

Modality effects in language evolution and language learning

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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

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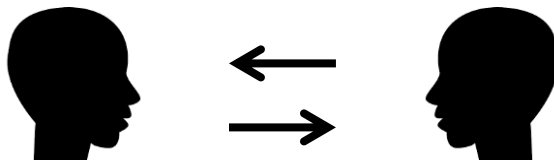
Language adapts...

- 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);



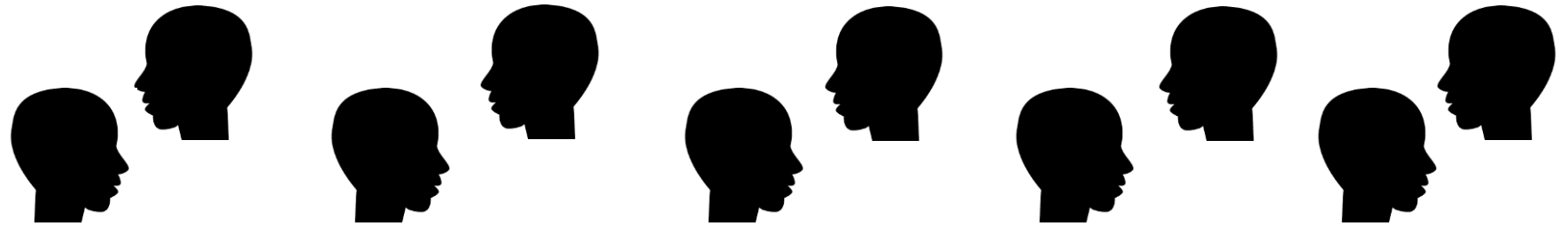
Study 1: how do transmission and interaction contribute to the emergence of linguistic structure in a manual communication system?

Motamedi, Y., Schouwstra, M., Smith, K., Culbertson, J., & Kirby, S. (2019). *Cognition*, 192, 103964.

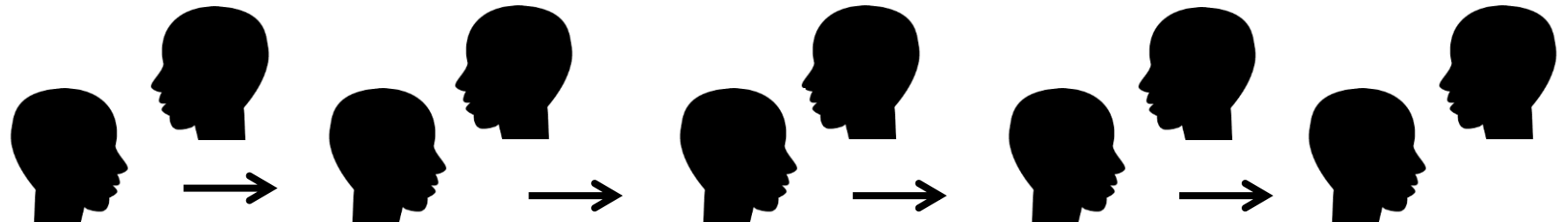
Transmission
only



Interaction
only



Transmission
+ Interaction



		Functional dimension			
		person	location	object	action
Thematic dimension	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

