Modality effects in language evolution and language learning

Yasamin Motamedi

Experimental Psychology, University College London

Human language is inherently multimodal

Modality in language evolution…

- Which properties of language are modality-general and modality-specific?
- How does modality shape linguistic structure?

…and language learning

- How do different modalities contribute to learning?

Modality-general and modality-specific factors in the evolution of language

Simon Kirby

Kenny Smith

Marieke Schouwstra

Jennifer Culbertson

- Which properties of language are modality-general and modality-specific?
- How does modality shape linguistic structure?

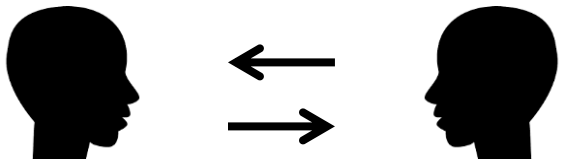
Language adapts…

- To new learners
  - Kirby, Cornish & Smith (2008); Kirby et al. (2015), Beckner et al. (2017); Carr et al. (2016); Silvey et al. (2014)

Language adapts…

- To new learners
  - Kirby, Cornish & Smith (2008); Kirby et al. (2015), Beckner et al. (2017); Carr et al. (2016); Silvey et al. (2014)

- To use in interaction
  - Garrod et al. (2007); Fay et al., (2010); Raviv et al. (2019); Nölle et al. (2018);

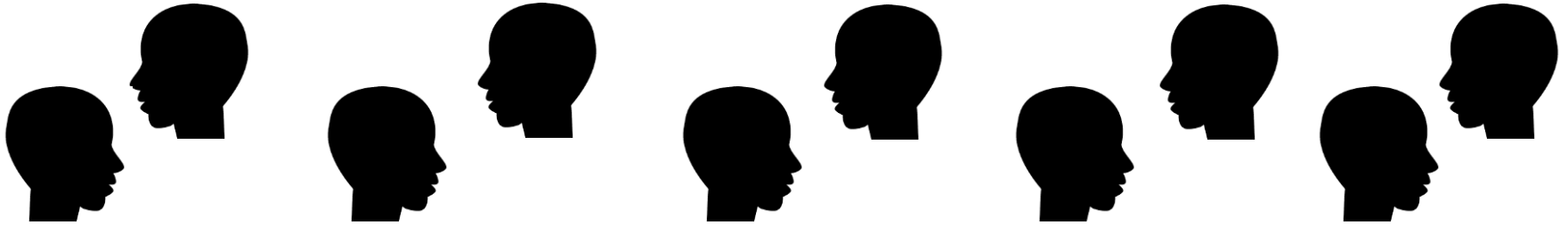


Study 1: how do transmission and interaction contribute to the emergence of linguistic structure in a manual communication system?

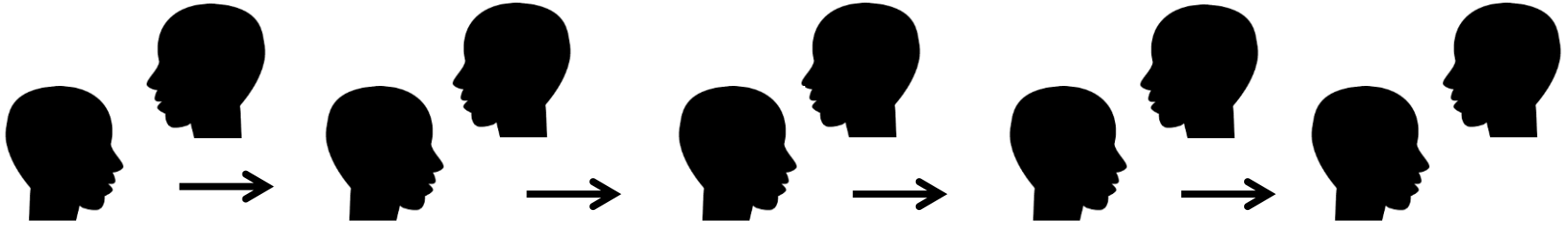
Motamedi, Y., Schouwstra, M., Smith, K., Culbertson, J., & Kirby, S. (2019). *Cognition*, *192*, 103964. https://doi.org/10.1016/j.cognition.2019.05.001

