Linking Language Development and Language Transmission

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Overview

1. Studying Language Evolution in the Lab:
   Overview and Demonstration

   Iterated learning: What's different in children?

2. Negotiating Meaning:
   Communicative Constraints in Children and Adults

   Can children invent a novel communication system?

3. Transmitting Symbolic Signals:
   Learnability Constraints in Children and Adults

   Who are the agents of language change?

4. Accommodating the Learner:
   The Role of Teaching in Language Transmission

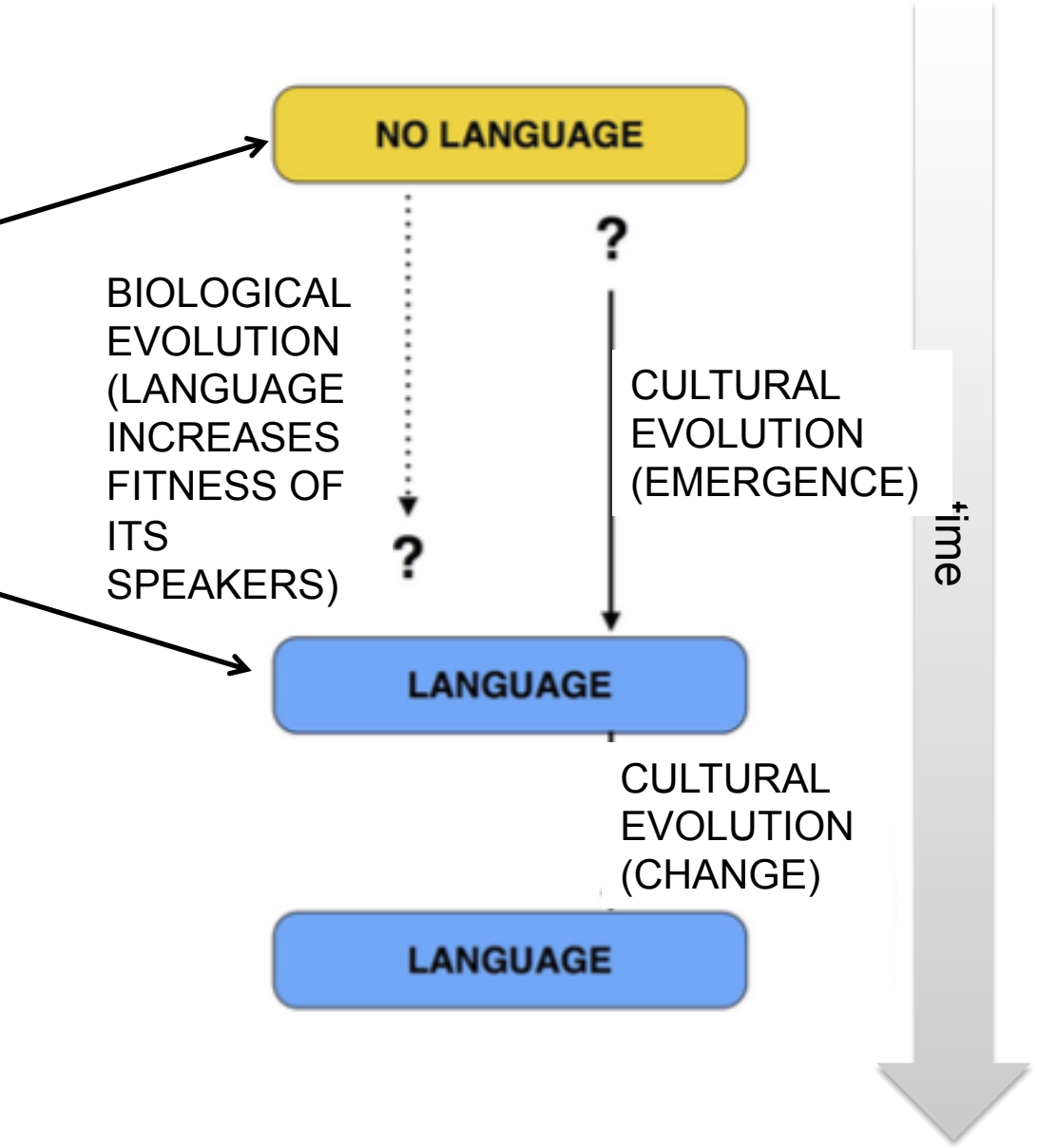
   How do experts transmit linguistic knowledge?

Last Time…

- Reproduction is biased in favour of more compressibility/structure.
- Iterated reproduction amplifies these (often weak) biases .
- As structure increases learnability increases too.
- Children may have fewer / simpler biases but may sample more broadly from them.

How did we get from here

to here?



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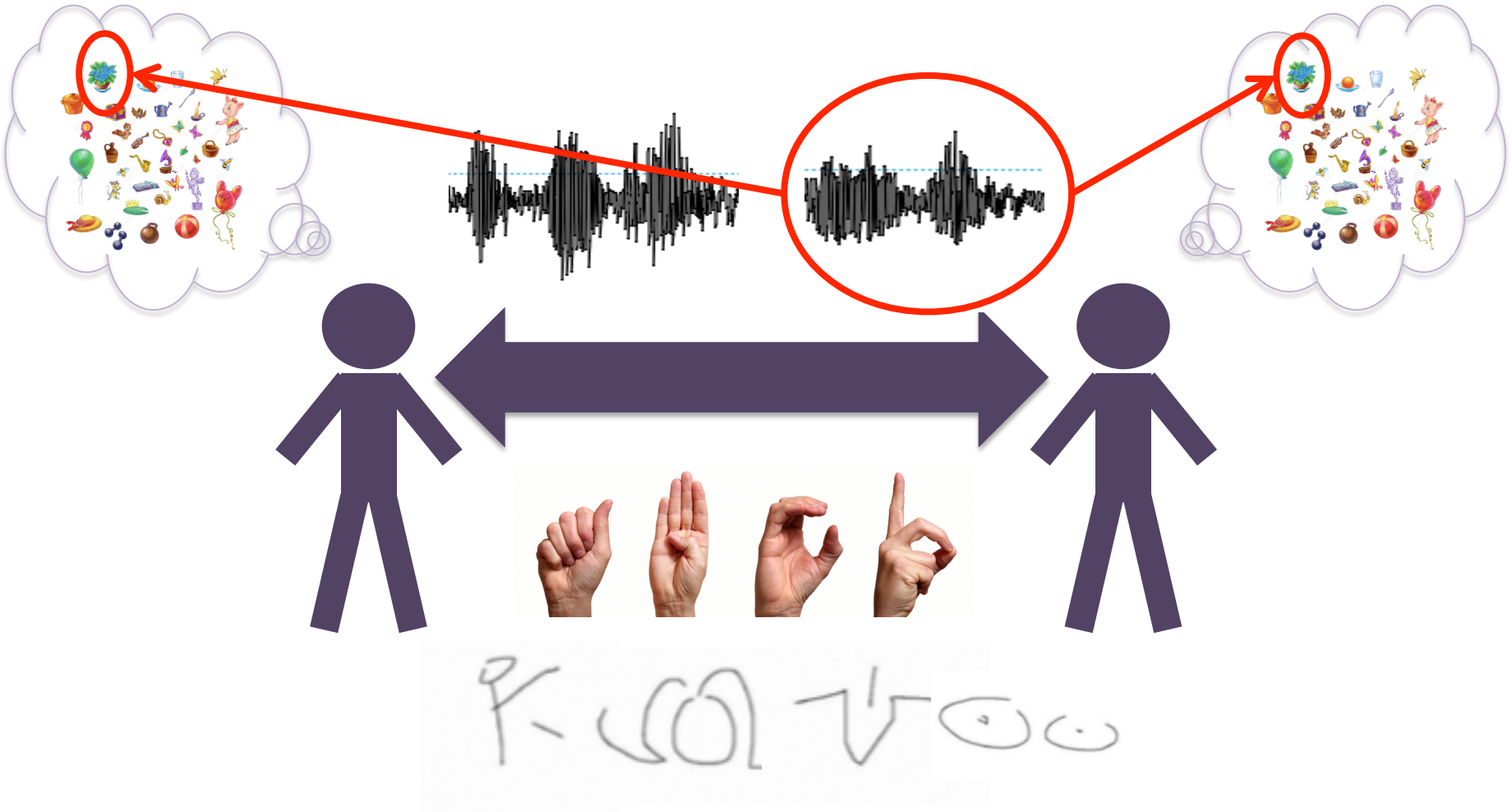
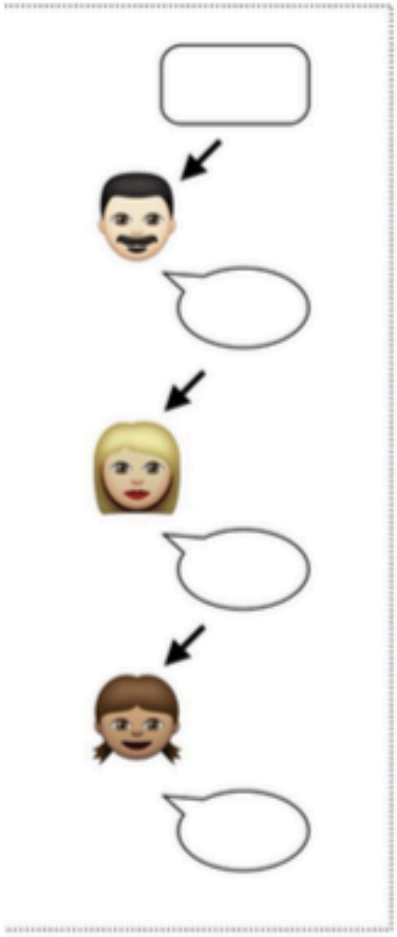
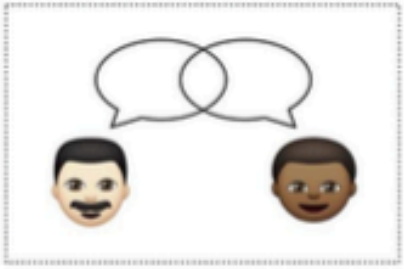
Experimental Semiotics





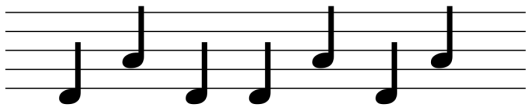
CHAIN

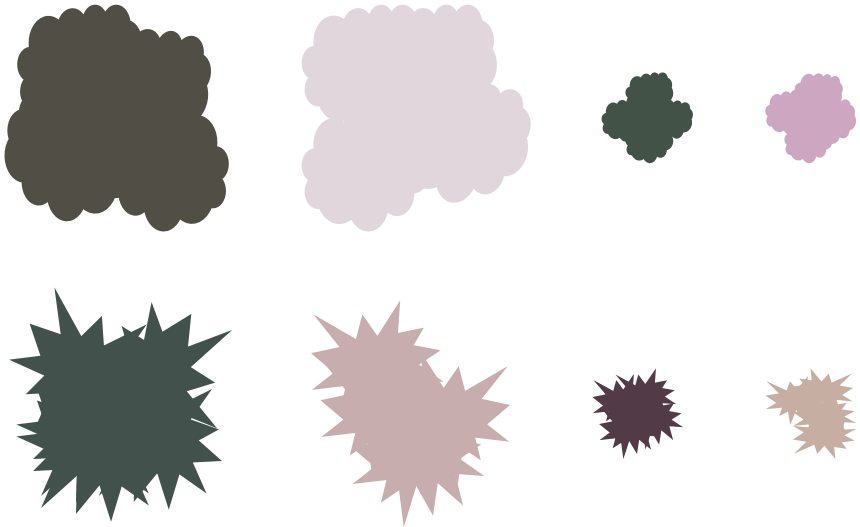


DYAD

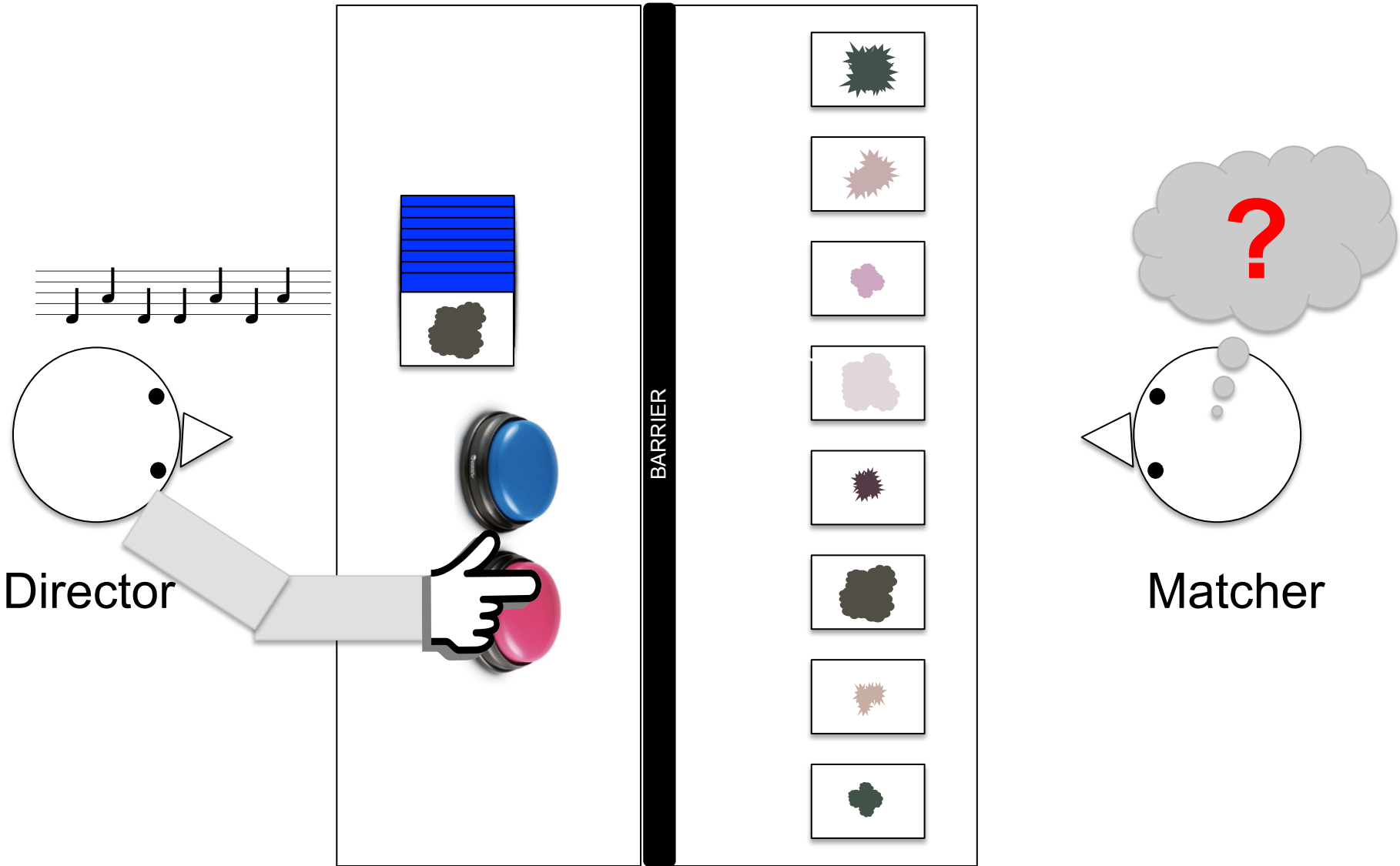
Tamariz & Kirby (2016)

Demo: How to Build a Human Communication System?



