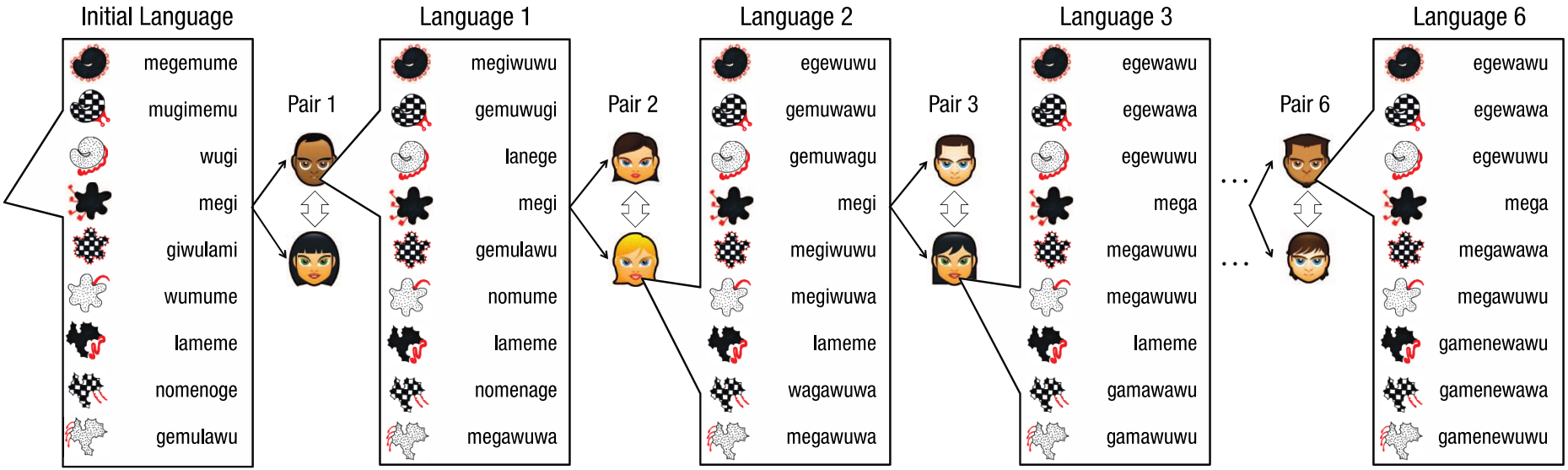
Origins and Evolution of Language
Week 9: Sign language as a window into language origins

Kenny Smith

kenny.smith@ed.ac.uk

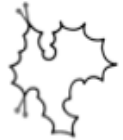
Finishing off from last week's lecture, and picking up on last week's tutorial

Kirby, Tamariz, Cornish & Smith (2015): Adding communication

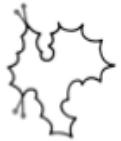


Kirby, S., Tamariz, M., Cornish, H., & Smith, K. (2015). Compression and Communication in the Cultural Evolution of Linguistic Structure. *Cognition, 141*, 87-102.

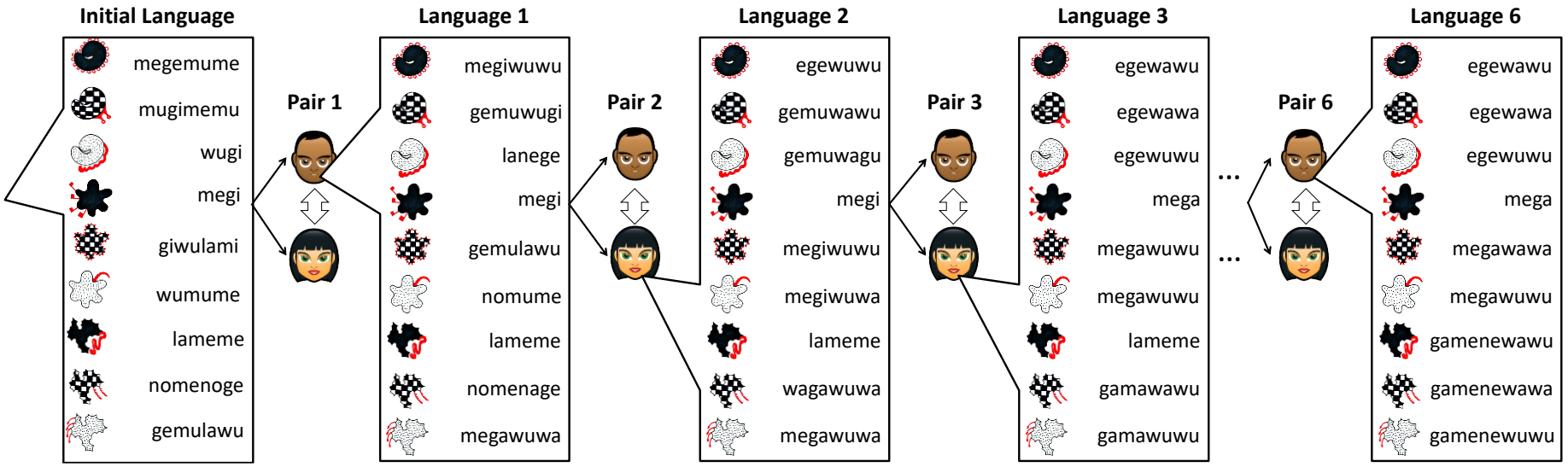
An initial language

 megemume	 megi	 lameme
 mugimemu	 giwulami	 nomenoge
 wugi	 wumume	 gemulawu
 lamege	 wulamugi	 megiwuwa

