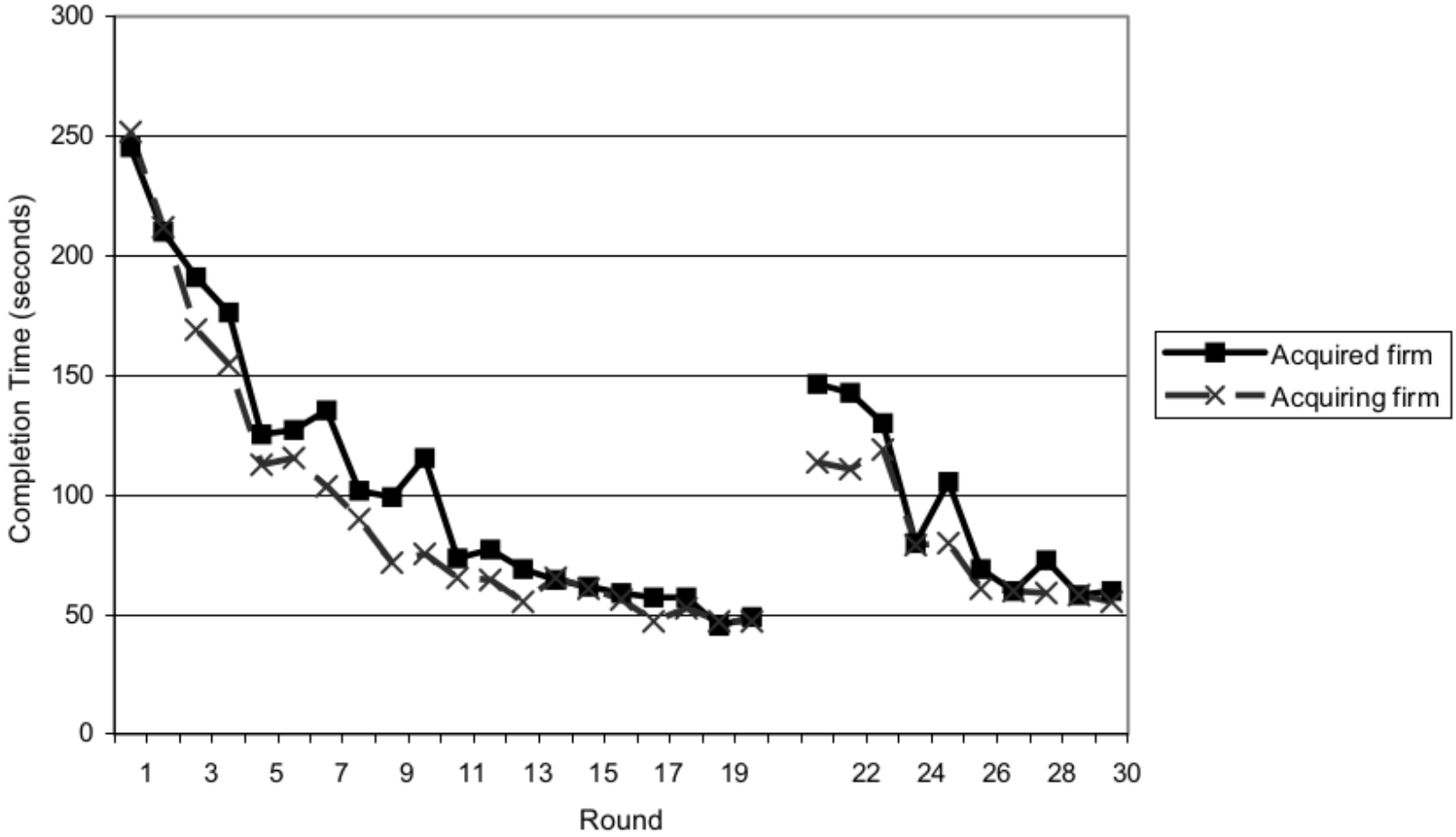
Speaker trains with some matchers
Then talks with knowledgeable and/or naive listeners