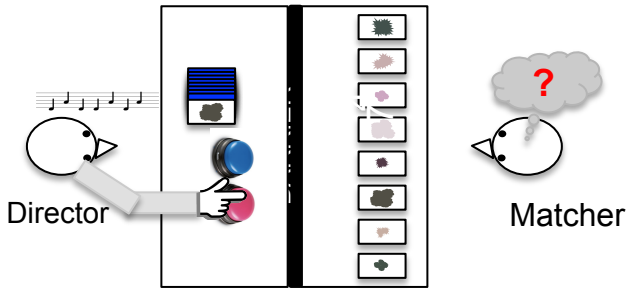


Referential Communication Task
aka Director-Matcher-Task



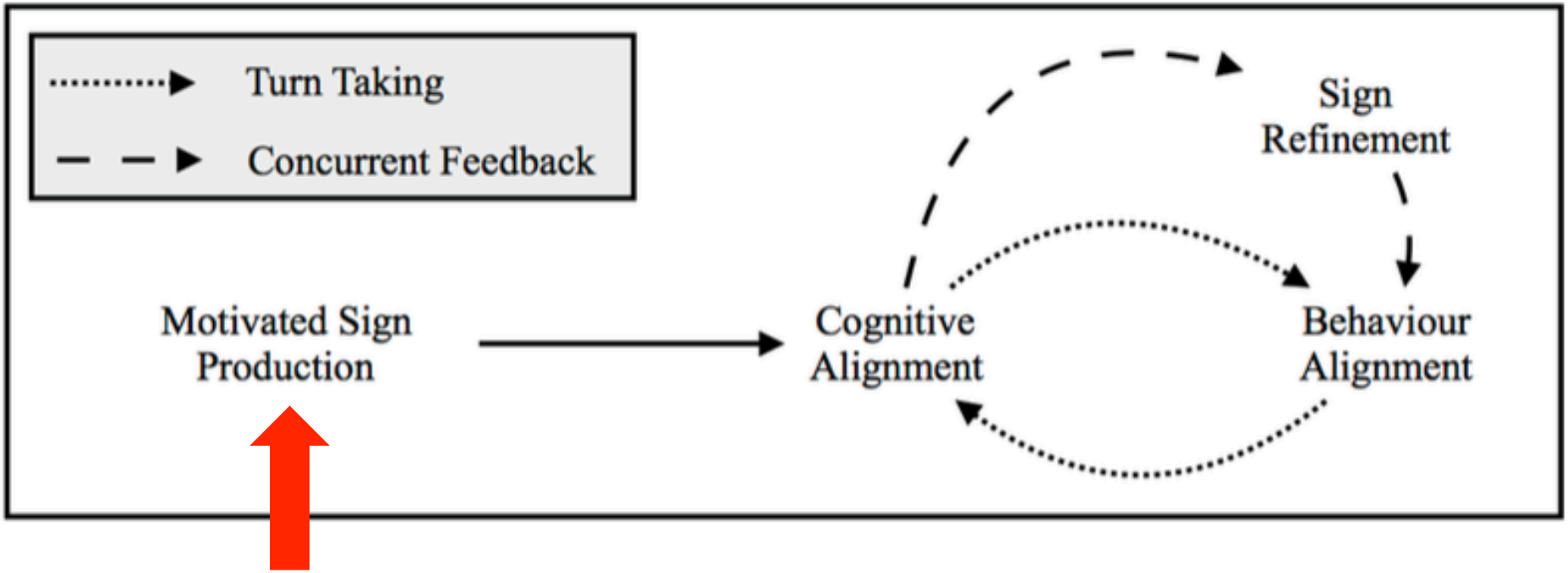
Demo: How to Build a Human Communication System?

1. 2 players: Each player gets set of 8 cards.
2. Player 2: Spread out cards,
3. Player 1: Shuffle stack, keep face down, pick top card, signal to Player 2 using only the buzzers.
4. Player 2: Select card you think has been ‘named’; put it in the middle.
5. Player 1: Reveal target card.
6. Player 2: Return card to line-up.
7. Everybody: give point if cards match / write down binary sequence: 0 = high, 1 = low
8. Player 1: Select next card …. 8th card
9. Change roles.
10. Play for several rounds.



Everybody: count matches / note patterns on protocol sheets.

How to Build a Human Communication System?



Lister & Fay (2017)

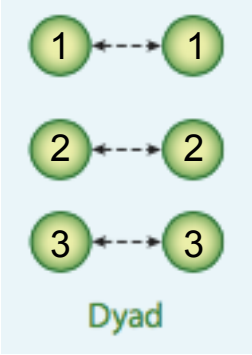
Task: Pictionary

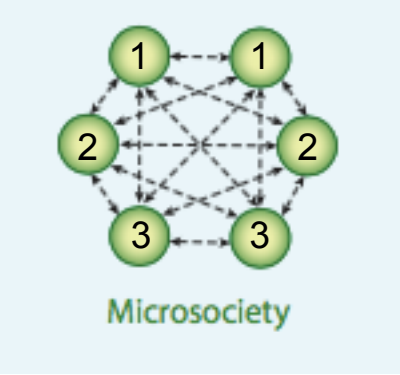
Draw one of the objects so your partner can identify it from the list!

Places	People	Entertainment	Objects	Abstract
Art Gallery	Arnold Schwarzenegger	Cartoon	Computer Monitor	Homesick
Parliament	Brad Pitt	Drama	Microwave	Loud
Museum	*Hugh Grant*	*Sci-Fi*	*Refrigerator*	Poverty
Theatre	Russell Crowe	Soap Opera	Television	*Sadness*

italics = distractors

2 conditions: isolated pairs vs. community drawings

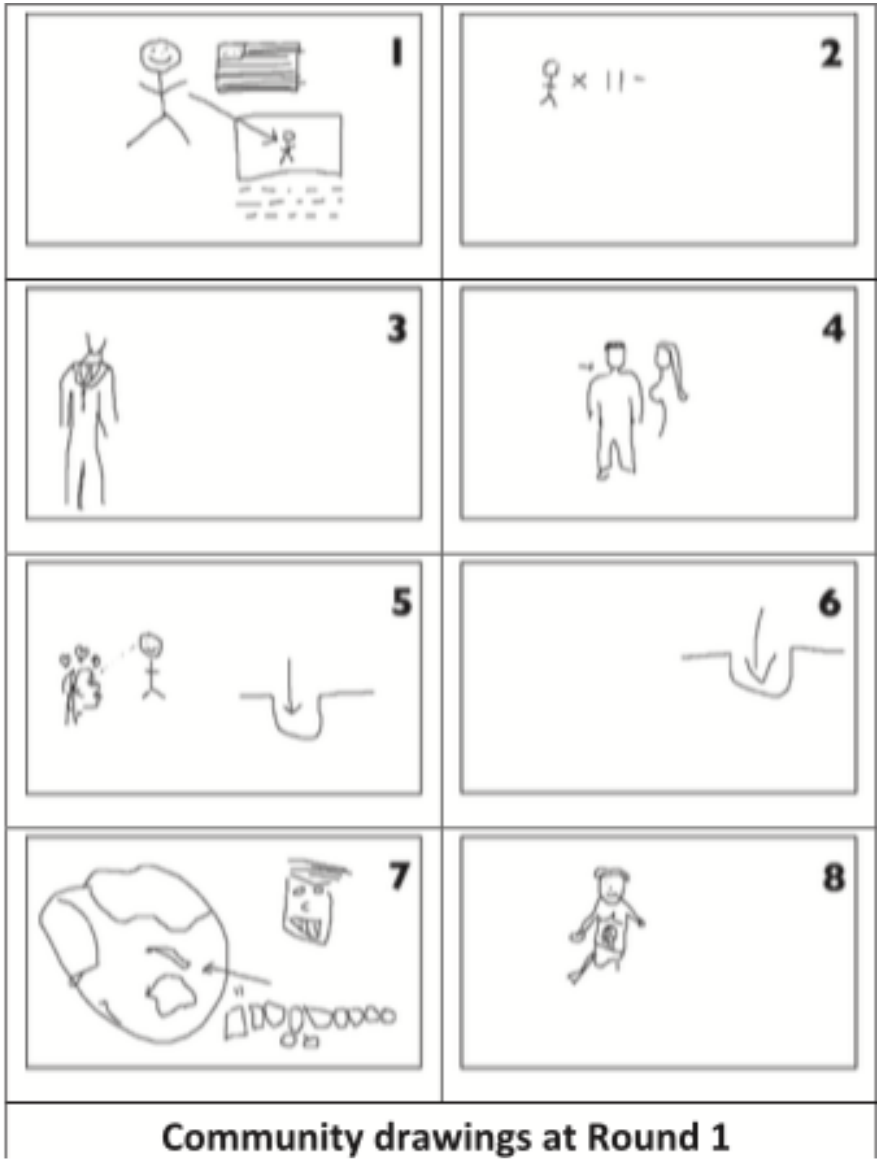




Fay, Garrod, Roberts & Swoboda (2010)

Motivated Sign Production

Pair drawings at Round 1



Community drawings at Round 1

Fay, Garrod, Roberts & Swoboda (2010)

Arbitrariness

table

stol

Tisch

mesa

Iconicity

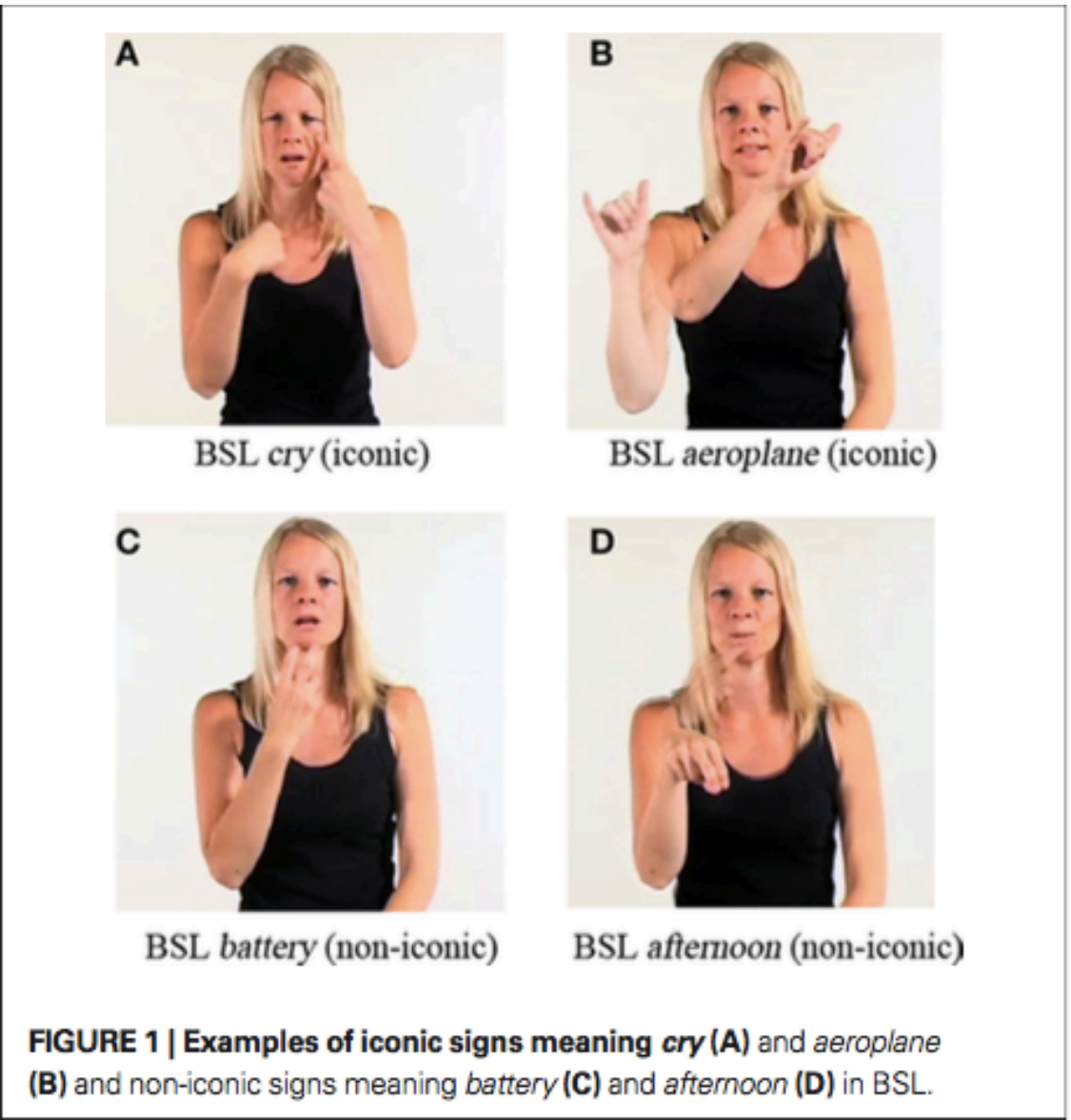
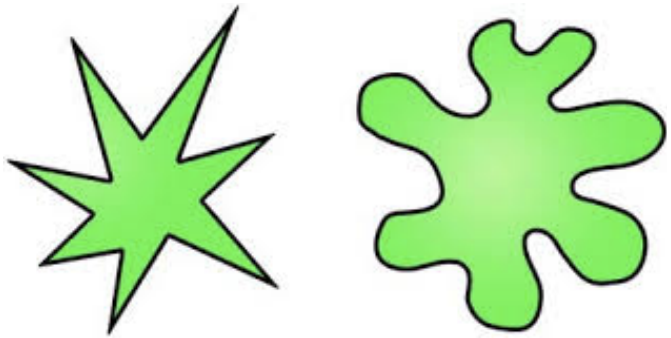


FIGURE 1 | Examples of iconic signs meaning *cry* (A) and *aeroplane* **(B)** and non-iconic signs meaning *battery* **(C)** and *afternoon* **(D)** in BSL.

