



Communication and
Learning Lab

CAREGIVER RECONSTRUCTION OF CHILDREN'S ERRORS: THE PRESERVATION OF COMPLEXITY IN LANGUAGE

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LANGUAGES CHANGE

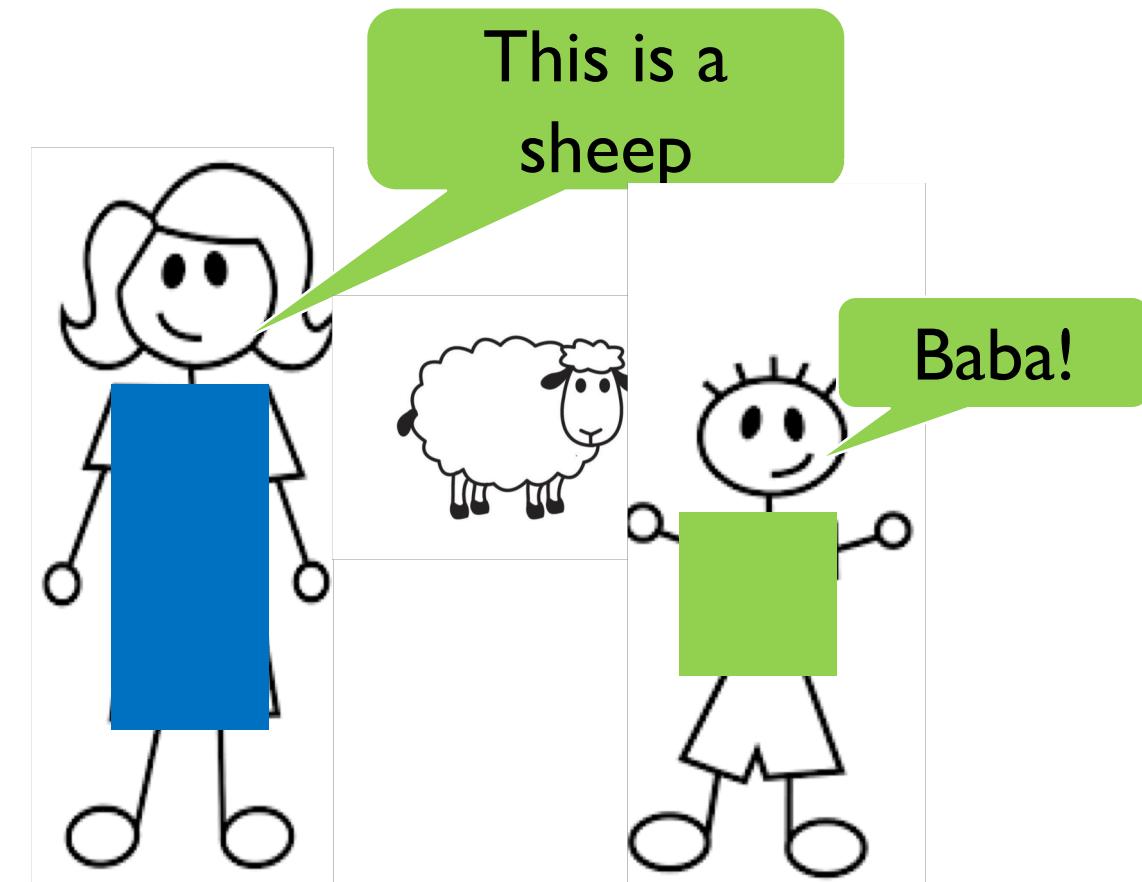
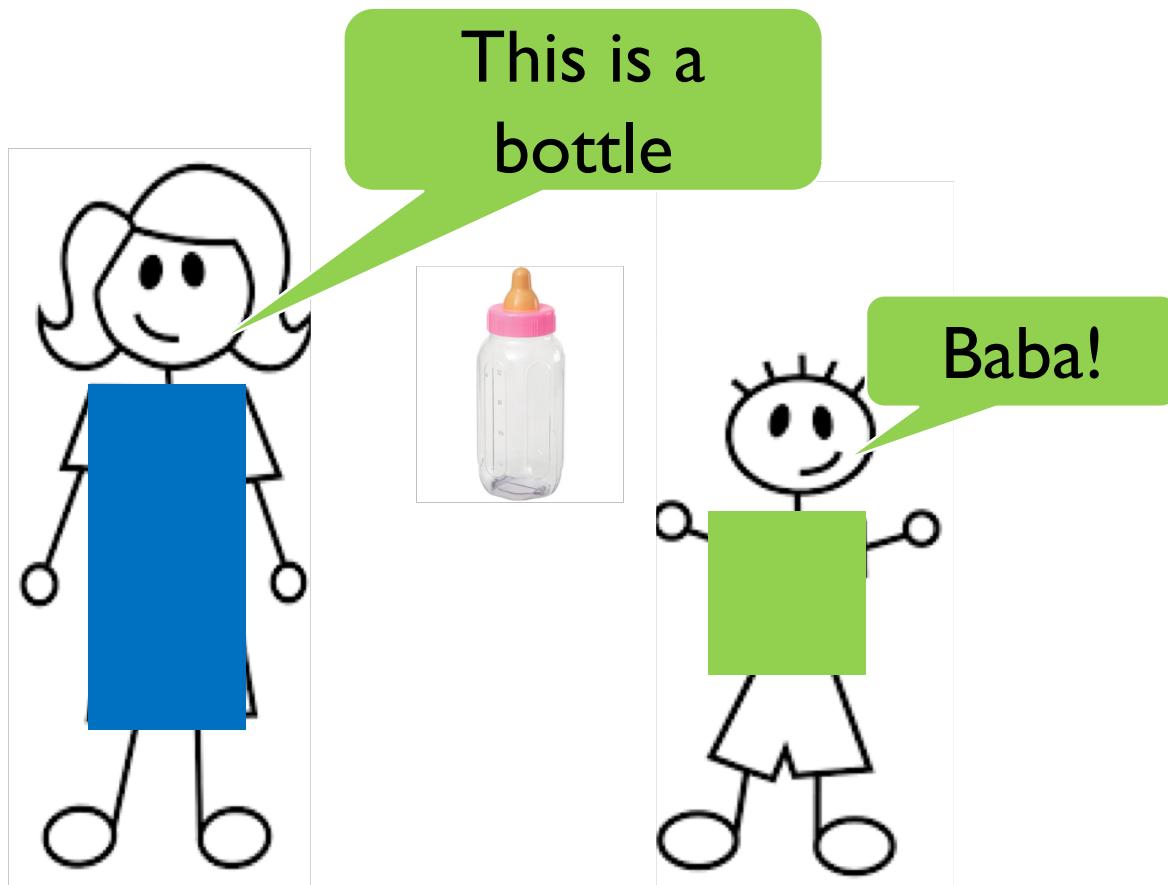
Old English (450 – 1150 BCE)	Modern English
heorte	heart
brodor	brother
thou	×

WHY DO LANGUAGES EVOLVE?