A final language from a chain

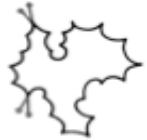
 egewawu	 mega	 gamenewawu
 egewawa	 megawawa	 gamenewawa
 egewuwu	 megawuwu	 gamenewuwu
 ege	 wulagi	 gamane

Kirby, Tamariz, Cornish & Smith (2015): Adding communication, removing learning



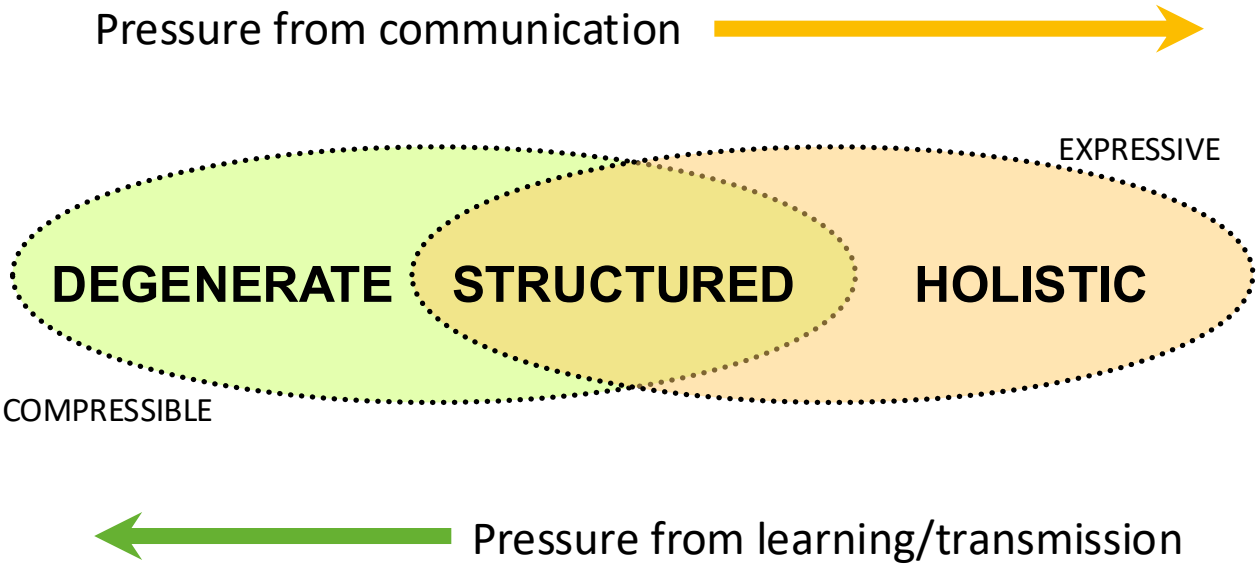
Kirby, S., Tamariz, M., Cornish, H., & Smith, K. (2015). Compression and Communication in the Cultural Evolution of Linguistic Structure. *Cognition, 141*, 87-102.

A final **holistic** language from a dyad

 manunumoko	 moko	 konu
 wekihumanunu	 mokowekihu	 lawa
 makihu	 mahiku	 wekihulawa
 manunumonu	 nomu	 wekihu

Learnability + expressivity = **structure**

Structure as a trade-off between compressibility and expressivity that plays out over cultural transmission



What about the beautiful adaptive fit between the structure of our thoughts and the structure of language?

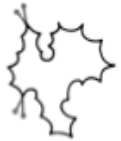
Reminder from week 2
Pinker & Bloom (1990)





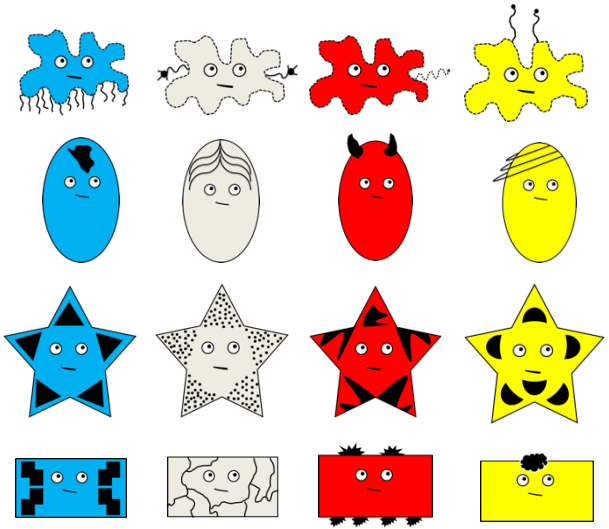
"All we have argued is that human language, like other specialized biological systems, evolved by natural selection. Our conclusion is based on two facts that we would think would be entirely uncontroversial: Language shows signs of complex design for the communication of propositional structures, and the only explanation for the origin of organs with complex design is the process of natural selection." (p. 726)

Pinker, S., & Bloom, P. (1990). Natural language and natural selection. *Behavioural and Brain Sciences, 13,* 707-784.

 egewawu	 mega	 gamenewawu
 egewawa	 megawawa	 gamenewawa
 egewuwu	 megawuwu	 gamenewuwu
 ege	 wulagi	 gamane