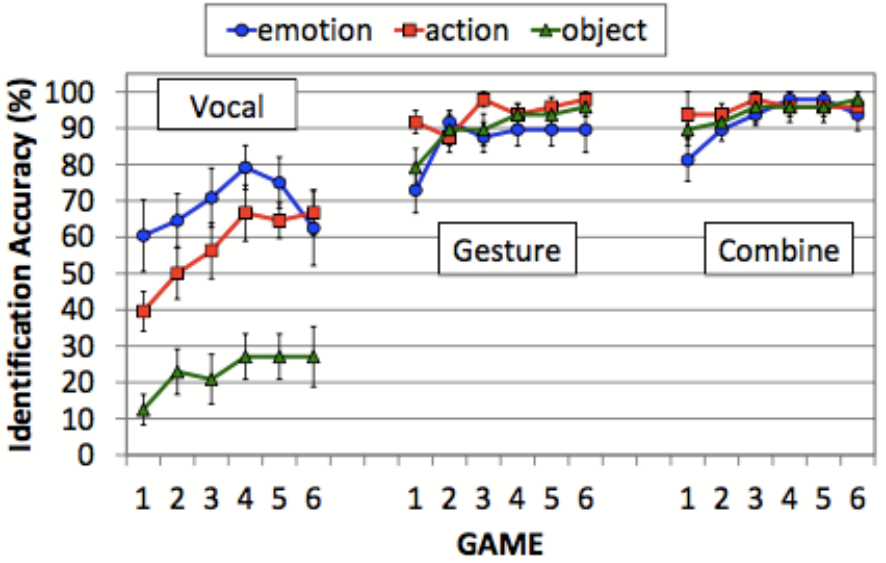


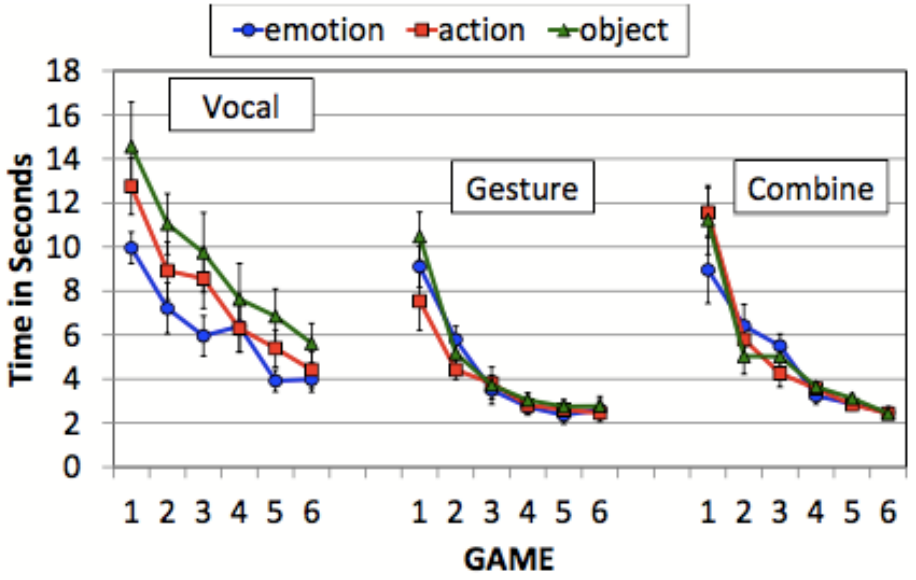
ideophones:
pitter-patter
splish-splash

glimmer, glitter, twinkle, tinkle, twiddle, glisten
…

Motivated Sign Production: Modality Matters

- 3 conditions:
- vocal (non-speech)
- gesture
- vocal + gesture
- concepts from 3 domains:
- emotions
- actions
- objects





Gesture affords motivated signs.

→ Gestural origins of language (Corballis, 2003)**?**

Fay, Arbib, Garrod (2013)

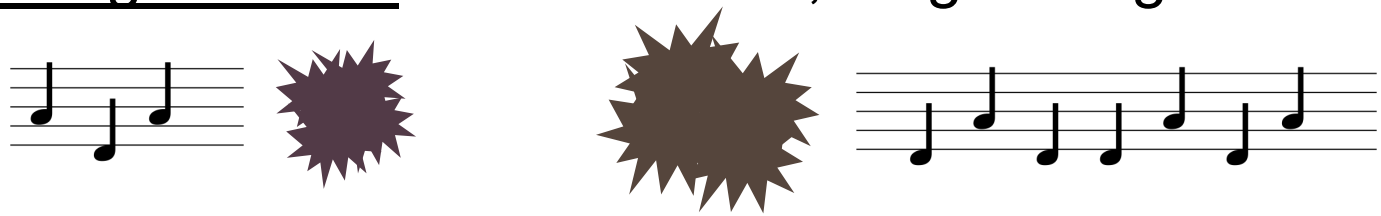
Motivated Sign Production

Iconic affordances of the signalling domain, e.g.:

- pitch – shape: high → spiky, low → fluffy

- pitch – size: high → small, low → large

- signal length – size: short → small, long → large



Kempe, Gauvrit, Gibson & Jamieson (under review)

A ‘Good’ System

	brightness	size	shape	good solution
	dark	big	fluffy	***111***
	light	big	fluffy	***1111***
	dark	small	fluffy	***1***
	light	small	fluffy	***11***
	dark	big	spiky	***0000***
	light	big	spiky	***000***
	dark	small	spiky	***0***
	light	small	spiky	***00***

online transmission pilot with N. Panayotov & M. Tamariz

- ***0 (high)*** = spiky, ***1 (low)*** = fluffy
- ***short*** = small, ***long*** = large
- ***shorter*** = dark, ***longer*** = bright (although inconsistent)

	brightness	size	shape	Adult1	Adult2
	dark	big	fluffy	***011010***	***010101***
	light	big	fluffy	***01101***	***01010011***
	dark	small	fluffy	***1010***	***0101***
	light	small	fluffy	***0101***	***0010***
	dark	big	spiky	***1000110***	***11001011***
	light	big	spiky	***100011***	***1001101***
	dark	small	spiky	***1010***	***1010***
	light	small	spiky	***10101***	***0100***

correct identification

Interlocutors produce longer signals for bigger referents.
→ iconicity

Kempe, Gauvrit, Gibson & Jamieson (under review)

Motivated Sign Production

Iconic affordances of the signalling domain, e.g.:

- pitch – shape: high (low) pitch → spiky (fluffy)

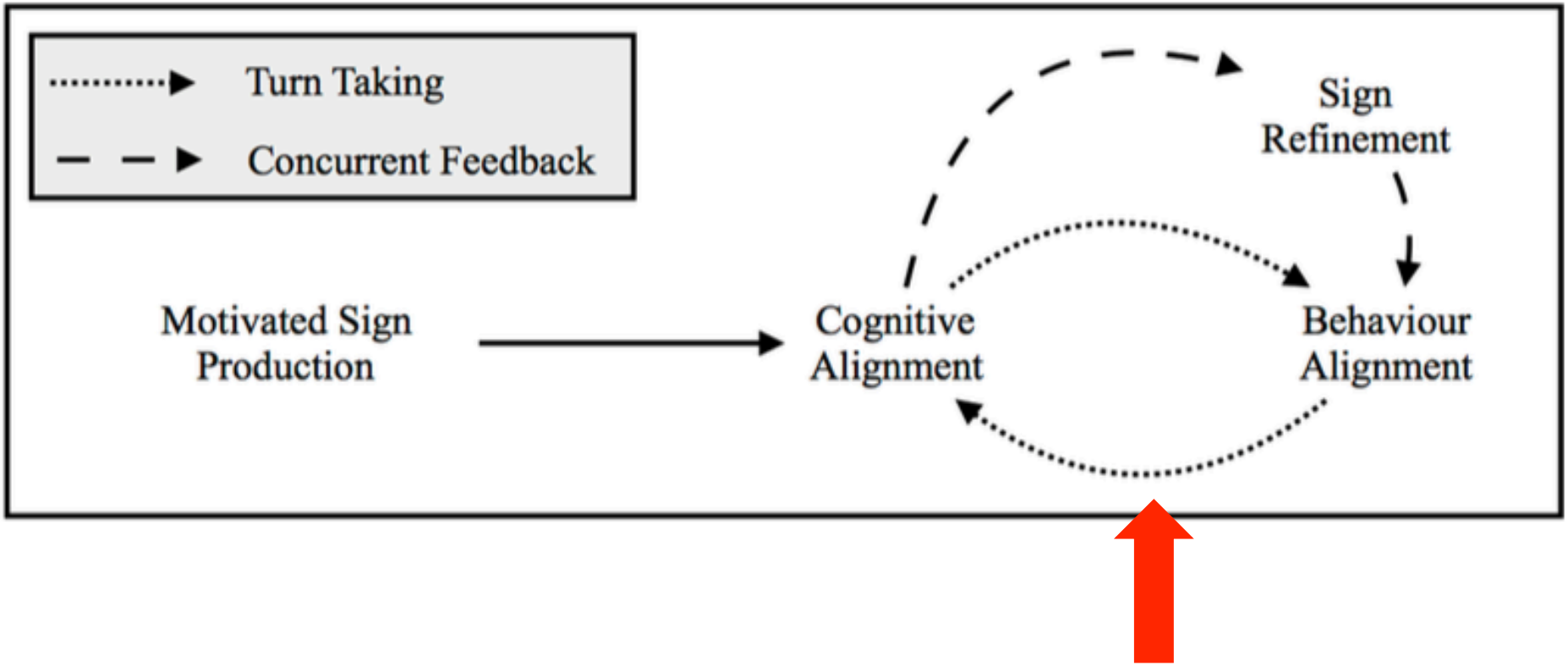
- pitch – size: high (low) pitch → small (large)

Adults explore iconic affordances even in 'weird' domains.

- signal length – size: short (long) → small (large)

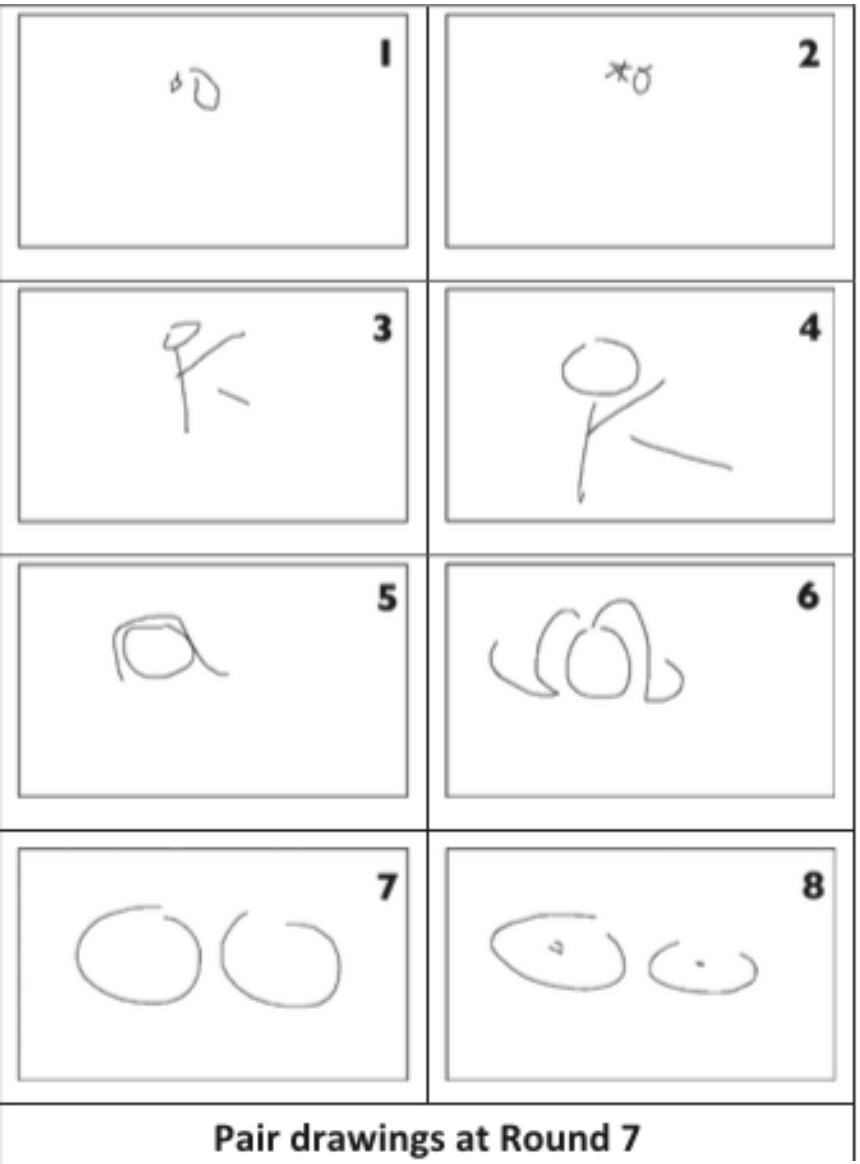
Kempe, Gauvrit, Gibson & Jamieson (under review)

How to Build a Human Communication System?