- 1) Languages need to be **useful** and **descriptive**
- 2) Languages need to be easily **learnable** by new speakers

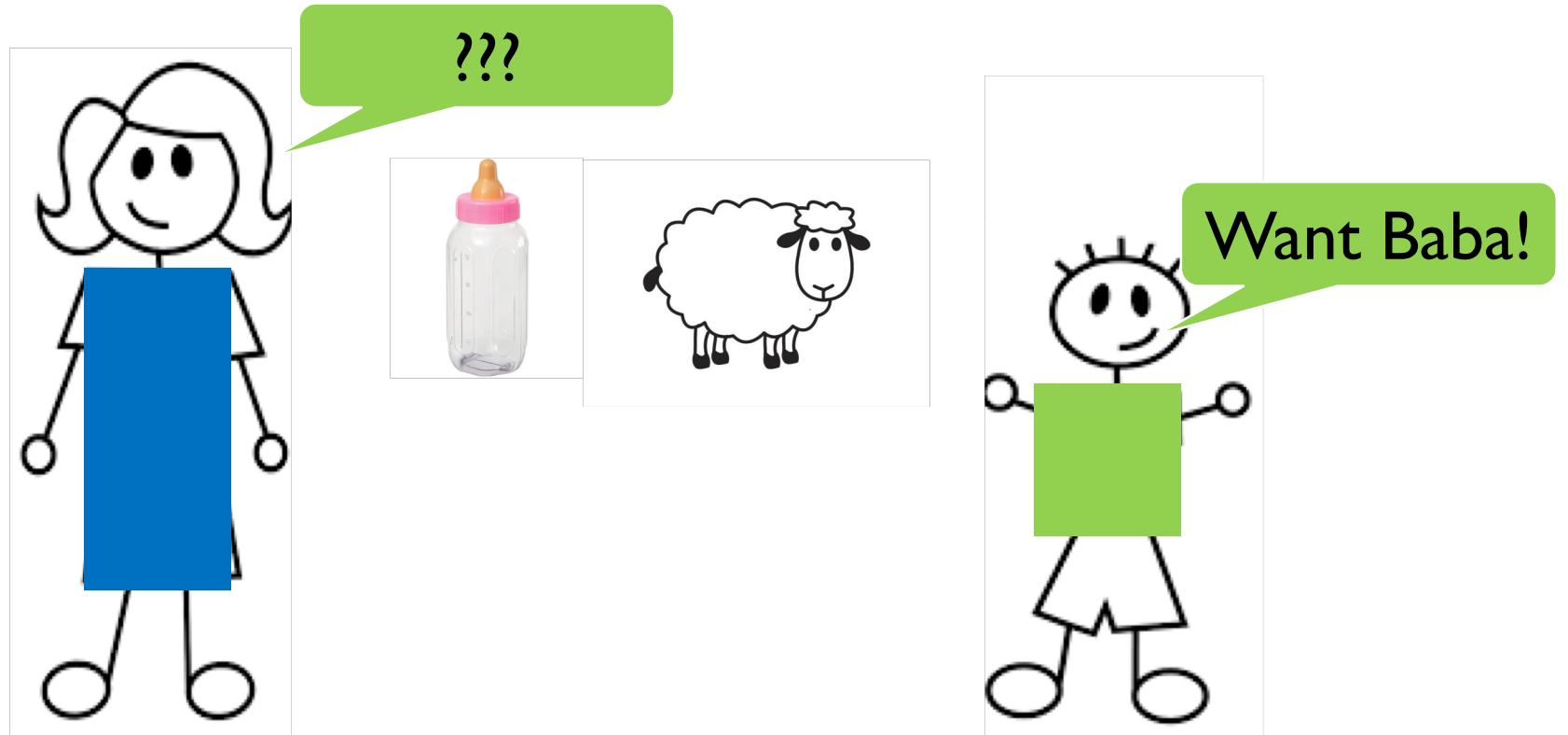
THESE PRESSURES ACT IN EVERYDAY INTERACTIONS

LEARNABILITY



THESE PRESSURES ACT IN EVERYDAY INTERACTIONS

DESCRIPTIVENESS

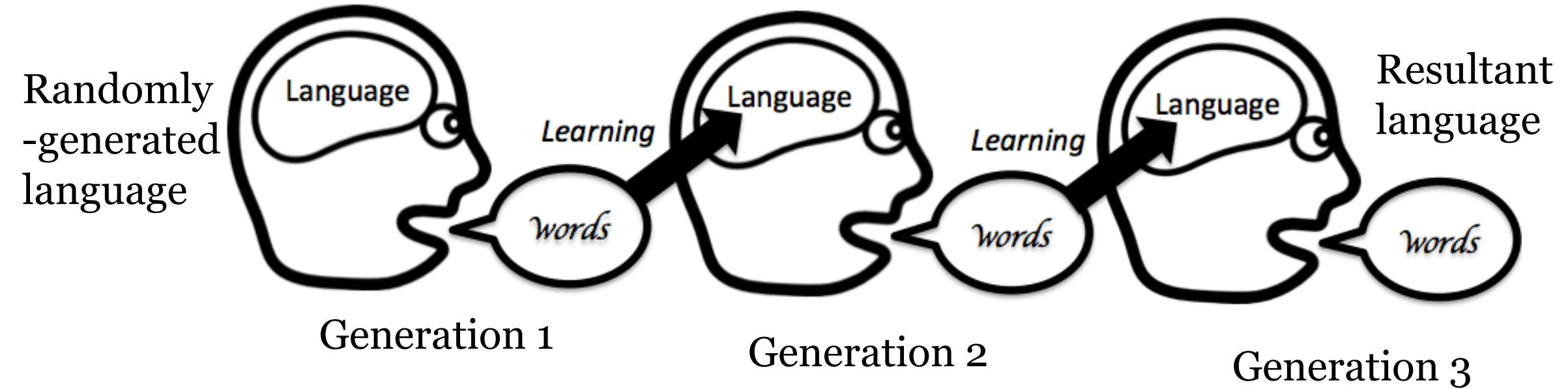


CHILDREN MIGHT RESPOND DIFFERENTLY TO THESE PRESSURES

- Children:
 - Often simplify words
 - Have less experience with language
 - Have different cognitive systems
 - Speak to different people