Transmission only

Interaction only



Transmission + Interaction



Thematic dimension	Functional dimension: person	location	object	action
food	chef	restaurant	frying pan	to cook
religion	vicar	church	bible	to preach
photography	photographer	darkroom	camera	to take a photo
music	singer	concert hall	microphone	to sing
hair styling	hairdresser	hair salon	scissors	to give a haircut
law enforcement	police officer	prison	handcuffs	to make an arrest

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Functional dimension

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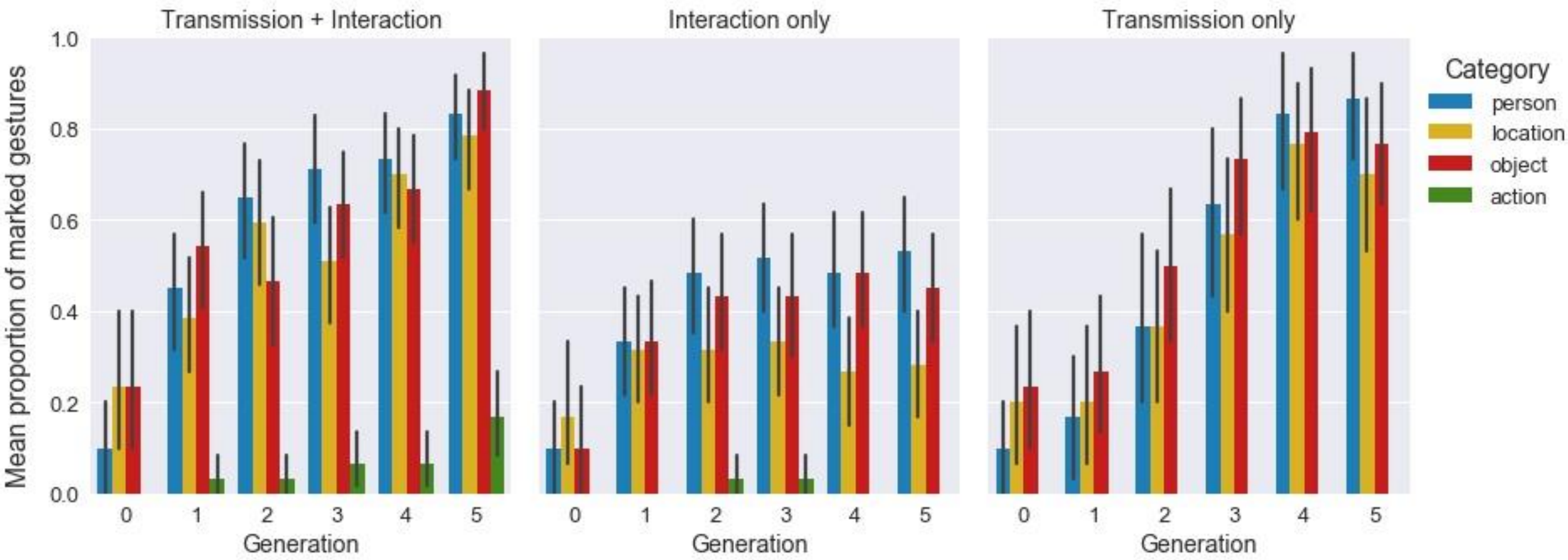
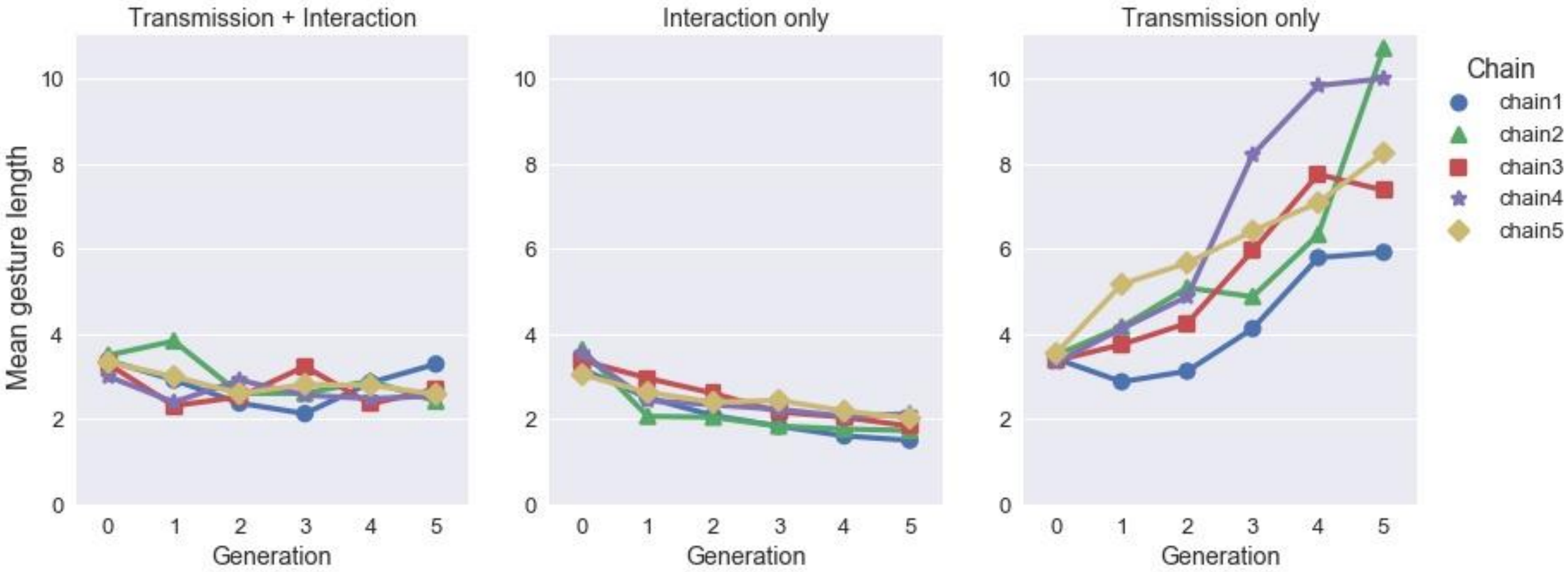
Transmission leads to a cumulative increase in systematic structure