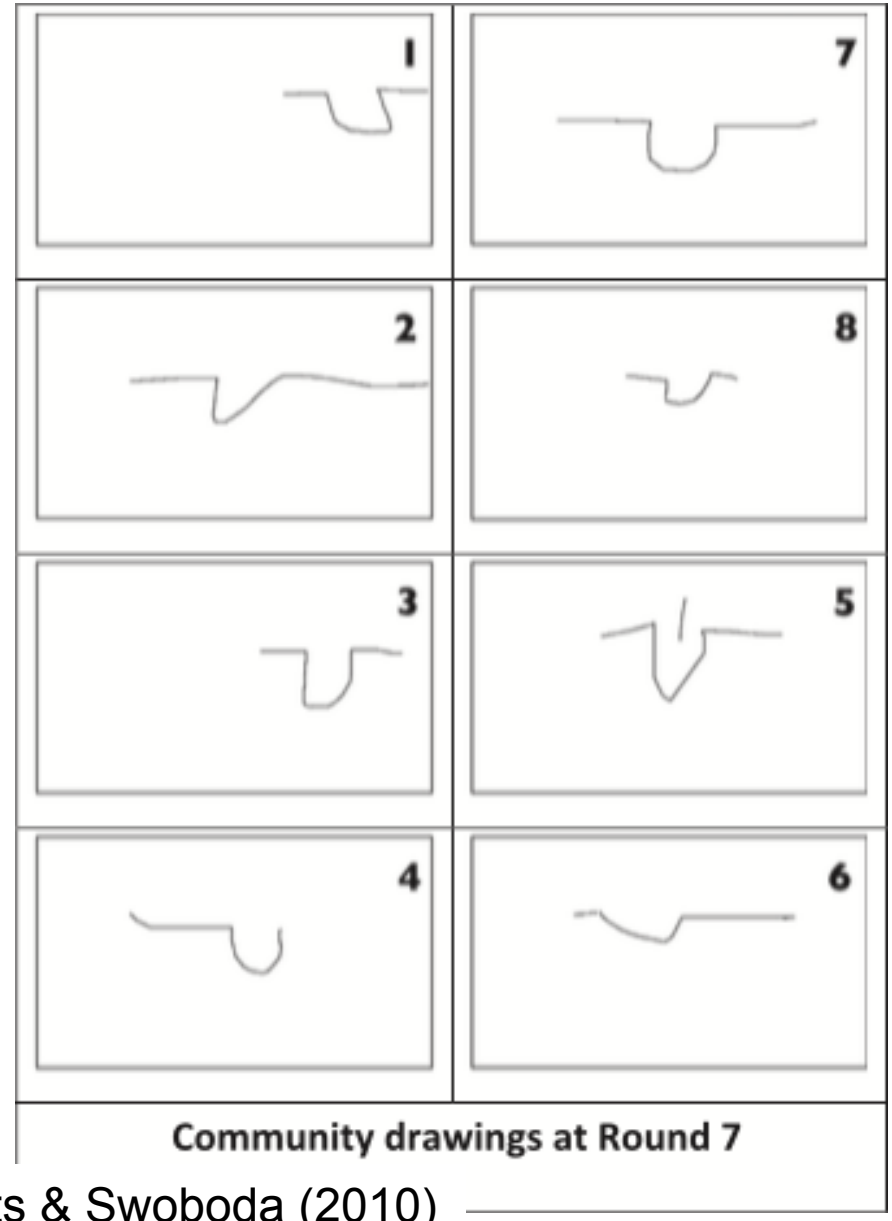


Lister & Fay (2017)

Sign Alignment



Pair drawings at Round 7

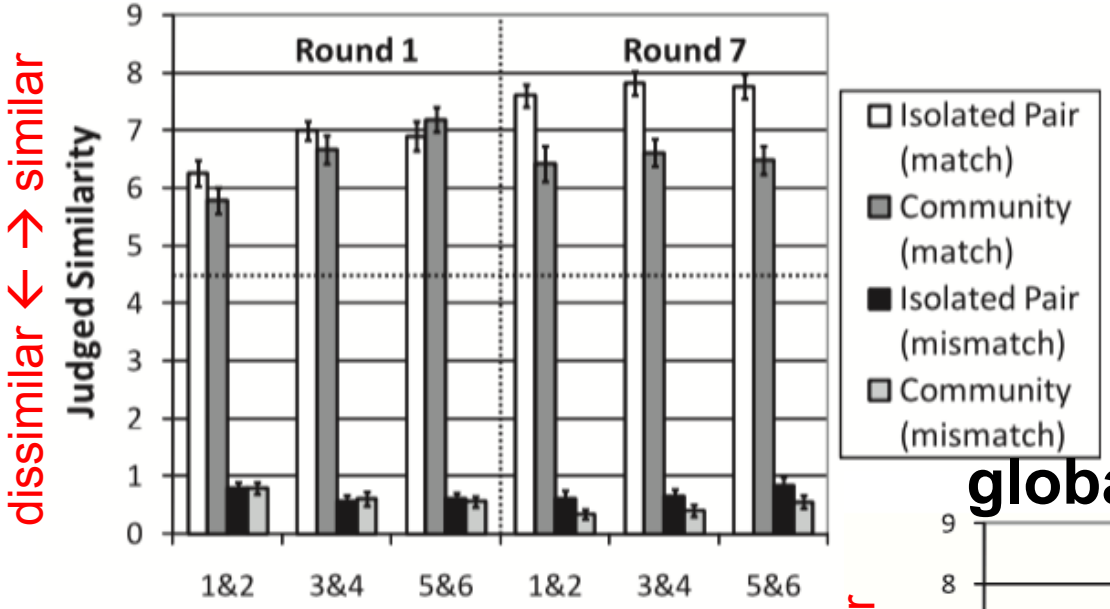


Community drawings at Round 7

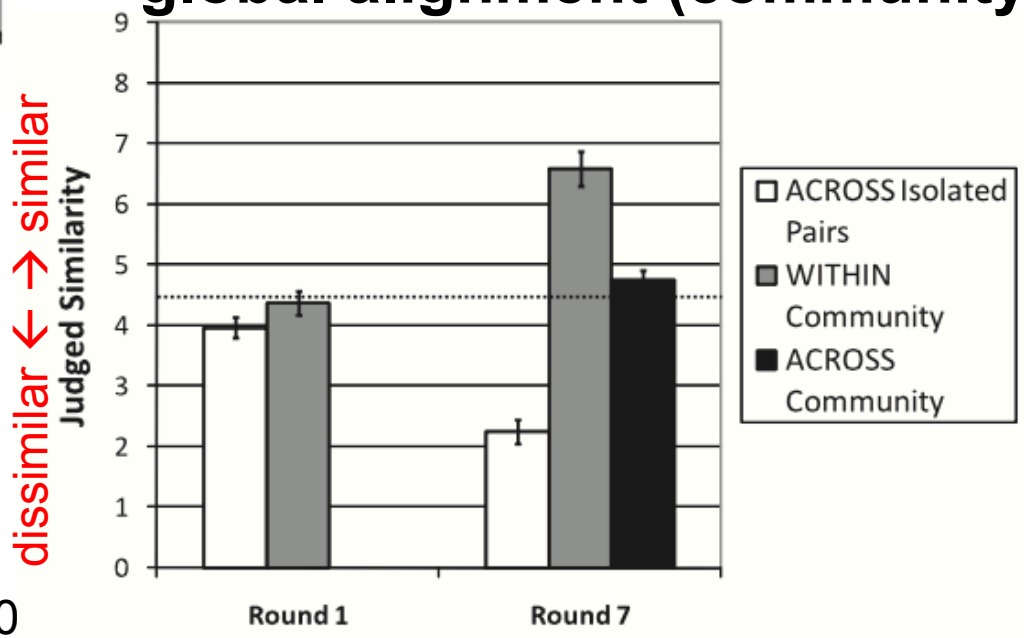
Fay, Garrod, Roberts & Swoboda (2010)

Sign Alignment

local alignment (pairs)

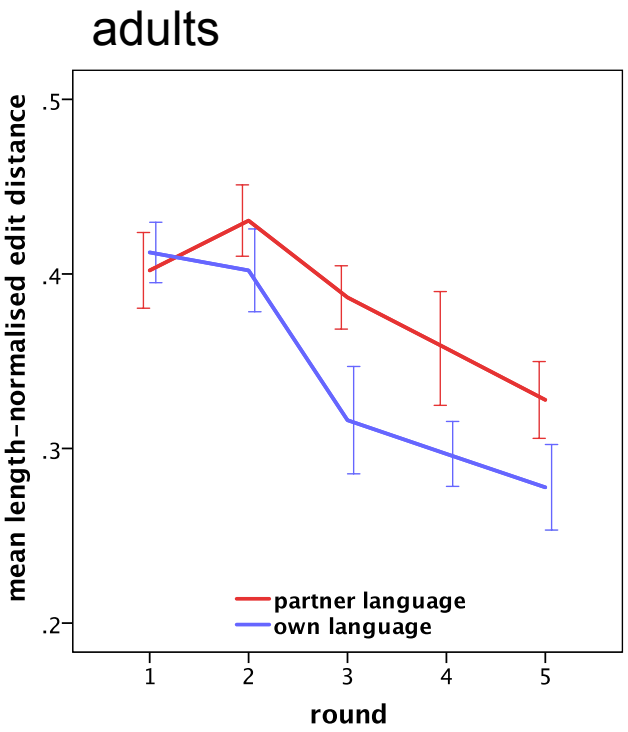


global alignment (community)



Fay, Garrod, Roberts & Swoboda (2010

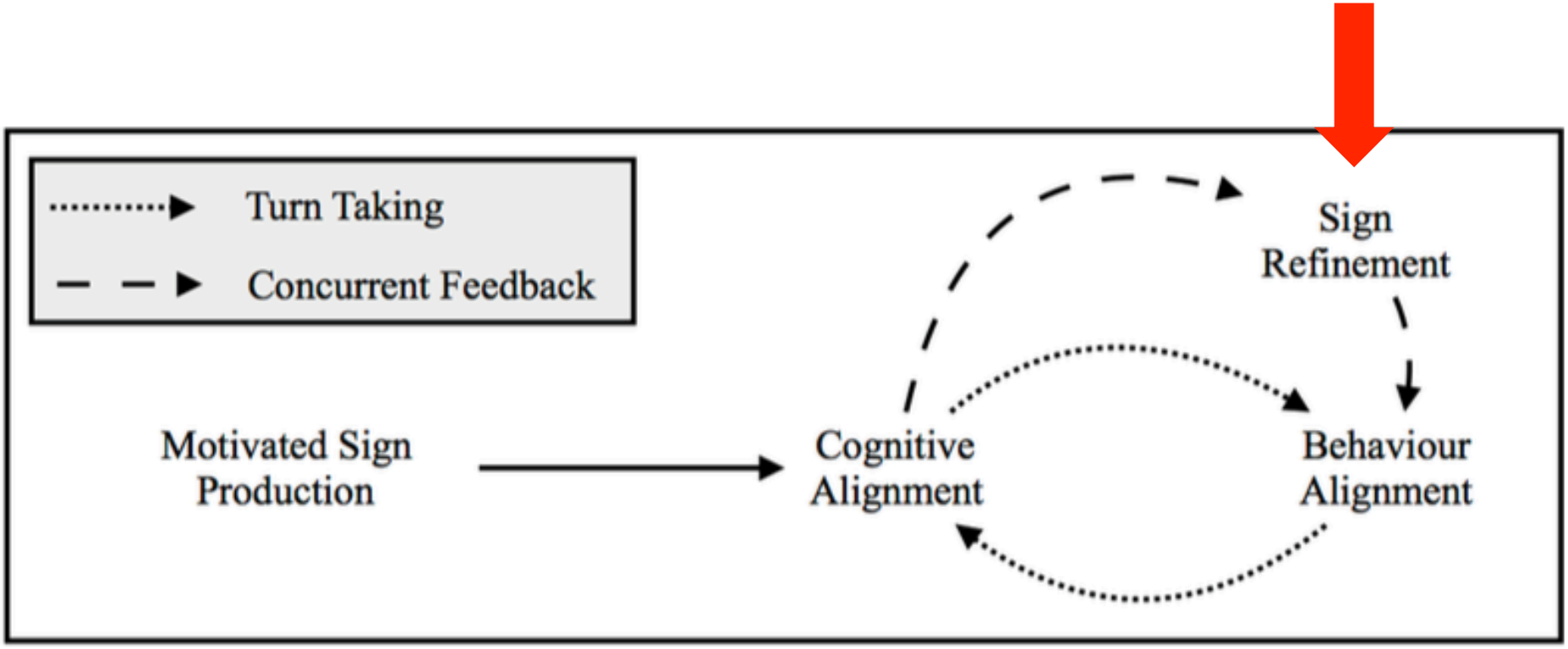
Sign Alignment



Interlocutors align.

