

# Cognition and Semiotics

MA Cognitive Semiotics, Fall 2020

Lecture 10  
Monday Nov 8th

# Overview

- Today's lecture: Cognition and semiotics reviewer bootcamp
  - Overview and **contextualization** of papers
    - Fay et al (2008)
    - Nölle et al (2018)
    - Derex et al (2019)
  - Assignment feedback
  - Peer feedback and sampling exercise

# Fay et al. (2008) paper

- Are there specific adaptive advantages of communication systems created under different conditions, such as between **isolated pairs** of individuals or in a **community of pairs**?

## The fitness and functionality of culturally evolved communication systems

Nicolas Fay<sup>1,\*</sup>, Simon Garrod<sup>2</sup> and Leo Roberts<sup>1</sup>

# Background

Lecture 8, slide 24

- Fay's critique of iterated learning model:
  - "Individualistic models, such as the iterated learning model (Kirby, 2002; Kirby & Hurford, 1997, 2002), assume that as language is transmitted from generation to generation it is incrementally influenced by agents' learning biases until the language reaches an equilibrium that reflects these prior linguistic biases."
  - "This account predicts that separate communities and separate isolated pairs will eventually converge on a set of shared priors."
- i.e. since the iterated learning model assume language to be shaped by subtle innate cognitive biases amplified through transmission, it should predict that all languages eventually converge?

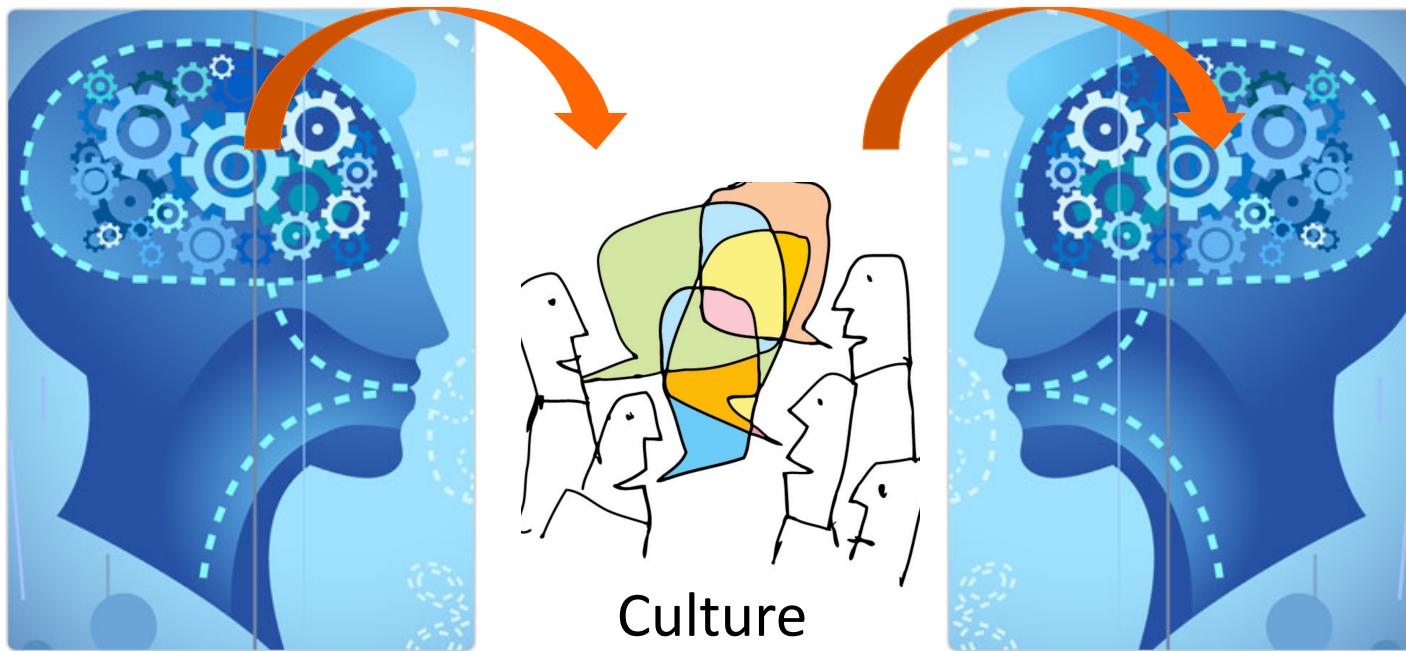
# The collaborative account

- Communication systems are shaped by function (communication), i.e. local grounding mechanisms:
  - “[...] a social collaboration account assumes that communication systems arise as a by-product of agents' local interactions within a closed community...”
  - ...According to this view, only members within the same community will align upon a globally shared sign system;...
  - ... initial pair-wise interaction will introduce several competing sign systems, and the need to establish a global sign system will cause a single scheme to propagate within each community.” (2010:359)
- Languages converge by contact/interaction
- No contact = great variability = no convergence

# Language, biology and culture

- “Inside-out”

- Language is first and foremost a biological phenomenon shaped by innate cognitive biases

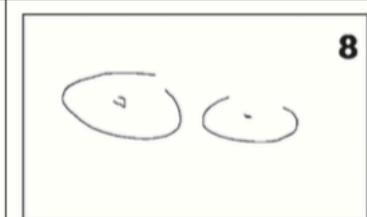
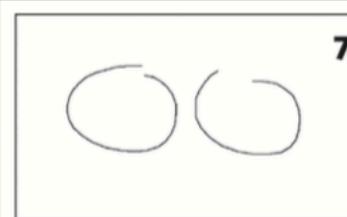
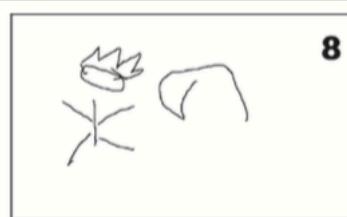
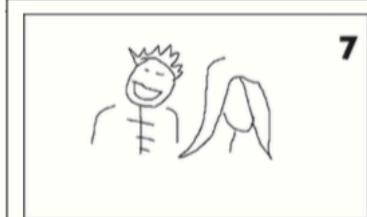
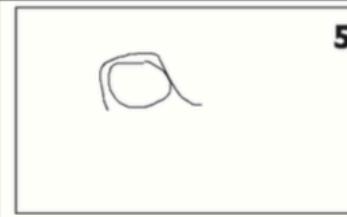
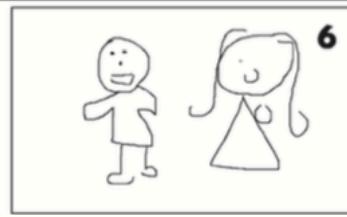
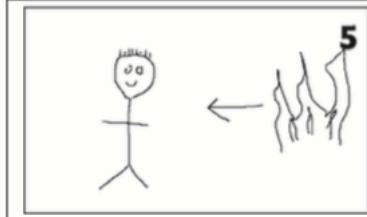
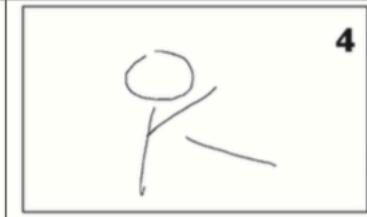
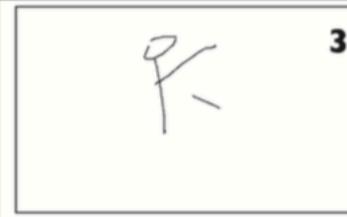
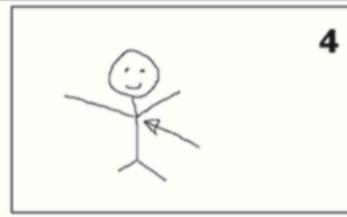
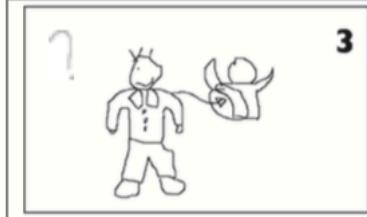
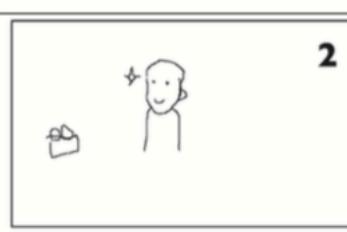
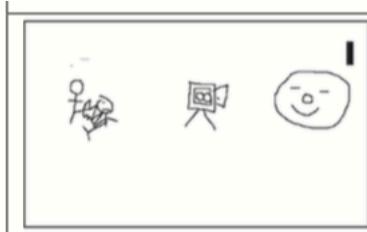


- “Outside-in”

- Language is first and foremost a cultural practice shaped by function (communication)

# Brad Pitt

(isolated pairs at round 1 & 7)

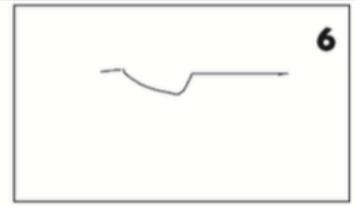
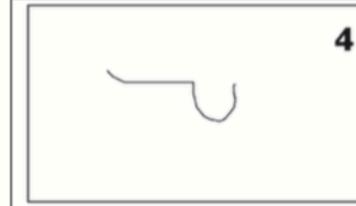
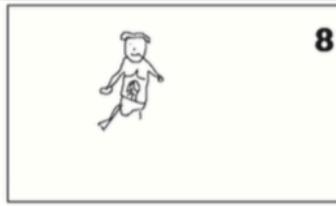
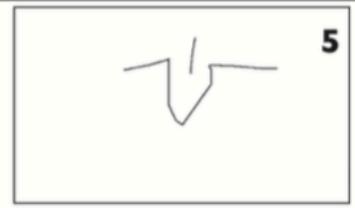
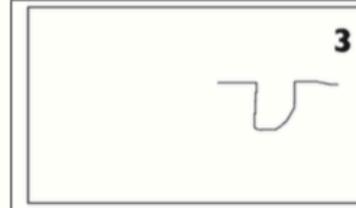
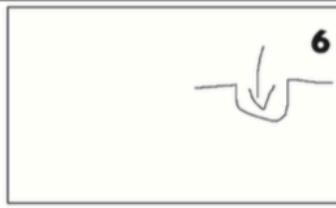
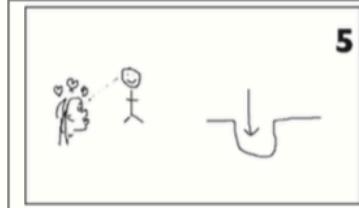
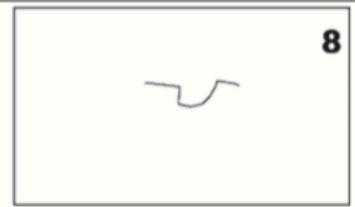
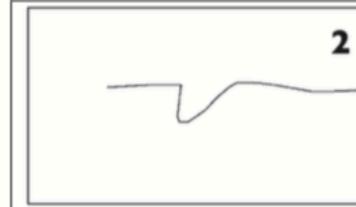
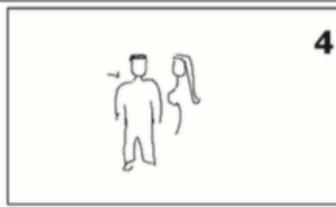
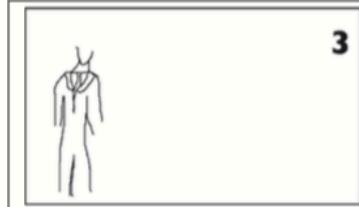
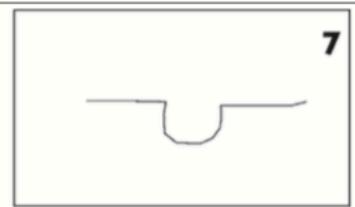
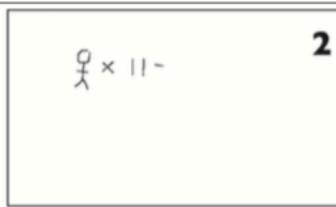
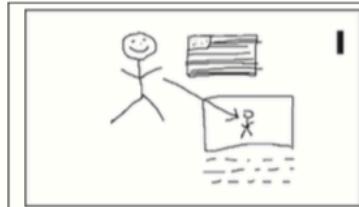