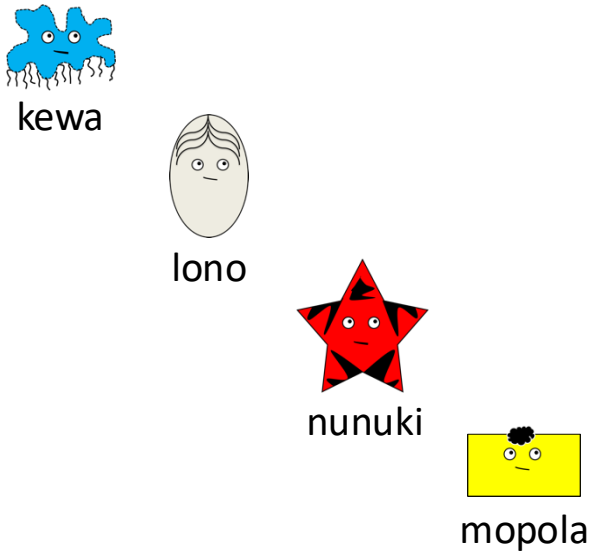
The structure of the communicative task affects the kinds of structures that emerge

E.g. Winters, J., Kirby, S., & Smith, K. (2018). Contextual predictability shapes signal autonomy. *Cognition, 176,* 15-30.



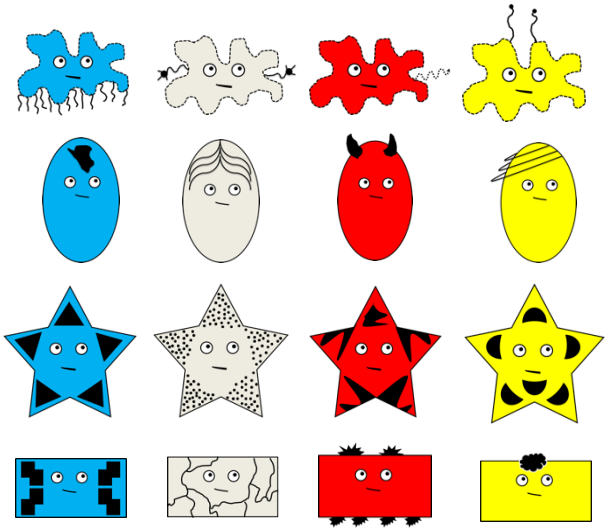
The structure of the communicative task affects the kinds of structures that emerge

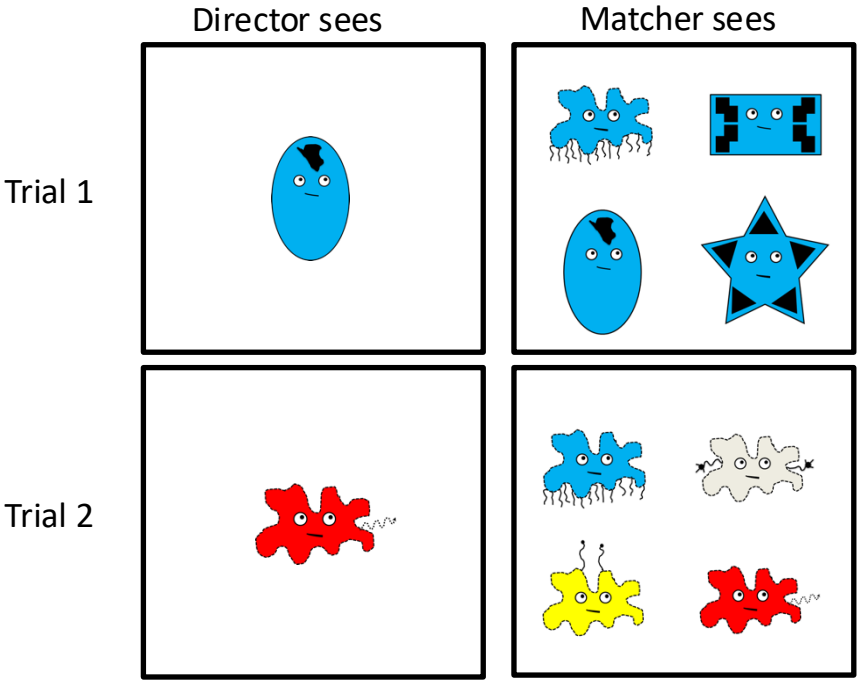
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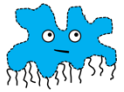


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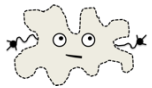
E.g. Winters, J., Kirby, S., & Smith, K. (2018). Contextual predictability shapes signal autonomy. *Cognition, 176,* 15-30.




Director sees
Matcher sees
Trial 1
Trial 2
...