Longer, more elaborated & disfluent utterances with mixed or naive listeners

Weber & Camerer 2003: Adversarially trained listeners

Figure 2 **Average Completion Times (11 Merger Sessions)**



Hard to accommodate listeners with different concepts

FYP: Communication in small groups

Compare groups of 2/3/4 communicators Follow paradigm of Hawkins et al

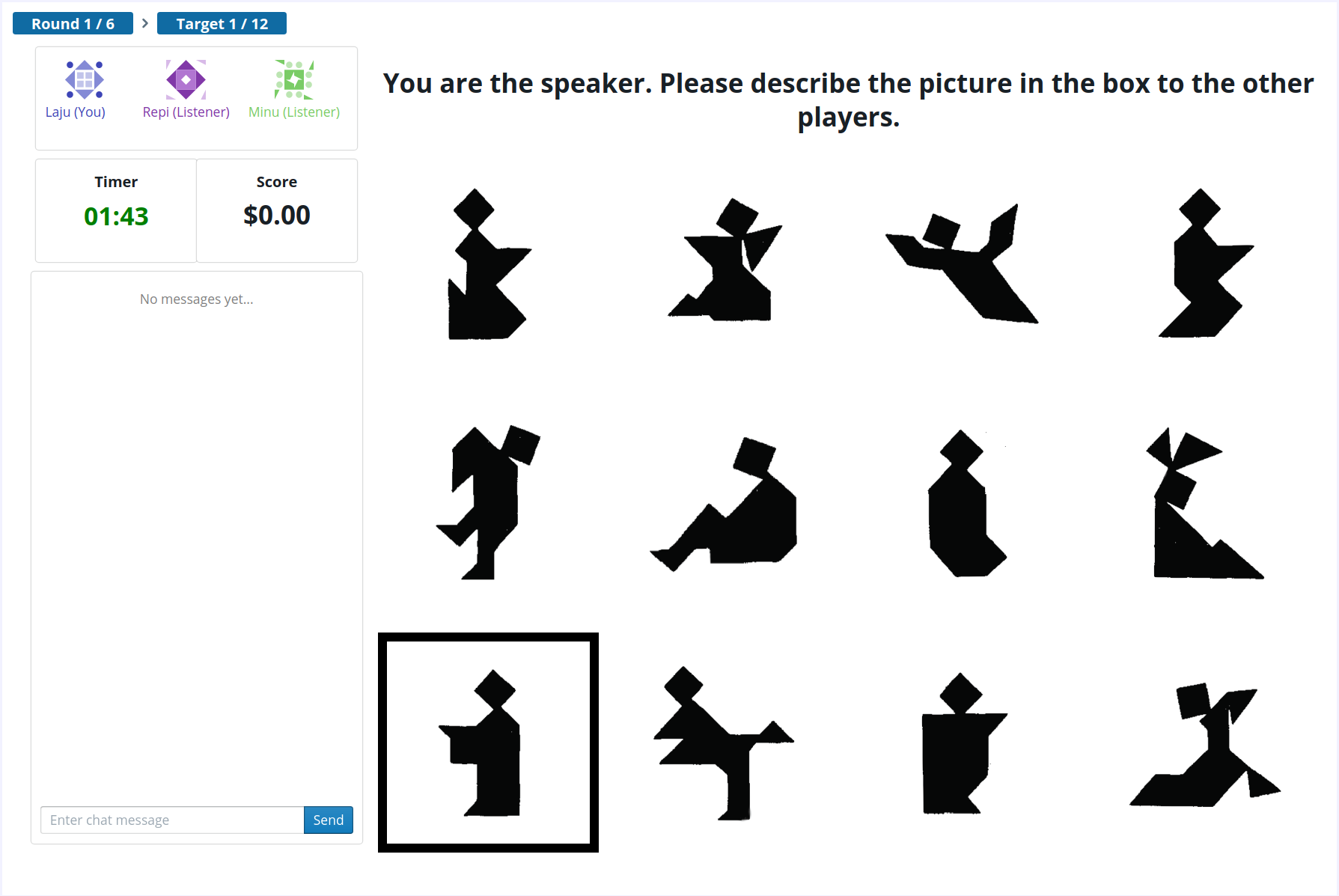
- Rotate who the speaker is
- Different feedback

Questions we can address:

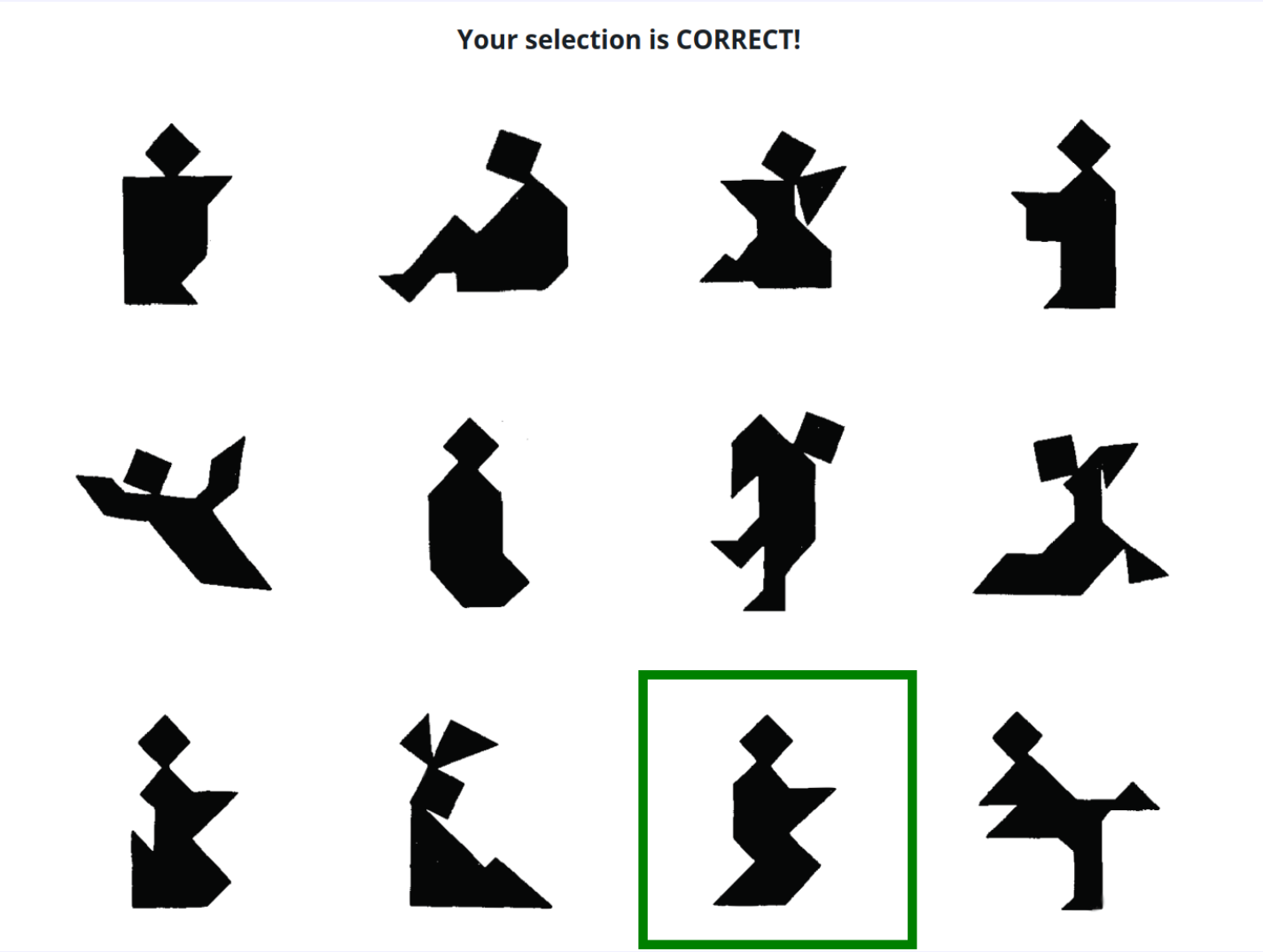
- speed of convergence by group size
- managing multiple listeners
- use convention v new description
- where/when do conventions originate