Pair drawings at Round 1

Pair drawings at Round 7

# Brad Pitt

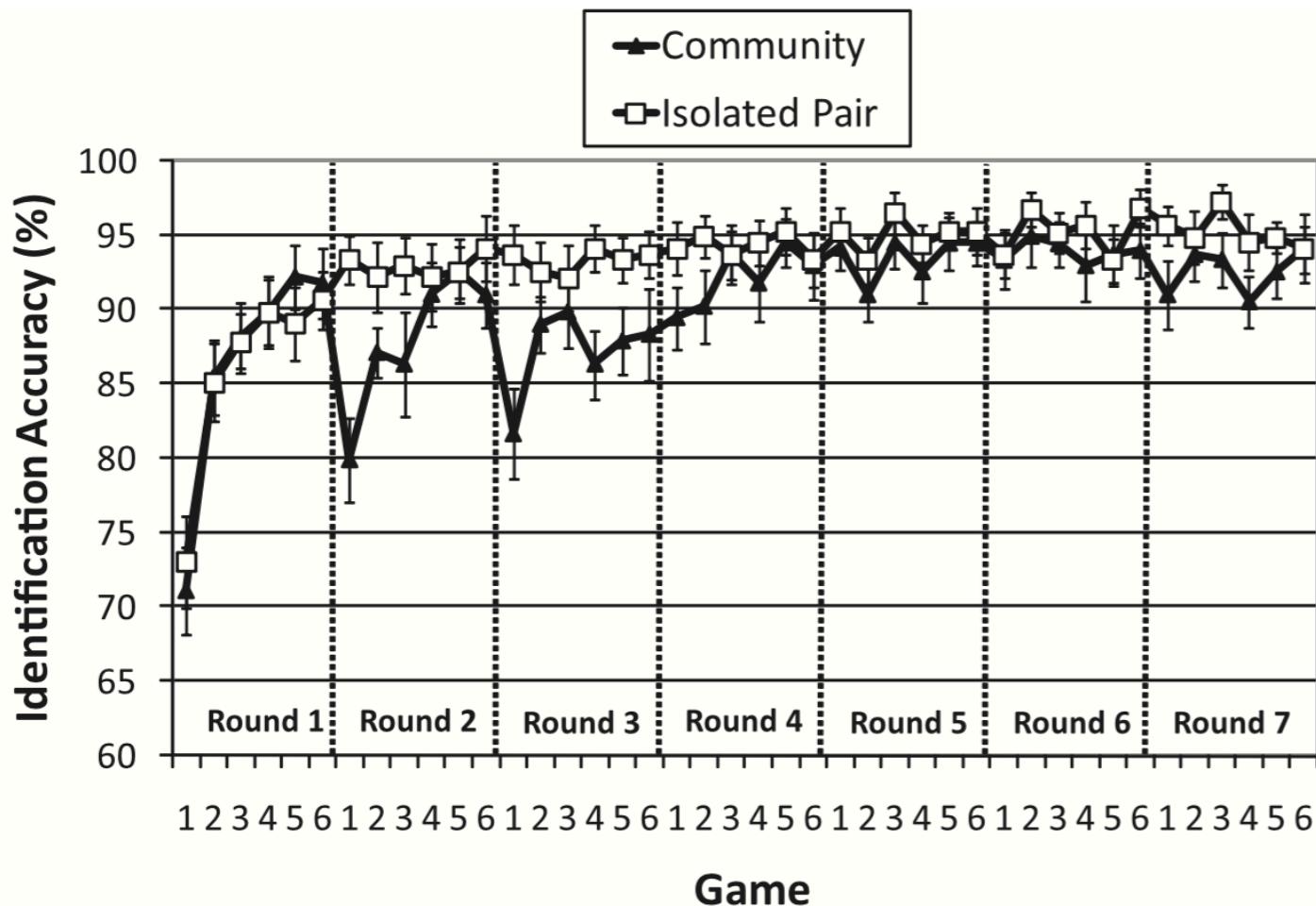
(community pairs at round 1 & 7)



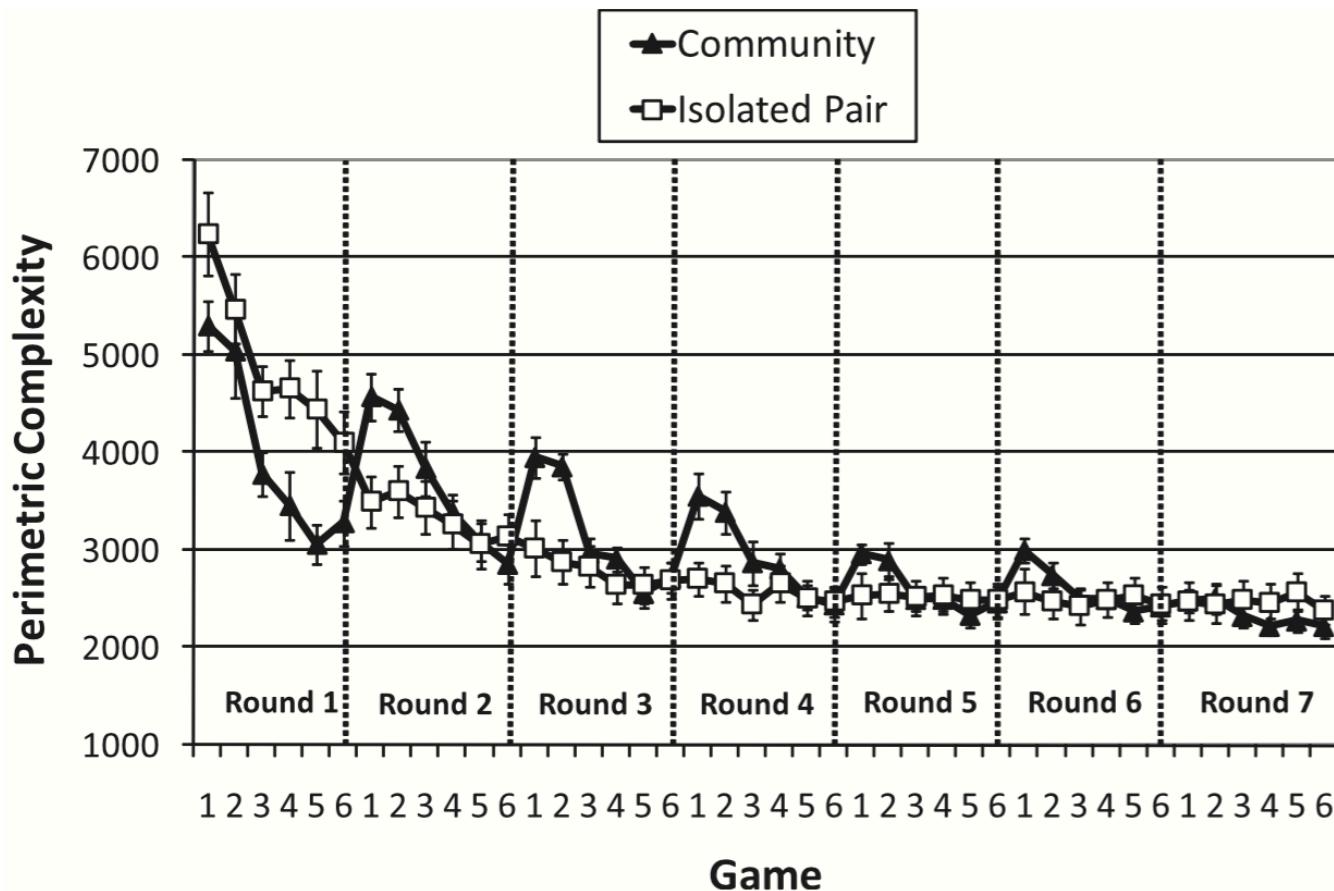
Community drawings at Round 1

Community drawings at Round 7

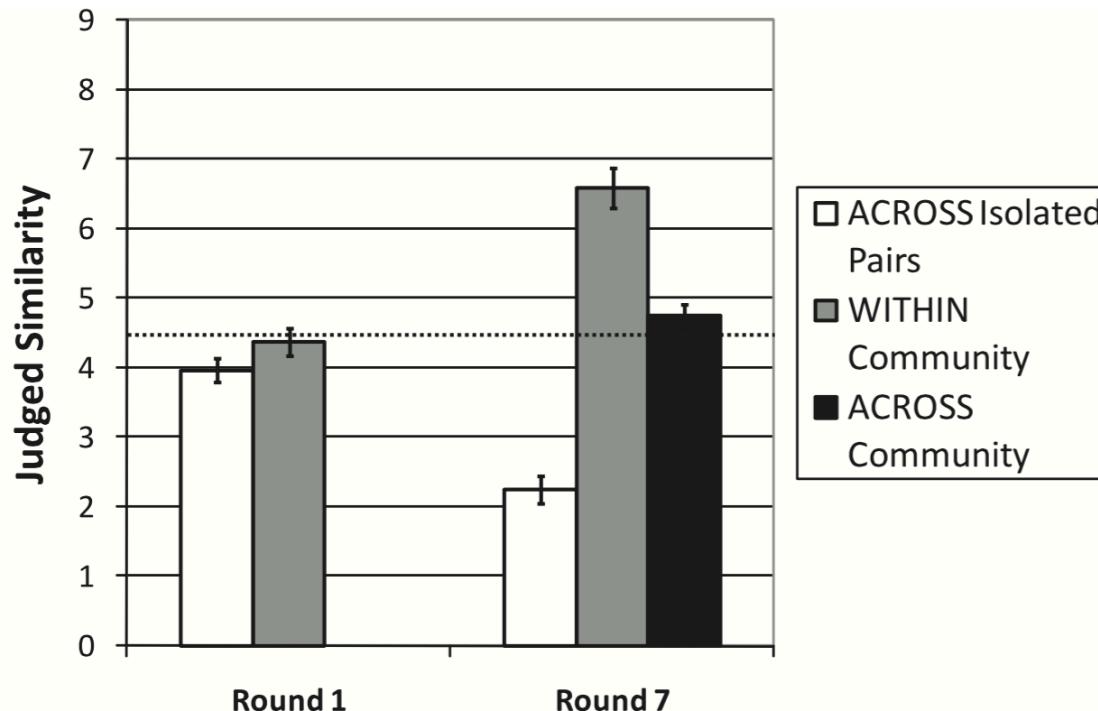
# Results - Identification accuracy



# Results - Complexity



# Results - Convergence



[...] for community pairs the “target” of alignment is the community as a whole rather than any particular partner in any round. That is, in this condition participants’ goal is alignment with the other members of the community, to the extent that globally aligning with the group takes precedence over locally aligning with a specific partner.” (2010:368)

# Fay et al. (2008) paper

- Back on track: Now for the current paper

## The fitness and functionality of culturally evolved communication systems

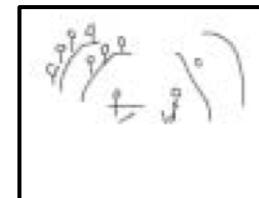
Nicolas Fay<sup>1,\*</sup>, Simon Garrod<sup>2</sup> and Leo Roberts<sup>1</sup>

# The research question

- Are there specific adaptive advantages of communication systems created under different conditions?
- Hypotheses:
  - Sign systems evolved in a community of interacting users will be more fit for transmission:
    - Easier to learn due to semantic transparency
    - Easier to detect due to saliency of form
    - Easier to memorize (encode), etc.