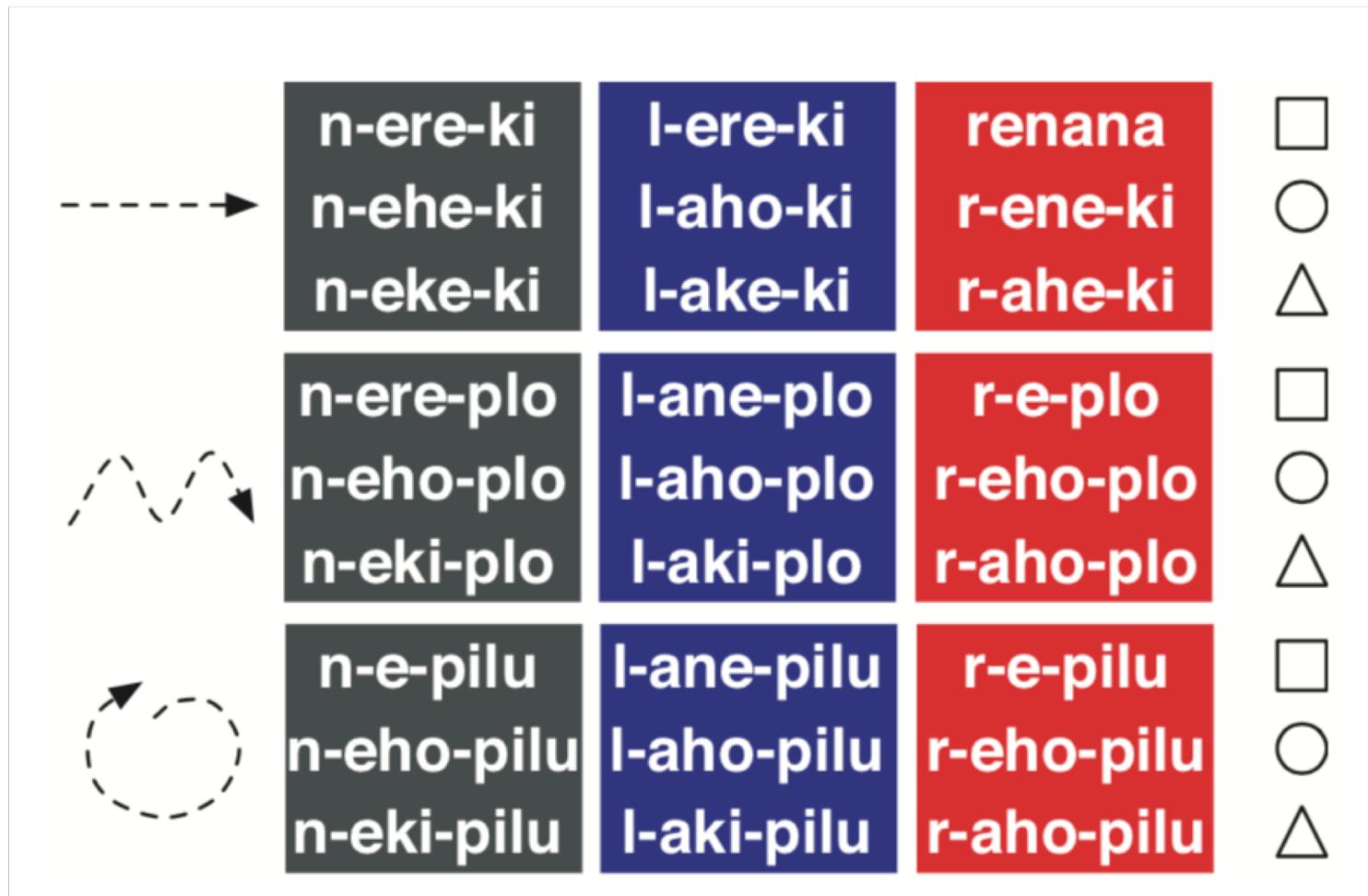


USING ITERATED LEARNING TO STUDY EVOLUTION



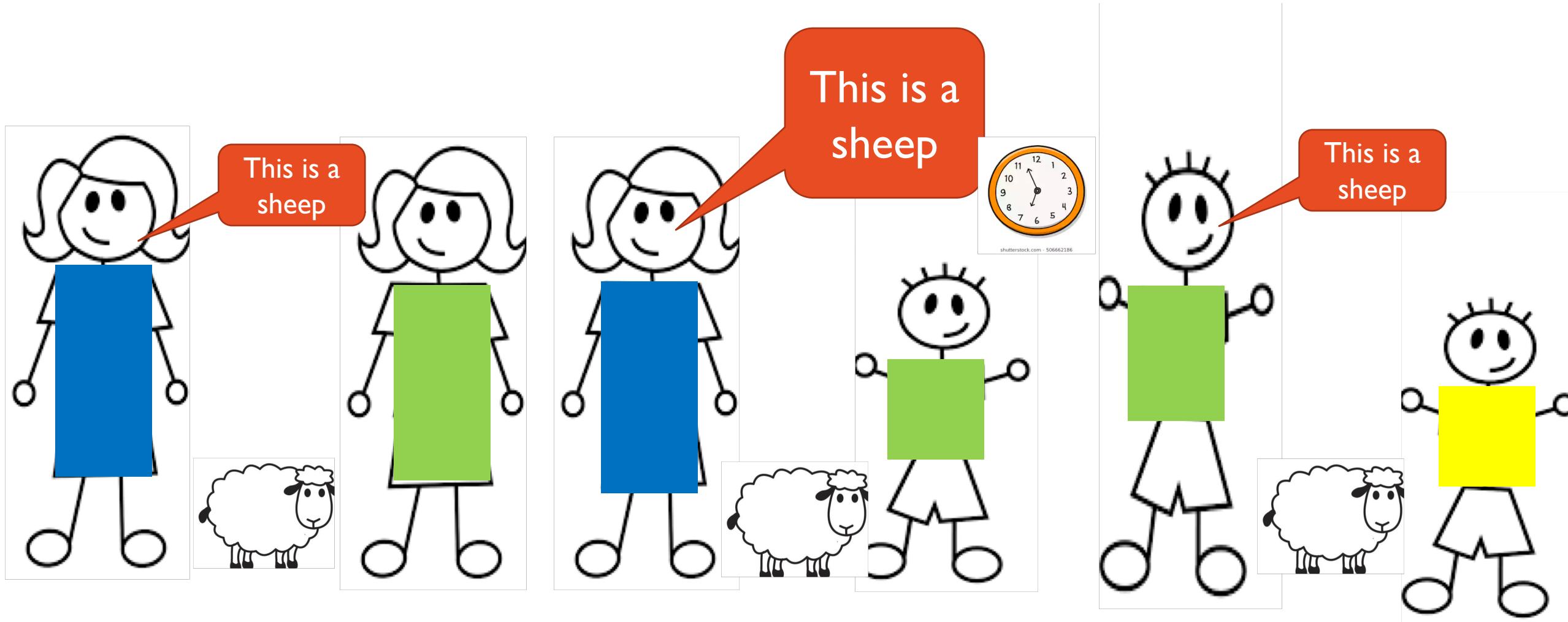
Kirby et al. (2008)

USING ITERATED LEARNING TO STUDY EVOLUTION

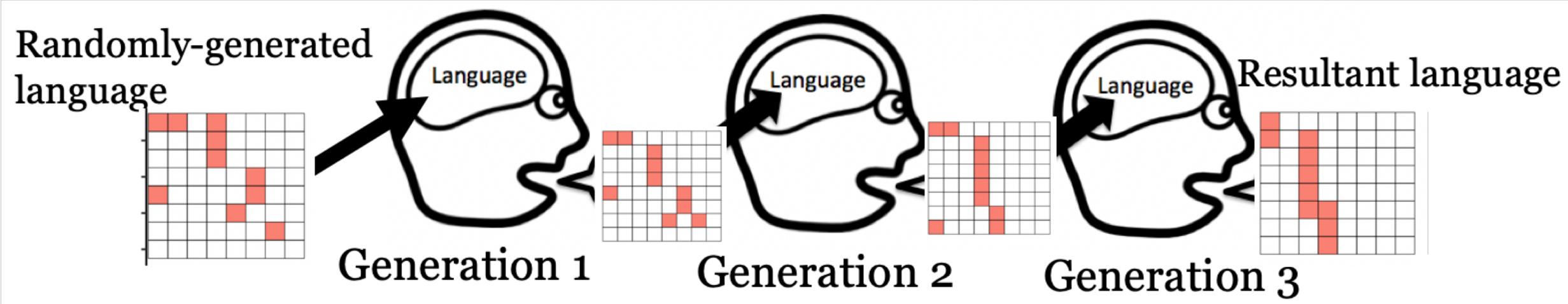


BUT...

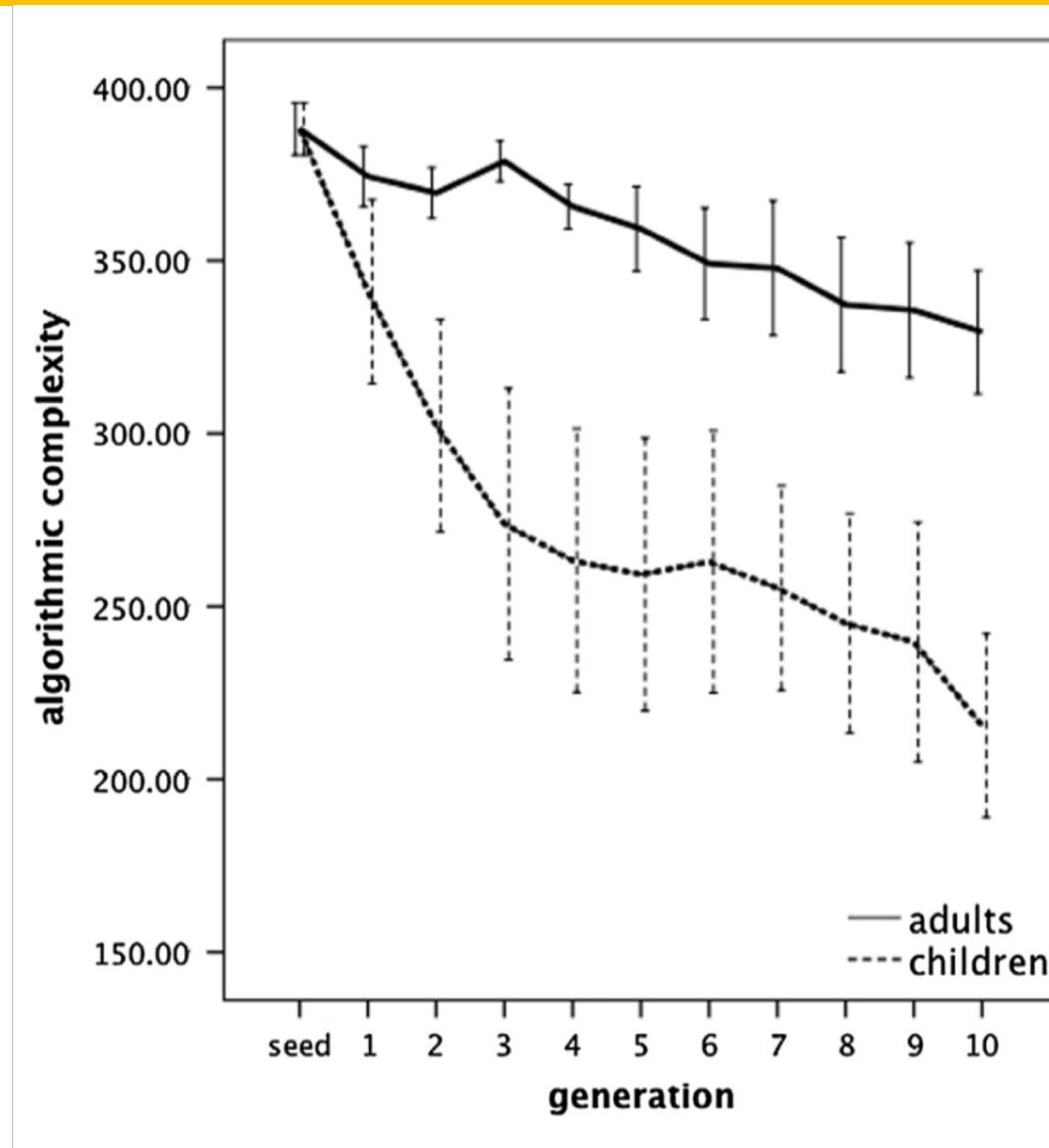
- This is not how generational transmission operates