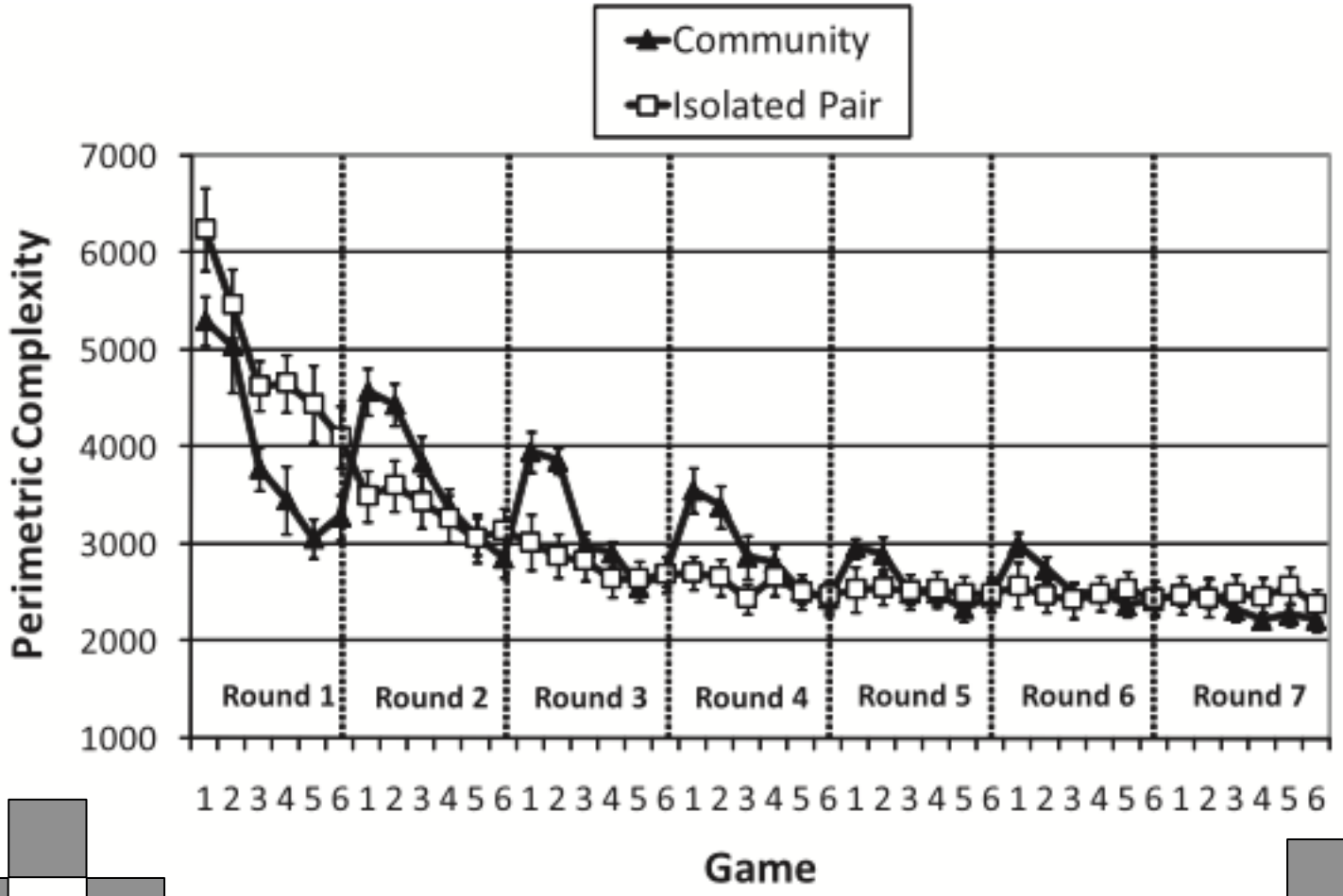
Kempe, Gauvrit, Gibson & Jamieson (under review)

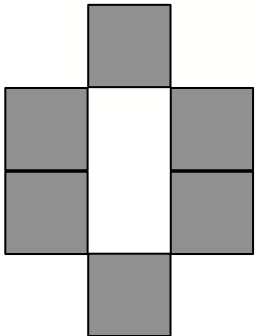
How to Build a Human Communication System?



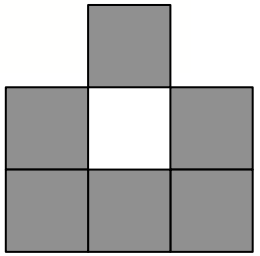
Lister & Fay (2017)

Sign Refinement / Symbolisation



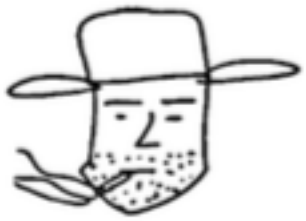
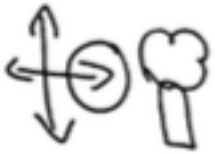


(outer perimeter + inner perimeter)^2/ink area



Fay, Garrod, Roberts & Swoboda (2010)

Sign Refinement / Symbolisation

		
Block 1 (DD+F)	Block 2 (DD+F)	Block 3 (DD+F)
		
Block 4 (DD+F)	Block 5 (DD+F)	Block 6 (DD+F)

Garrod, Fay, Lee, Oberlander & MacLeod (2007)

Sign Refinement/Symbolisation

No Feedback

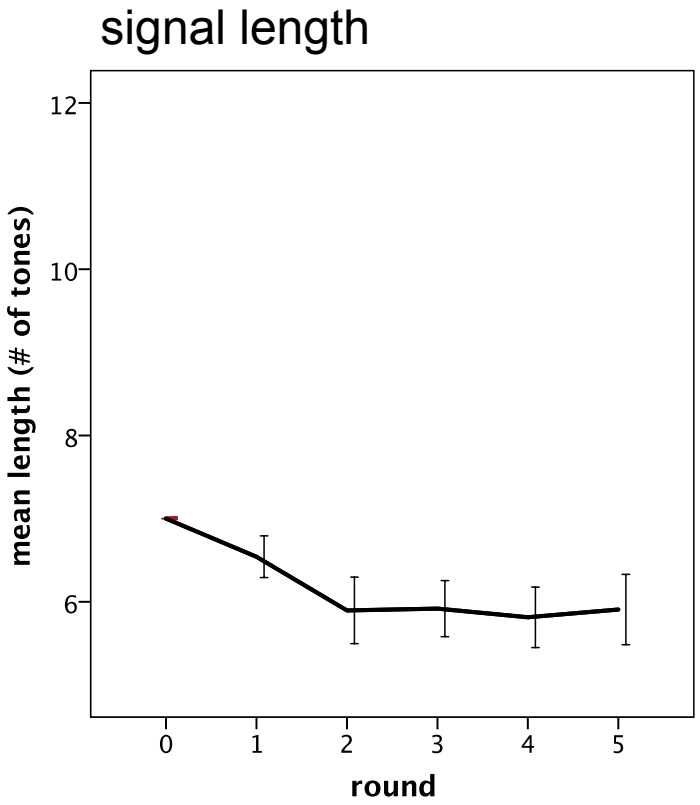
			
Block 1 (SD-F)	**Block 2 (SD-F)**	**Block 3 (SD-F)**	**Block 4 (SD-F)**

Feedback

		
Block 1 (SD+F)	**Block 2 (SD+F)**	**Block 3 (SD+F)**
		
Block 4 (SD+F)	**Block 5 (SD+F)**	**Block 6 (SD+F)**

Garrod, Fay, Lee, Oberlander & MacLeod (2007)

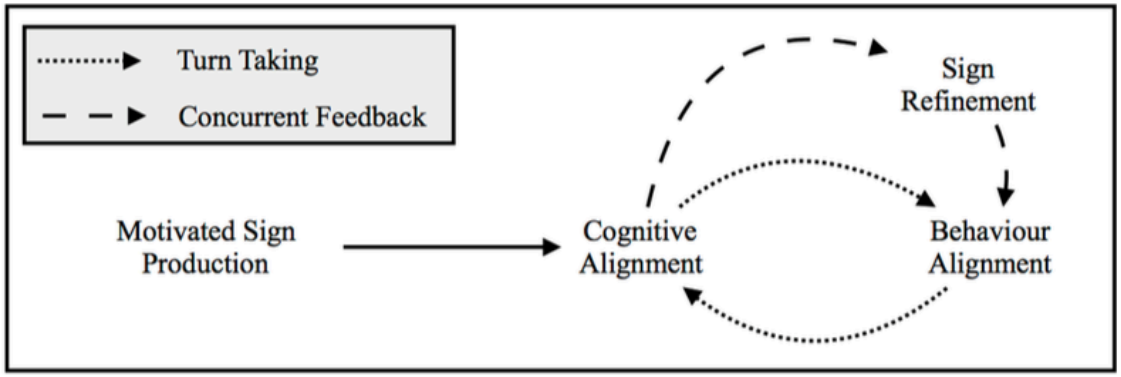
Sign Refinement / Symbolisation



Signs become simpler.

Kempe, Gauvrit, Gibson & Jamieson (under review)

Summary: Adults



- **Interlocutors negotiate meaning by producing motivated (iconic) signs, depending on affordances of the domain.**
- **Signs become more similar through alignment; in communities global alignment happens even if people have not interacted directly.**
- **Signs become arbitrary symbols through a process of refinement which leads to reduced algorithmic complexity.**

Can Children Negotiate a Novel Communication System?

Children acquire meaning…

…but also like this.

…not just like this…

Can Children Negotiate a Novel Communication System?

Yes

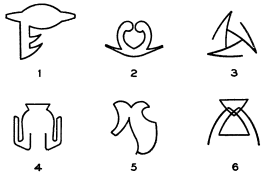
Iconic Bootstrapping Hypothesis (Imai & Kita, 2014): Children's language learning benefits from iconicity.

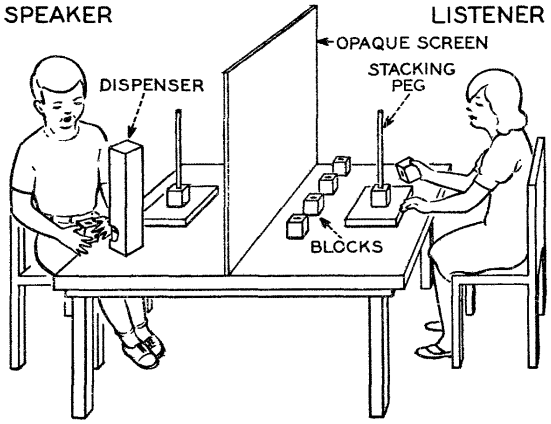
No

Children perform very poorly in referential communication tasks.

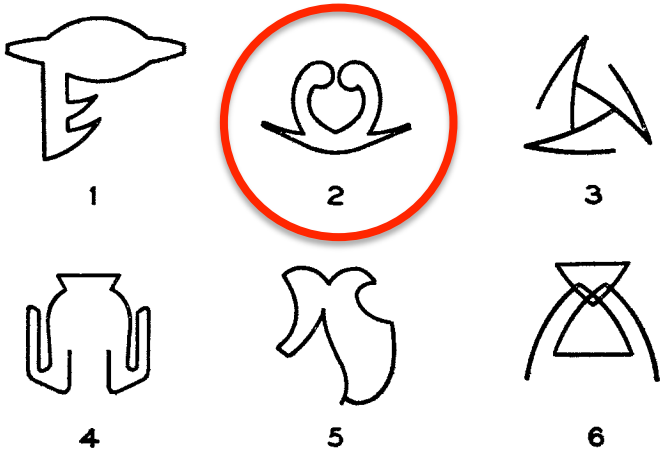
- provide privileged information (e.g. Kraus & Glucksberg, 1969)
- prefer available labels (Kahan & Richards, 1986)
- have the ability but still fail to monitor the context for ambiguity (e.g. Rabagliati & Robertson, 2017)
- don't know what to monitor – need adult guidance (Matthews et al., 2007)
- fail to self-monitor / self-correct their utterances (Nilsen et at., 2008)
- fail to repair communicative break-down (Robinson & Robinson, 1978; Garrod & Clark, 1993)

Provide Privileged Information





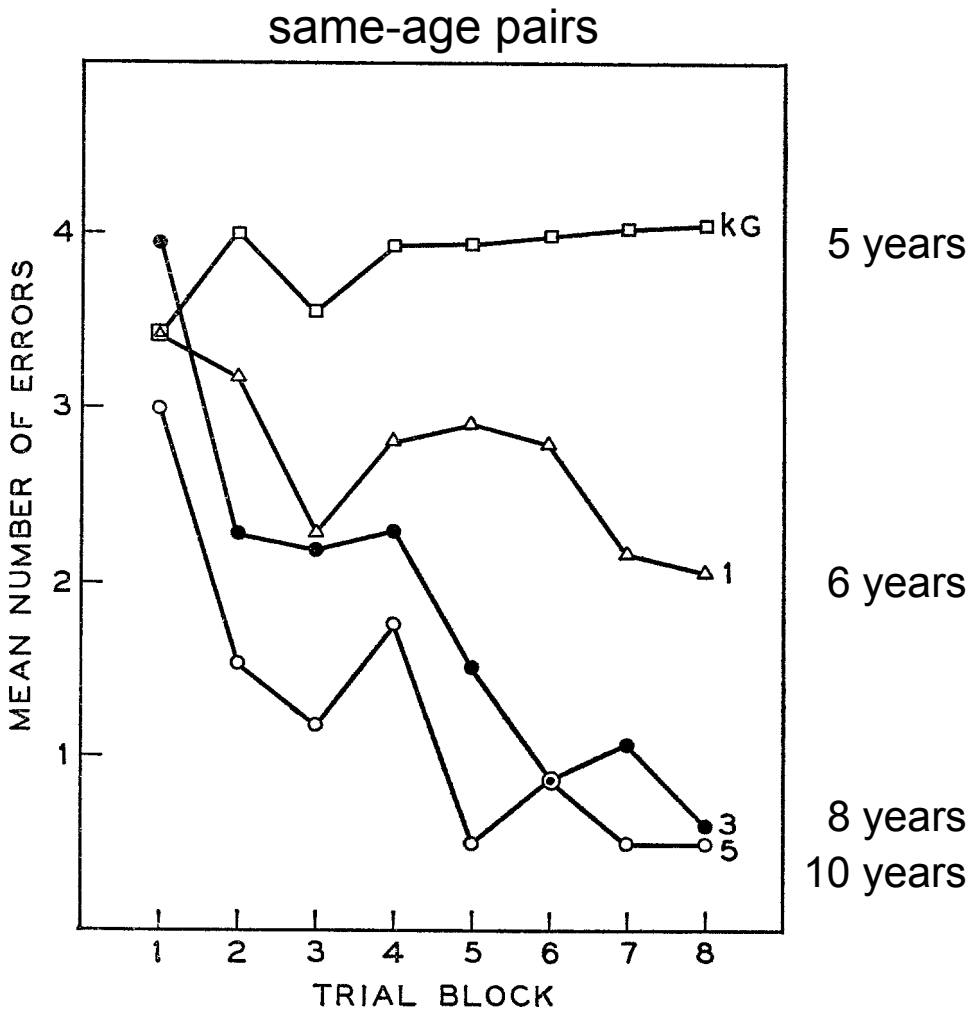
4-year-old: *'Mummy's hat'*



adult:
'two worms looking at each other '

Kraus & Glucksberg (1969)