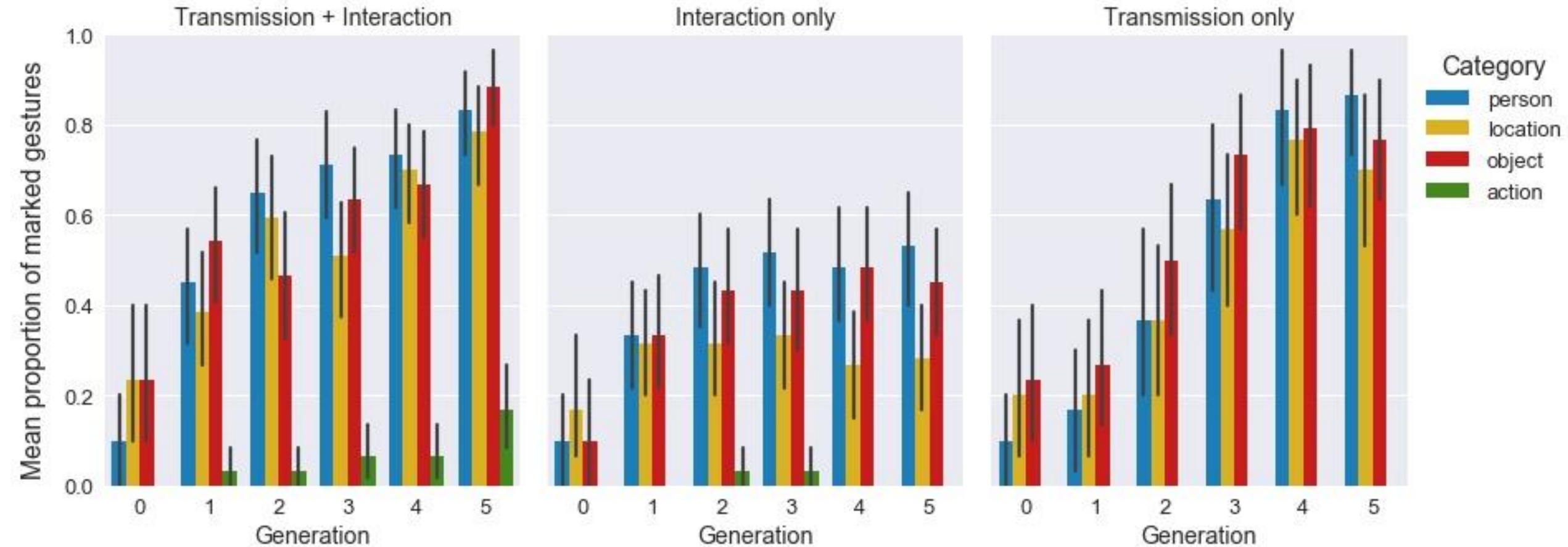
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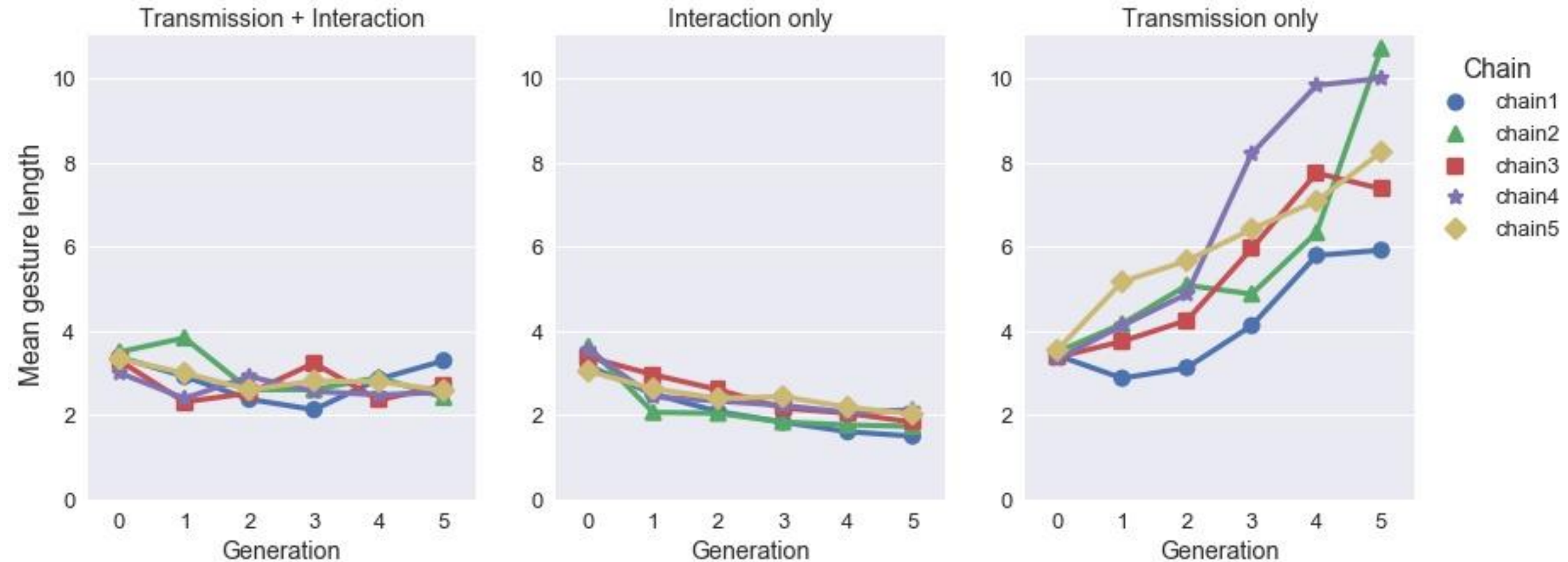
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Transmission leads to a cumulative increase in systematic structure