mege-ha



mege-hi



mege-hu



megi-lo



waka-ha



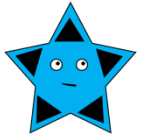
waka-hi



waka-hu



waki-lo



goko-ha



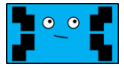
goko-hi



goko-hu



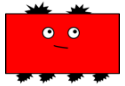
goki-lo



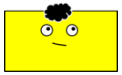
kuki-ha



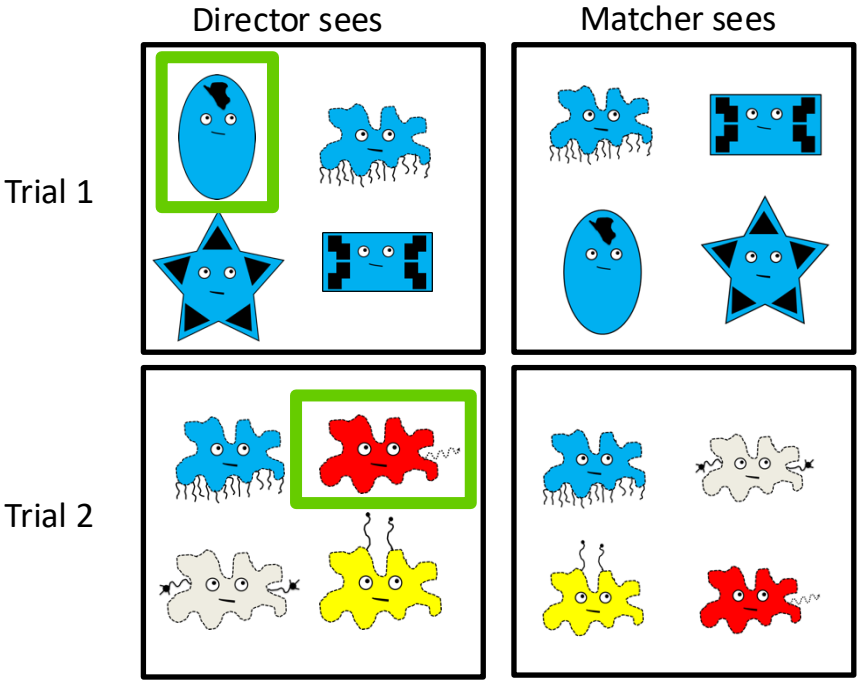
kuko-hi



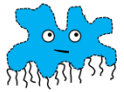
kuko-hu

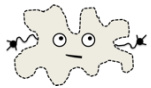


kuki-lo


Director sees
Matcher sees
Trial 1
Trial 2
...

On shape-relevant trials …


kewu


kewu


kewu

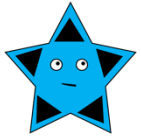

kewu


nunuki

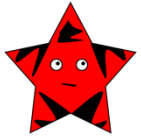

nunuki


nunuki

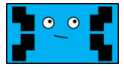

nunuki


lono

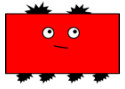

lono

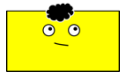

lono


lono


mopola

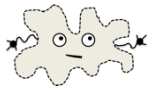

mopola


mopola


mopola

On colour-relevant trials…


kewu mopola


kewu nunuki


kewu lono

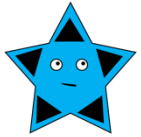

kewu kewu


nunuki mopola


nunuki


nunuki lono

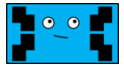

nunuki kewu


lono mopola

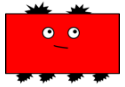

lono nunuki

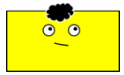

lono

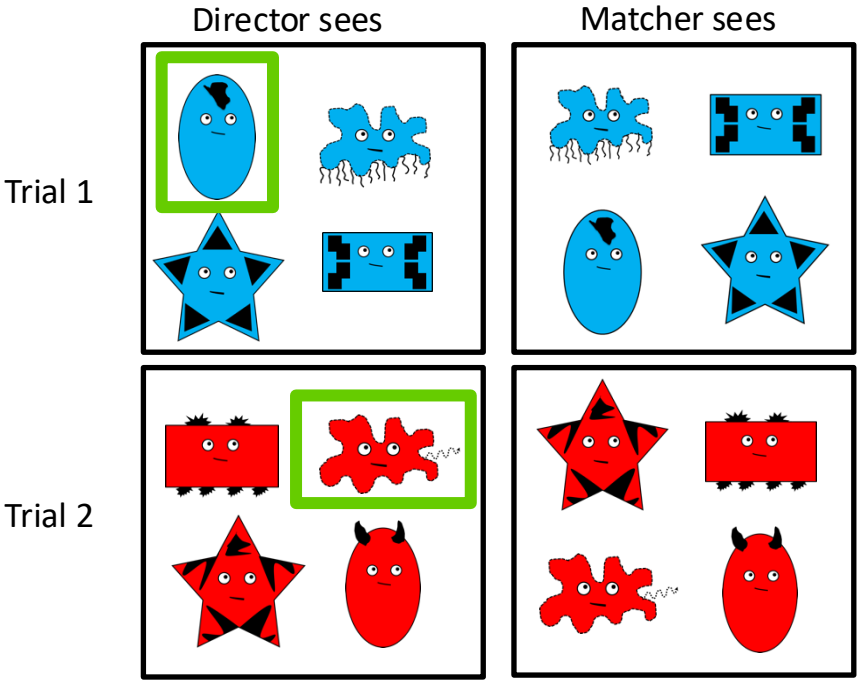

lono kewu


mopola mopola


mopola nunuki

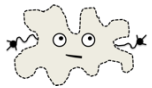

mopola lono


mopola kewu


Director sees
Matcher sees
Trial 1
Trial 2
...



hagolo



hagolo



hagolo



hagolo



nuhumi



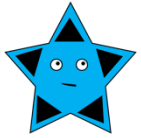
nuhumi



nuhumi



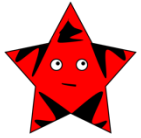
nuhumi



winigo



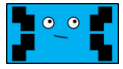
winigo



winigo



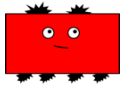
winigo



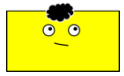
kamu



kamu



kamu



kamu

A question from the pre-lecture quiz

“Could you explain what generalisation pressure means (Smith 2022 reading) and whether it counteracts or works alongside pressures of simplicity and expressivity?

Reminder from week 2
Pinker & Bloom (1990)





"All we have argued is that human language, like other specialized biological systems, evolved by natural selection. Our conclusion is based on two facts that we would think would be entirely uncontroversial: Language shows signs of complex design for the communication of propositional structures, and the only explanation for the origin of organs with complex design is the process of natural selection." (p. 726)

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Reminder from week 2
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Pinker, S., & Bloom, P. (1990). Natural language and natural selection. *Behavioural and Brain Sciences, 13,* 707-784.