Empirica (Almaatouq et al 2020)

Virtual Lab platform for real-time interactive experiments

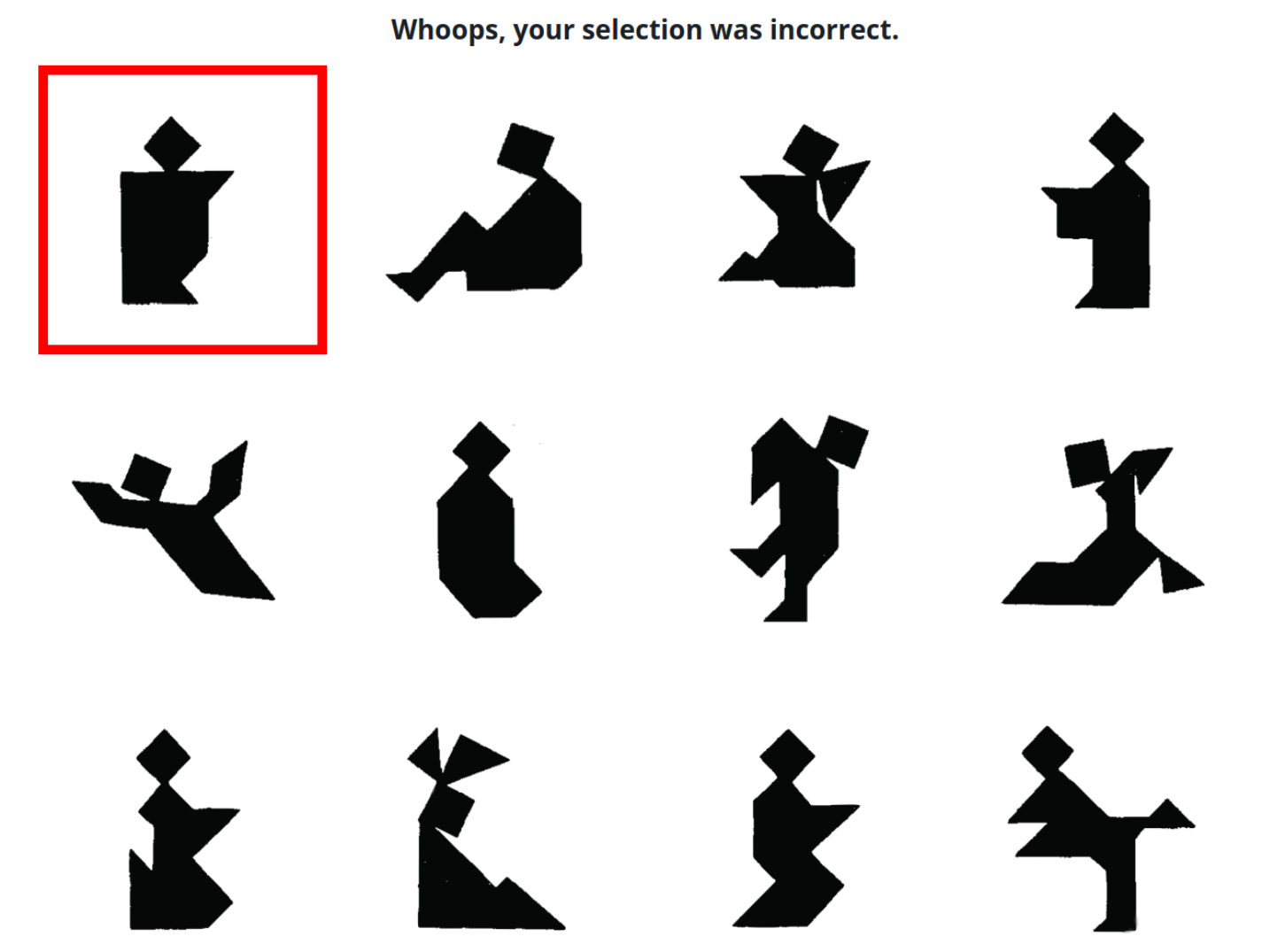


Experiment Framework



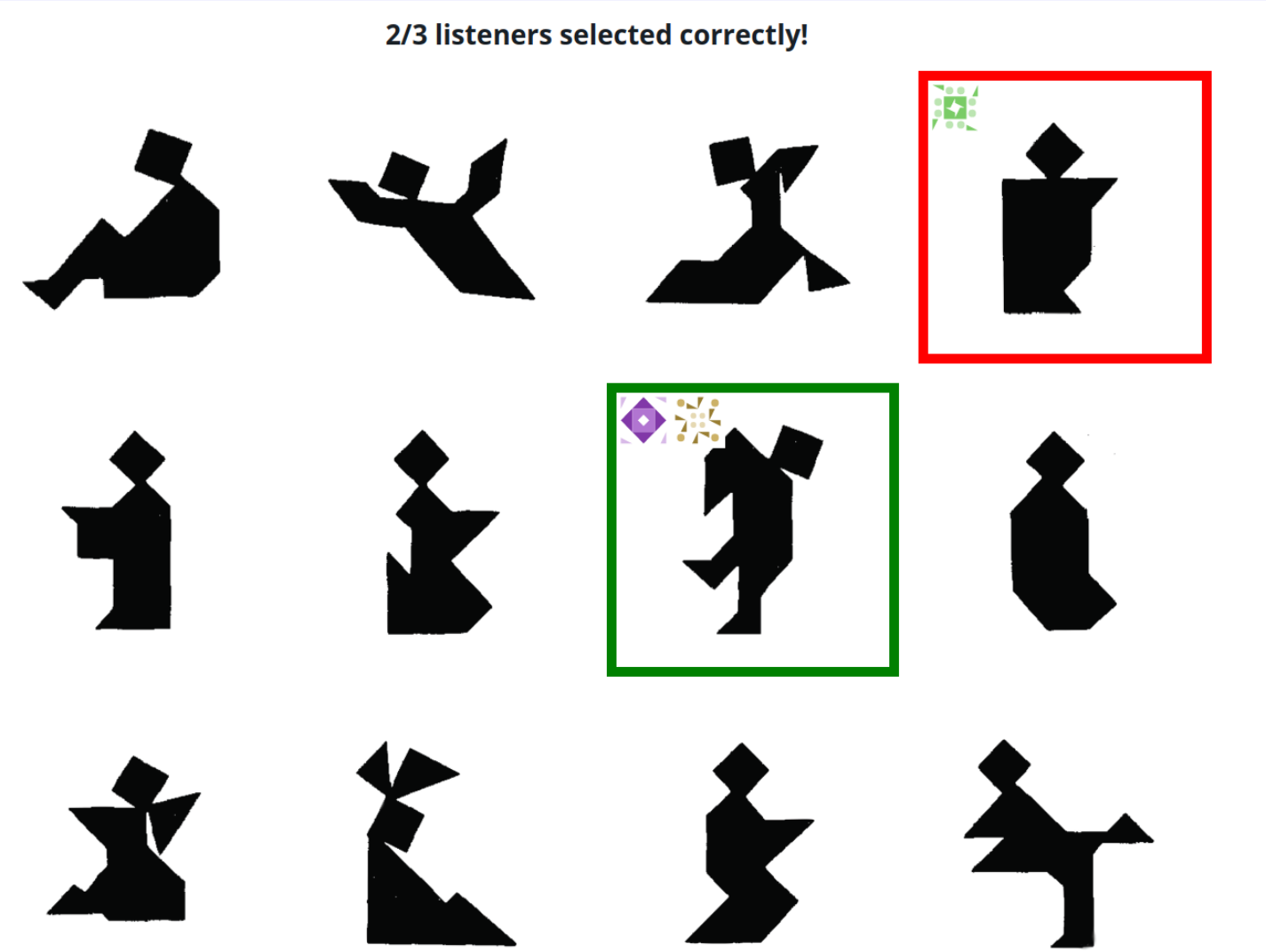
Bonus: 4 points

Experiment Framework



Bonus: 0 points

Experiment Framework