Interaction applies a pressure for communicatively efficient signals



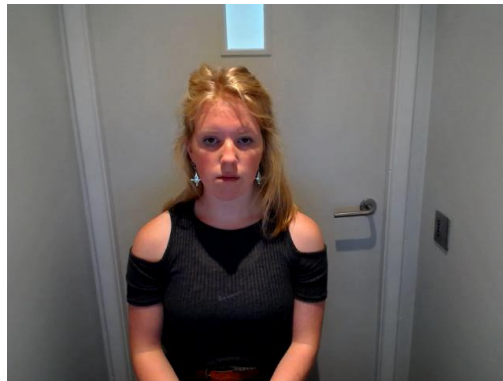
Transmission only

Generation 1



church

Generation 5



church



prison

Interaction only

Generation 1

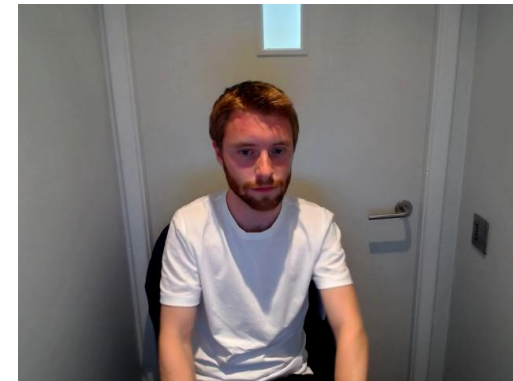


church

Generation 5



church



prison

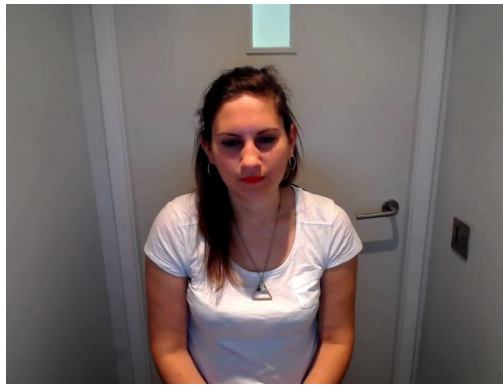
Transmission + Interaction

Generation 1

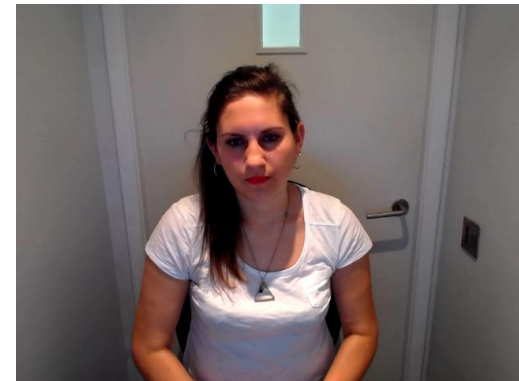


church

Generation 5



church



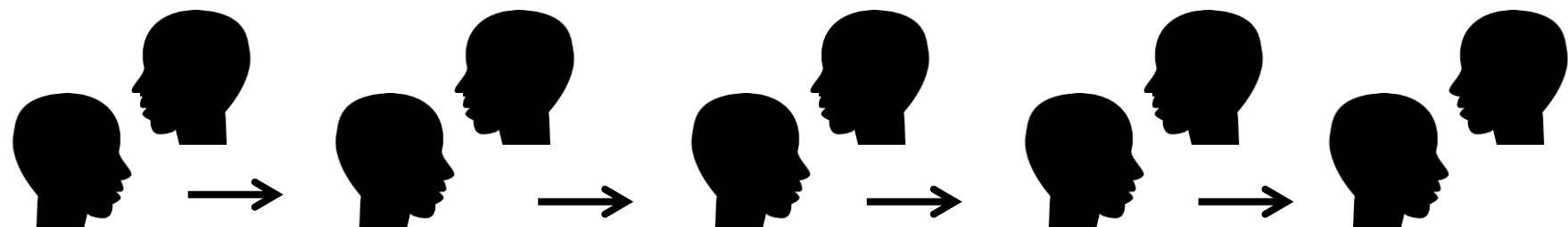
prison

- 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

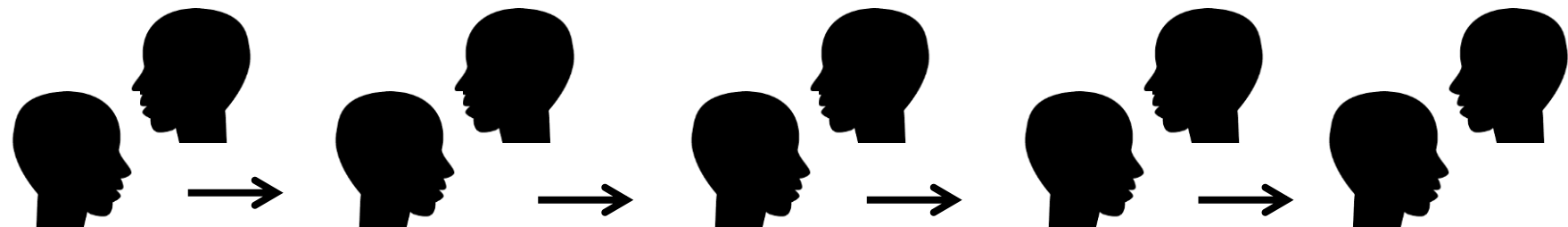


Kocab, A., Pyers, J., & Senghas, A. (2015).
<https://doi.org/10.3389/fpsyg.2014.01540>