ITERATED LEARNING STUDIES WITH CHILDREN



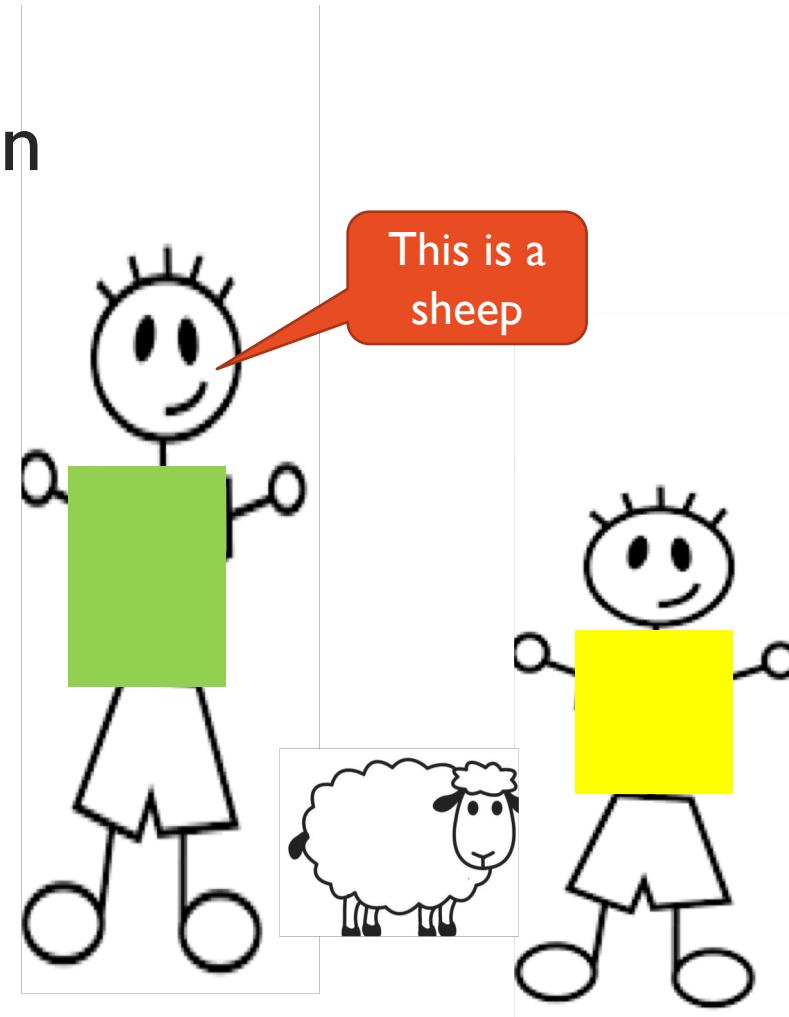
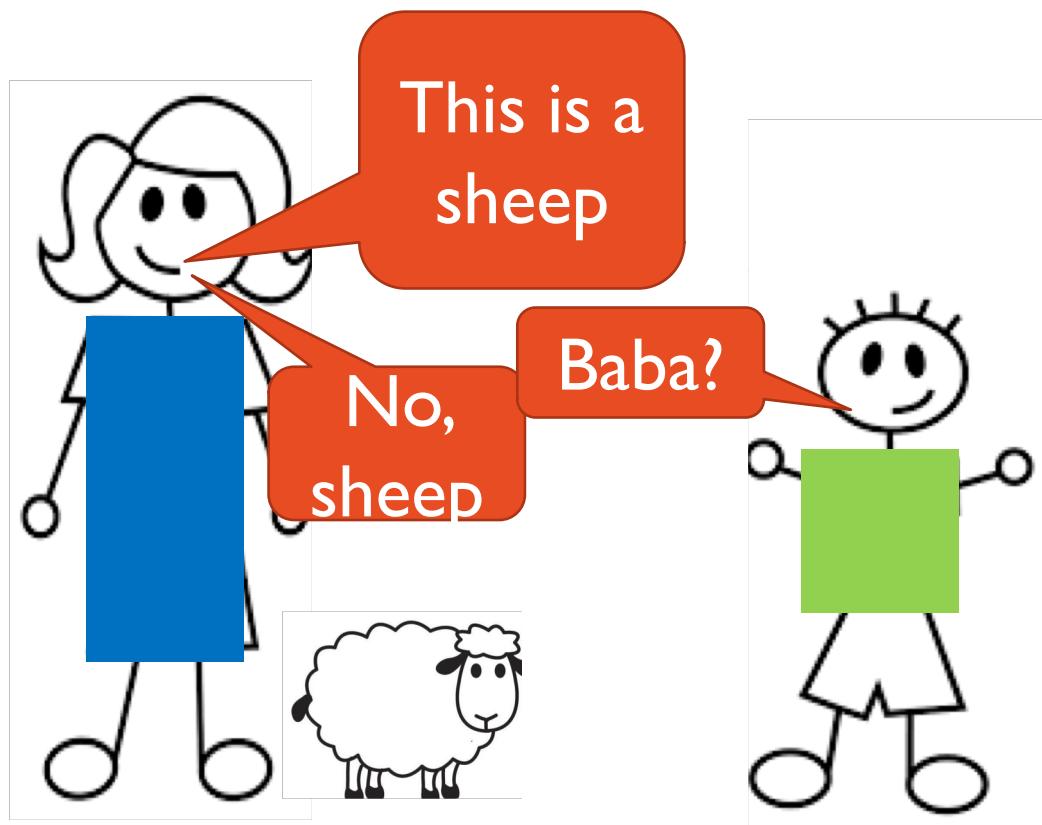
ITERATED LEARNING STUDIES WITH CHILDREN