Bonus: Average of listeners = (2/3) * 4 points

Recruitment

Goal: 20 games in each of 2/3/4-player conditions
Each game has 6 blocks of 12 tangrams

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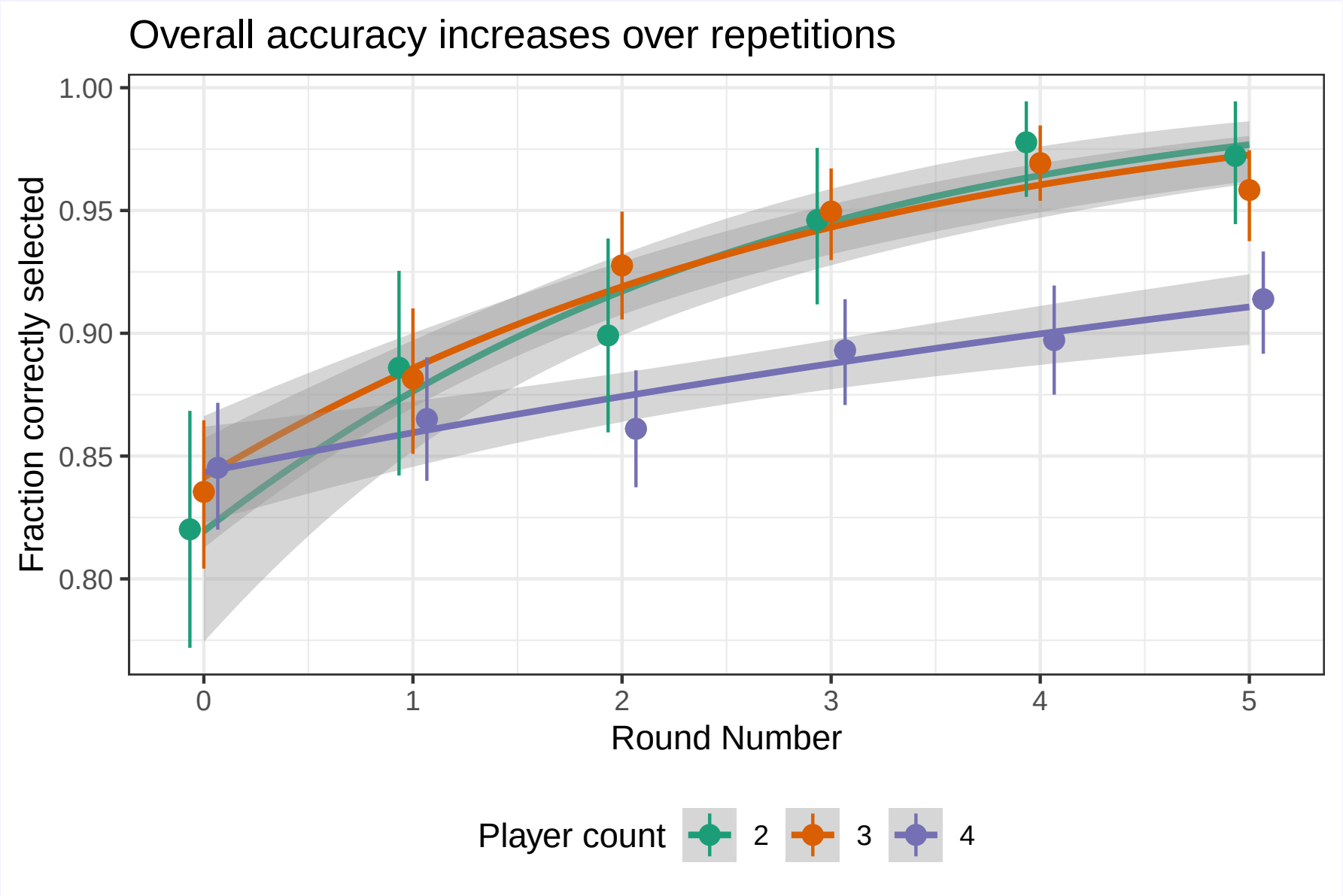
Each game has 6 blocks of 12 tangrams