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

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

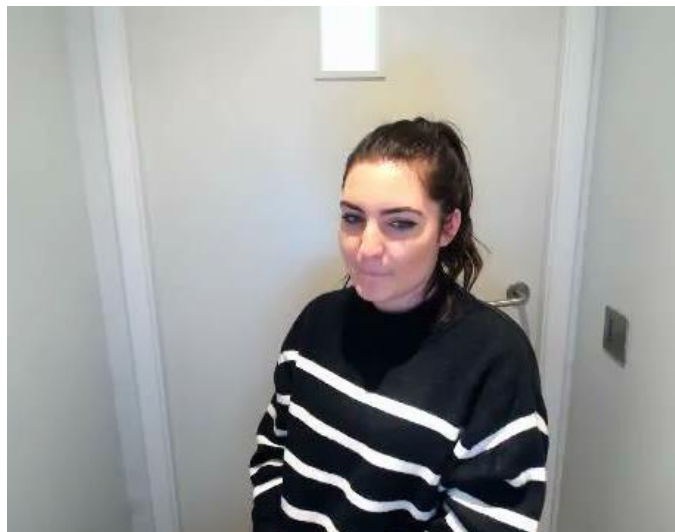
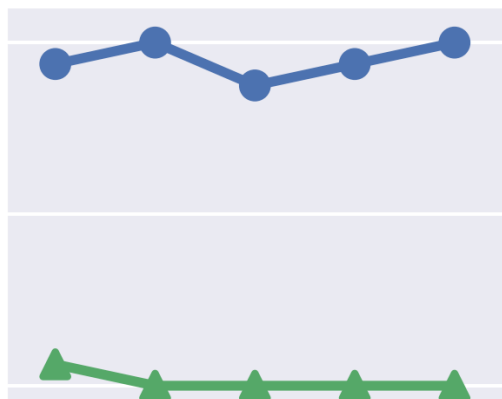
Same agent

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Sarah is kicking a ball to Hannah

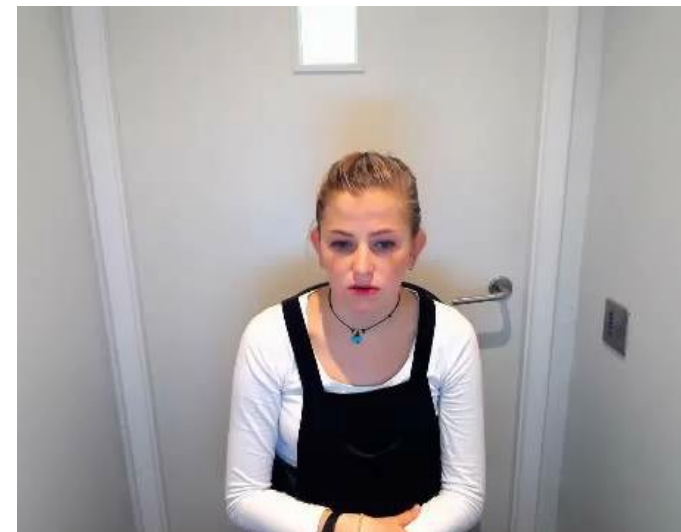
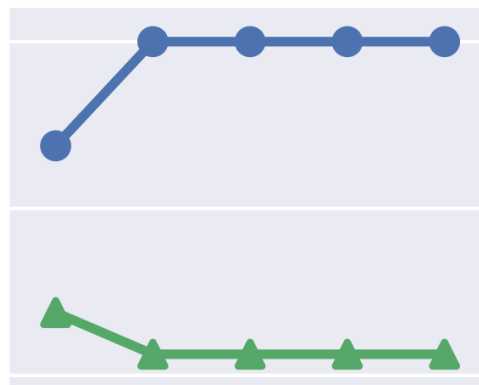
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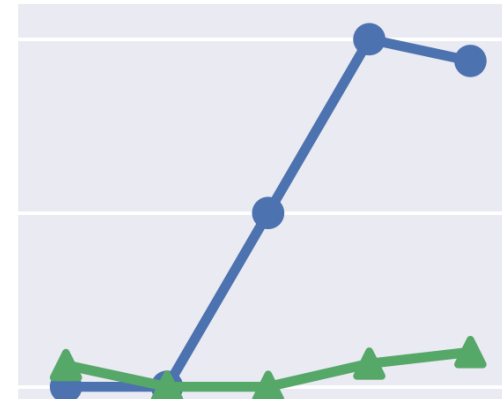
Lexical



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.