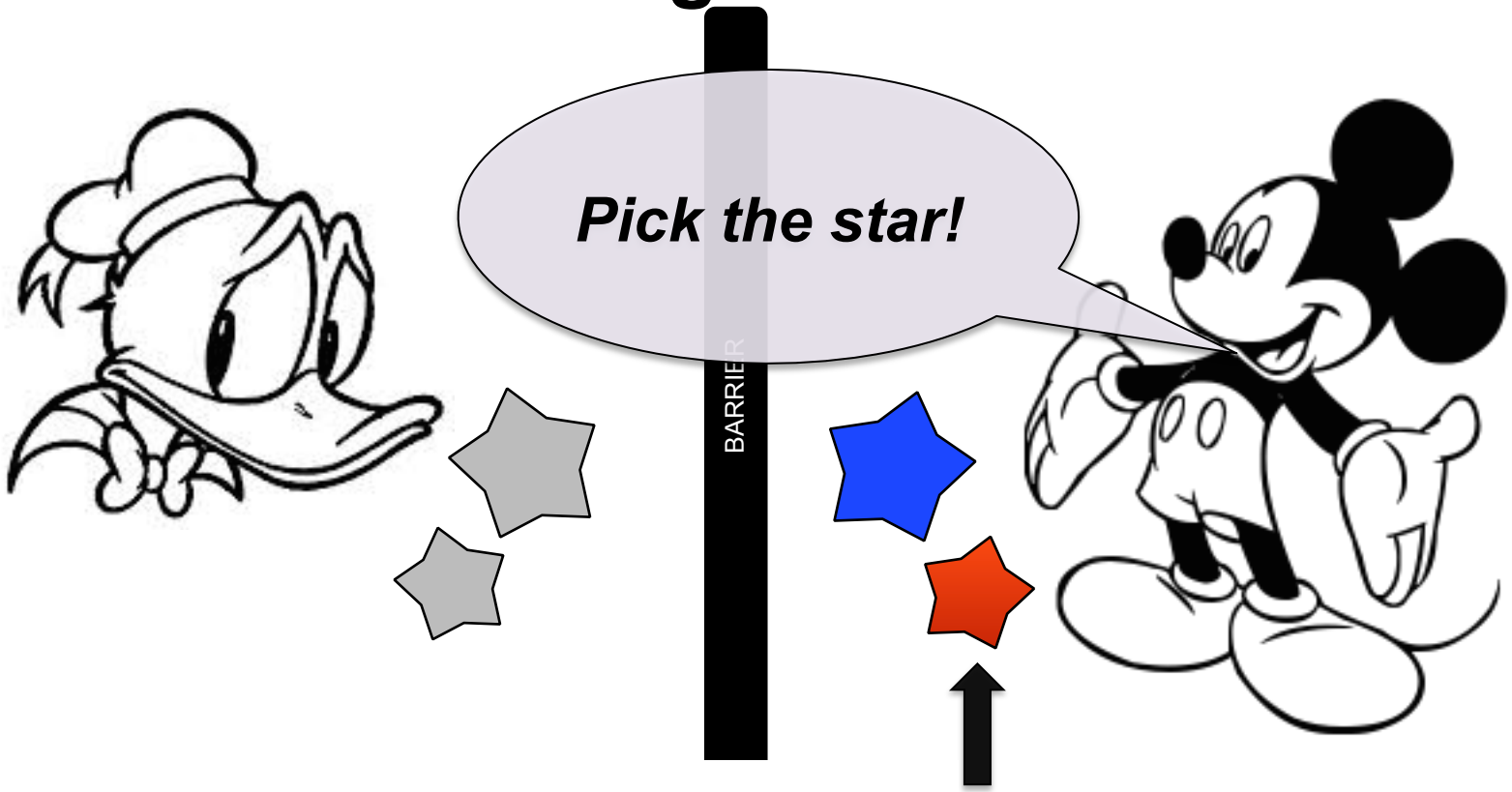
Provide Privileged Information



Preschoolers fail to describe referents adequately.

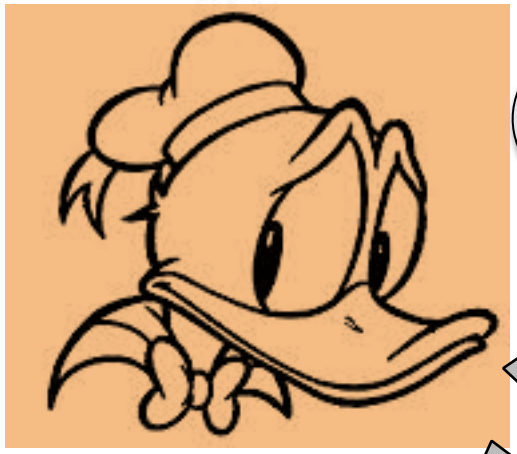
Kraus & Glucksberg (1969)

Misunderstanding Miscommunication



Robinson & Robinson (1978)

Misunderstanding Miscommunication



Pick the red star!

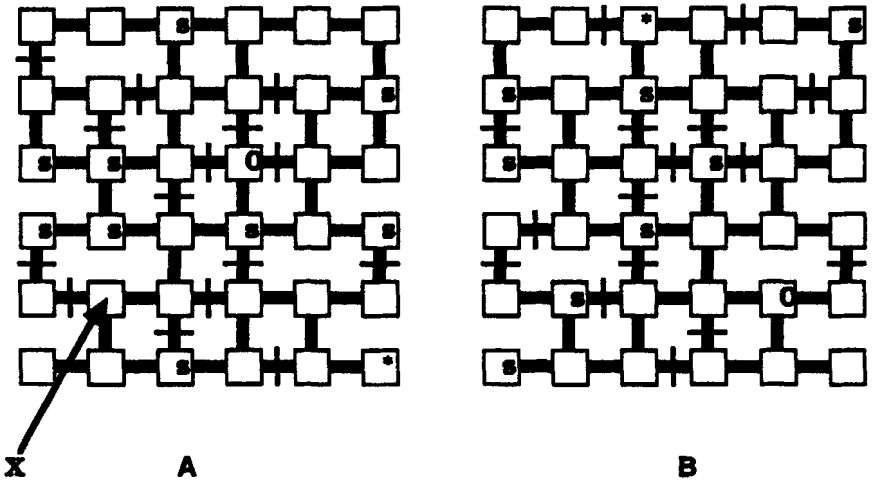
BARRIER

Whose fault is it?

Preschoolers blame the listener for miscommunication.

Robinson & Robinson (1978)

Repairing Miscommunication?



Maze task: Describe position of own token in maze to partner who cannot see it.

7-8-year-olds: Superficial coordination (lexical alignment, e.g. *'box'* → *'box'*; *'row'* → *'row'*)

11-12-year-olds: Deep coordination = suppression of superficial alignment and strategic repair of miscommunication (effortful!)

Garrod & Clark (1993)

Can Children Negotiate a Novel Communication System?

Yes

Iconic Bootstrapping Hypothesis (Imai & Kita, 2014): Children's language learning benefits from iconicity.

Egocentricity (limited ToM)?
(Recent issue of *Dev Sci:* failures to replicate early ToM studies!)

Cognitive capacity limitation?

No

Children perform very poorly in referential communication tasks.

- provide privileged information (e.g. Kraus & Glucksberg, 1969)
- prefer available labels (Kahan & Richards, 1986)
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Negotiating a Novel Signalling System: Adults vs. 7-Year-Old Children

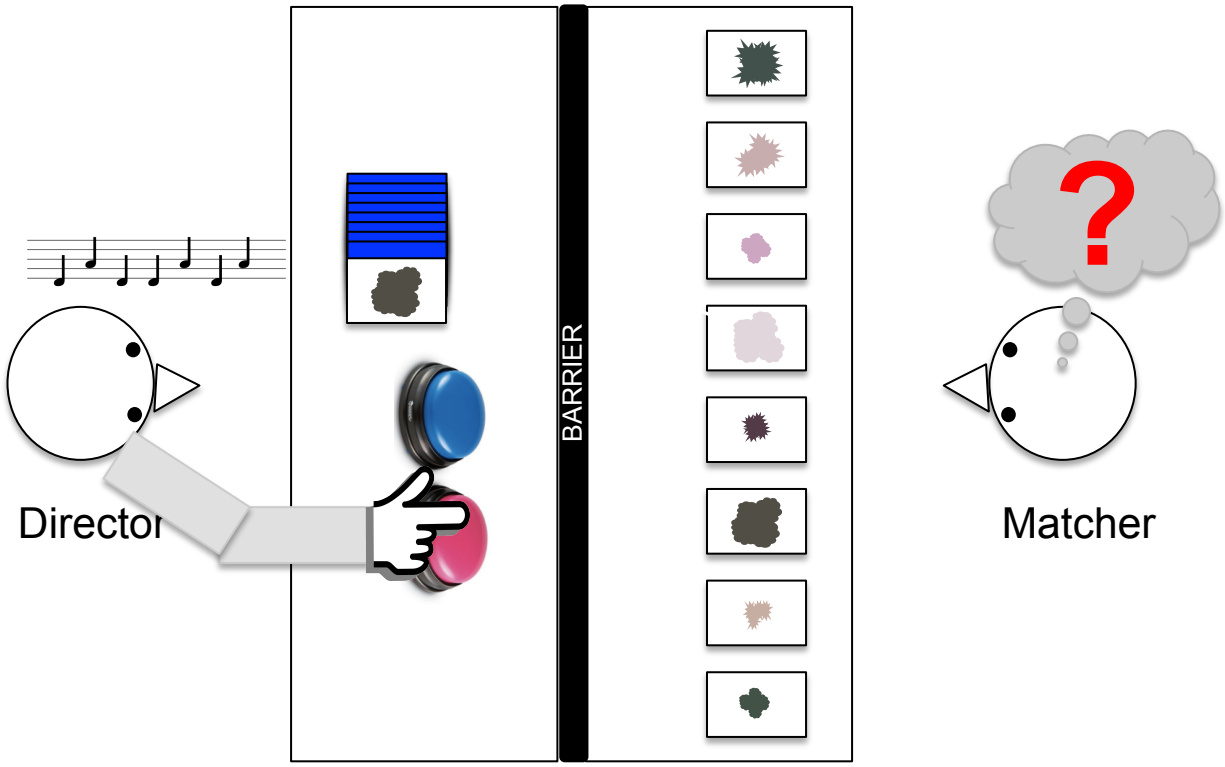
tion	Shape	Color	0
Bn	●	Bk	h
Bnc	●	Bl	maneh u
Bnc	●	R	w ho
Bnc	■	Bk	pam apo
Bnc	■	Bl	emipo
Bnc	■	R	howu
Bnc	▲	Bk	nehowu
Bnc	▲	Bl	nemi
Bnc	▲		wunene
Hor	●		lipapo
Hor	●	l	poliho
Hor	●	R	maho
Hor	■	Bk	nehomami
Hor	■	l	powuma
Hor	■		wumaleli
Hor		Bl	lilema
Hor		Bl	lemaho
Hor	▲	R	lemilipo
Sp	●	Bk	lepali
Sp	●	Bl	lemi
Sp	●	R	mine
Sp	■	Bk	poh ali
Sp	■	Bl	ma li
Sp	■	R	wu
S	▲	Bk	wulepar
	▲	Bl	nepa
p	▲	R	mahomine

Kirby et al. (2008)

Fay et al. (2010)

erniss et al. (201

Negotiating a Novel Signalling System: Adults vs. 7-Year-Old Children

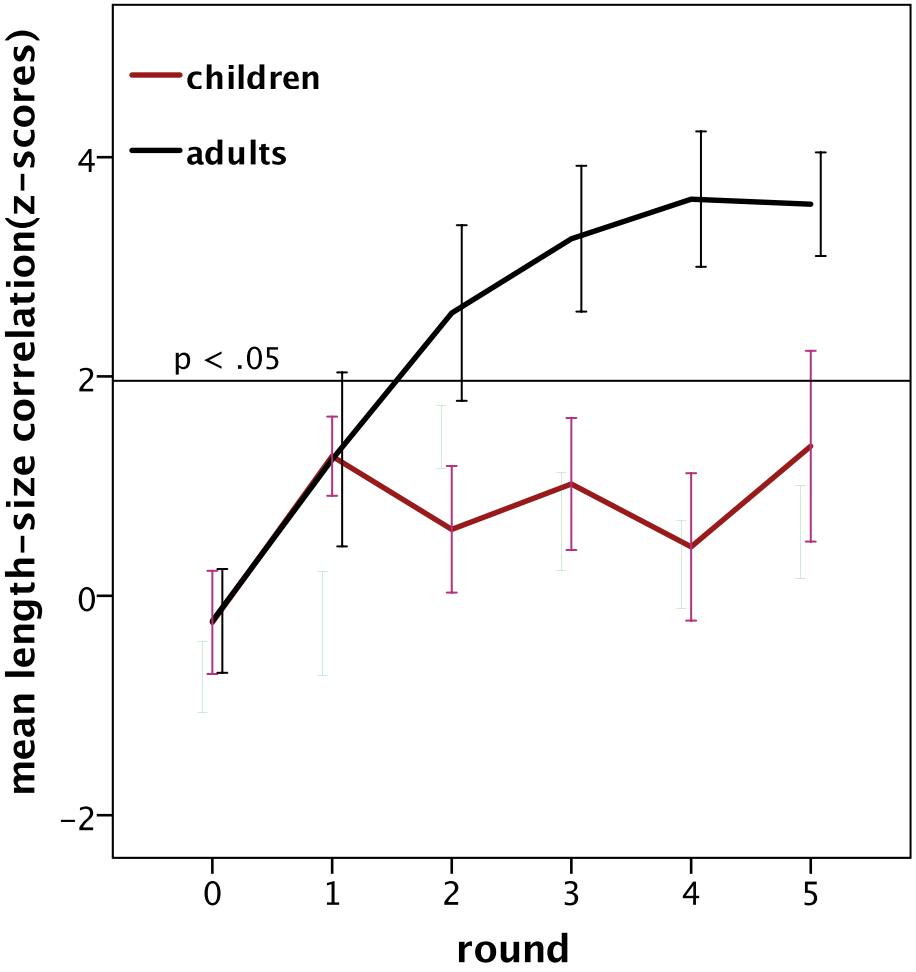


Kempe, Gauvrit, Gibson & Jamieson (under review)

	brightness	size	shape	Adult1	Adult2
	dark	big	fluffy	***011010***	***010101***
	light	big	fluffy	***01101***	***01010011***
	dark	small	fluffy	***1010***	***0101***
	light	small	fluffy	***0101***	***0010***
	dark	big	spiky	***1000110***	***11001011***
	light	big	spiky	***100011***	***1001101***
	dark	small	spiky	***1010***	***1010***
	light	small	spiky	***10101***	***0100***

	brightness	size	shape	Child1	Child2
	dark	big	fluffy	***1010101010***	***111001***
	light	big	fluffy	***1110001101***	***100011***
	dark	small	fluffy	***1110001***	***00101100***
	light	small	fluffy	***000111011***	***111010***
	dark	big	spiky	***000111011***	***111010***
	light	big	spiky	***11110000***	***001101***
	dark	small	spiky	***111100110***	***0011000111***
	light	small	spiky	***11100010***	***0010110001***

Motivated Signs

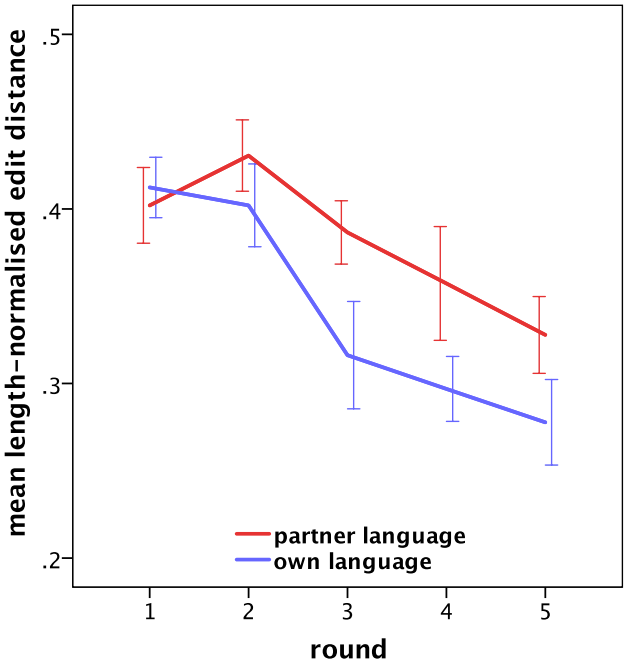


Only adults introduce motivated signs using iconicity!