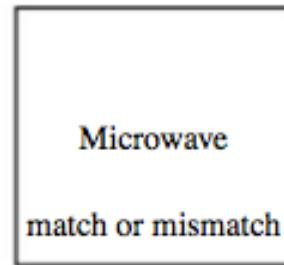
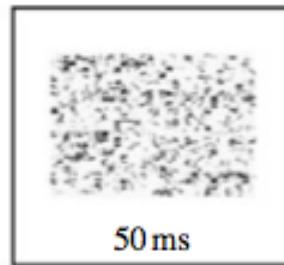
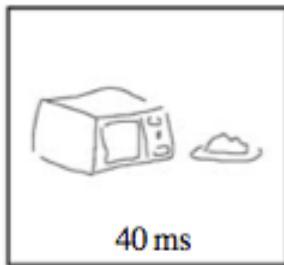
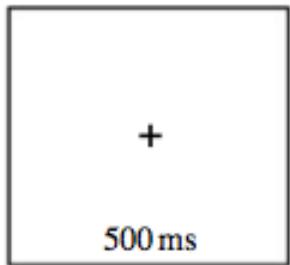
# Experiment 1: decoding signs

- Training phase: Participants are introduced to a sign and its label and tested on these until they perform at 80% accuracy

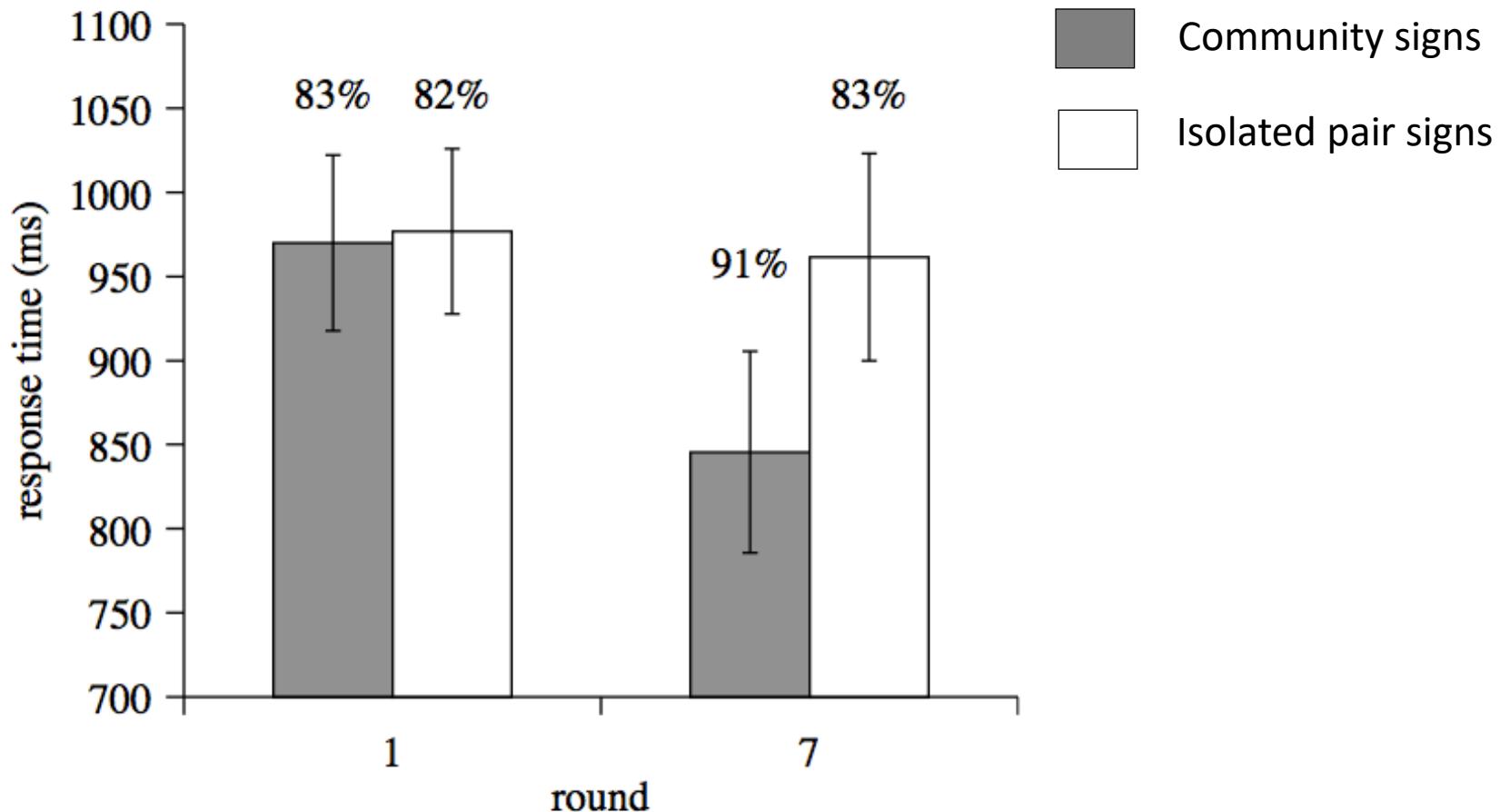


'Parliament'

- Timed decoding task:



# Results of experiment 1

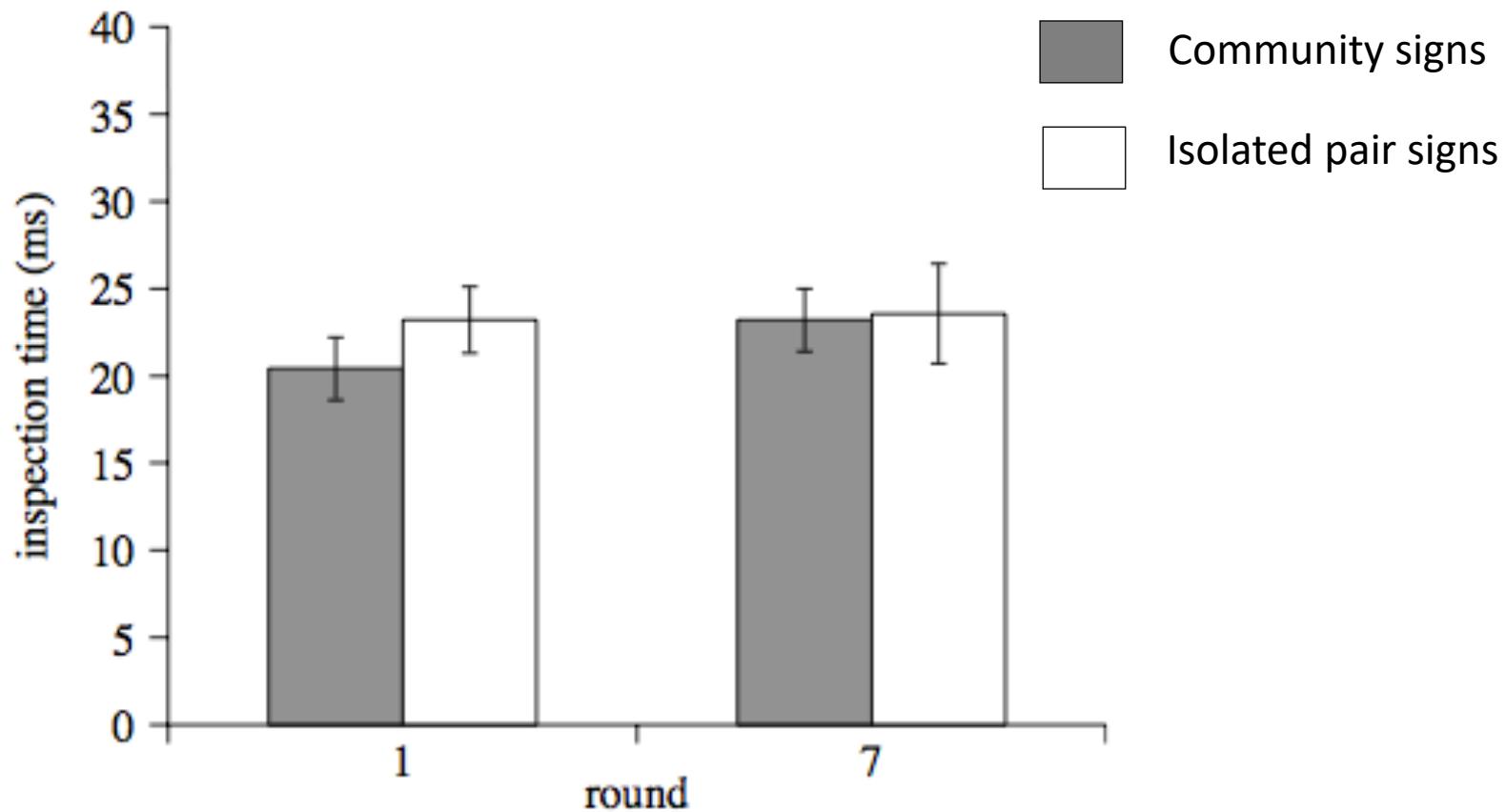


In summary, community evolved signs (round 7) offer a substantial learning advantage over signs that locally develop among isolated pairs. (Fay et al 2008:3557)

# Experiment 2: encoding signs

- **Training phase:** participants are introduced to a number of ‘target’ signs (encoding) and asked to identify these among distractor signs until they perform at 80% accuracy
- Inspection time task:
  - 800 trials of presentation of target and distractor signs at various inspection times: staircase (0 – 40 ms)
  - Identification of inspection time that gives an 70% accuracy

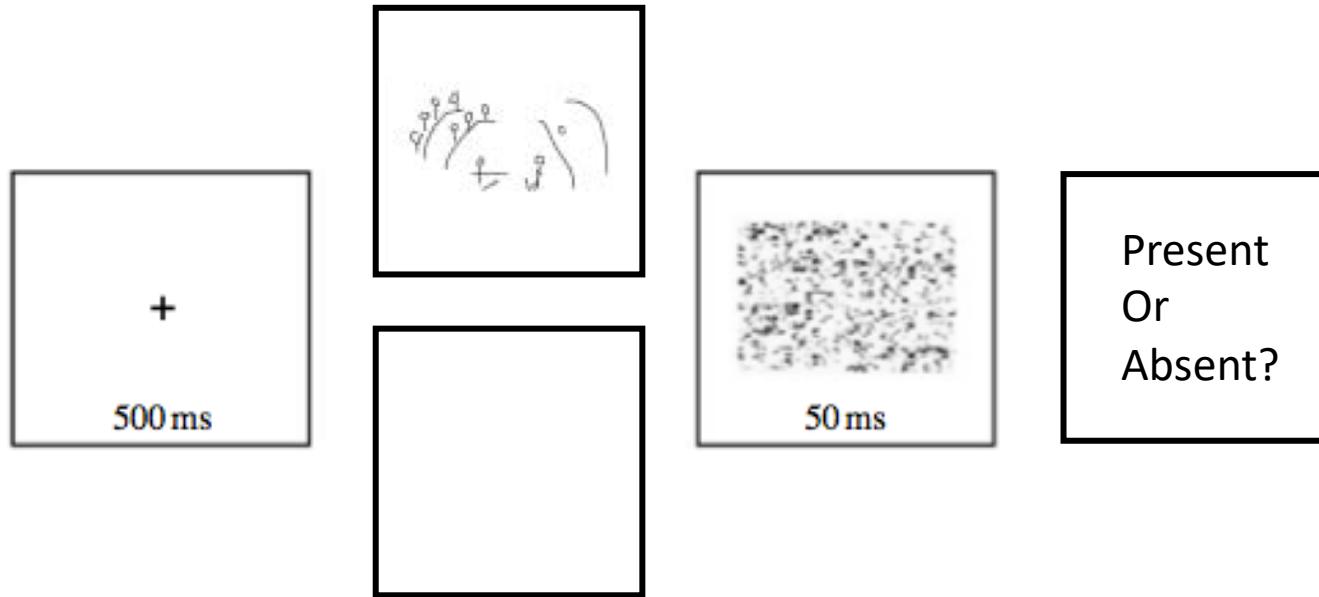
# Result of experiment 2



... the near-identical encoding efficiency of round 7 community and isolated pair images indicates that the decoding benefits of community evolved signs (experiment 1) cannot be attributed to more efficient sign encoding or discrimination. (Fay et al 2008:3558)