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

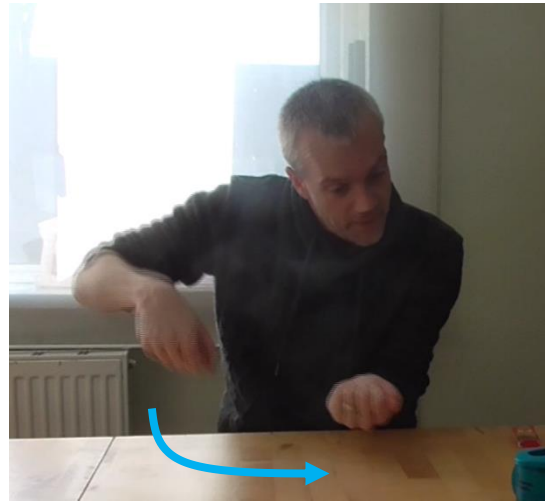


unknown





Onomatopoeia



Representational
gestures



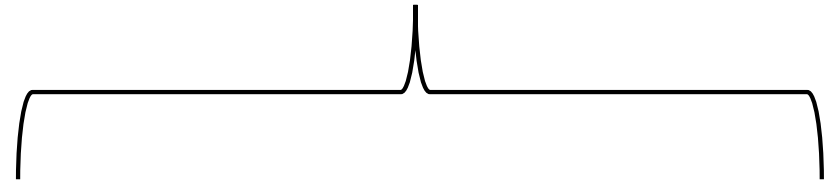
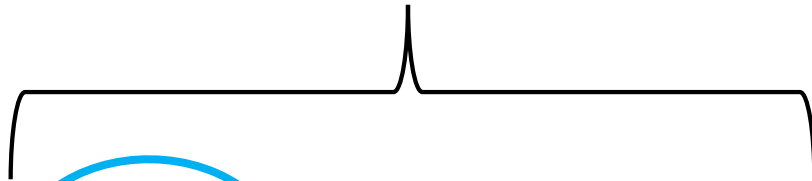
Pointing