Cultural evolution of language: a summary

A uniformitarian approach

- We should attempt to explain the (hidden) past in terms of processes we can see operating in the present
- How far can we get in appealing only to the same processes we see shaping language in the present?

Language change

- (analogy-based) learning and (ostensive-inferential) use are important mechanisms

Language evolution

- Same processes can explain origins of symbols, compositionality, and duality of patterning
- At least in populations capable of the right kind of learning and use

Sign language as a window into language origins

Four **very different** occurrences of manual communication in language evolution research

1. Naturally-occurring gestural communication in great apes
   - E.g. Hobaiter, C. (2020). Gestural Communication in the Great Apes: Tracing the Origins of Language. In L. M. Hopper & S. R. Ross (Eds.), *Chimpanzees in Context: A Comparative Perspective on Chimpanzee Behavior, Cognition, Conservation, and Welfare,* (pp. 233-259). Chicago, IL: University of Chicago Press.
   - Also see week 3 workshop
2. Gestural communication in language-trained apes
   - E.g. Gardner, R.A. and Gardner, B.T. (1969). Teaching sign language to a chimpanzee. *Science, 165*, 664-672.
   - See also week 7 lectures on artificial grammar learning, animal production experiments

Four **very different** occurrences of manual communication in language evolution research

3. Manual communication as a novel linguistic medium for controlled experiments
   – E.g. gestural iterated learning experiments in this week's workshop

4. **Emerging sign languages as real-world "natural experiments"**
   – Show what kinds of linguistics systems develop under what constraints, in the real world (not the lab)

“National” sign languages

E.g. British Sign Language (BSL), Lingua dei Segni Italiana (LIS), American Sign Language (ASL), Auslan, …

Patterns of historical relatedness

- Old French Sign Language (LSF) -> ASL with influence from local languages
- BSL -> Auslan, New Zealand Sign Language (NZSL), with influence from Irish Sign Language

Substantial sociolinguistic variation

- see e.g. https://bslsignbank.ucl.ac.uk/regional/numbersigns/

These are **languages**!

- They have phonology, arbitrary and conventionalized lexicons, morphology, syntax, rich sociolinguistics, …
- They can be used for all the things spoken languages can be used for
- They are manual rather than spoken, so they sometimes solve similar problems in different ways
- They are relatively young, so relatively little grammaticalization has taken place

cat



flower



orange



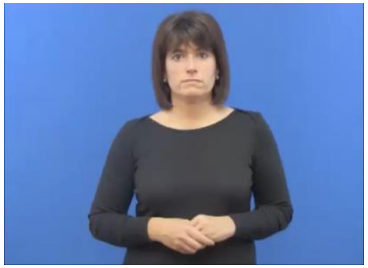
black



insurance



cheap



All BSL videos from https://www.signbsl.com

High frequency

Lower frequency

no



adventure



in



information



her



conversation



High frequency

Lower frequency

no



adventure



in



information



her



conversation



Phonology: handshape, orientation, location, movement, non-manual features (e.g. facial expression)

talk





work

afternoon





name

English basic word order: Subject-Verb-Object

BSL basic word order: Object-Subject-Verb

“The man crossed the bridge”



https://www.youtube.com/watch?v=IL_1poFZ-gc&t=48s

“Why was the black cat climbing the tree in your garden yesterday?”



https://www.youtube.com/watch?v=aJPfy2J7pJc&t=239s

Natural experiments

- Observational, real-world
- Individuals are exposed to different conditions that are determined by factors outside of the control of the investigator
  - Staggered introduction of carrier bag charges in UK nations
  - Minimum Unit Pricing for alcohol in Scotland vs Northern England
  - Differing Covid lockdown policies in Scotland vs England or globally

Natural experiments in sign language emergence

Whenever communities form where some or all individuals cannot access or use the ambient spoken language, new manual communication systems rapidly form

Homesign: isolated deaf children in hearing households

Small-community "village" sign languages: often rural communities with high proportion of deaf community members

Deaf community sign languages: in schools for deaf students; in cities where deaf communities form

Homesign

Relatively stable lexicons

- Same meaning, same form
- Iconicity important for communicating with non-signers
- Noun-verb distinction



From Goldin-Meadow, S. (2012). Homesign: gesture to language. In R. Pfau, M. Steinbach and B. Woll (Eds.) *Sign Language: An International Handbook* (pp 601-625). Berlin: De Gruyter Mouton.

Homesign



Stable word order tendencies

- OV
- SV

Inflection-like use of space

- you give me vs I give you

Possible evidence of hierarchy?

From Goldin-Meadow, S. (2012). Homesign: gesture to language. In R. Pfau, M. Steinbach and B. Woll (Eds.) *Sign Language: An International Handbook* (pp 601-625). Berlin: De Gruyter Mouton.

Homesign

Markers of past and future, negation, wh-words



From Goldin-Meadow, S. (2012). Homesign: gesture to language. In R. Pfau, M. Steinbach and B. Woll (Eds.) *Sign Language: An International Handbook* (pp 601-625). Berlin: De Gruyter Mouton.