Actual recruitment (over 3 days):

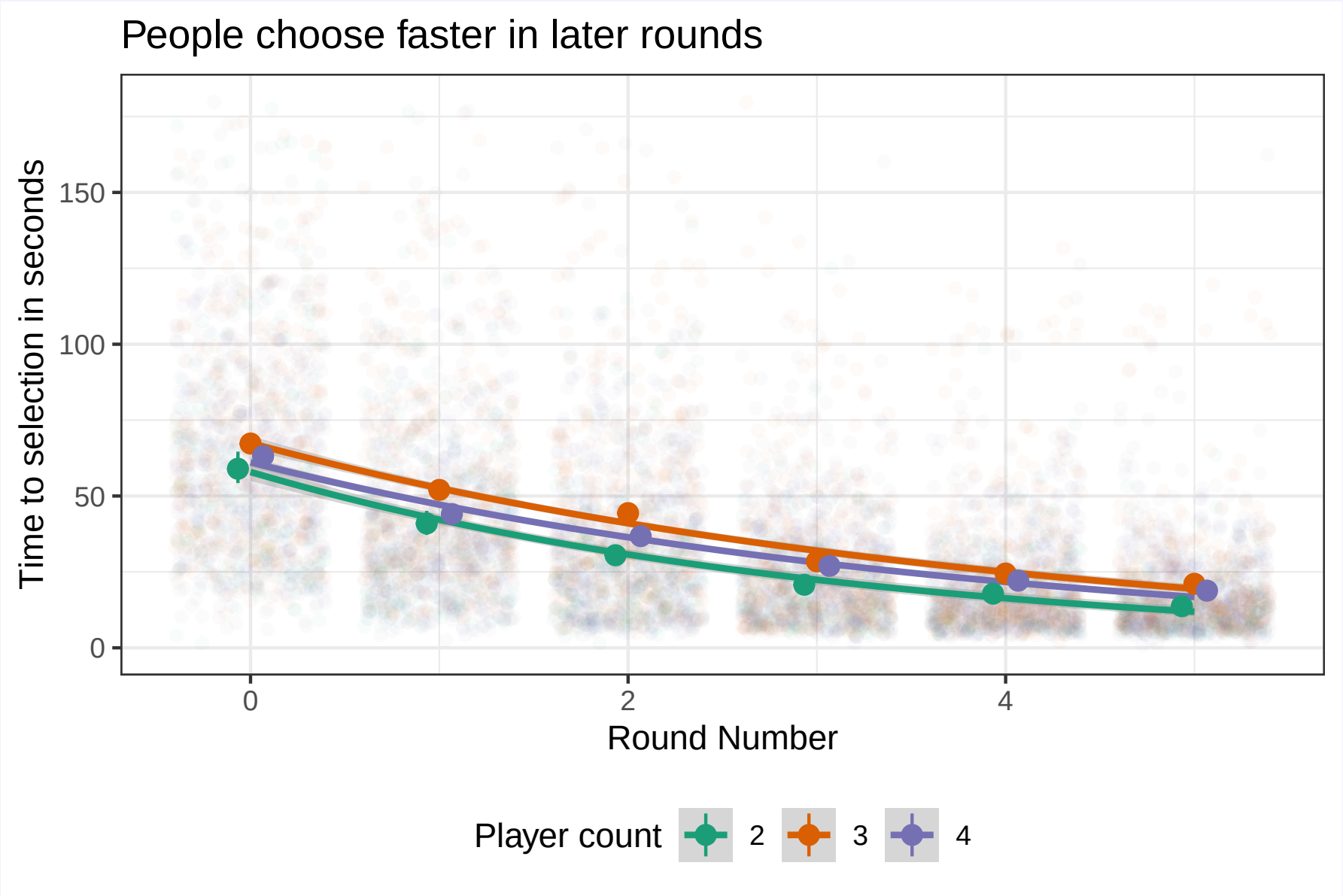
- 15 2-player games (+ 4 partial)
- 18 3-player games (+ 2 partial)
- 20 4-player games (+ 1 partial)