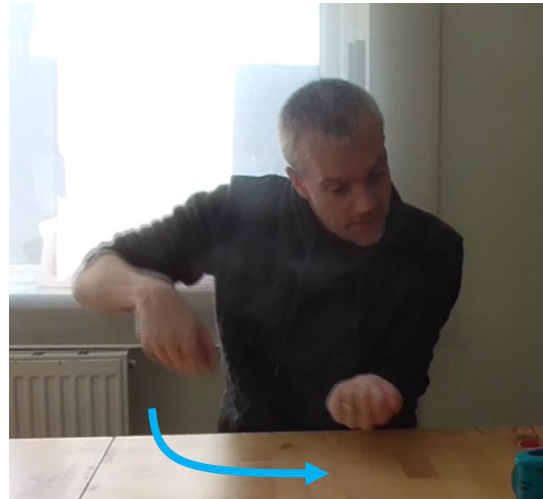
Hand actions

iconic cues

indexical cues



woof
woof

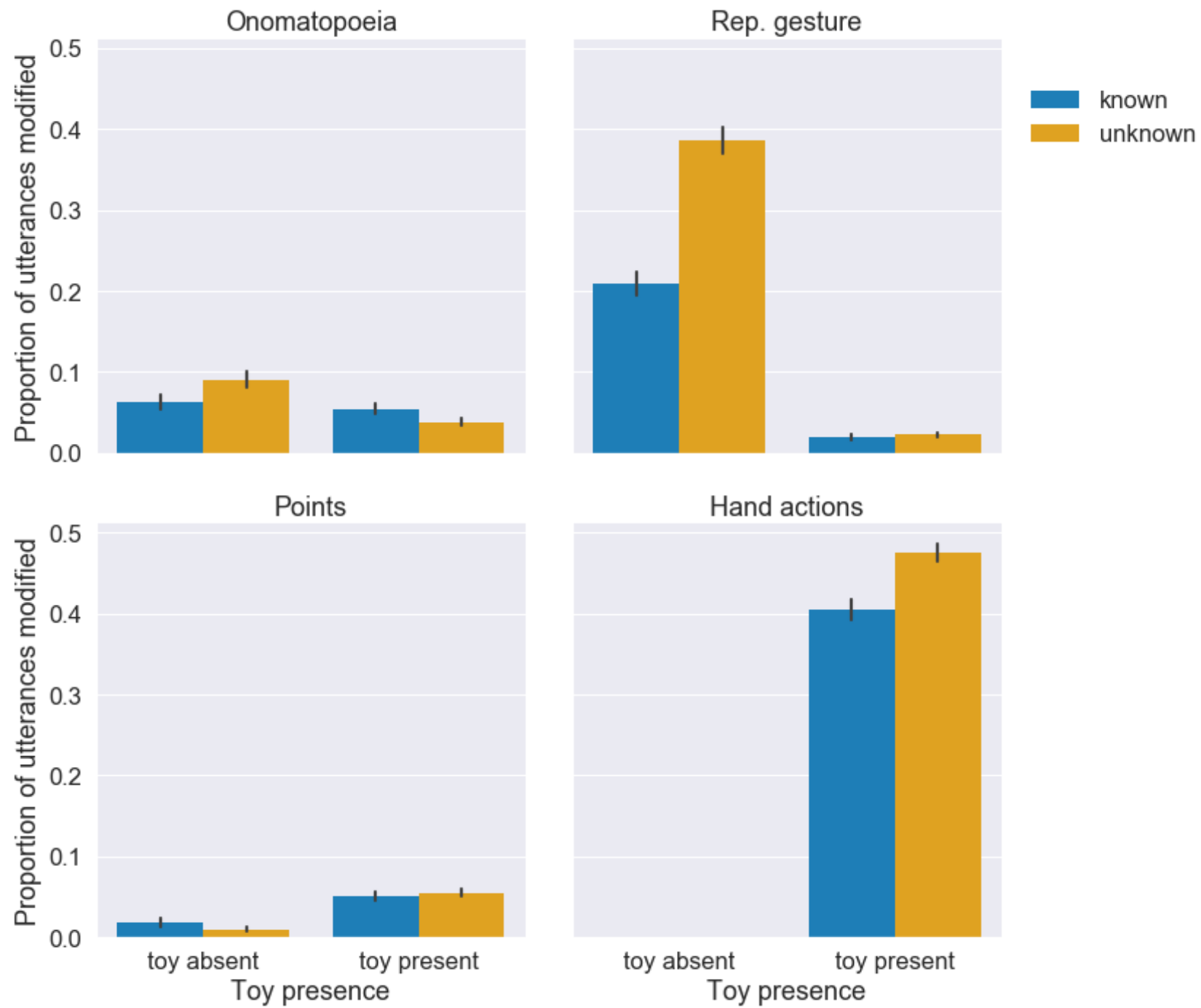