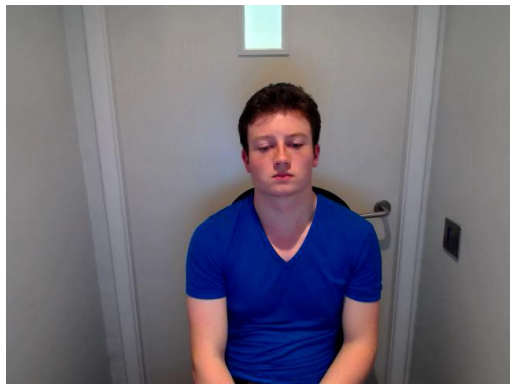


Interaction applies a pressure for communicatively efficient signals



Transmission only

Generation 1



church

Generation 5

church

prison

Interaction only

Generation 1

church

Generation 5

church

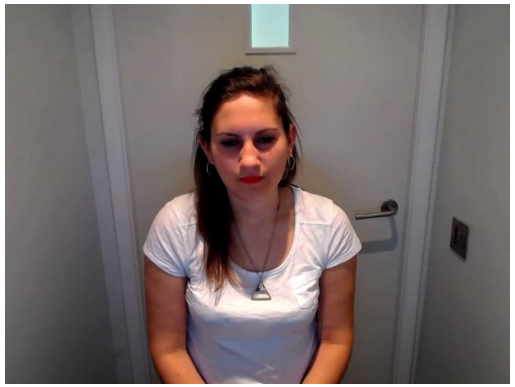
prison

Transmission + Interaction

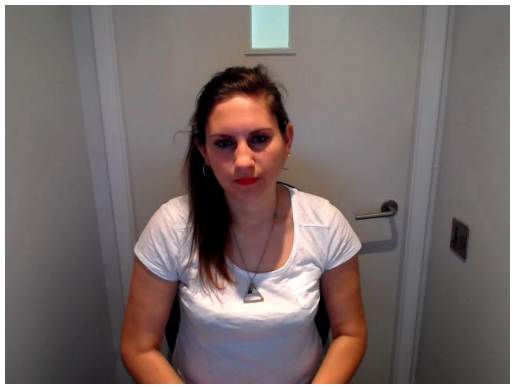
Generation 1

church

Generation 5



church



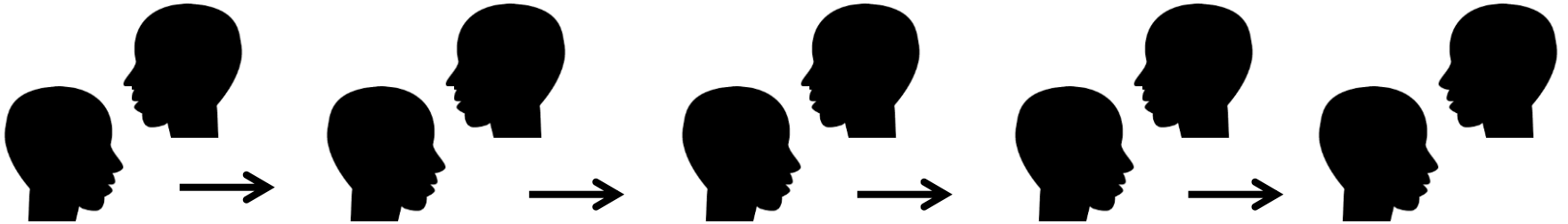
prison

- Transmission to new learners leads to increase in systematic structure
- Interaction between language users leads to communicatively efficient signals
- Both mechanisms combined demonstrate a trade-off between pressures
- Underscore adaptations to learning and interaction as modality-general adaptations

Study 2: how do constraints/affordances of the modality affect the emergence of systematic structure?

Motamedi, Y., Schouwstra, M., Smith, K., Culbertson, J., & Kirby, S. (in prep.) Pre-print at https://doi.org/10.31234/osf.io/p6zy4.

Transmission
+ Interaction



Grammatical space in sign languages

https://www.signbsl.com/sign/ask

Grammatical space in sign languages

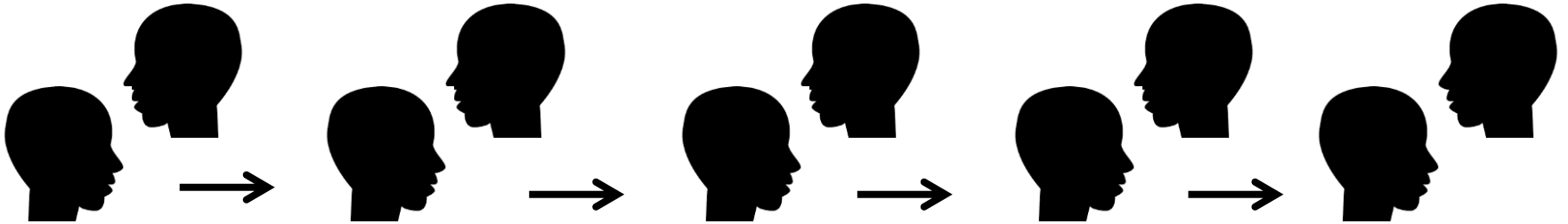
Kocab, A., Pyers, J., & Senghas, A. (2015). https://doi.org/10.3389/fpsyg.2014.01540

Grammatical space in sign languages

- Spatial modulation and role shift
  - Prevalent in sign languages cross linguistically
  - Modality-specific
  - Highly iconic
    - Iconicity resists systematisation (e.g. Verhoef et al., 2015; Roberts et al., 2015)
  - Gradual systematisation in emerging sign languages

    (Padden et al., 2010; Montemurro et al., 2019)