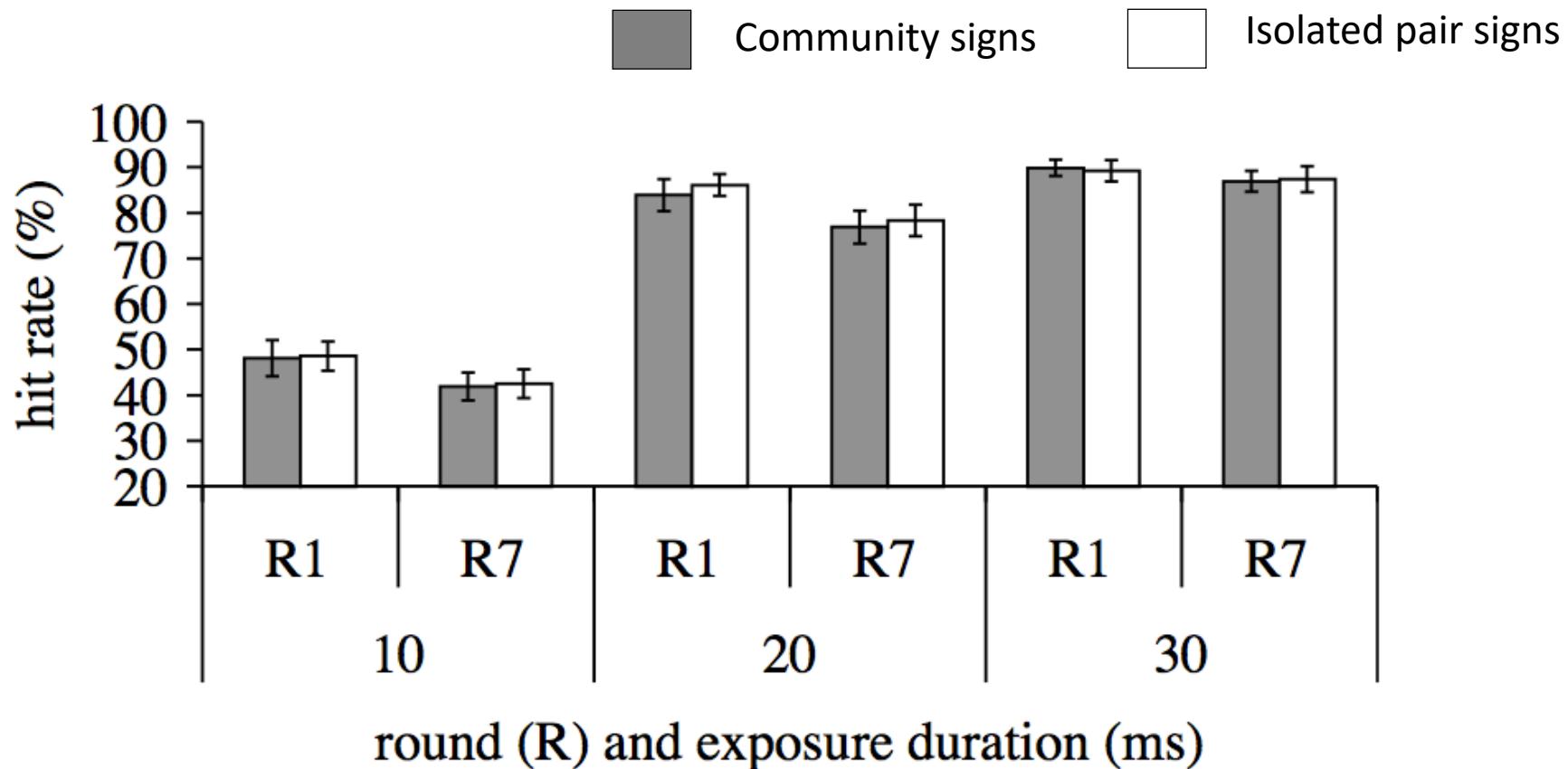
# Experiment 3: detecting signs

- A two-alternative forced choice task



10, 20 or 30 ms

# Results of experiment 3

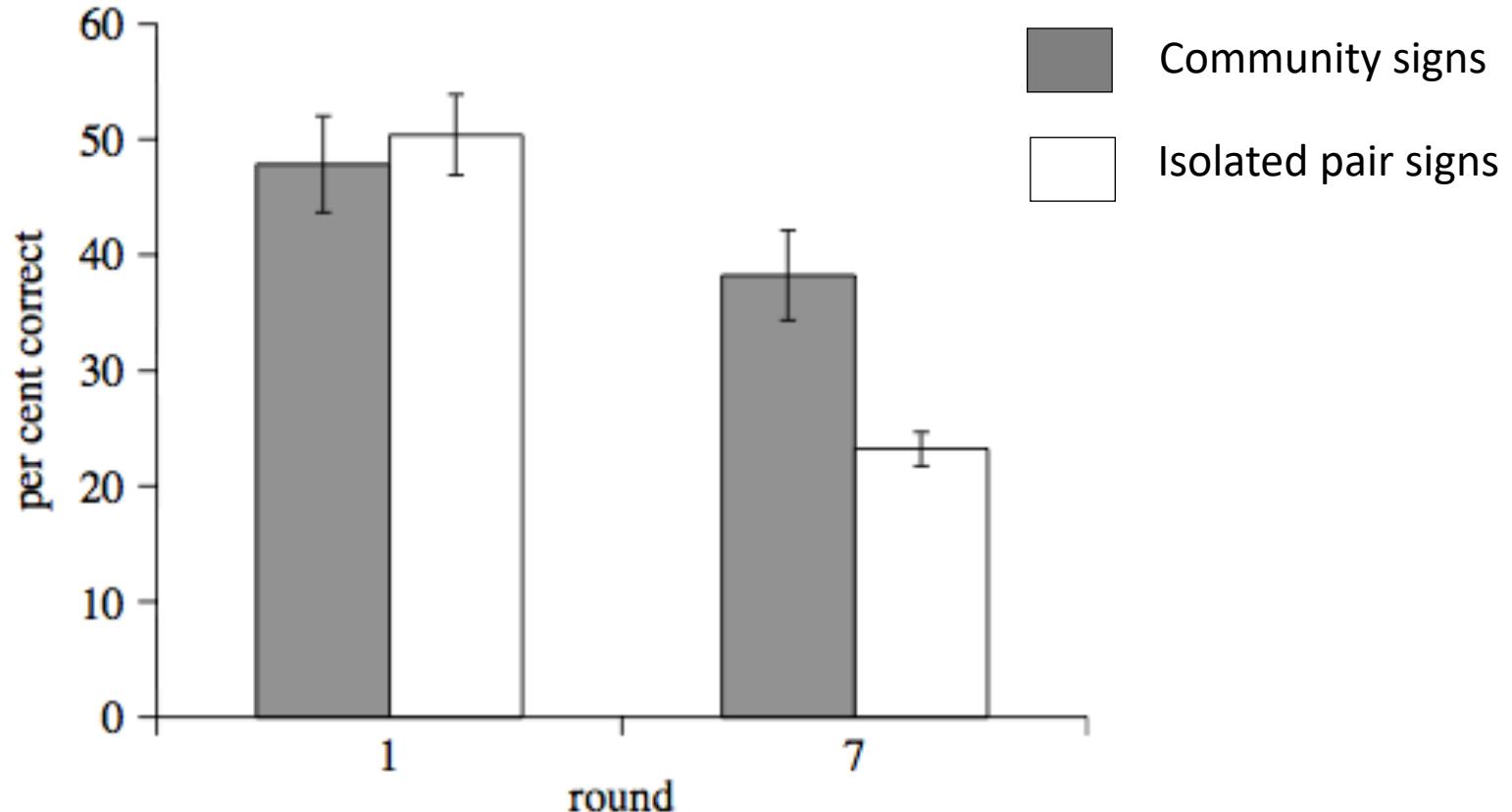


The equivalent detection rates for community and isolated pair images confirm that the decoding benefits seen for community evolved signs (experiment 1) cannot be attributed to ease of detection.

# Experiment 4: the semantic transparency of signs

- Can **naive observers** guess the original meaning of the two kinds of signs?
- Participants saw animated videos of the original drawing of signs
- Then they selected the intended meaning of the sign on a list of 20 items

# Results of experiment 4



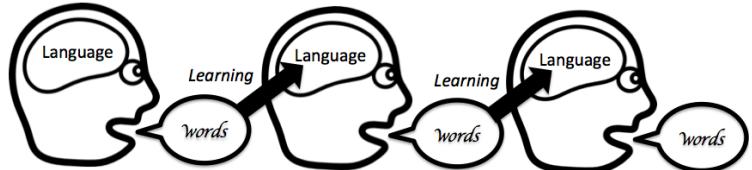
... community evolved signs retain more residual iconicity when compared with isolated pair developed signs, and this makes the translation from sign to meaning more transparent to naive overseers. (Fay et al 2008:3559)

# Summing up

- “Signs need to be effective both in terms of communicative fitness within each pair of the group and in terms of transmission fitness for other group members ...
- Communities achieve this by **developing increasingly simple signs**, but nevertheless signs that retain sufficient residual **iconicity** to be easily **recognized** (experiment 4) and **learned** (experiment 1) by new members of the population from which the community was drawn” (Fay et al 2008:3560)

# Open questions

- Recall: In the iterated learning model, even subtle, **latent cognitive biases** can be amplified to create **emergent structure** (“**The invisible hand**”), i.e. no one is intentionally trying to improve language (cmp. Pictionary games)
- Fay et al. (2008) suggest that the **Kirby et al (2008) results** in **lecture 8** may not be very useful for anyone outside the involved participants
- Different ‘types of interactions’ may have qualitatively different resulting outcomes – as we have also seen in group decision-making and joint action research



# Nölle et al. (2018) paper

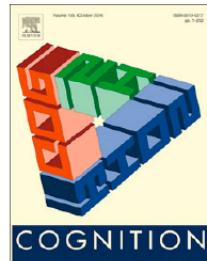
- Are communicative and environmental factors important for systematicity in linguistic structure to emerge?



Contents lists available at [ScienceDirect](#)

Cognition

journal homepage: [www.elsevier.com/locate/cognit](http://www.elsevier.com/locate/cognit)



Original Articles

The emergence of systematicity: How environmental and communicative factors shape a novel communication system



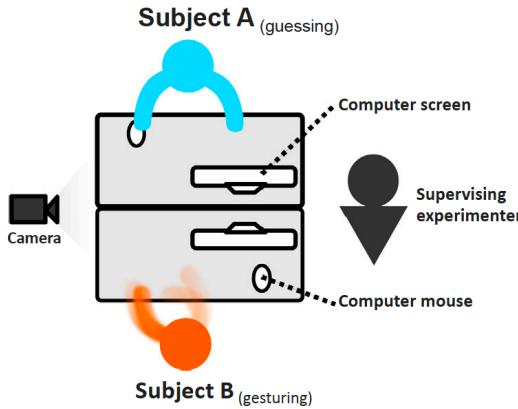
Jonas Nölle<sup>a,c,\*</sup>, Marlene Staib<sup>c</sup>, Riccardo Fusaroli<sup>b,c</sup>, Kristian Tylén<sup>b,c</sup>

# Research question

- Investigating *when systematicity* evolves in a novel sign system even if *idiosyncratic* signs are equally afforded
  - *Idiosyncratic*: "person with the funny-looking beard"
  - *Systematic*: combination of general traits such as gender or job, e.g. "female doctor"
  - What *conditions* promote the latter?
- *Linguistic Niche Hypothesis*: assumes that systematicity evolves adaptively in response to particular ecological and social affordances
  - Here, they test the role of
    1. Structural properties of the physical and social environment (so-called 'functional adaptivity')
    2. Open vs closed environment (unstable changing environment)
    3. Displaced communication (depending on memory, see also lec 8)

# Experimental set-up

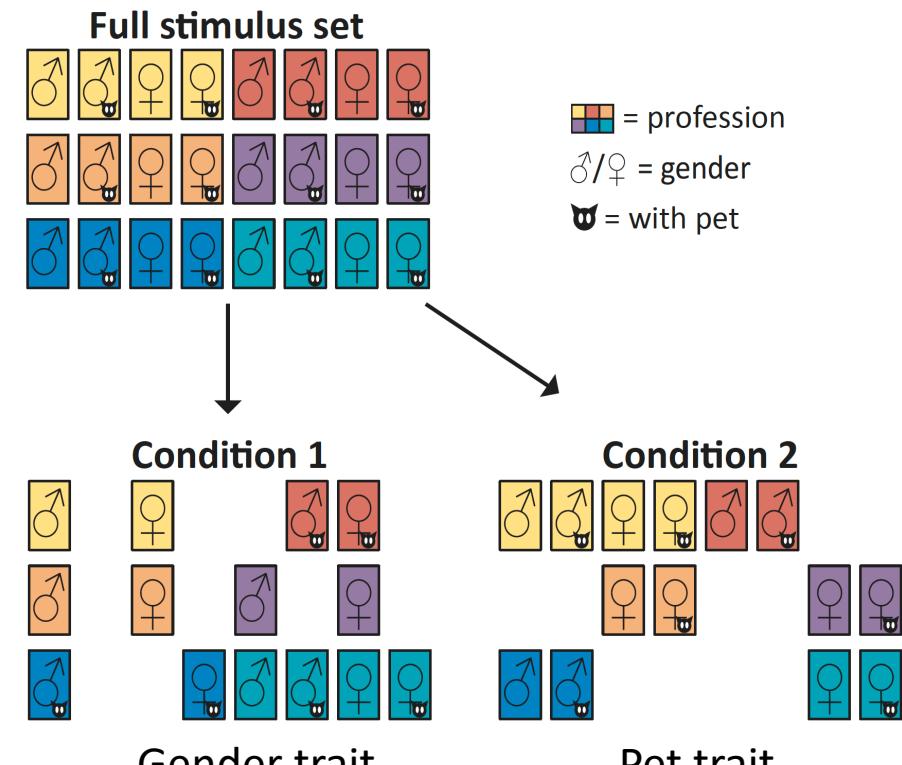
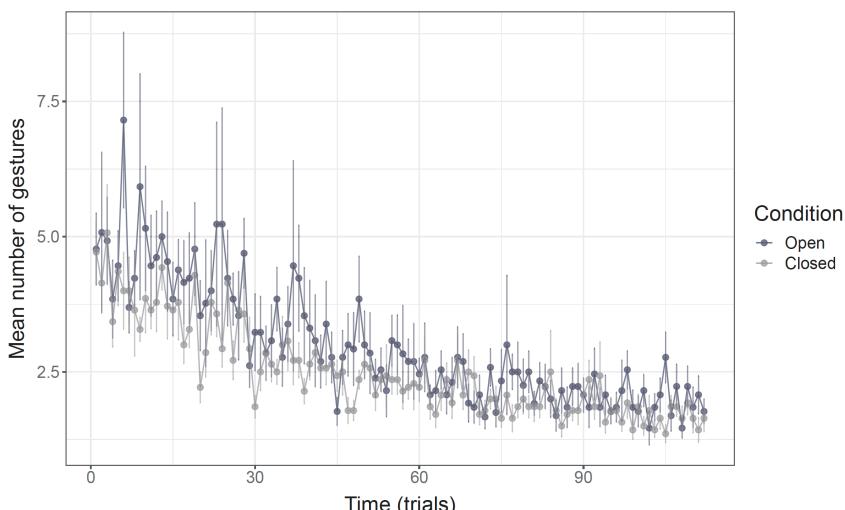
- Referential semiotic game: ‘Silent gesture’ paradigm