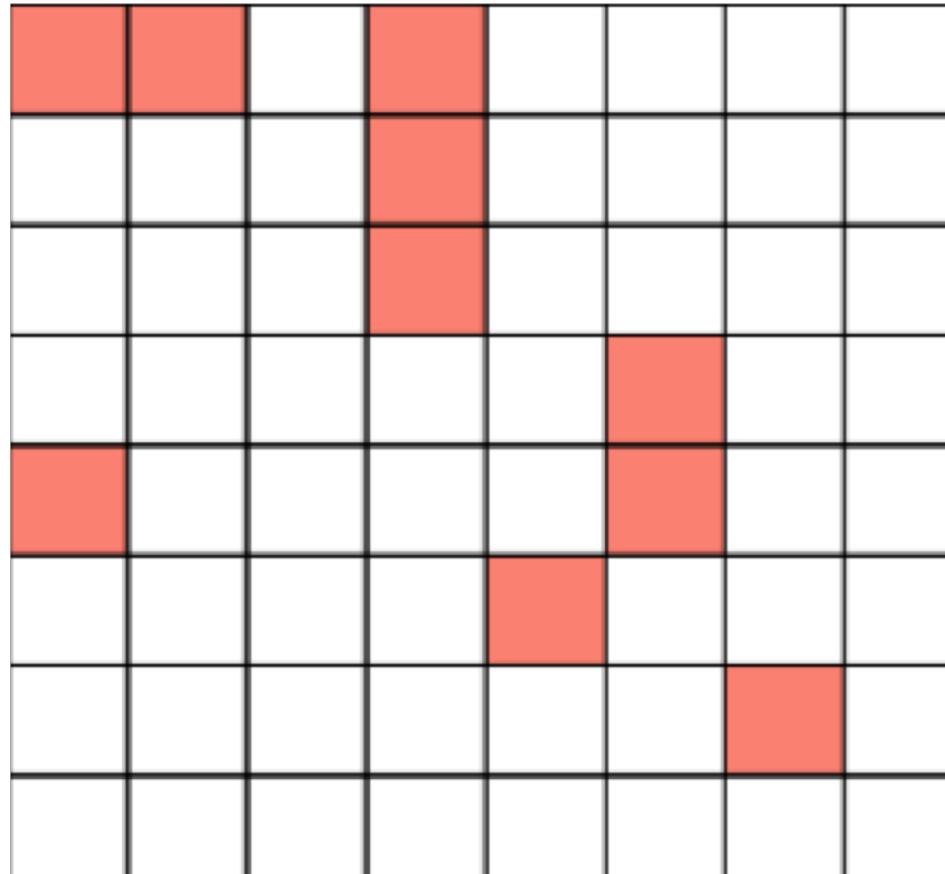
Kempe et al. (2015)

THIS IS STILL NOT HOW GENERATIONAL TRANSMISSION OPERATES

- Language is understood based on the listener's inferences and prior knowledge
- Predictions are subject to feedback and correction



EXPERIMENT I PARADIGM

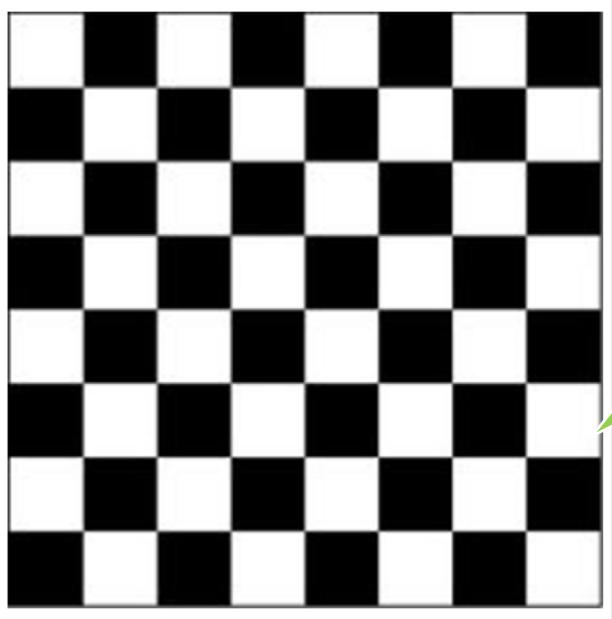


EXPERIMENT I PARADIGM

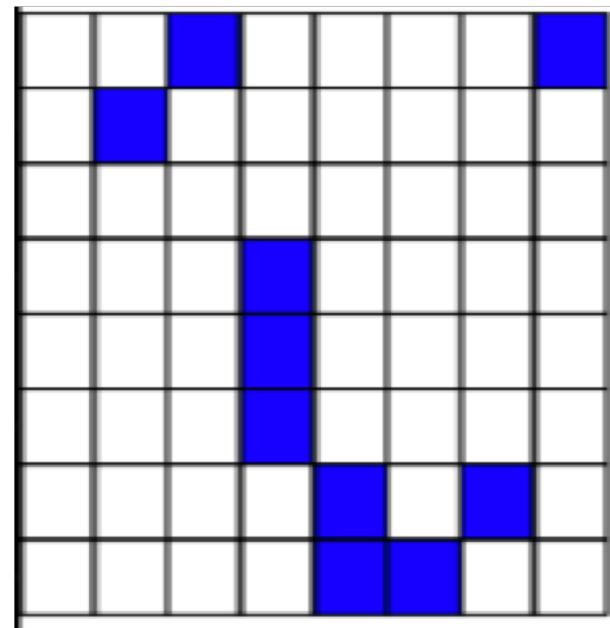
EXPERIMENT I: ADULT BASELINE

- 480 adults on Amazon Mechanical Turk
 - 40 separate chains of 12 generations
- Measured
 - Complexity
 - Percent Accuracy

ALGORITHMIC COMPLEXITY MEASURE

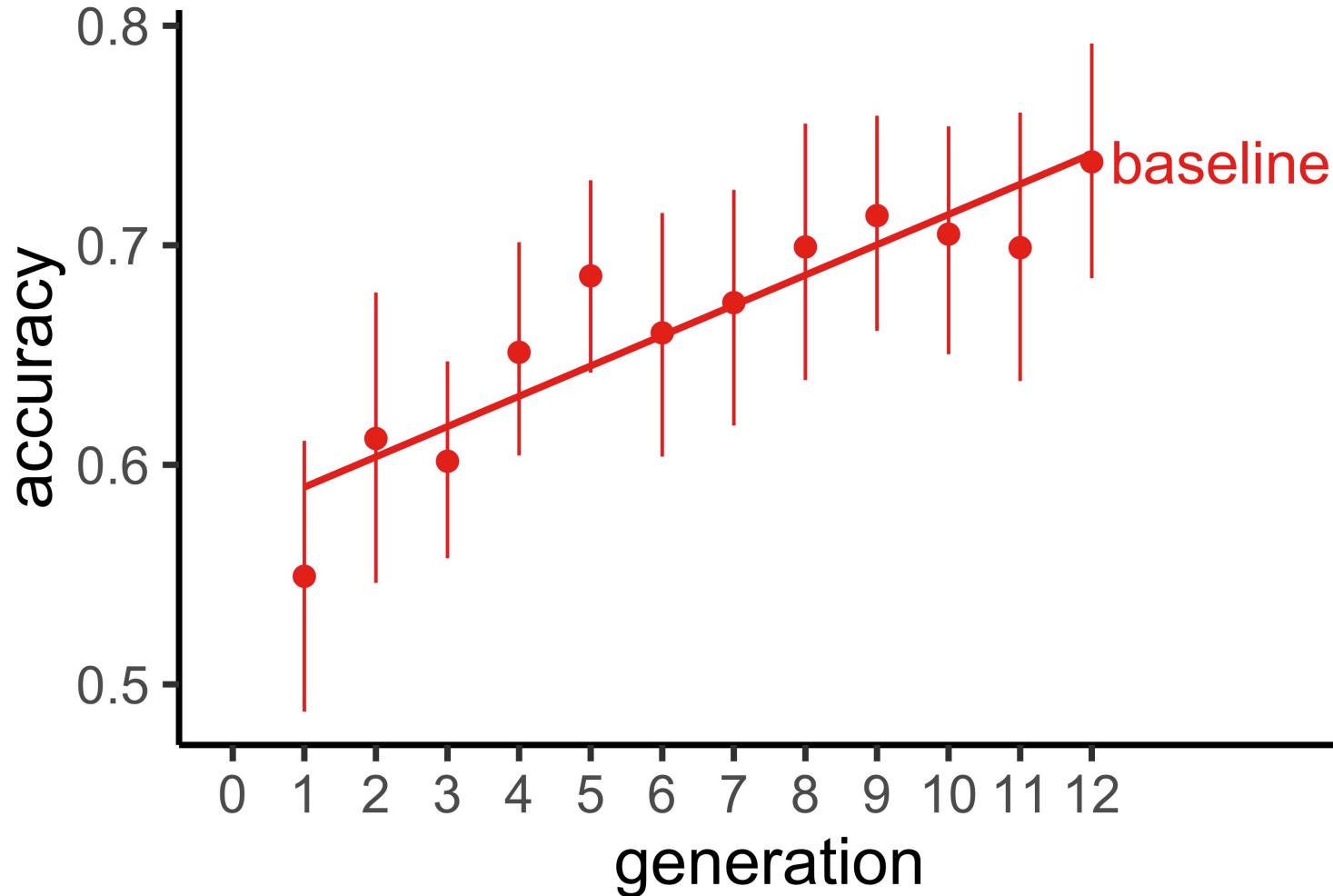


“fill in every other cell”