Al-Sayyid Bedouin Sign Language

[See also: Kata Kolok (Indonesia), Adamarobe (Ghana), Central Taurus Sign Language (Turkey), …]

Bedouin community of 3500, with ≈ 130 deaf members

ABSL: village sign language, used by deaf and hearing

- Stable word order (SOV, unless object is pronoun then it's SVO)
- Little use of space for inflection (about 10% of the time)
- Morphology: compounding

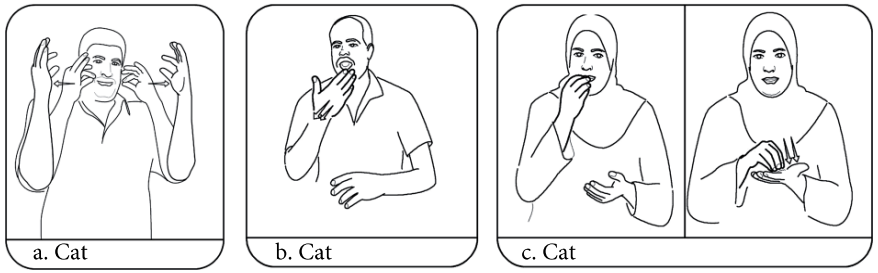


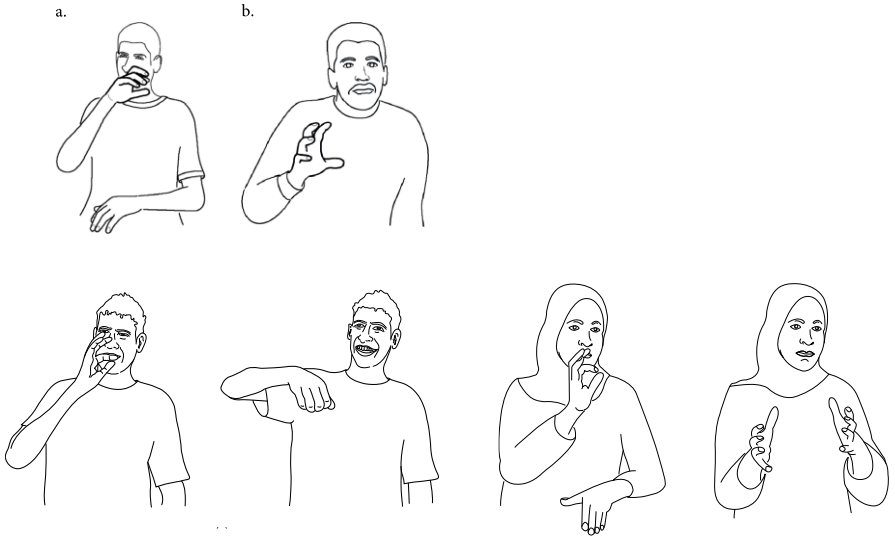




Meir, I., et al. (2012). The influence of community on language structure: Evidence from two young sign languages. *Linguistic Variation, 12, 247-291.*

https://en.wikipedia.org/wiki/Al-Sayyid,_Israel





Substantial lexical variation, no phonology?

Substantial inter-speaker / inter-family lexical variation

- Perhaps as a result (?) no evidence of phonology-like sublexical regularities

Sandler, W. et al. (2014). Language emergence: Al-Sayyid Bedouin Sign Language. In N. J. Enfield et al. (Eds.) *The Cambridge Handbook of Linguistic Anthropology* (pp. 250-284). Cambridge: CUP.

Patterned Iconicity



'handsaw'
handling (lexical)



'handsaw'
instrument (lexical)



'spoon'
handling



'spoon'
instrument

- Use of handshape for systematic distinction between nouns and verbs
- Seen in ASL, rapidly emerges in ABSL, present but much less sharp in non-signers

Padden, C. A., et al. (2013). Patterned iconicity in sign language lexicons. *Gesture, 13,* 287-308.



Nicaraguan Sign Language

Formed in schools for the deaf in Managua since the late 1970s. Current population of ≈ 3000 deaf members



- Evolving word order (broadly verb-final, but more complex when two animate entities involved, e.g. NVNV or NVVN)
- Increasingly systematic use of space for inflection
- Morphology: compounding
- Phonology?

A. Senghas, A. et al (1997). Argument structure in Nicaraguan Sign Language: The emergence of grammatical devices. In E. Hughes et al. (Eds.) *BUCLD 21*. Cascadilla Press.
Montemurro, K., et al. (2019). Grammaticalization of the Body and Space in Nicaraguan Sign Language. In M. M. Brown & B. Dailey (eds.) *BUCLD 43*. Cascadilla Press.

The emergence of conventions for more fine-grained distinctions



MAN WOMAN HIGH-FIVE

Symmetrical



MAN WOMAN PUNCH GET-PUNCHED, PUNCH GET-PUNCHED.

Reciprocal

Gleitman, L., et al. (2019). The emergence of the formal category “symmetry” in a new sign language. *Proceedings of the National Academy of Sciences, USA, 116,* 11705-11711.

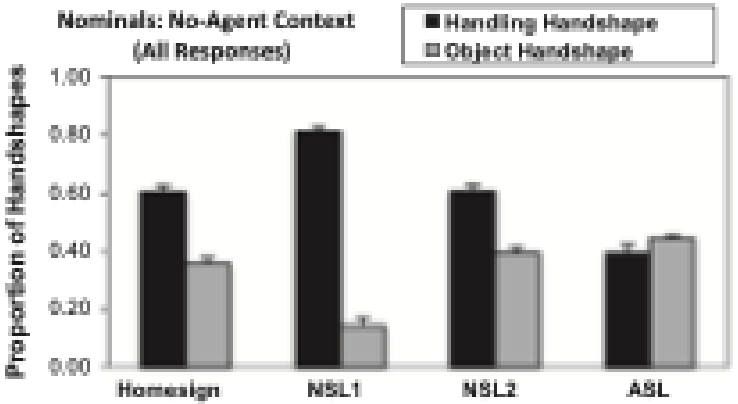
A question from the pre-lecture quiz

“”If participants were choosing the form that was the best (for them) iconic representation of an object to use as a label for that object in their nominals, that iconicity was overridden in their predicates– they always used the object handshape to represent the object when indexing its role in a no-agent event. In other words, iconicity was overridden when the handshape served as a morphological (grammatical) marker." (p. 390)

If iconicity influences the creation of individual signs, but grammatical functions can override iconicity, does this suggest that grammatical structure develops according to principles that are partly independent of the desire to represent meaning transparently? What does this tell us about the relationship between iconicity and grammatical organisation in the emergence of language?”