*Idiosyncratic:* Necklace, bead, glasses  
*Systematic:* Profession, gender, pet

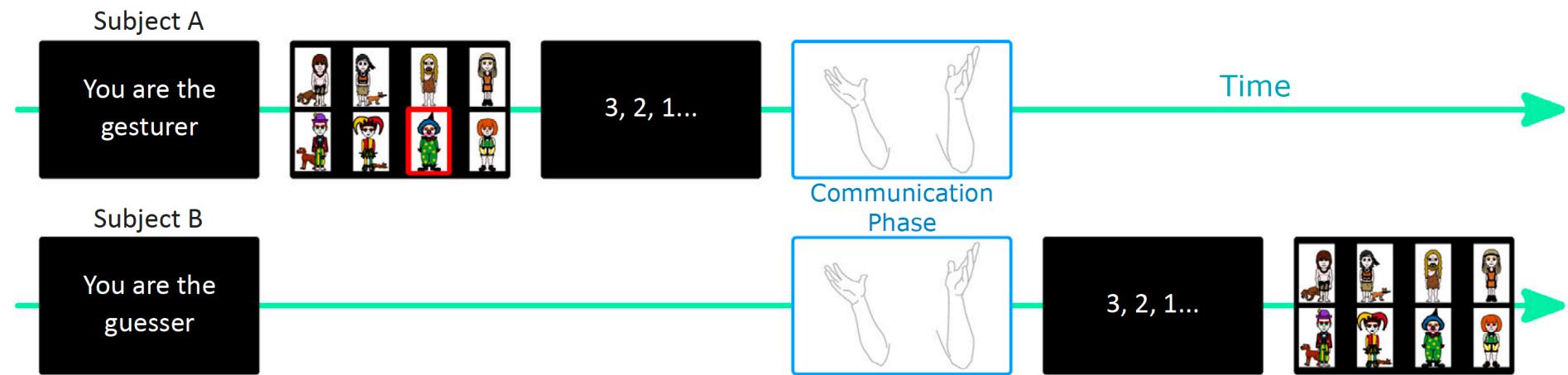
# Experiment 1

- Testing **low and high functional adaptivity** (distribution of *gender & pet*) - with an **open** and a **closed condition** (whether distractors were drawn from the full set or not)
- Gestures **aligned**, and subjects **adhered to functional adaptivity**, but **no increase in systematicity** or effect of the **open environment**



# Experiment 2

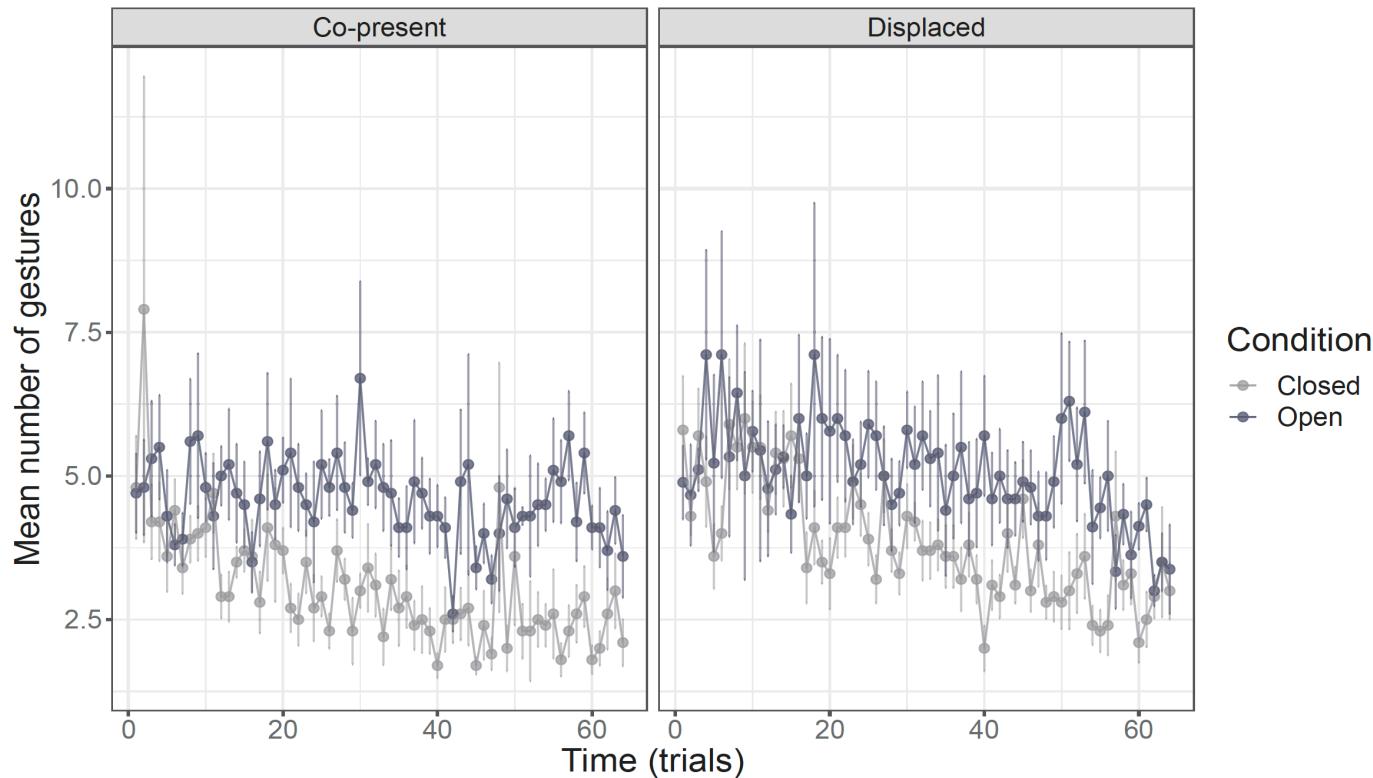
- Rather than only distractors, they now let **both distractors and targets** be drawn from the full set in the **open condition**!
  - That should introduce more “pressure” for systematicity, right?
- Also, main purpose here was to test **displaced communication**: Now subjects had to rely on memory



**Fig. 6.** Schematic representation of the procedure for a trial in the ‘displaced communicative context’ condition.

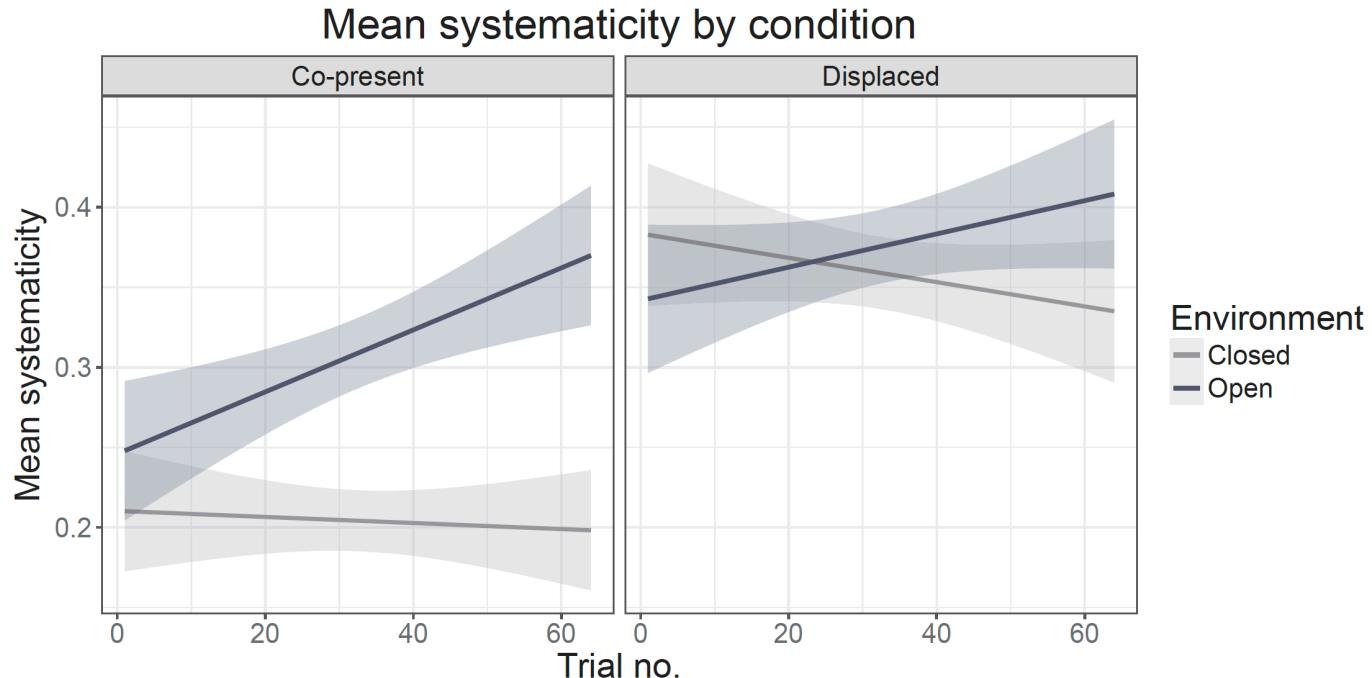
# Experiment 2 - results

- Again, gestures aligned - but compression was less so for the open condition, as well as for the displaced condition:



# Experiment 2 - results

- And systematicity did indeed emerge as a result of the (revised) open unstable and changing environment
- In addition, displaced communication promoted systematicity as well



# In summary

- Participants relied on structural features to motivate systematic aspects of the evolving communication system, even when idiosyncratic ones were available
- Systematicity emerged from an open and unstable referent environment vs. a closed set of referents
- Displacement of communication promoted and accelerated systematicity (due to working memory advantage)

Original Articles

The emergence of systematicity: How environmental and communicative factors shape a novel communication system

Jonas Nölle<sup>a,c,\*</sup>, Marlene Staib<sup>c</sup>, Riccardo Fusaroli<sup>b,c</sup>, Kristian Tylén<sup>b,c</sup>



# Open questions

- Is this in line with Fay's collaborative account?
  - I.e. communication systems are **shaped by function** (communication), i.e. local grounding mechanisms
- Yes, they conclude that they provide experimental evidence for the idea that linguistic structure evolves adaptively from contextually situated language use
- The study also partly elaborates on the **Christensen et al. (2018) paper** on environmental constraints of emerging communication systems, no?
- Questions?

# Derex et al. (2019) paper

Do we need to understand the causal relationships between elements or the underlying theory in order to cumulatively improve technology across ‘generations’?

nature  
human behaviour

LETTERS

<https://doi.org/10.1038/s41562-019-0567-9>

**Causal understanding is not necessary for the improvement of culturally evolving technology**

Maxime Derex<sup>ID 1,2\*</sup>, Jean-François Bonnefon<sup>3</sup>, Robert Boyd<sup>4,5</sup> and Alex Mesoudi<sup>ID 1</sup>

# Background

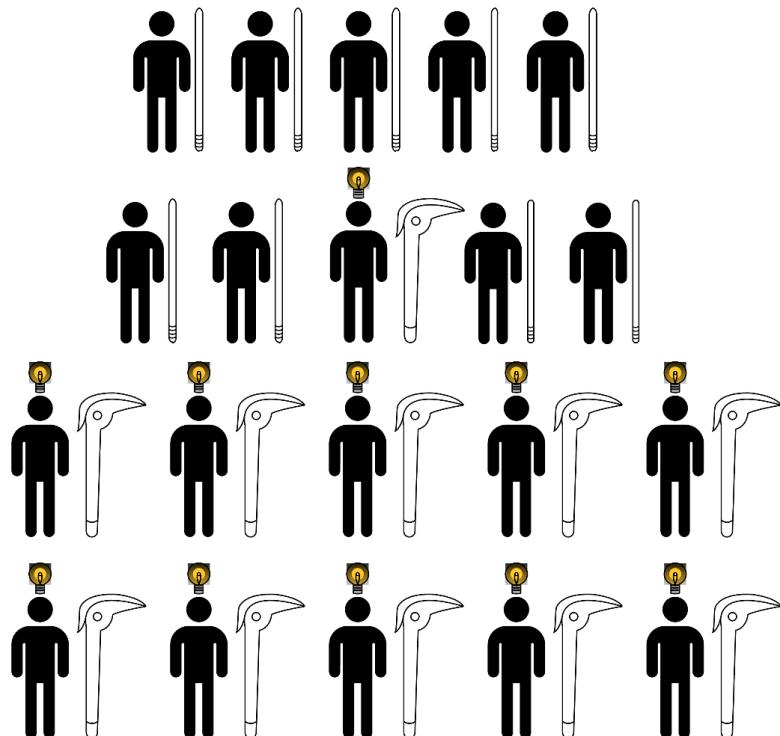
- What kind of technological understanding is required? 2 competing hypotheses!
- Cognitive niche hypothesis: natural selection enhanced our ancestors' ability to think creatively, plan and engage in causal reasoning about their environment,
  - This enabled the production of more efficient technologies that powered human expansion
- Cultural niche hypothesis: Slowly, but surely, our ancestor's have accumulated many small and poorly understood improvements
  - But over time, across generations of cultural transmission, they have given rise to the same result

We're geniuses!