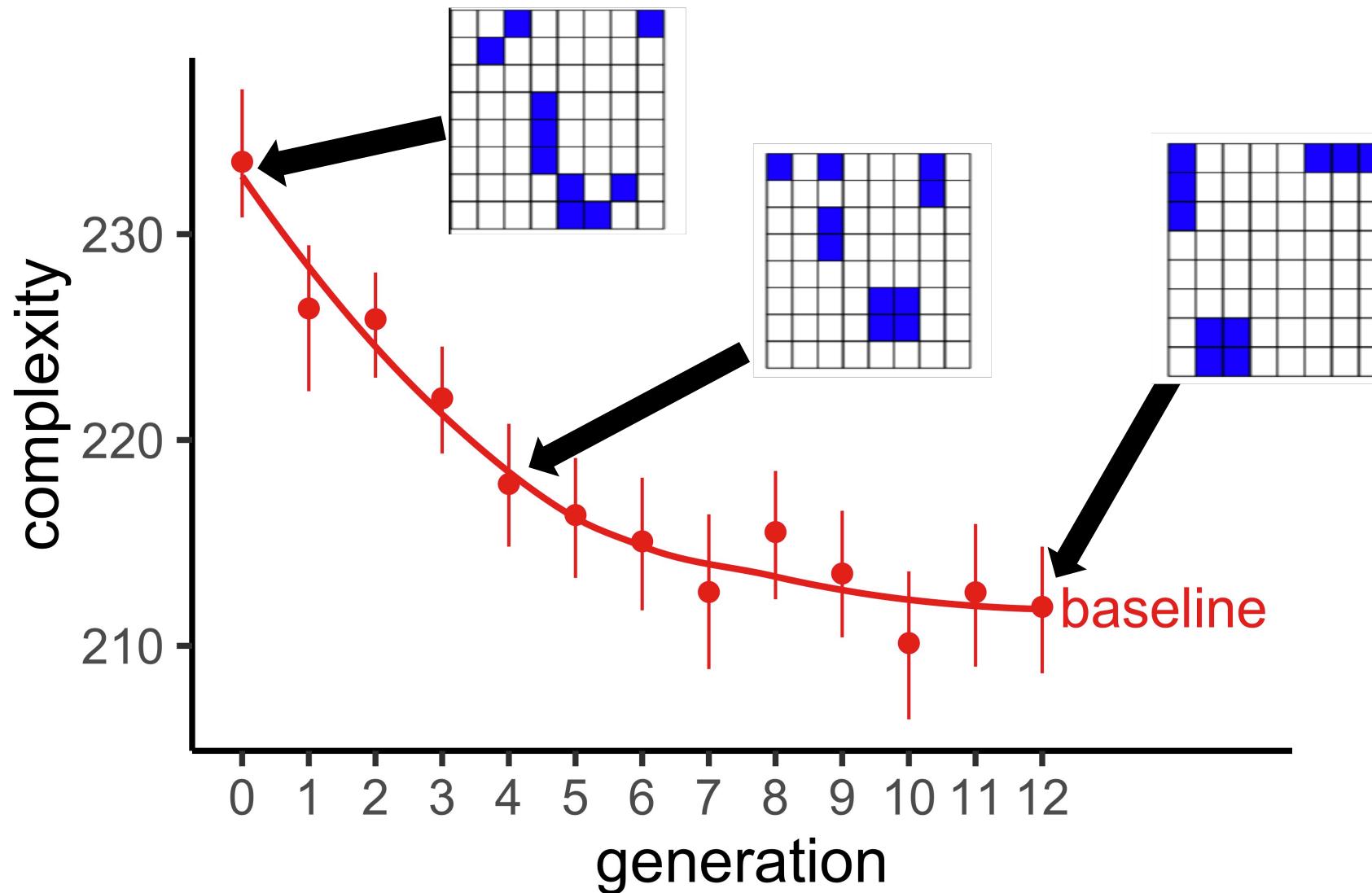


“fill in two cells diagonal in the top, one on the right hand corner, three that are third from the left, make an angular shape and add a diagonal.”

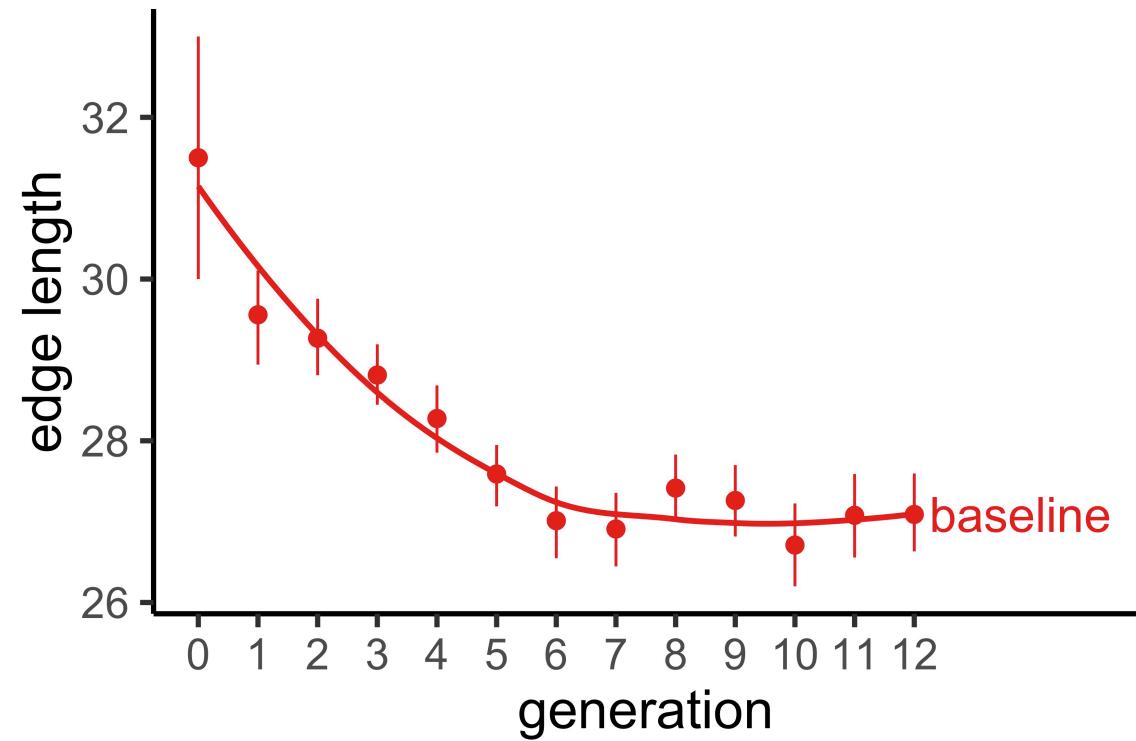
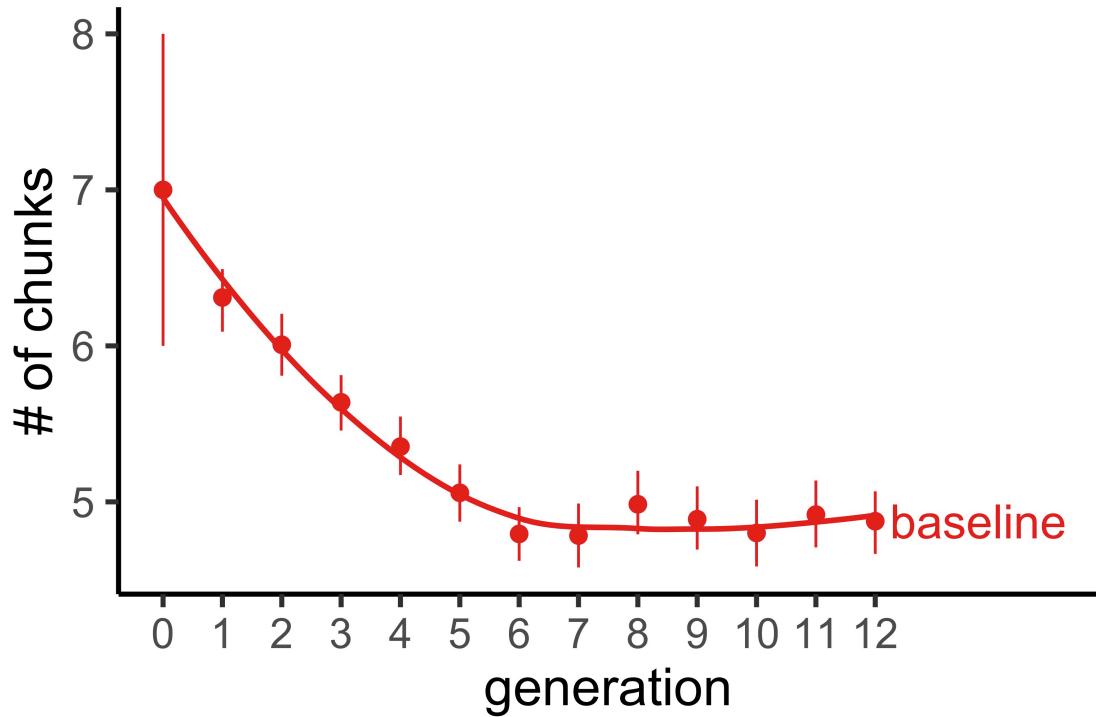
ACCURACY INCREASES OVER GENERATIONS