Include all complete blocks

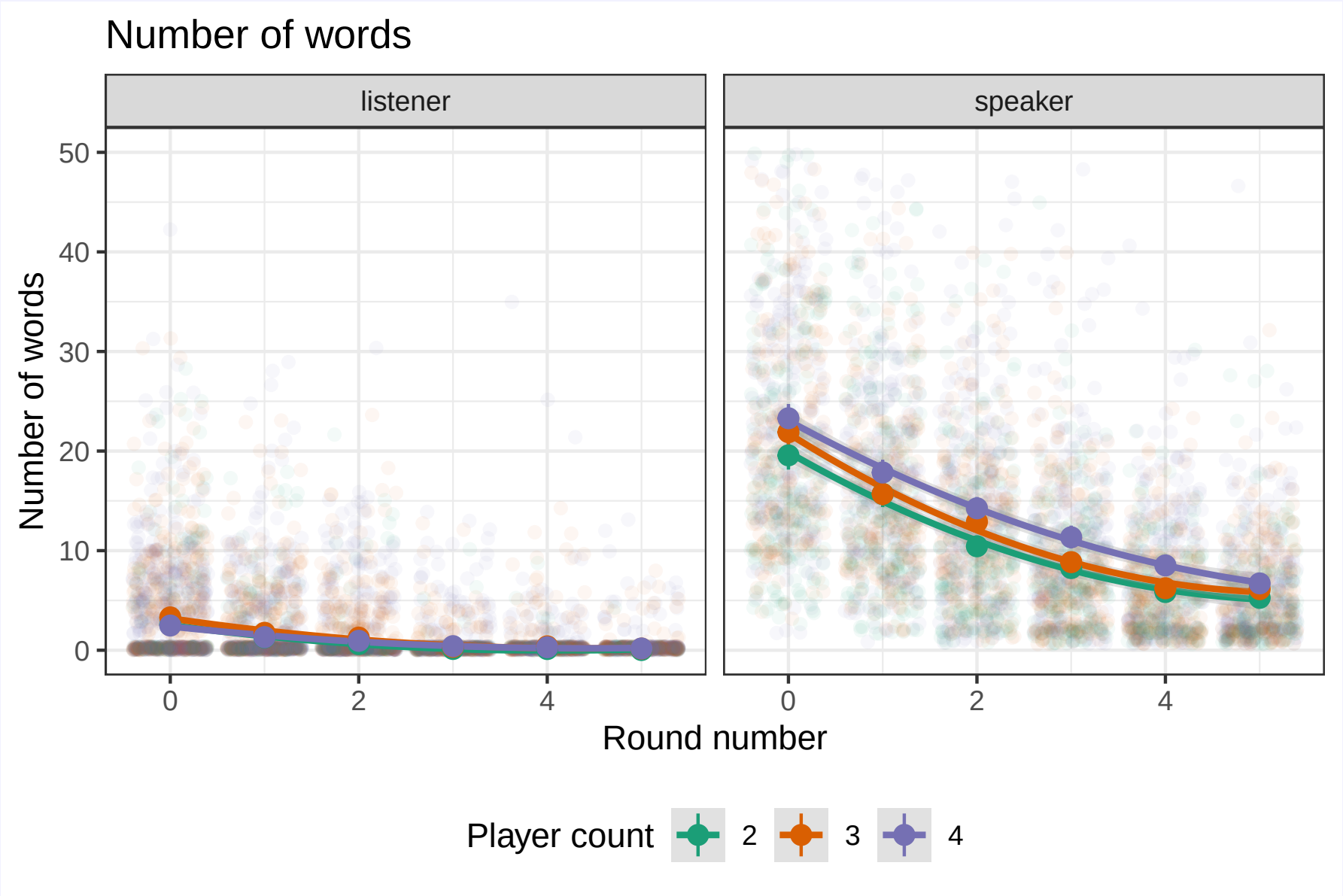
Results: Accuracy is high and increasing