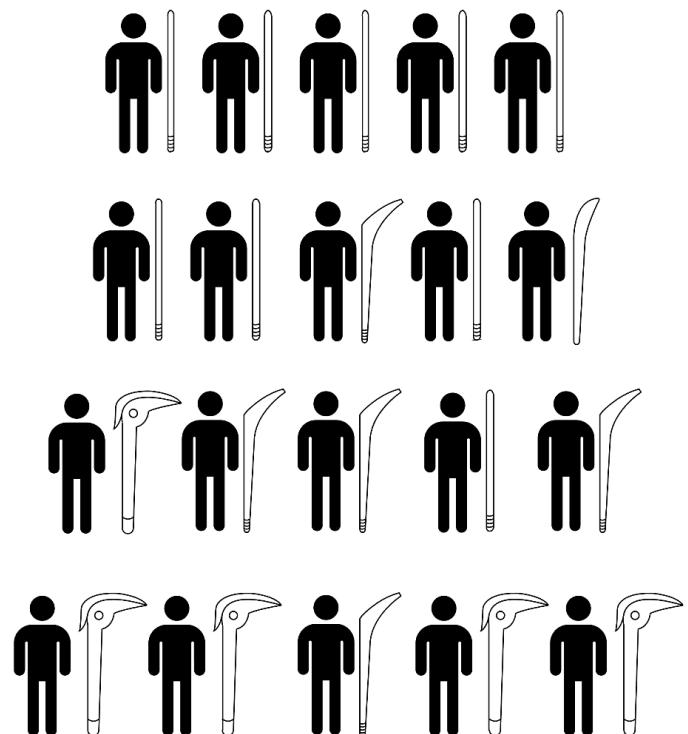
We're "the little train that could", little by little!

# Background

Cognitive niche hypothesis



Cultural niche hypothesis

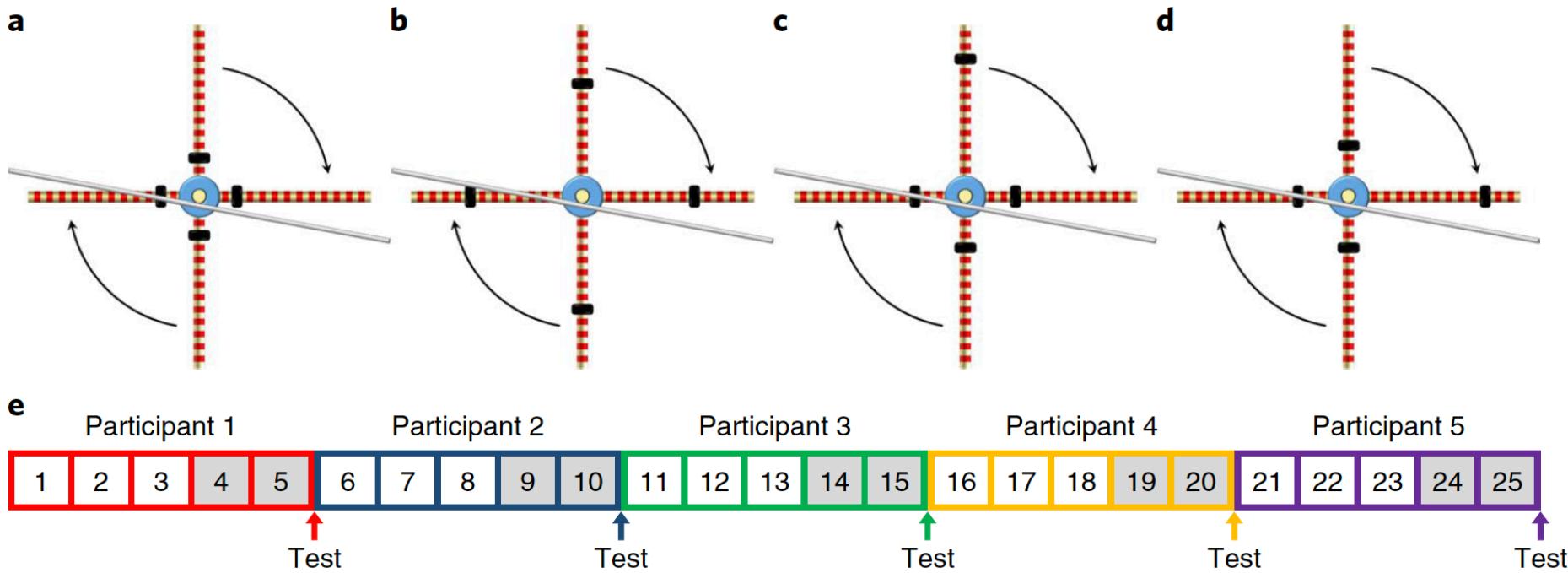


# Experimental task: The wheel

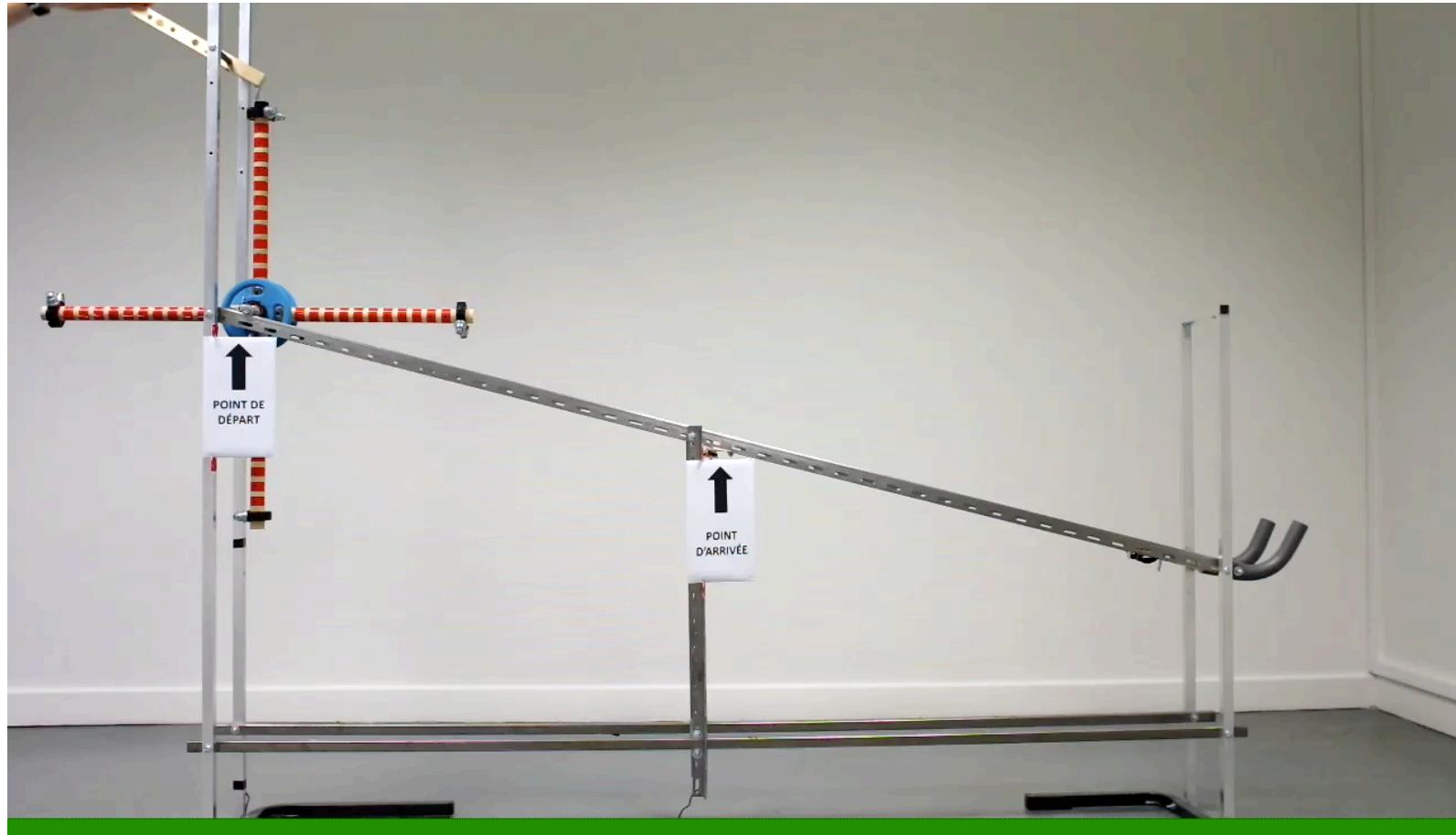
- Two key factors
  - Moment of inertia
  - Position of its centre of mass

Benefits:

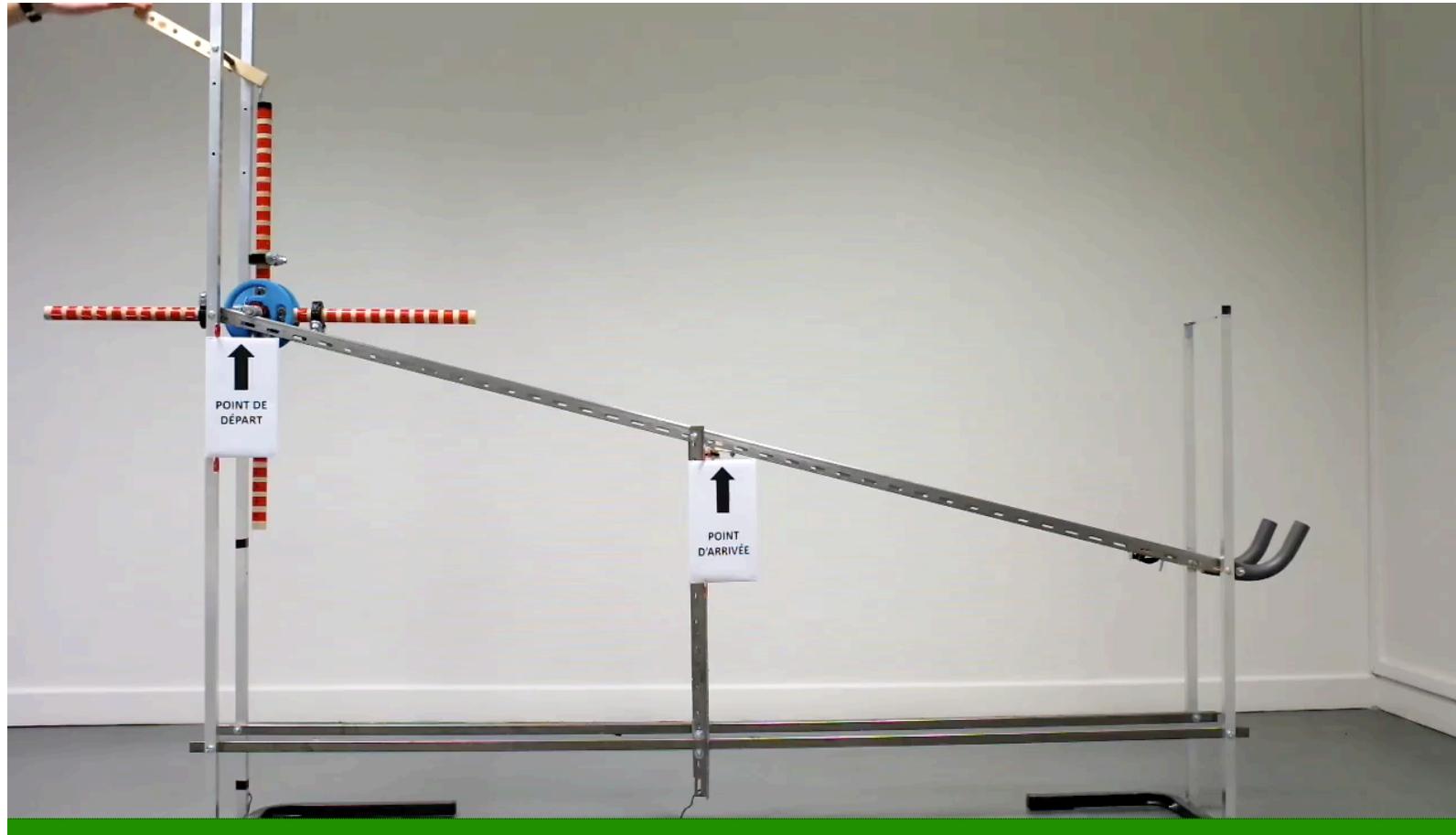
- Unfamiliar to participants
- Depends only on laws of physics, not arbitrary principles
- Low-dimensional