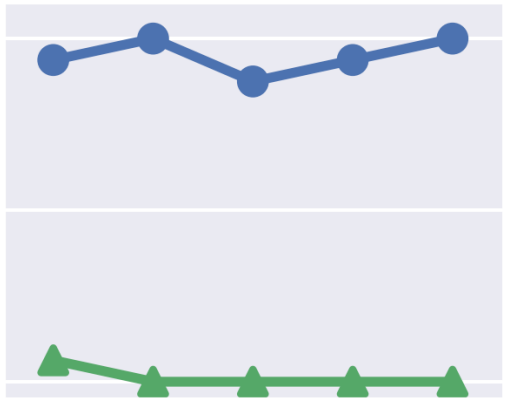
Transmission
+ Interaction



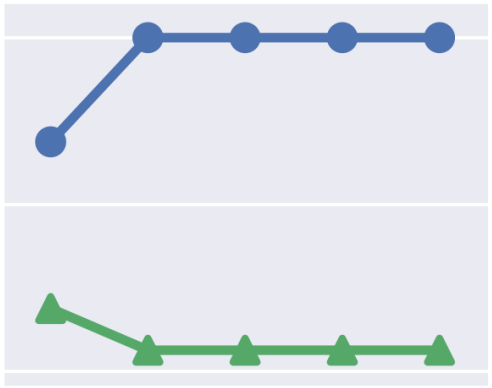
Different agent	Same agent
Hannah is throwing a hat to Sarah Sarah is kicking a ball to Hannah	Sarah is throwing a hat to Hannah Sarah is kicking a ball to Hannah

Hannah is throwing a hat to Sarah
Sarah is kicking a ball to Hannah

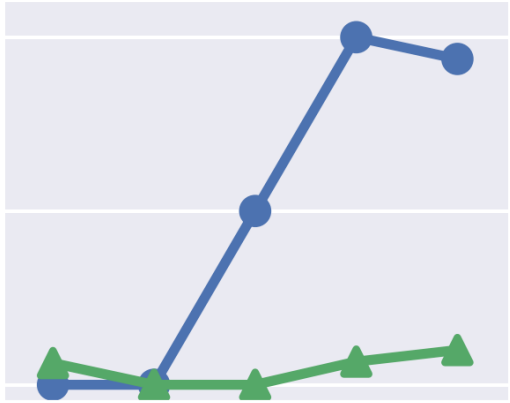
Lexical



Body shift



Spatial modulation



- Participants use a range of strategies, some of which are based in the affordances of the manual-visual modality
  - Reflect structures found in natural sign languages

- All strategies (even modality-specific) are subject to the same modality-general constraints at work to shape language
  - Different strategies might evolve at different rates (or in different ways)

Multimodality in child-directed language

Where is the tractor?

Where is your tiger?

Language is multimodal…

…and non-arbitrary

Study 3: how are multimodal forms distributed in child-directed language?

Vigliocco, G., Motamedi, Y., Murgiano, M., Wonnacott, E., Marshall, C. R., Milan Maillo, I., & Perniss, P. (2019). Onomatopoeias, gestures, actions and words in the input to children. https://doi.org/10.31234/osf.io/v263k

Gabriella Vigliocco

Pamela Perniss

Margherita Murgiano

Iris Milan Maillo

Liz Wonnacott

Chloe Marshall

Semi-naturalistic interaction between parents and children

- Parent-child dyads, filmed in their homes in London
- Children aged 24 – 48 months
- Play sessions
  - 4 sets of toys – food, animals, musical instruments, tools
  - 2 manipulations

2 manipulations:

2 manipulations:

Context

Toy present

Toy absent

2 manipulations:

Context

Toy present

Toy absent

Label familiarity

known

unknown

Onomatopoeia

Representational gestures

Pointing

Hand actions

iconic cues

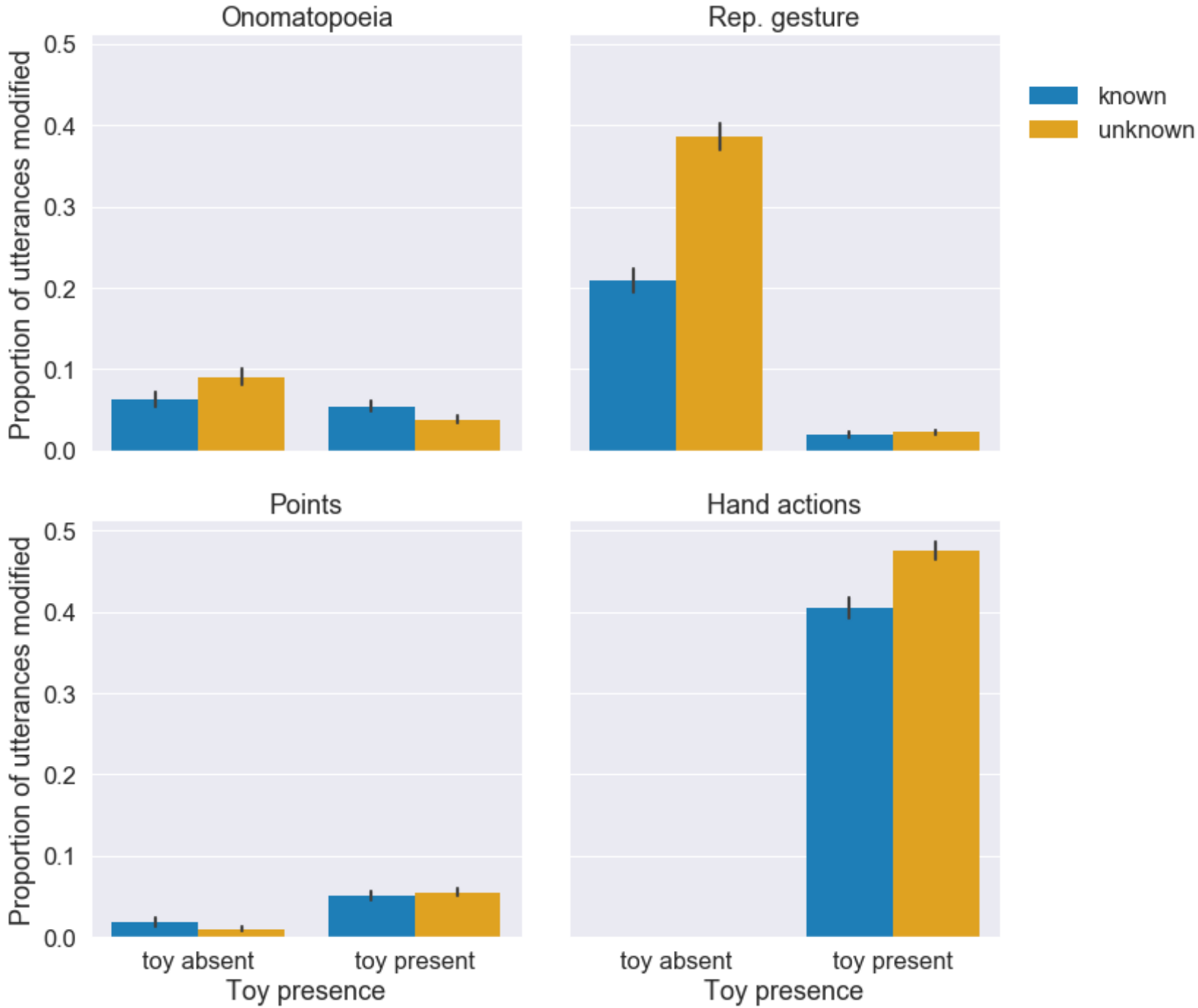
indexical cues

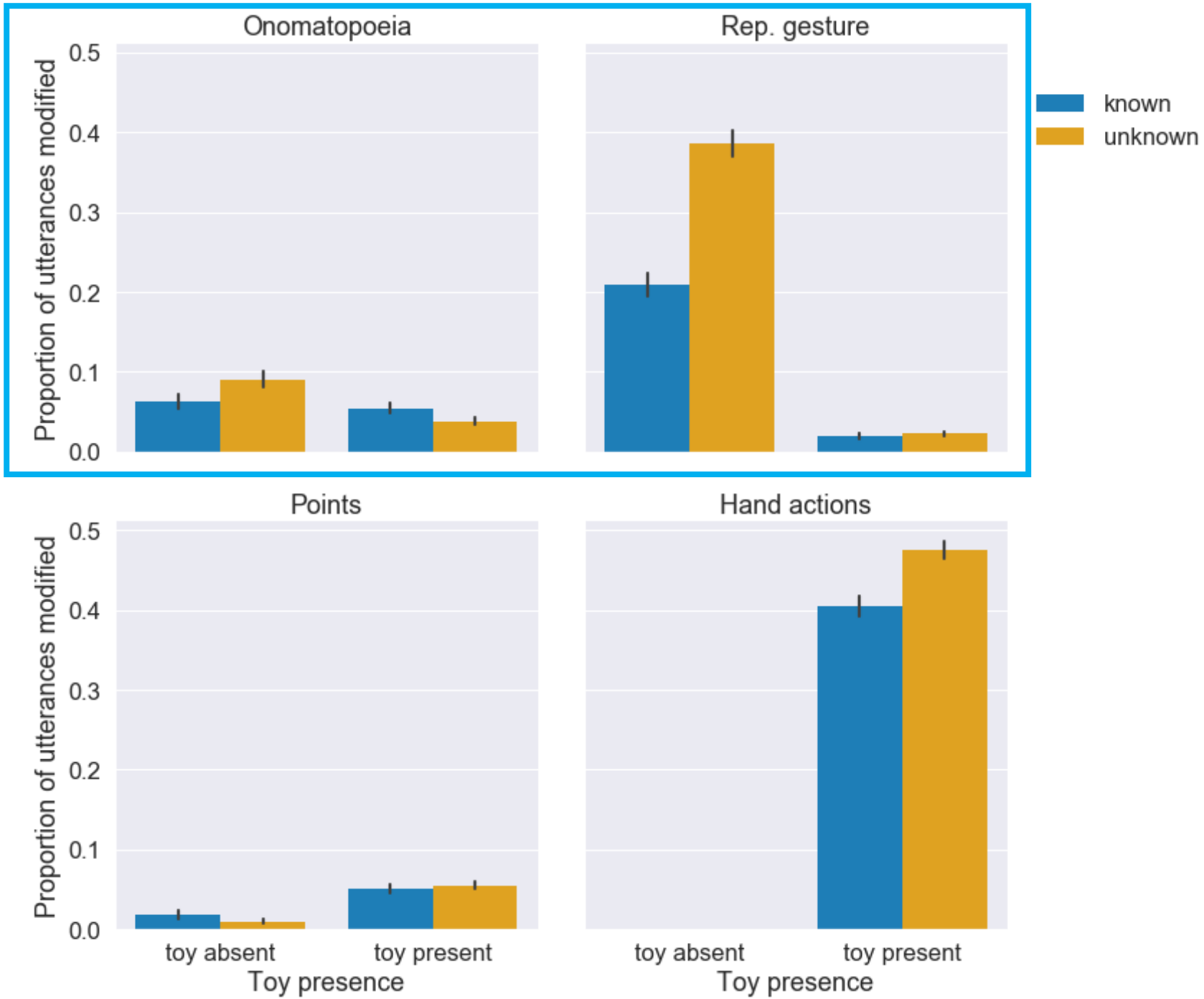
Onomatopoeia

Representational gestures

Pointing

Hand actions


Onomatopoeia
Rep. gesture
Points
Hand actions
Proportion of utterances modified
0.0
0.1
0.2
0.3
0.4
0.5
known
unknown
toy absent
toy present