COMPLEXITY DECREASES OVER GENERATIONS

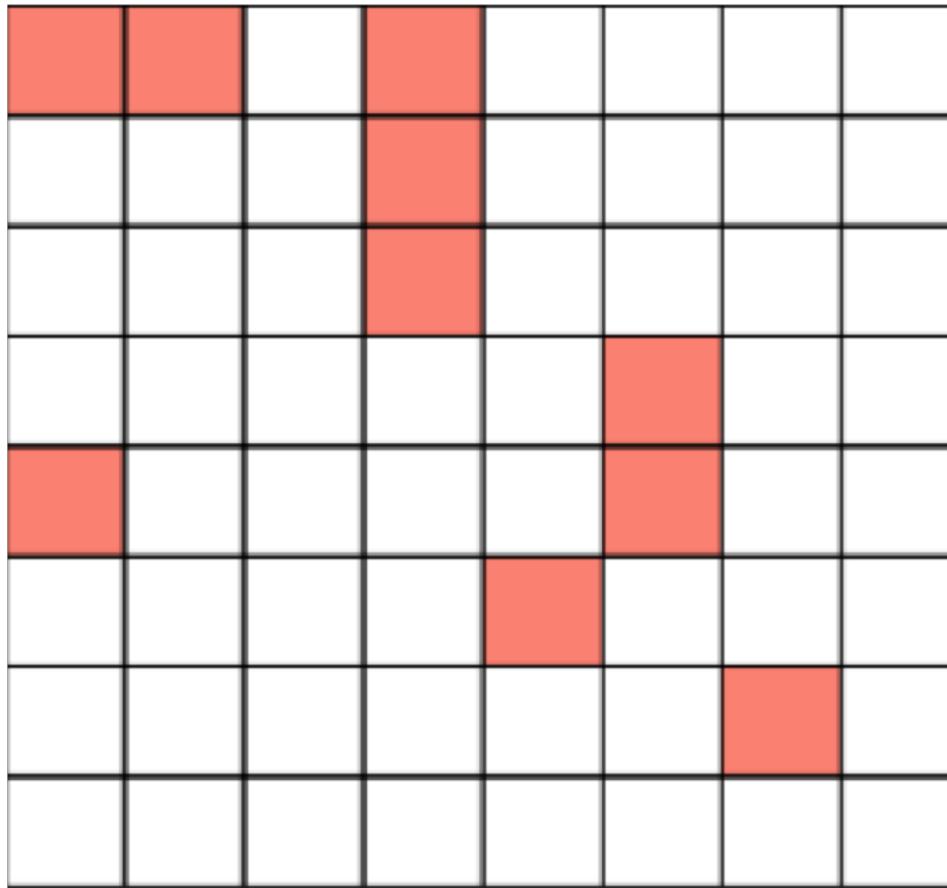


ADDITIONAL COMPLEXITY PLOTS



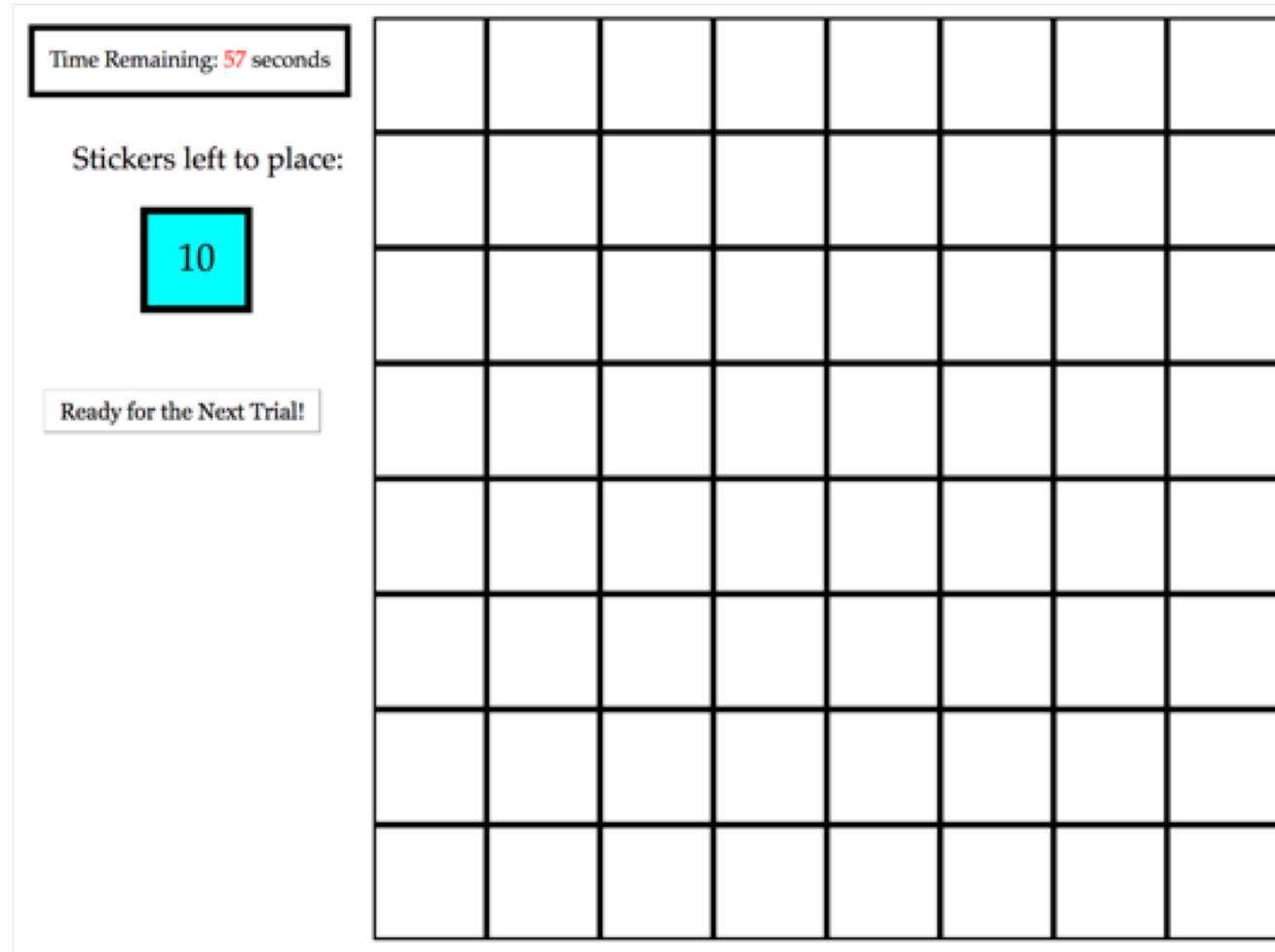
EXPERIMENT 2 PARADIGM

1) Learner



EXPERIMENT I PARADIGM

1) Learner



“your job is to re-create patterns to match a target”