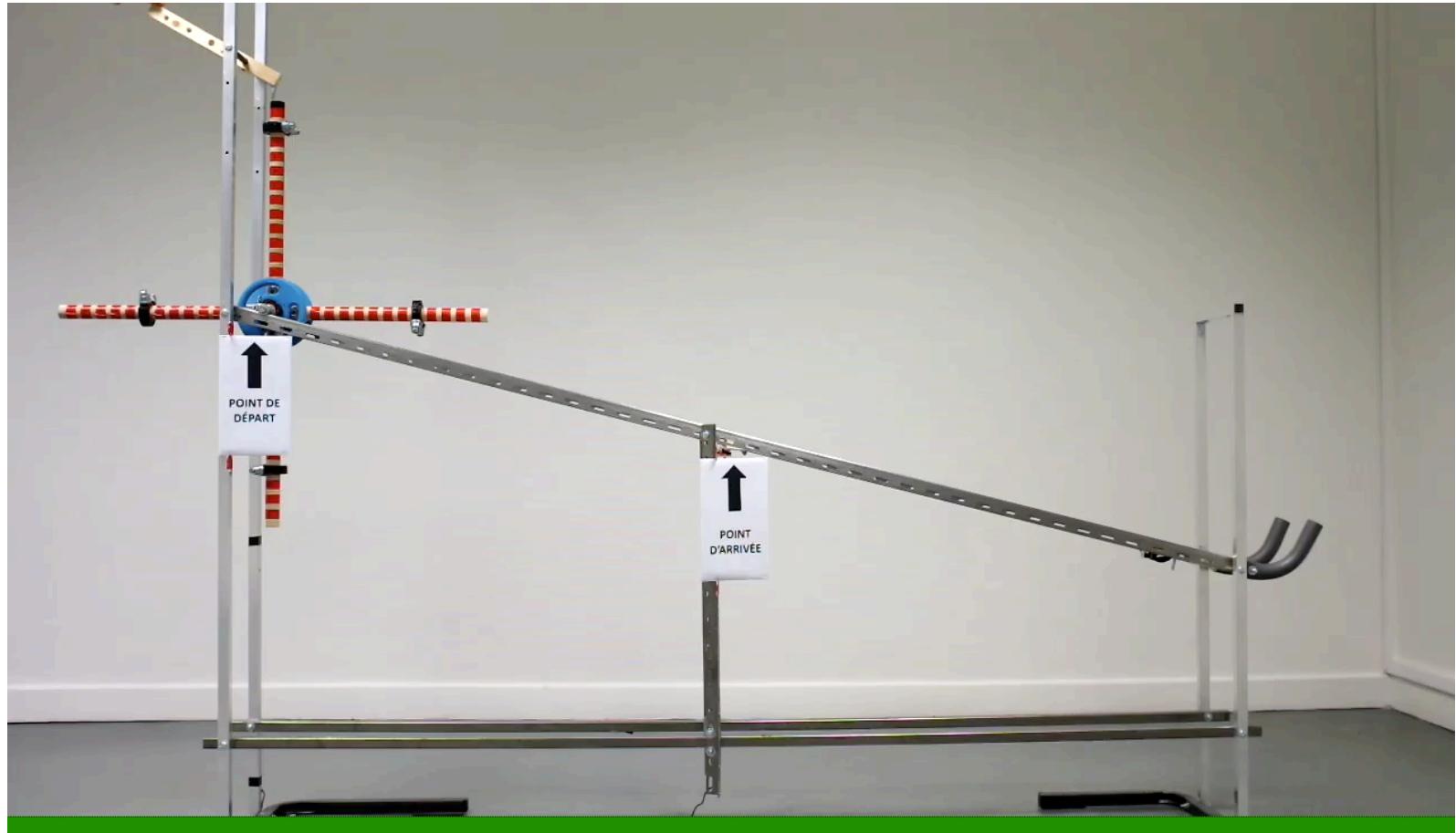
# Balanced wheel with a high moment of inertia



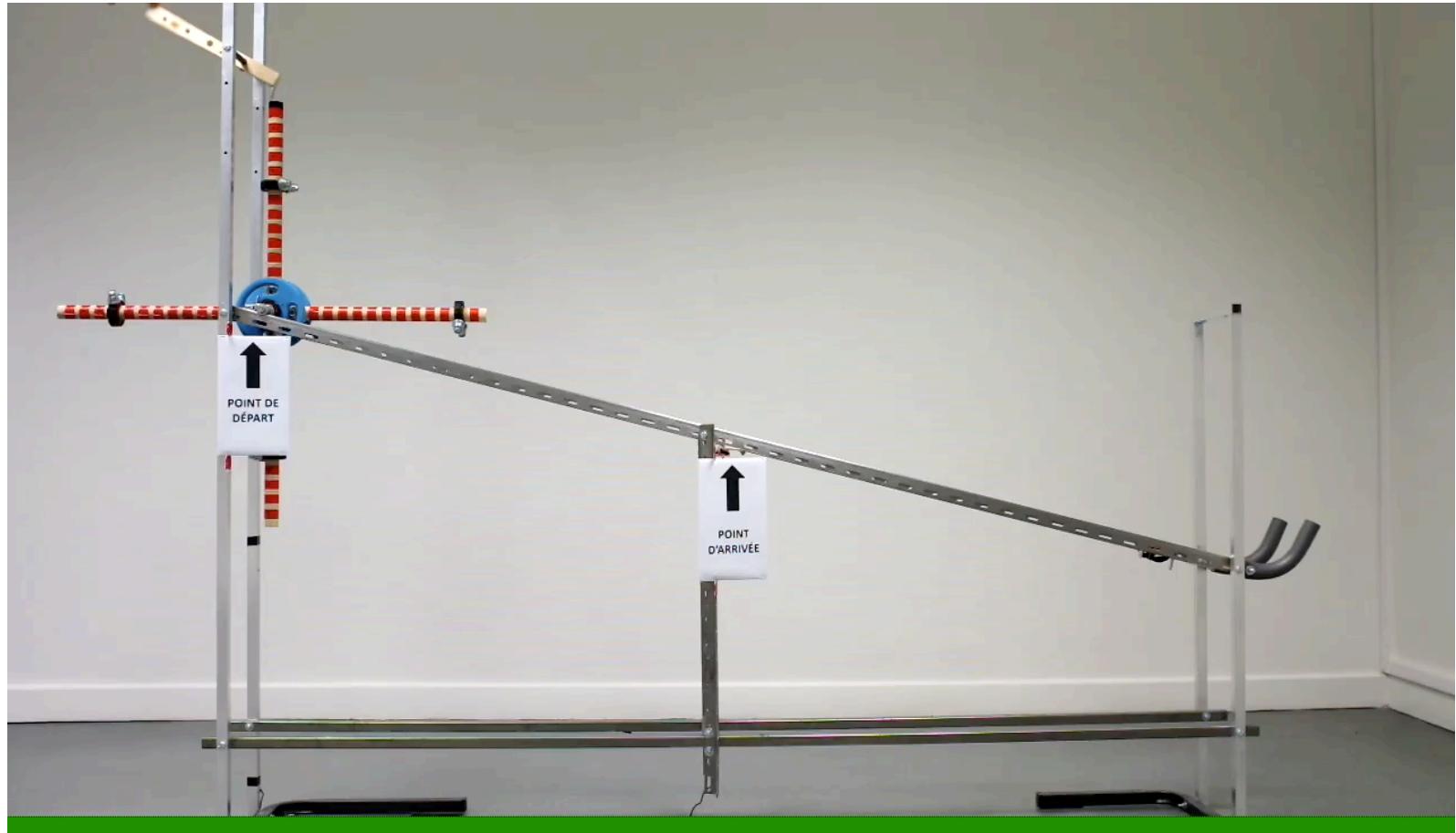
# Balanced wheel with a low moment of inertia



Movie of an unbalanced wheel with its centre of mass on the upper right side of the axis