Results: Faster in later rounds

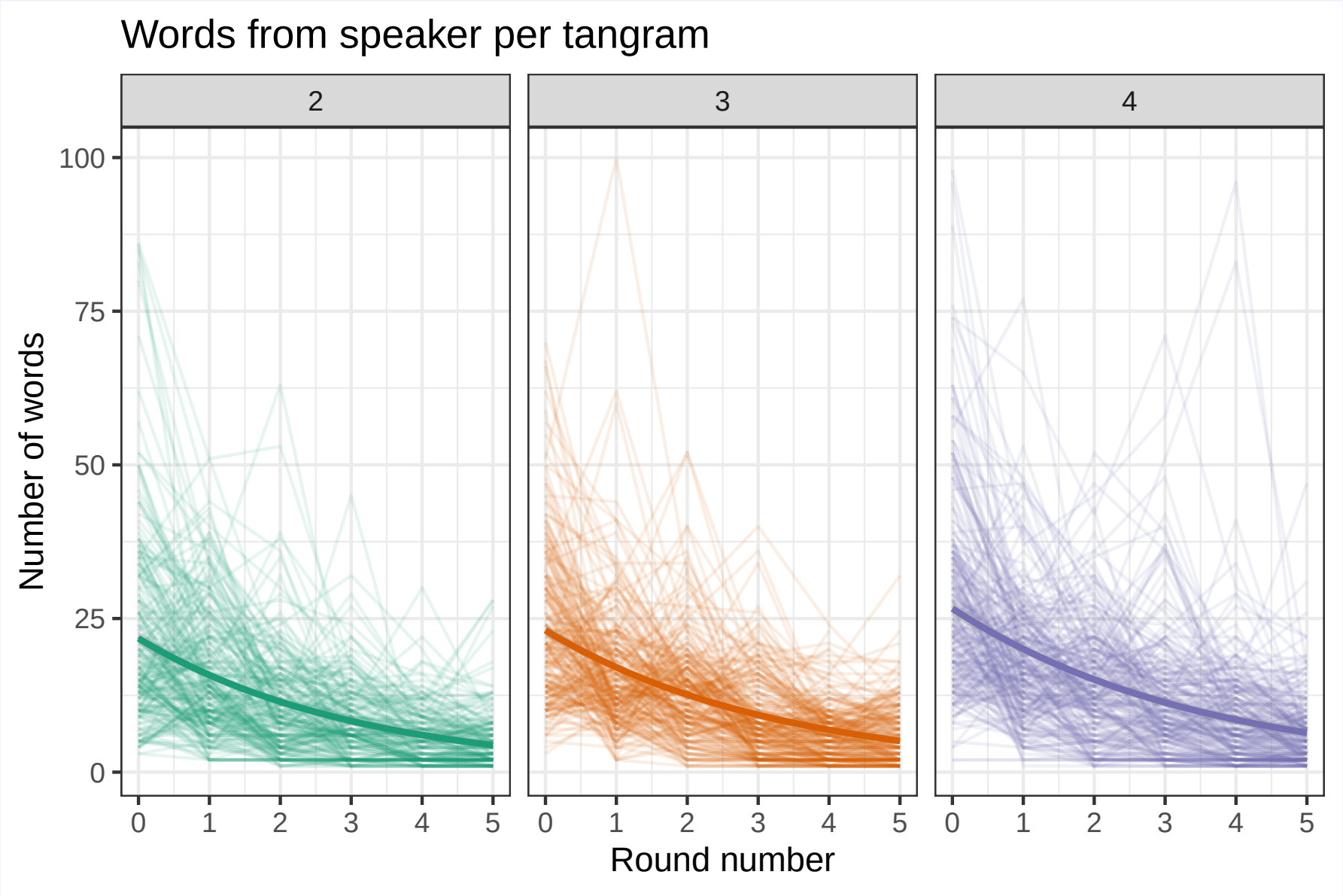


Results: Reduction in words over time

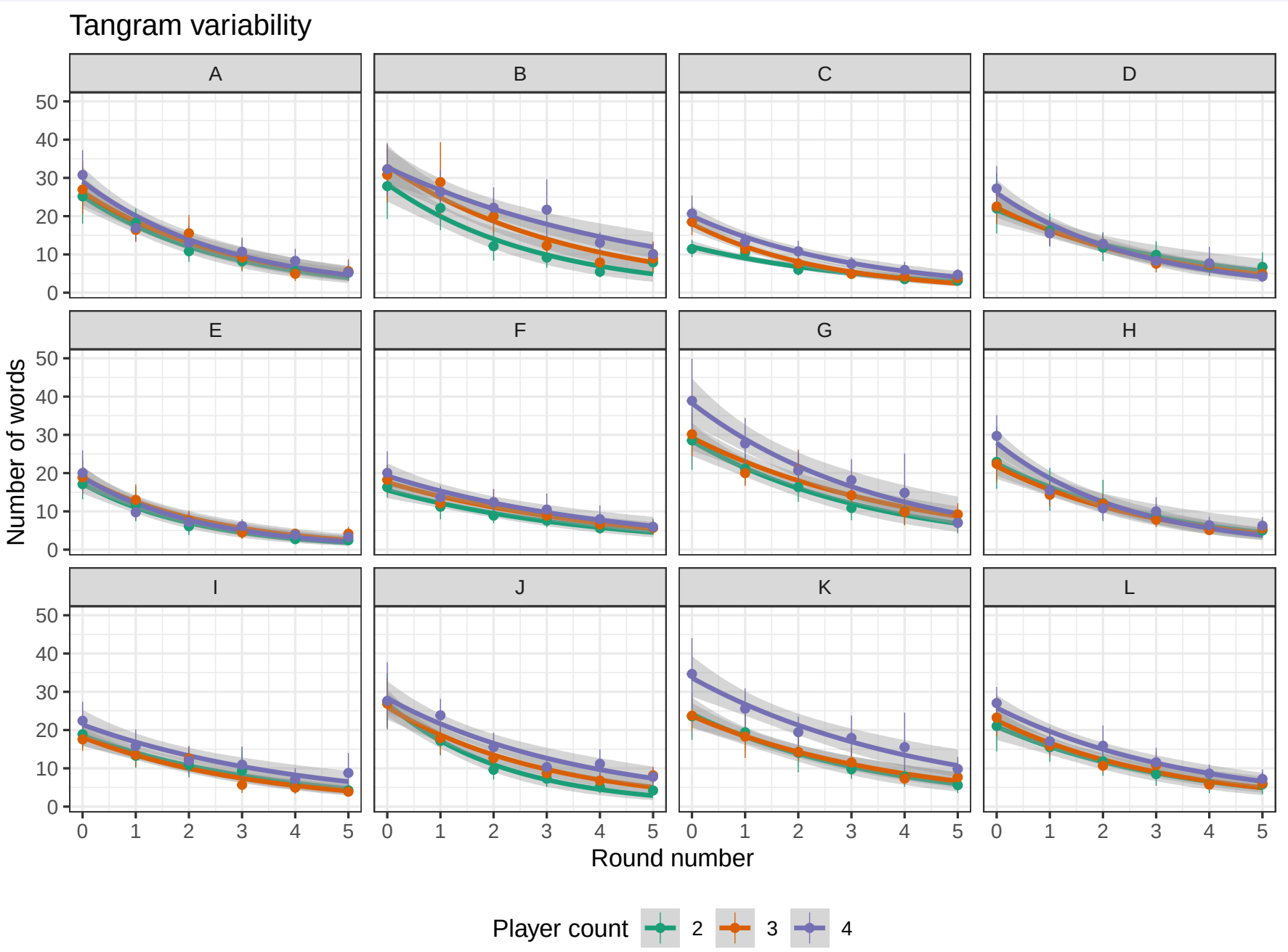


Results: Variability in reduction rate

Most groups/tangrams reduce gradually



Results: Tangrams vary in nameability

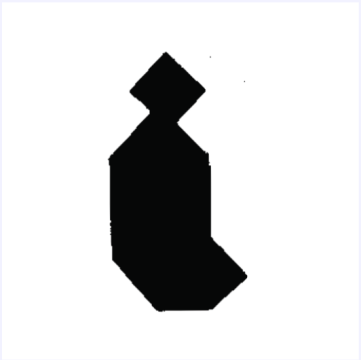


Results: Models

Bayesian model to allow for correlated variability

- Block: -3.22 words [-4.95, -1.55]
- Player count: 1.93 words [-0.15, 4.02]
- Speaker choosing wrong on the previous block: 4.15 words [2.54, 5.79]