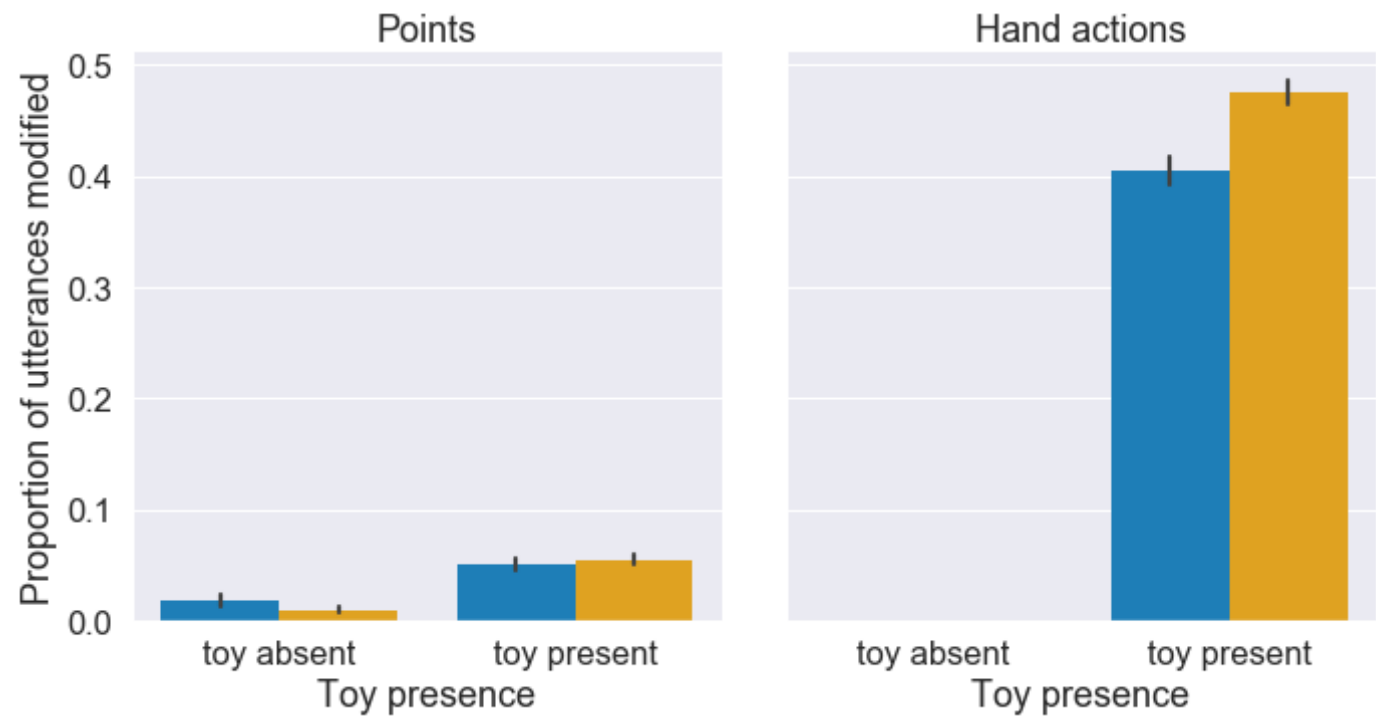
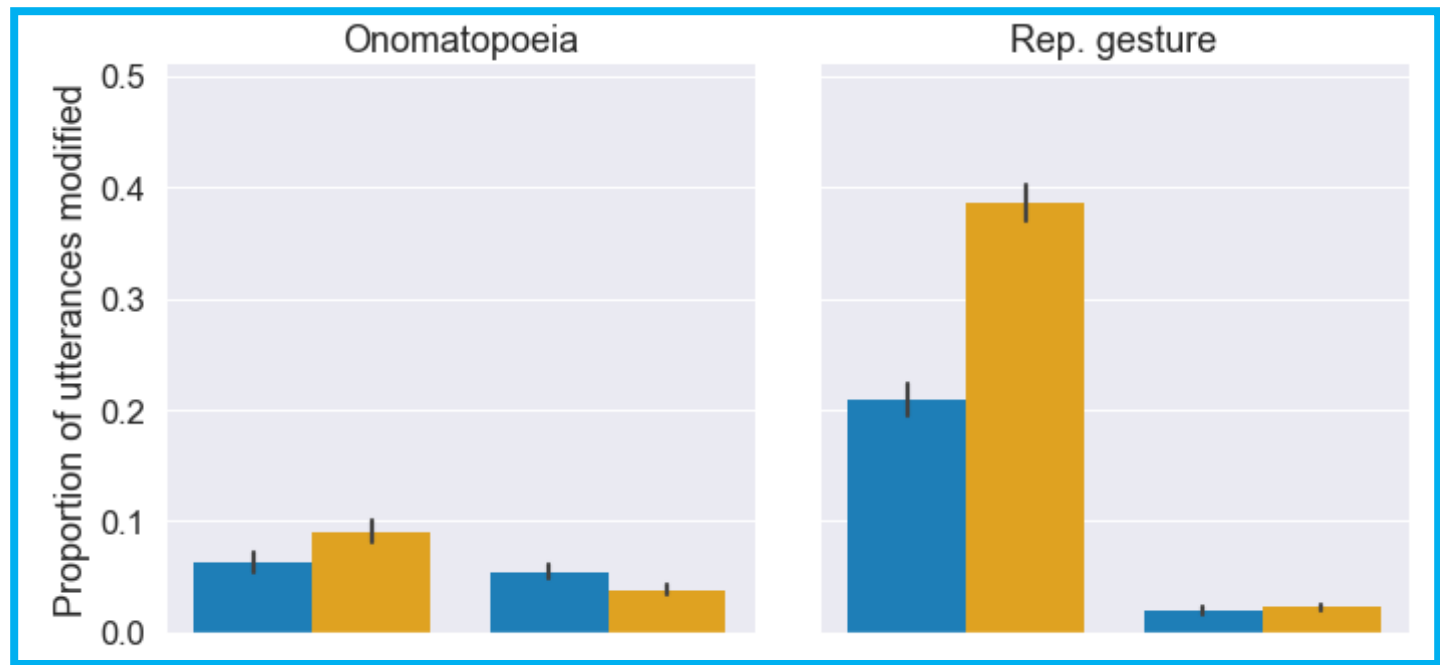
Onomatopoeia