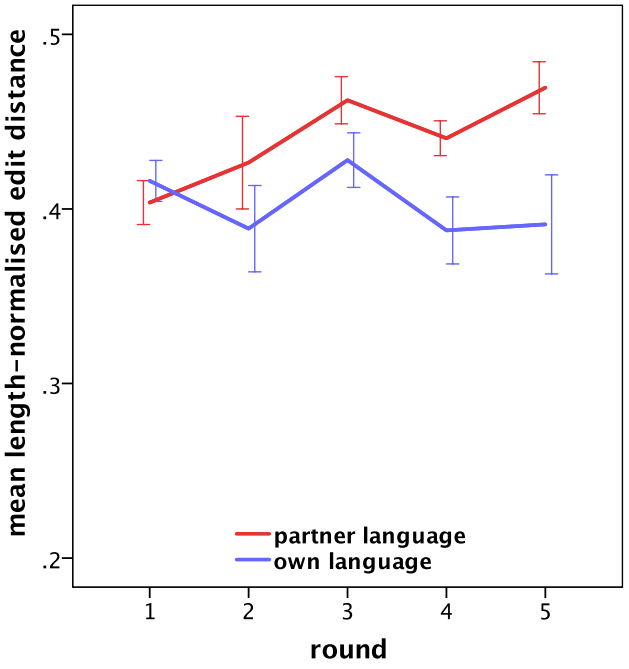
Kempe, Gauvrit, Gibson & Jamieson (under review)

Alignment

adults



children

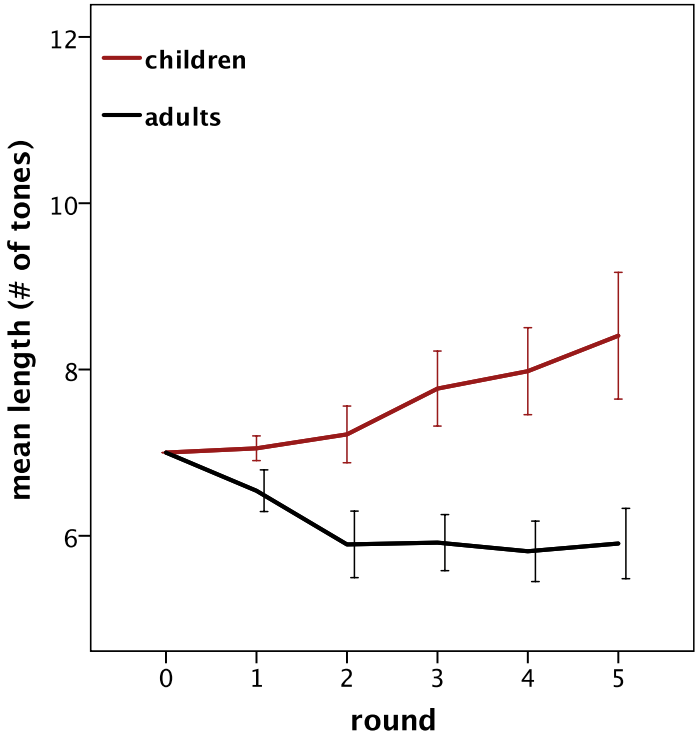


Only adults align.

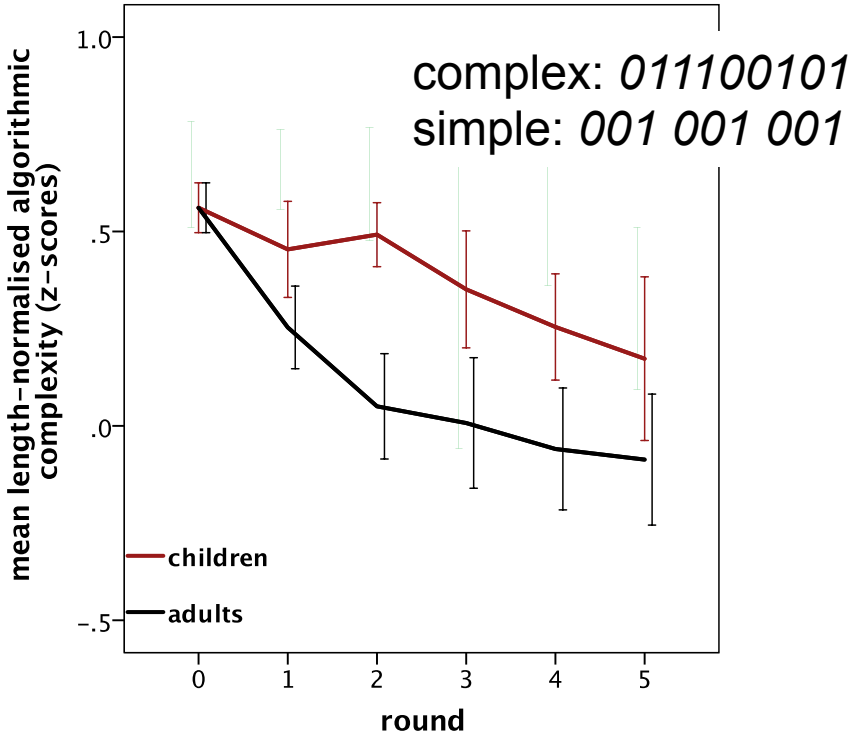
Kempe, Gauvrit, Gibson & Jamieson (under review)

Sign Refinement

signal length



signal structure

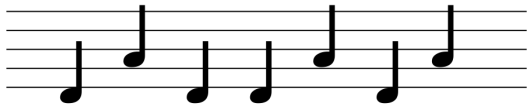


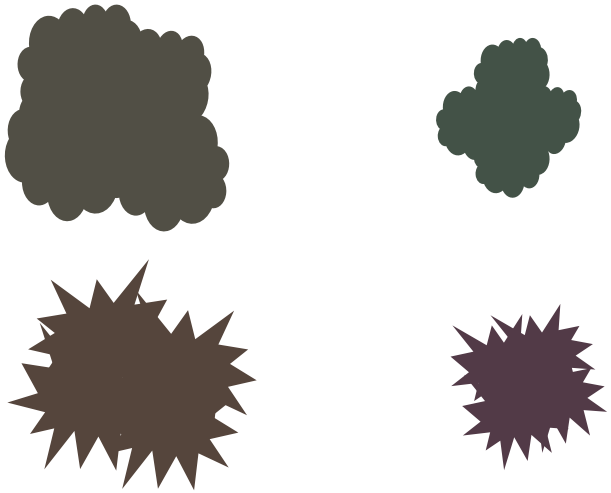
Adults simplify/compress more readily.

Kempe, Gauvrit, Gibson & Jamieson (under review)

Reduced ‘Alien’ Buzzer Language

- Binary auditory sequences:

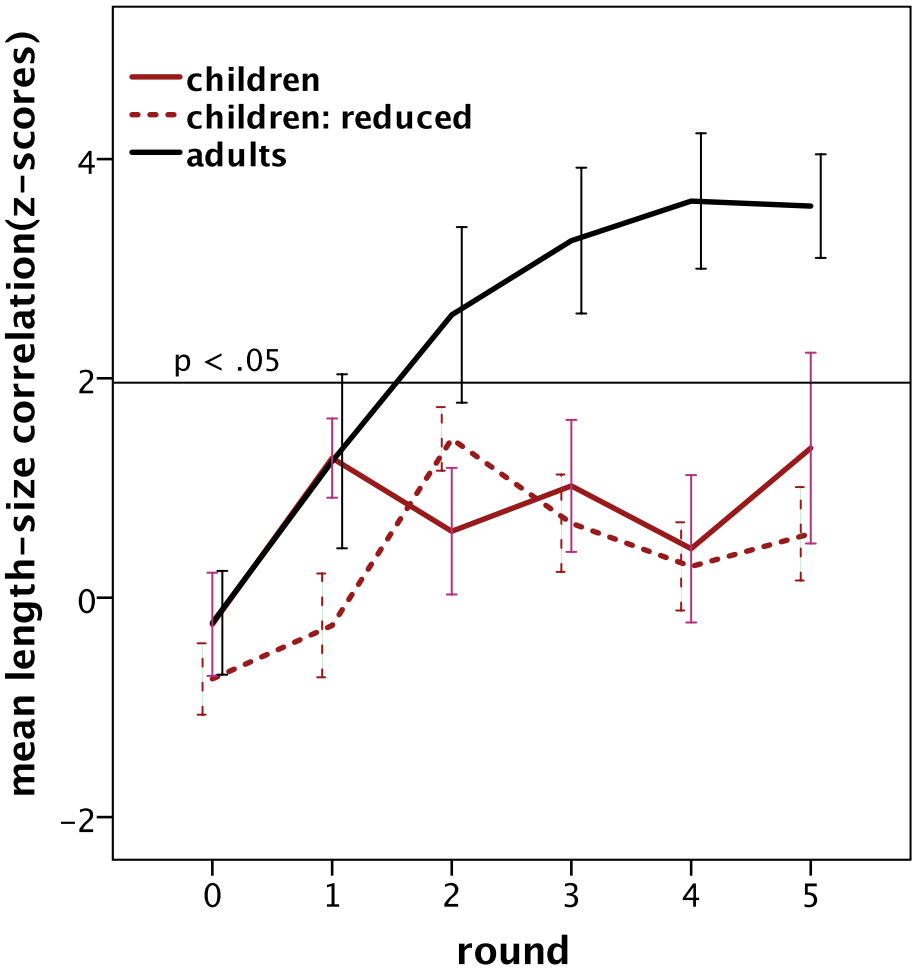




  - smaller set of **four** meanings to reduce cognitive load
  - 6 dyads of 7-year old children playing a referential communication game for 5 rounds

Kempe (2017)

Motivated Sign Production

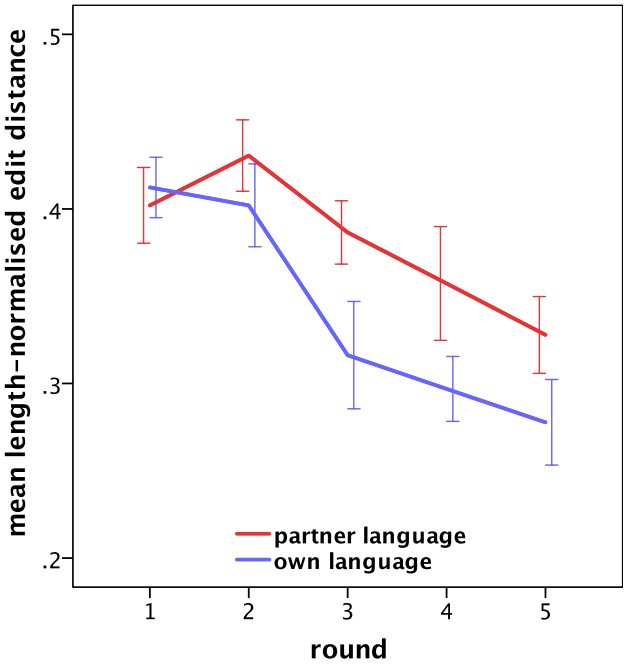


Still no motivated signs.