A question from the pre-lecture quiz

"Maybe I am missing it in the paper, but why does NSL1 seem to break the pattern in many places? For example, having the greatest proportion of handling handshapes for both no-agent and agent context nominals, and the lowest proportion of predicate no-agent object handshapes (albeit that one is a smaller difference)."



A question from the pre-lecture quiz

“What do the results from the homesigners suggest about non-linguistic thinking in non-human animals or in our pre-linguistic ancestors? For example, does it suggest that thinking propositions does not require a stable vocabulary but does require a grammatical structure to organise non-linguistic representations of things? And therefore, a way of structuring representations (like an innate grammar) emerged before stable linguistic symbols and communication?”

What does this tell us about language origins?

- Language emerges fast (in communities of modern humans)
- It needs a community
- Maybe stable lexicon, compositionality, stable word order established very early (as in homesign)?
- But gradual process of conventionalization, systematization (patterned iconicity, duality of patterning) and grammaticalization unfold **over generations**

The problem with natural experiments

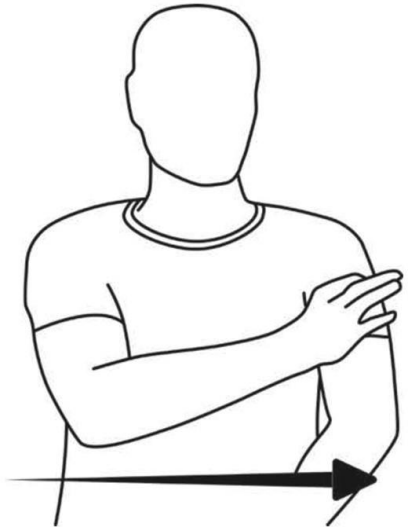
Some disagreement over core elements of the findings (e.g. potential influence of other established sign languages on Nicaraguan Sign Language)

Surprising amount of disagreement over the interpretation of these findings!

- Me: Ah what a beautiful example of how learning and use create structure!
- Senghas & Coppola, 2001, p. 323: "It has long been postulated that language is not purely learned, but arises from an interaction between environmental exposure and innate abilities. The innate component becomes more evident in rare situations in which the environment is markedly impoverished. … sequential cohorts of interacting young children collectively possess the capacity not only to learn, but also to create, language"

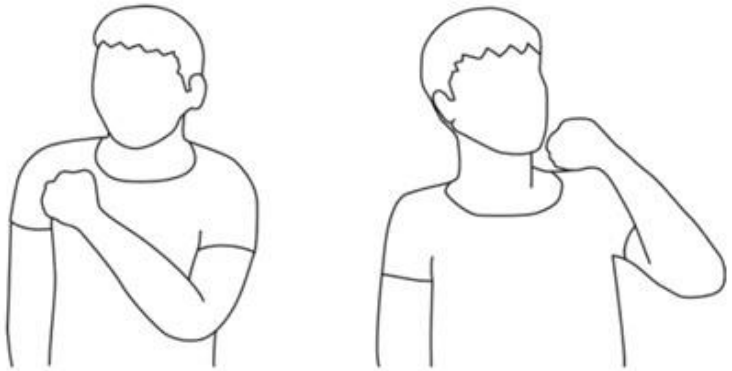
Spatial modulation

Spatial modulation with referential loci



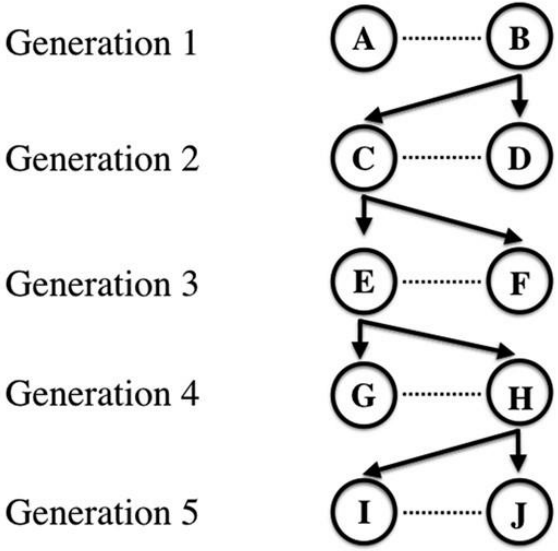
BOY-IX$_b$ GIRL-IX$_a$ $_a$**ask**$_b$
'The girl asks the boy'

Role shift



MAN [SWINGS-FIST]; (body-shift) FIST-GRAZES-CHEEK
'The man swung at his cheek.'