Example: iBaby

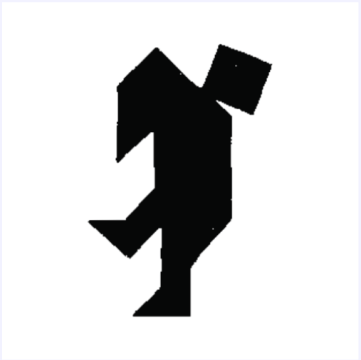


1. A(S):Looks like a letter ’i’
   C: does it look like with its hand out or not
   B: ˆ
   A(S): no hand it is just a head and a body.
   C: oke
   A(S): more like a baby that has been swaddled in a blanket
2. B(S): swaddled baby
   B(S): I
   B(S): i
3. C(S): the baby i
4. D(S): baby swaddled, looks like an i
5. A(S): swaddled baby
6. B(S): iBaby

Example: Skydiving ghost superman

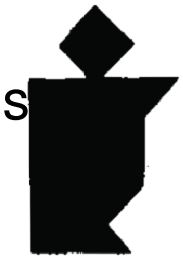
1. A(S):flying man
   A(S): like superman
   A(S): hands in the air
   A(S): like skydiving
2. B(S): the diver with no legs
   A: ok
3. C(S): This one looks like a ghost to me, but you called it superman or skydiver
   A: ok no legs?
   C(S): Correct A: ok
4. A(S): ghost, superman, skydiver
5. B(S): sky diver, ghost
   A: ok
6. C(S): Skydiving ghost superman

Example: Karate kid



1. A(S): Similar to the karate kid movie
   A(S): the crane kick
   B: Haha! Does it look like they have dangly sleeves!
   C: I don't know that one.
   A(S): yes
   D:yes i see, thats a good explenation.

Example: Lack of shorthand

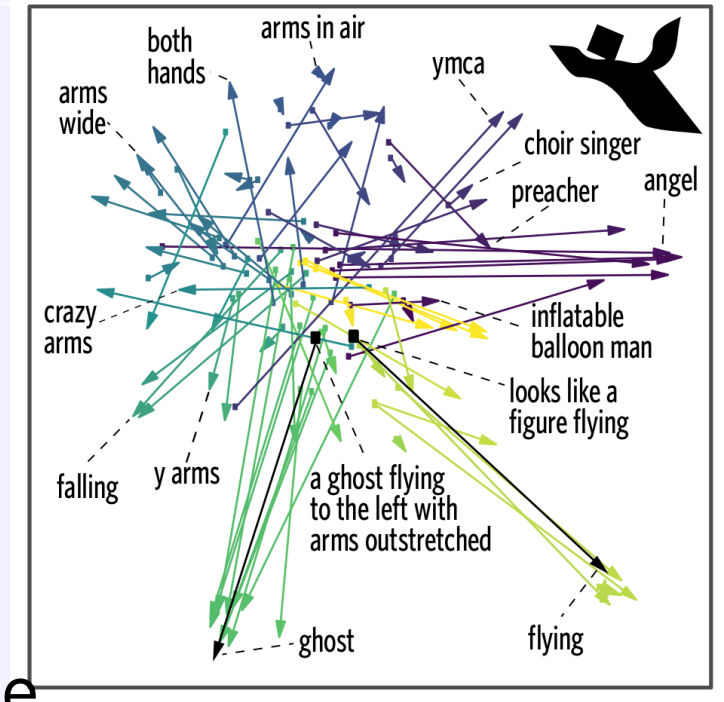


1. A(S):Diamond on top. Body with no real arms or legs. The body is shaped like a boot with the diamond on top.
   C: Is the boot pointed left or right?
2. B(S): diamond on top, large body beneath it. Left is a straight line all the way down, small variations on the right to the main body
3. C(S): Diamond in center on top. Left side straight, right side carved out like a vase.
4. D(S): Diamond head, flat topped body, straight on the left side with two triangles pointing out on the left
   D(S): *on the right
5. A(S): Diamond on top. Left side is straight, right side is obstructed, looks like a boot
   B: what do you mean by obstructed?
   A(S): The left side of the body is right, right side has bents in it
6. B(S): Diamond on top of a long large body/rectangle. Left side is complete, right side has bits missing

Example: Meta doesn't always help

1. ...A(S): yes, the legs are like a zig zag
   C: CODE name ZIGZAG
   A(S): There are no legs upwards
2. B(S): okay so similar to begger guy but no foot pointing up
   B(S): its like a zigzag
   B(S): i forgot the code name
   D: zigzag yea
   A: The one standing with knees bent
   B(S): yeah
   B(S): standing
   C: Yeah zigzag
3. C(S): The begger with no foot coming out from the left
   B: zigzag
   C(S): zigzag it is
   C(S): sorry i forgot
4. D(S): zigzag
5. A(S): zigzag
6. B(S): beggar guy
   B(S): zigzag

Future analyses: Semantics



- Convergence by group size
- Accuracy & convergence
- Geometric v metaphorical language
- Where/when are (atypical) concepts introduced?

Future directions

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How far does this generalize?

- Group size
- Stimuli
- Game set ups, feedback

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Online implementation makes iterations, variations easy

Comments, Questions?

Looking for feedback on

- Analyses
- Future data sets