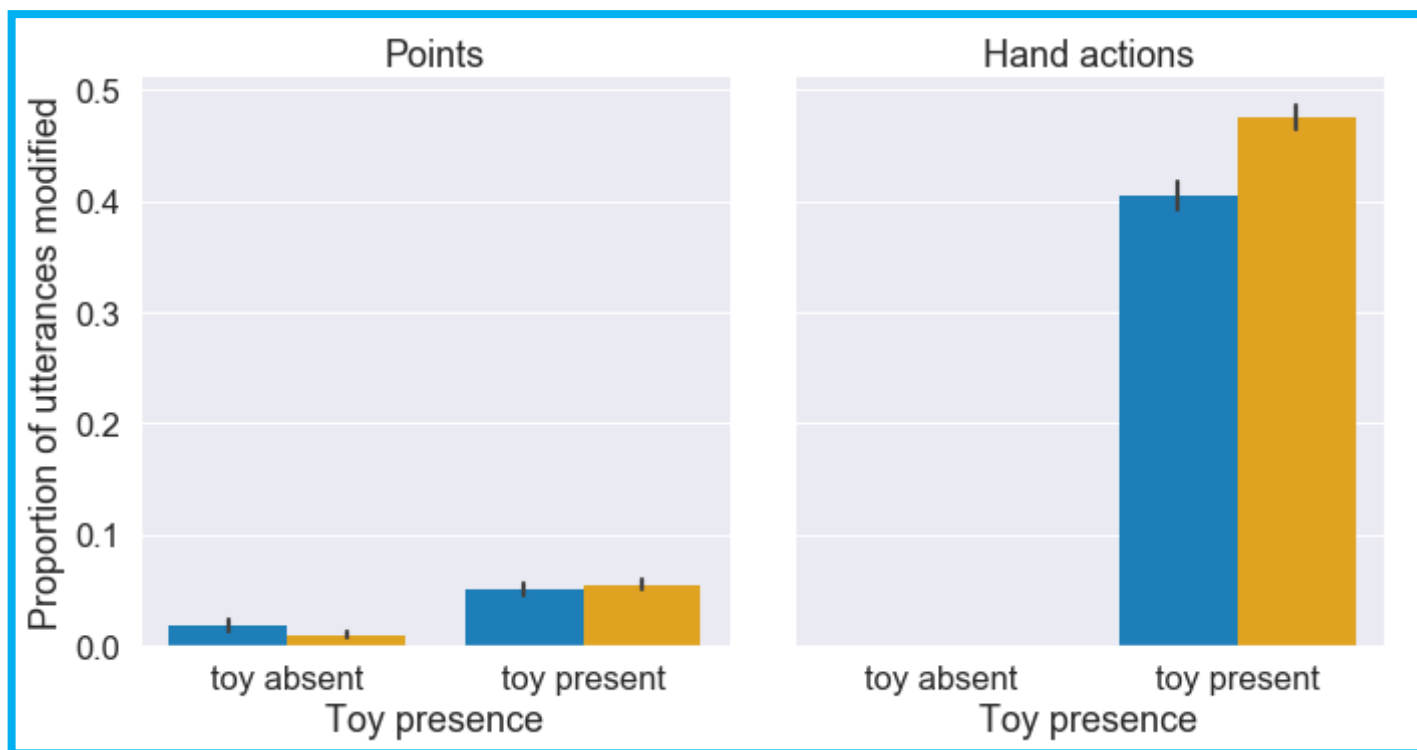
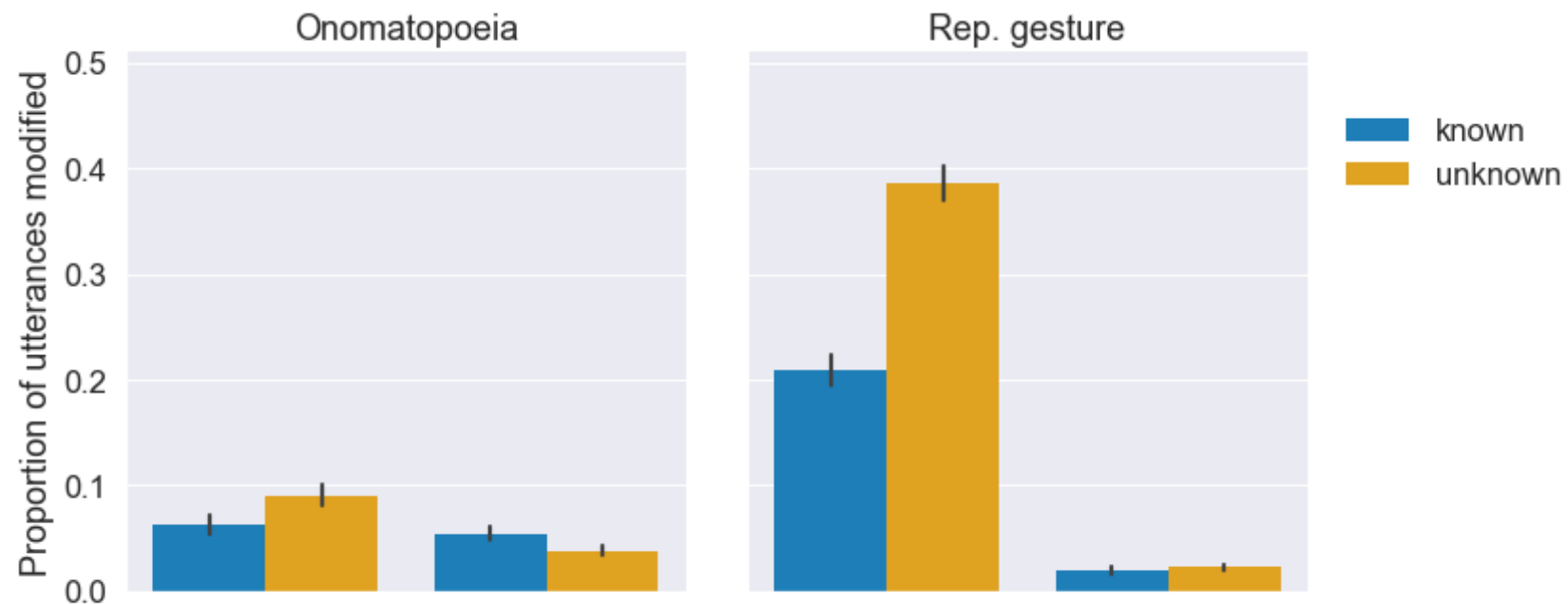
Representational
gestures

Pointing

Hand actions







- 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