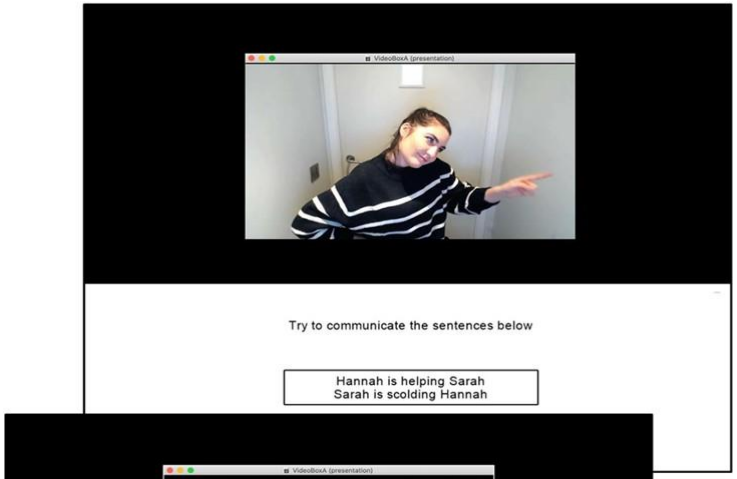
An iterated learning experiment **with adults**

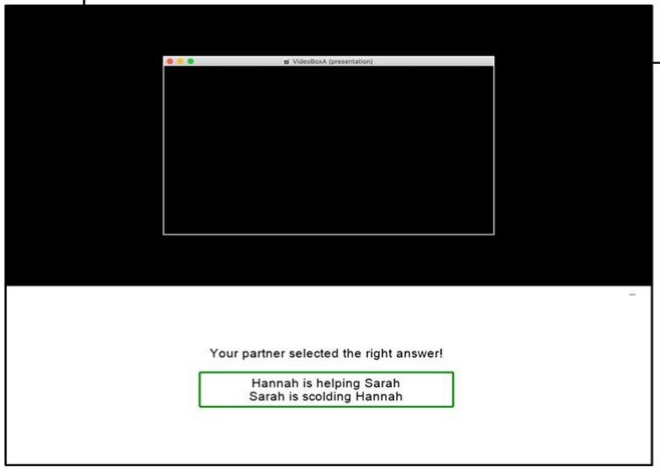


TARGET PAIR	Hannah is helping Sarah Sarah is scolding Hannah
Foil 1. DIFFERENT VERB FROM CATEGORY	Hannah is **praising** Sarah Sarah is **phoning** Hannah
Foil 2. DIFFERENT AGENT CONFIGURATION	Hannah is helping Sarah **Hannah** is scolding **Sarah**
Foil 3. BOTH DIFFERENT	Hannah is **praising** Sarah **Hannah** is **phoning Sarah**

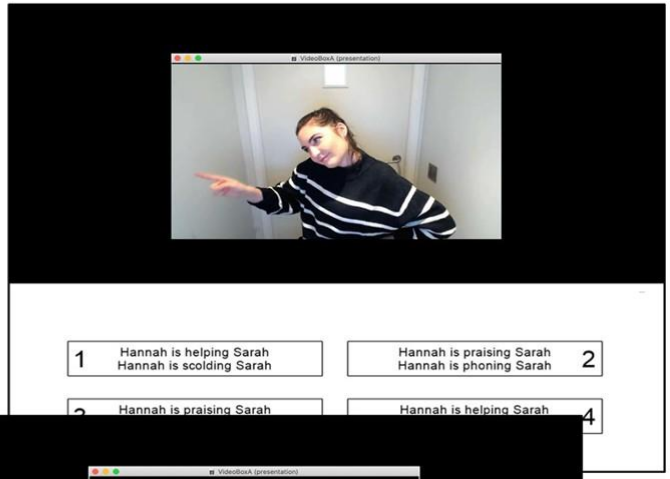
Motamedi, Y., et al. (2021). The emergence of systematic argument distinctions in artificial sign languages. *Journal of Language Evolution, 6,* 77-98.

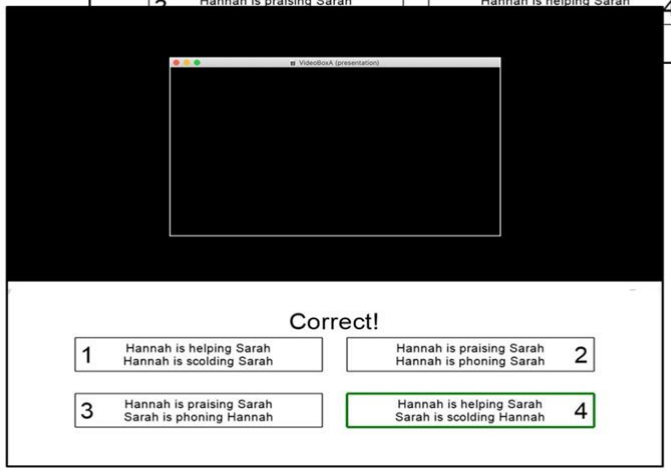
director view





matcher view





Lexical strategy (generation 5, chain 5)

Hannah is swimming to Sarah, Sarah is running to Hannah



Sarah is praising Hannah, Hannah is scolding Sarah



Body shift (Generation 5, chain 2)

Sarah is sending a letter to Hannah, Hannah is giving a book to Sarah,



Hannah is phoning Sarah, Sarah is praising Hannah



Spatial modulation (Generation 3, chain 3)

Hannah is giving a book to Sarah, Sarah is sending a letter to Hannah



Hannah is praising Sarah, Sarah is phoning Hannah



The role of **the child** in creating structure?

"sequential cohorts of interacting young children collectively possess the capacity not only to learn, but also to create, language" (Senghas & Coppola, 2001, p. 323)

- Can get some of the same kinds of solutions to the same kinds of problems **with adults**, in the lab
- Transmission and communication key, not children per se

Next up

- Workshop
  - Artificial sign languages in the lab (another Motamedi paper)
- Next week
  - Last contentful week: gene-culture co-evolution
- Week 11
  - Exam Q&A in lecture slot (attendance optional!)