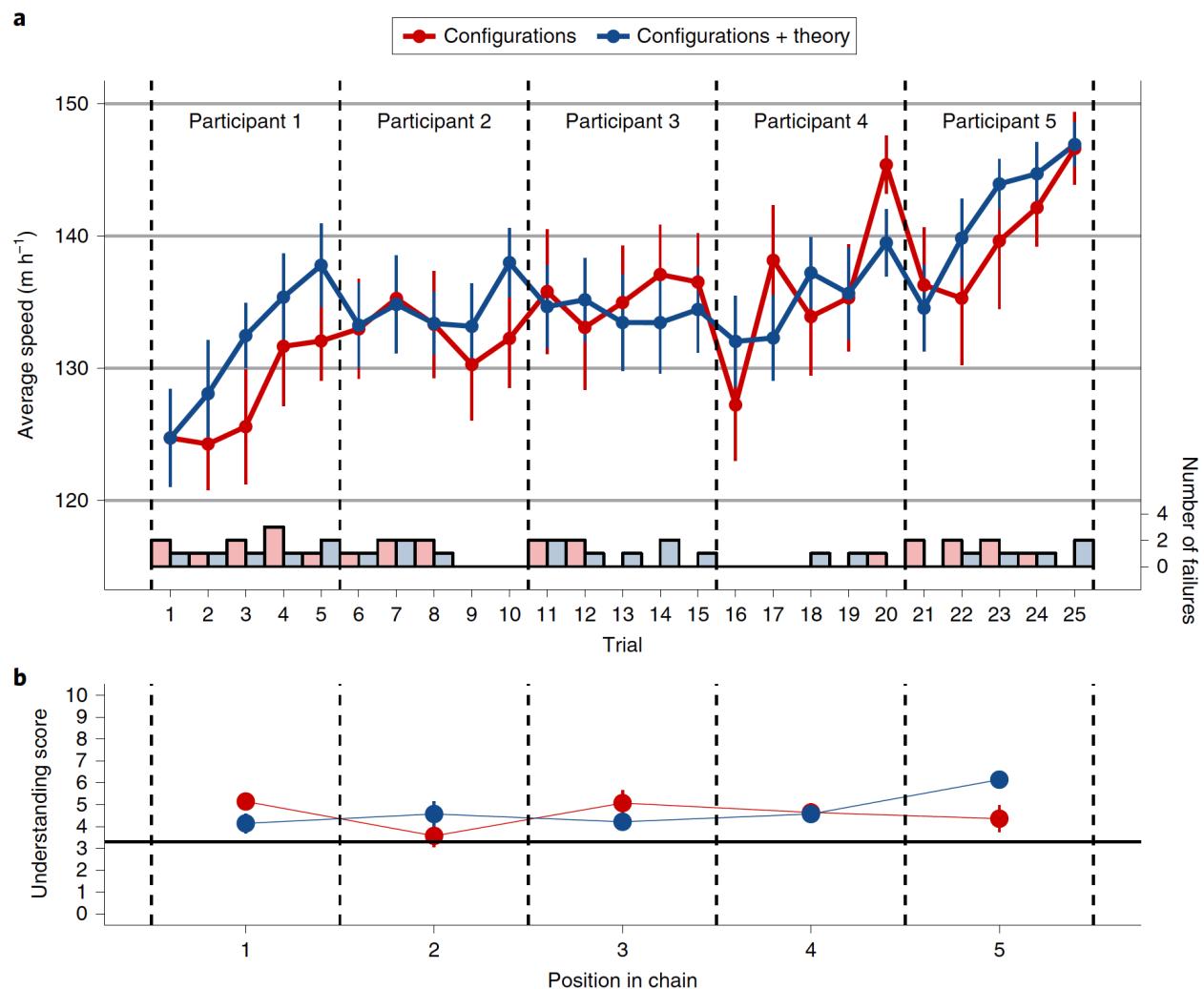


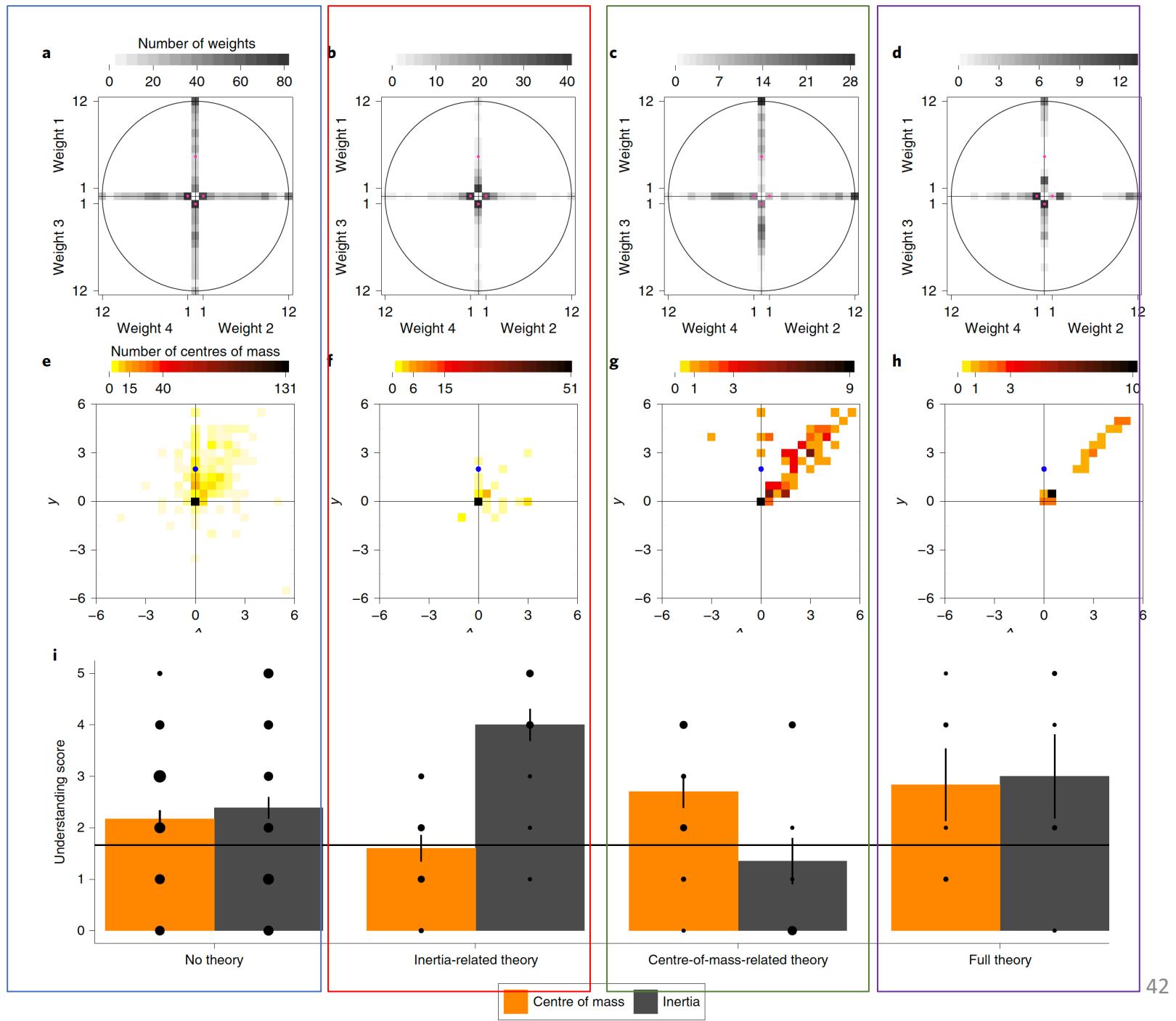
Movie of an unbalanced wheel with its centre of mass on the lower right side of the axis



# Results of the study

- 2 treatments (conditions):  
“Configuration”  
“Configuration + theory”
- Both result in cumulative improvements in the task / speed
- Neither result in improved “causal understanding” of the task
- Follow-up analysis:



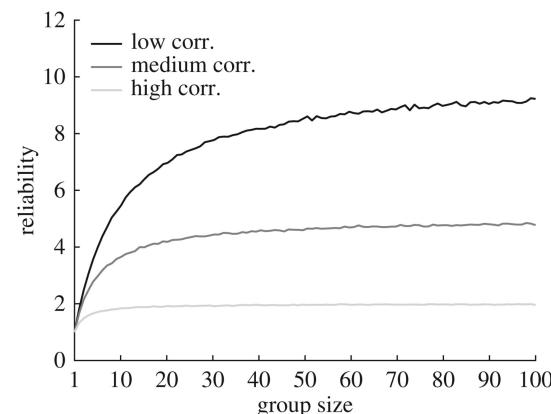
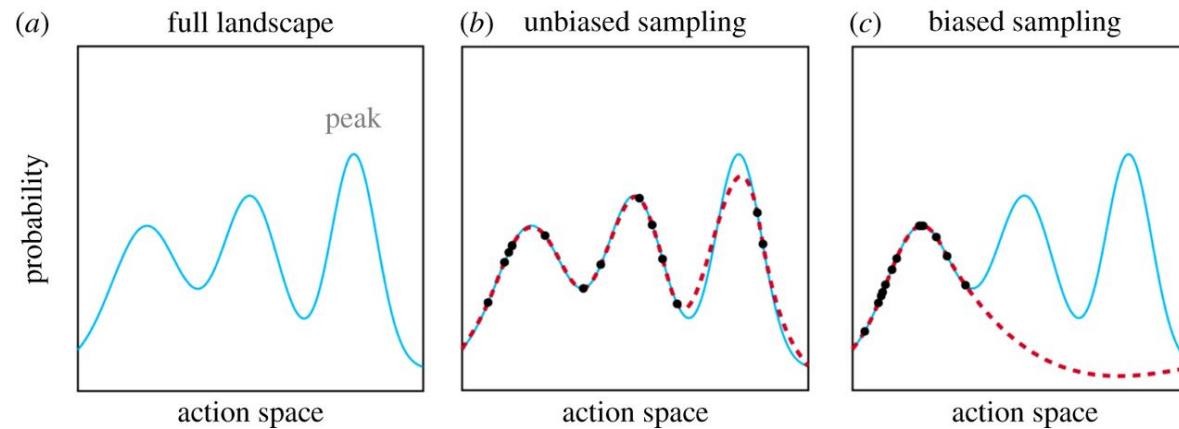


# Summing up

- As per the title, understanding the causal relationships between elements or the underlying theory **is not necessary** in order to cumulatively improve technology across ‘generations’
- Inheriting the “causal understanding” of the previous generation may in some cases **restrict the exploration space** and limit innovation, rather than facilitate understanding
- Despite this, inheriting a theory neither helps or impairs task performance on the wheel
  - Which may say something about the experimental task

# What's going on in the +theory condition?

## From Lecture 4



# Open questions

- How is ‘Understanding’ measured?
  - Is it a good and reliable way of assessing understanding?
  - The entire premise of the paper, from the title to the conclusion, rests on this questionnaire
- What’s baseline performance and is it a good task?
  - What if the same individual repeated all ‘generations’?
  - Is there simply a lower bound to how badly you can perform in this task, regardless of ‘theory’ manipulation?
  - We don’t know!
- Other questions

# Assignment: General feedback

- General level was very good!
  - On average, I was very pleased and impressed with the amount of effort put into the assignments
  - In fact, the average grade was very high
- The most common challenge or problem was the last question:
  - 5. What does it tell us (discussion)?
  - Not all went beyond the paper and discussed connection to broader context (or papers we've covered)



# Assignment: General feedback

- The structures of the assignments progressed well and elegantly! (nice ‘hour glass structure’ too)
  - (Perhaps also a result of the format)
- Carefully building your descriptions in a way that facilitates the naive reader’s ability to follow your writing / taking the reader by the hand is very important
- In a longer paper, it helps to introduce a section with, e.g.
  - *In the following this paper will firstly ...*
- And sum up a long sections or series of points using meta-text. e.g.
  - *Taken together, these results suggest that ...*

Readers (and most examiners) love the help from meta-text

# Assignment: General feedback

- Vast majority were good at using short and clear sentences, i.e. not long and overly complicated with "nice-sounding" words
  - But be consistent in your terminology and dont use new words for the same things
- If there is a requirement, such a **word limit** – stick to it!
- Also, no need to be overly stylistic. If you use a direct quote, just simply put it in quotation marks (and put page nr in reference. That's it!)
  - No new line, no italics, no indents, or the like
  - "And only use direct quotes if it doesn't make sense to just paraphrase" (Olsen, 2020: 48).

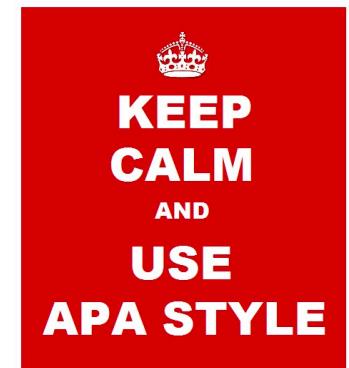
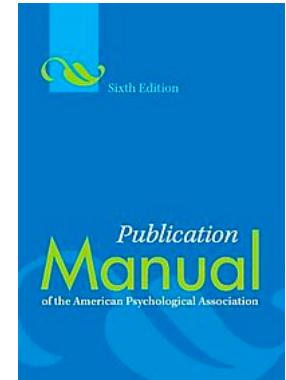
*Genius is the ability to reduce the complicated to the simple.*

~ C.W. Ceram



# Assignment: General feedback

- References: Quite a few used in-text references slightly wrong or – in the reference list – forgot to put the correct or whole reference
  - In-text: Goes before the period, and includes a comma before the year
  - If you wrote *et al.*, then there's also a period after *al*
  - If more than one, use a semi-colon
  - According to Olsen *et al.* (2019), ...
  - ... for the study (Olsen, 2018; Olsen *et al.*, 2019).
- For articles, only the *journal name* is in *italics*
  - Fx: Longden, K. D. (2016). Central brain circuitry for color-vision-modulated behaviors. *Current Biology*, 26(20), 981-988.
- For books, only the *book title* is in *italics*
  - Fx: Tomasello, M. (2009). *The cultural origins of human cognition*. Harvard university press



# Assignment: General feedback

- Apart from these details, the texts were well-written, the content was spot on for the most part, you made clear points, and presented your understanding very well!
- Questions?



# Last time on “Reviewing a journal article”

- The Review is a **critical reading of the manuscript** and include **constructive recommendation** (suggestions, requirements) for how to improve it before publication
- It can target all components:
  - *The conceptual framing*
  - *Terminology*
  - *The literature review*
  - *The materials and methods*
  - *Results*
  - *Discussion*
  - *References*
  - *Figures and tables*
  - *Suppl information* (appendix)
- Your lecturerers and scientists generally are thus used to very critical (sometimes brutal) feedback on their precious work
  - The trick is to know that "**it's just work**" and has nothing to do with you personally



# Peer feedback task

- You are given **2** other assignments from this dropbox folder:  
<https://www.dropbox.com/sh/fkofwf91x45oayo/AAARsHtOpGReakC80W7SFo--a?dl=0>
- 1. Write short comments **on the positive parts** that you identify
- 2. Write or suggestions for **improvements** (simplifications, clarifications, inconsistencies potential problems)
- *Throughout both reviews, be polite but constructive*
- The reviews are also **an opportunity** to see how all the others have approached their topic, **be efficient and use what has been learned** in your own exam paper
- **Disclaimers:** It's just an assignment = opportunity for learning

# Selection of other topics to review

- If your assignment is **about the same paper – or your own paper**, then *switch with someone else*
  - No need to say why!
- Read the selected papers in your browser (or download) - and write your review comments in a separate document (without your name)
- Make it clear which paper it's about in the title:
  - save it as “**Review of Fay et al #4**”

## Cog&Sem Peer Review

from Karsten Olsen (Playtrack) via [Dropbox Business](#)

Name

 Derex et al #1.docx

 Derex et al #2.docx

 Derex et al #3.pdf

 Fay et al #1.pdf

 Fay et al #2.docx

 Fay et al #3.docx

 Fay et al #4.docx

 Nölle et al #1.docx

The author presents an excellent overview of the Derex *et al.* (2019) paper. In particular, the writing is very clear and precise. One place of improvement, however, could be to shorten some of the sentences in the...

# Questions?