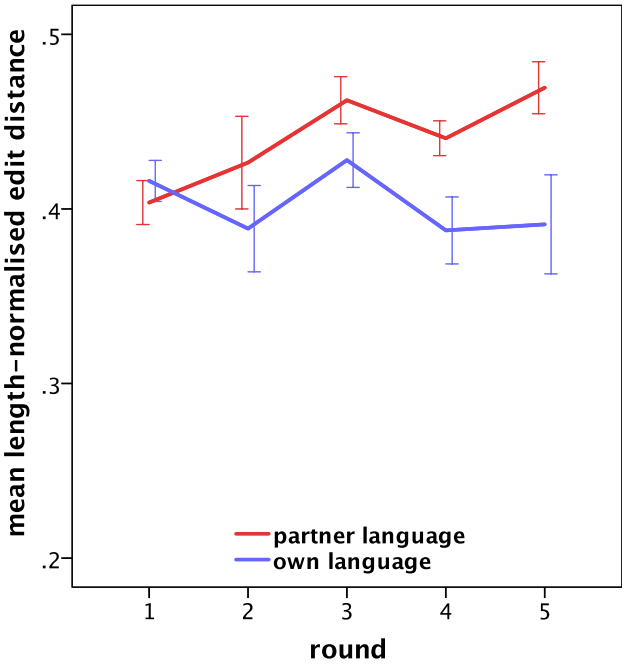
Kempe (2017)

Alignment

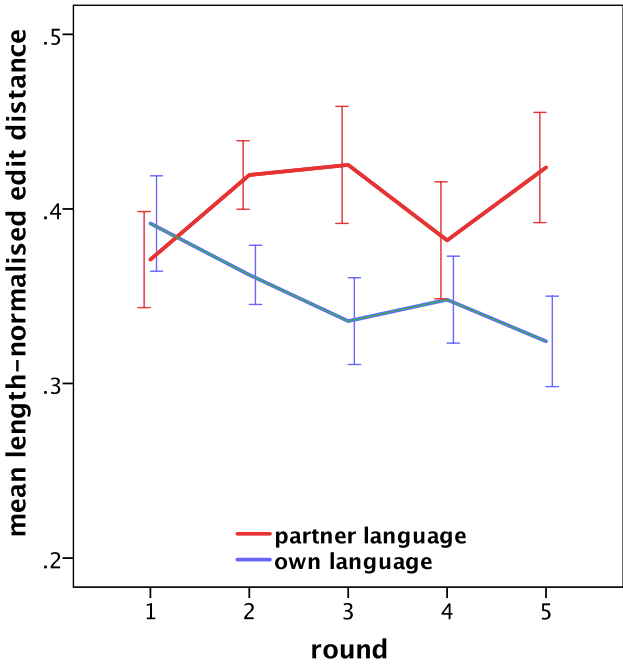
adults



children



children: reduced set

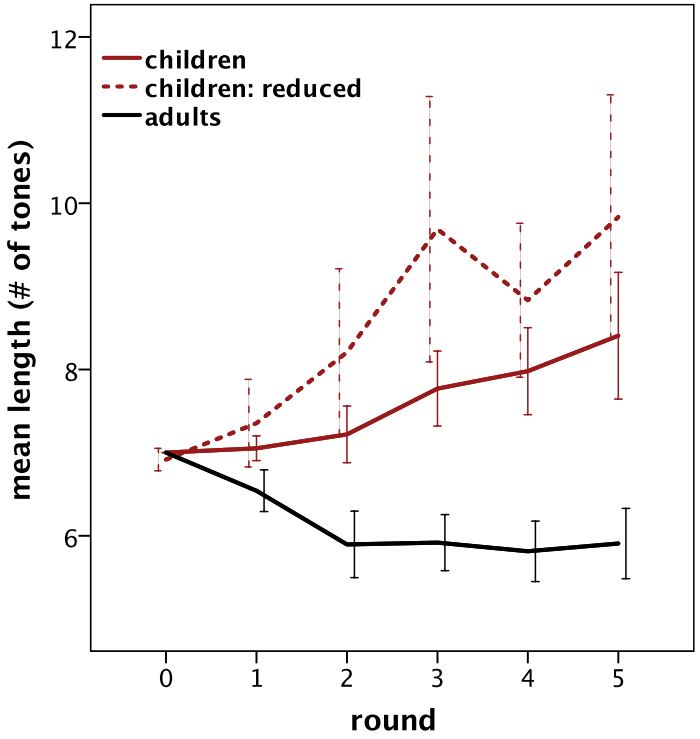


Still no alignment.

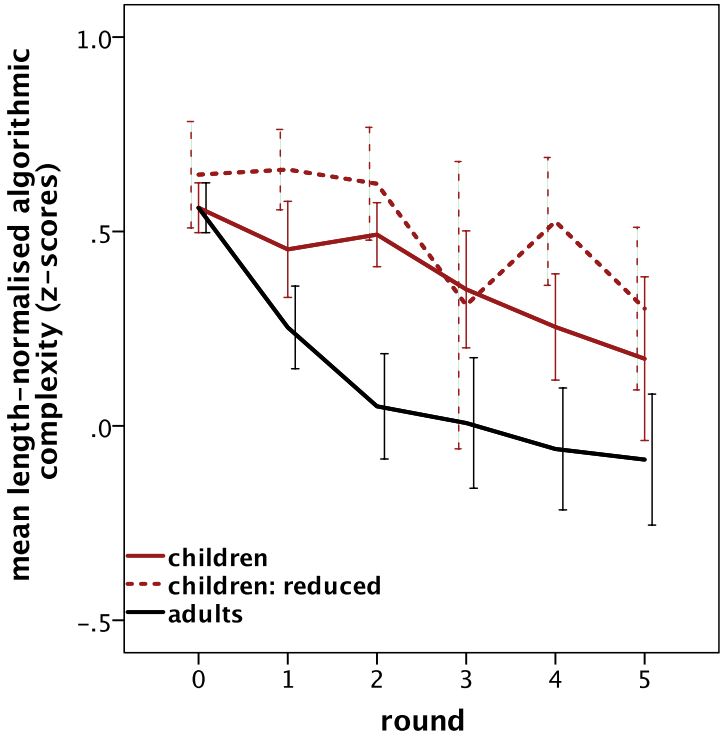
Kempe (2017)

Sign Refinement

signal length



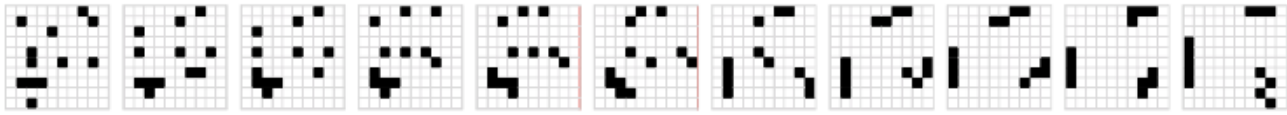
signal structure

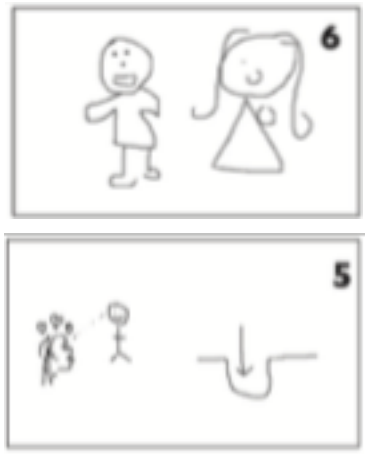


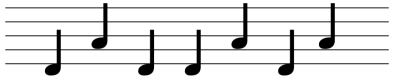
Still no refinement / symbolisation.

Kempe (2017)

Hang on! What about….?



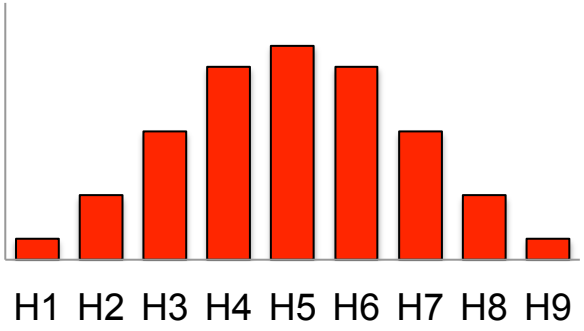


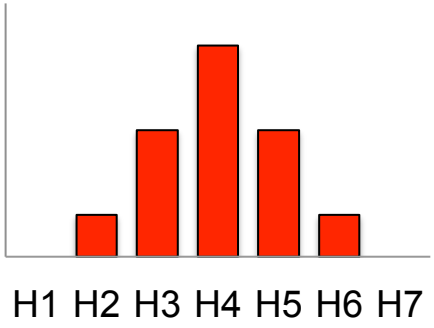


Motivated and refined signs depend on prior familiarity with the signalling domain.

- Shared cultural knowledge about the domain is learned.
- Many cross-modal associations are experience-based / learned too (Spence, 2011).

If there is no prior knowledge inventing and refining motivated signs is difficult!

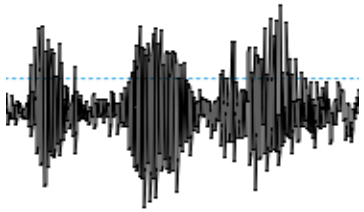


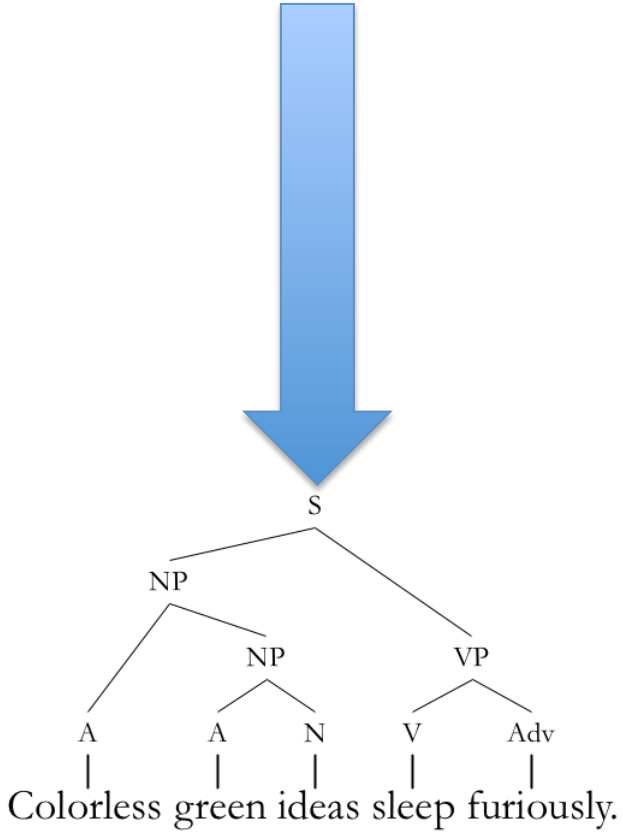


Summary: Children

- **Motivated signs:**
  - **Children display little ambiguity avoidance, either due to limited Theory of Mind or limited cognitive capacity or both.**
  - **Children's reduced shared cultural knowledge and experience appear to limit their ability to produce motivated signs.**
- **Alignment:**
  - **Cognitive capacity limitations may make it difficult to keep track of interlocutor output necessary for alignment.**
  - **Children seem to lack understanding that signs are shared conventions and, hence, need to be aligned.**
- **Refinement / Symbolisation:**
  - **In the absence of structurally simpler priors children show little evidence for refinement and symbolisation. Given that the ability to compress *per se* does not much improve with age** (Mathy et al., 2016)**, this also points to pragmatic deficits.**

Outlook




S
NP
NP
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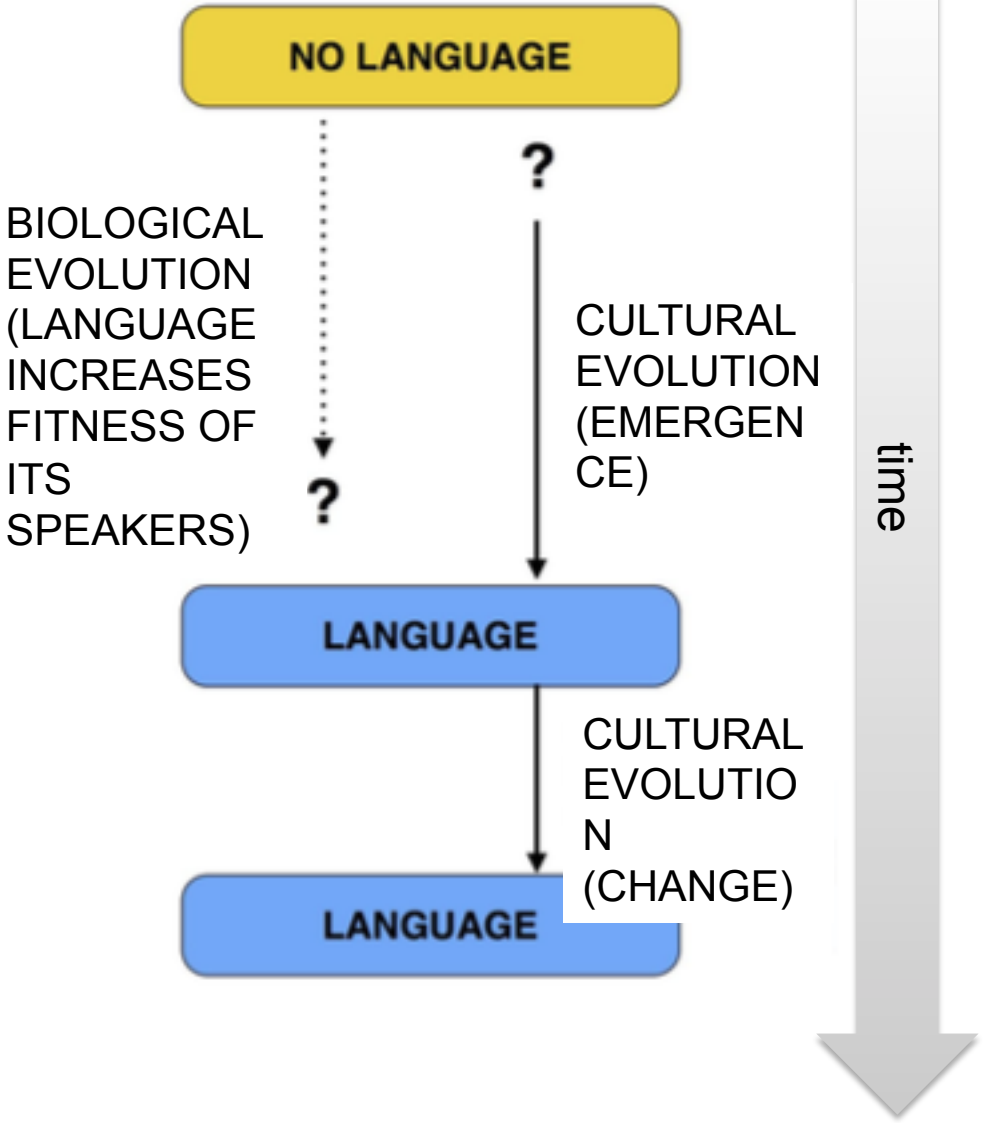
Adv
Colorless green ideas sleep furiously.


NO LANGUAGE
?
BIOLOGICAL EVOLUTION (LANGUAGE INCREASES FITNESS OF ITS SPEAKERS)
?
CULTURAL EVOLUTION (EMERGENCE)
LANGUAGE
CULTURAL EVOLUTION (CHANGE)
LANGUAGE
time

slides at: https://language.abertay.ac.uk/SSoL2018/

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