Toy presence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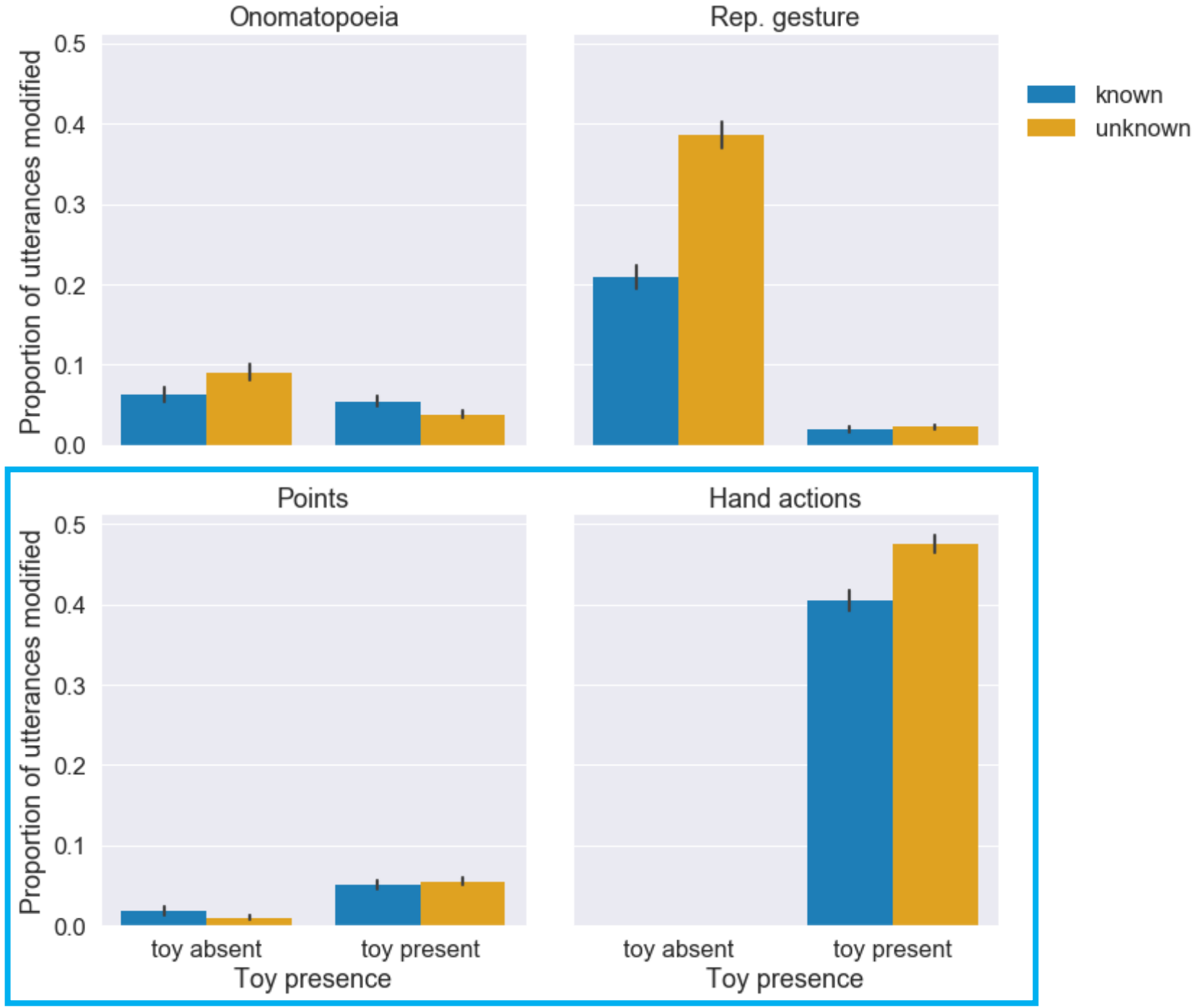
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- Caregivers use a range of multimodal cues when interacting with their children

- Caregivers use different cues in ways that may facilitate learning
  - iconic cues more common when referents absent
  - indexical cues common when referents present (rely on physical/visual connection)
  - cues more frequent when the referent is unknown to the child

- **Next steps:** do children learn from multimodal iconic cues?

To sum up…

- Language is multimodal
  - A rich and dynamic system
  - Arbitrary and non-arbitrary ways of conveying meaning
- Accounting for language as multimodal has important implications for language evolution and language acquisition
- Building multimodality into experimental models allows us to test for modality-general mechanisms and understand modality-specific effects

Thank You