EXPERIMENT I PARADIGM

1) Learner

Time Remaining: 57 seconds

Stickers left to place:

10

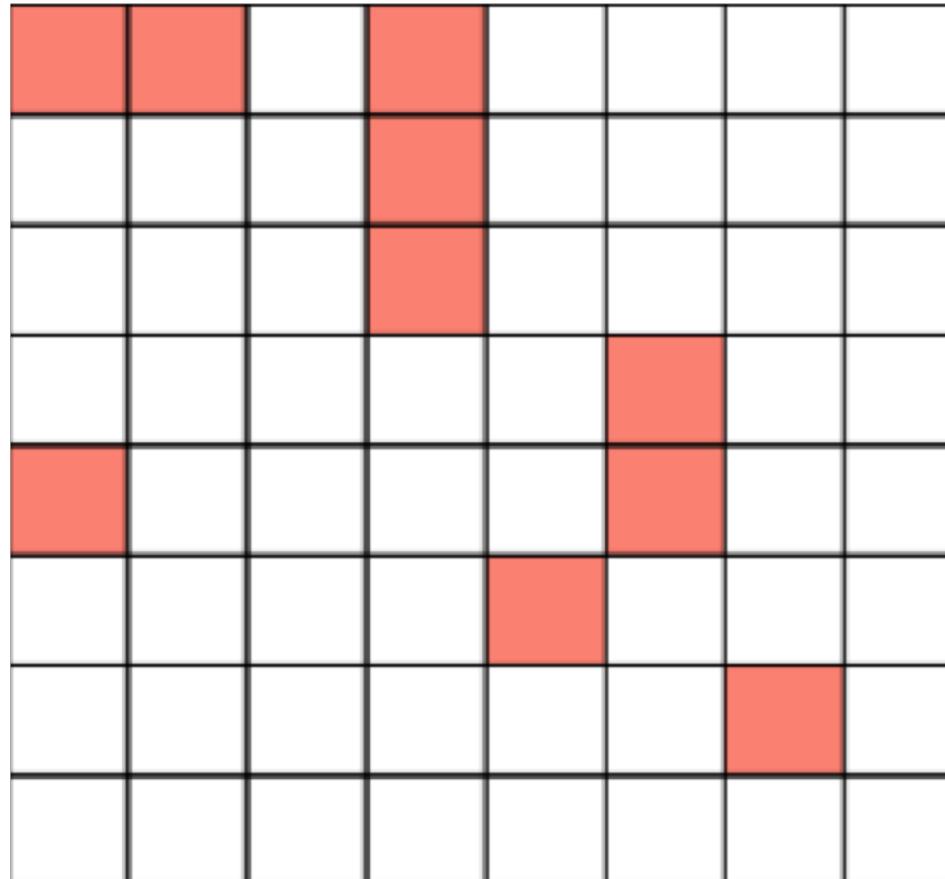
Ready for the Next Trial!

The grid consists of 48 squares arranged in 6 rows and 8 columns. The colors of the squares are as follows:

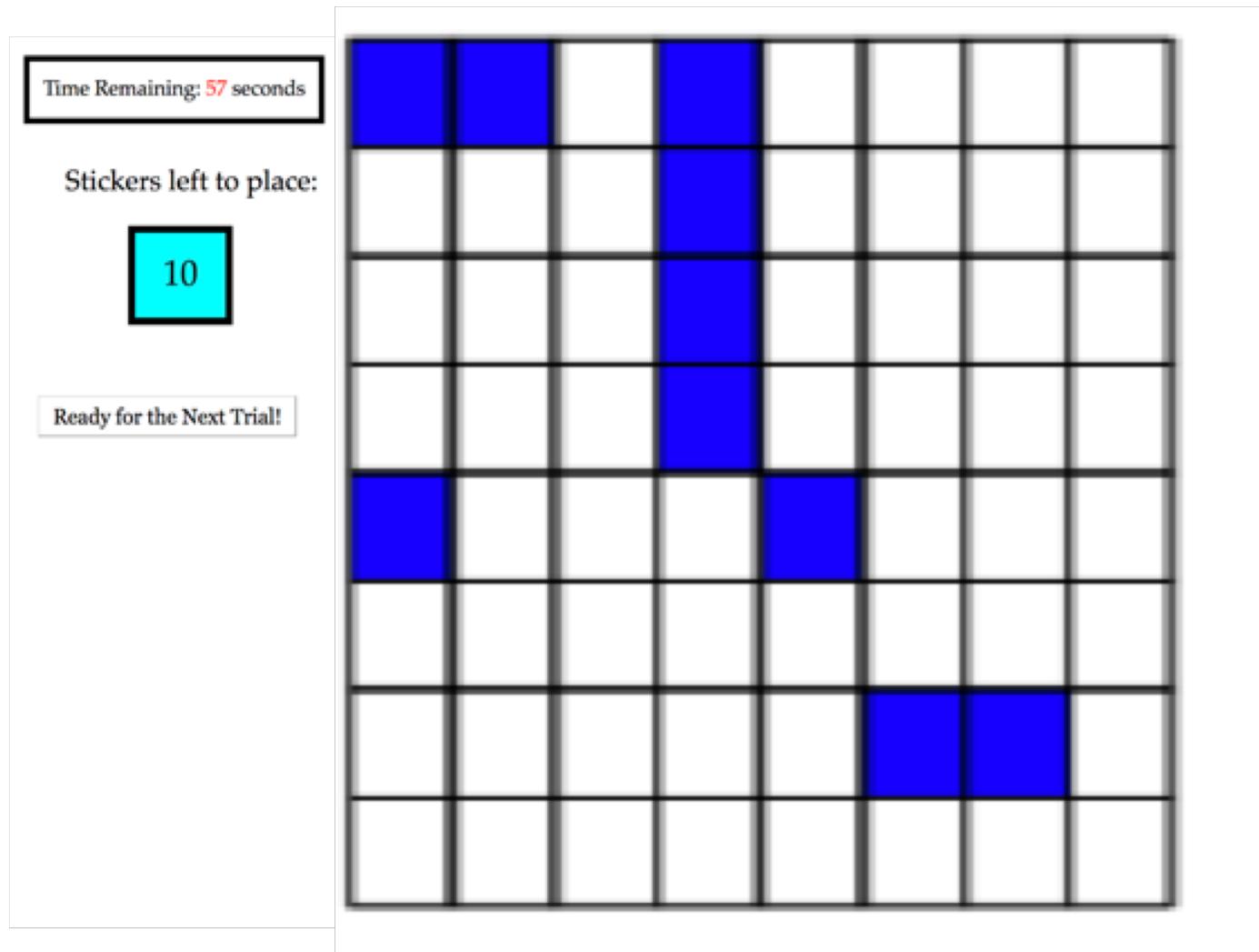
- Row 1: Blue, Blue, White, Blue, White, White, White, White
- Row 2: White, White, White, White, White, White, White, White
- Row 3: White, White, White, White, White, White, White, White
- Row 4: Blue, White, White, White, White, White, White, White
- Row 5: White, White, White, White, White, White, White, White
- Row 6: White, White, White, White, White, Blue, Blue, White

EXPERIMENT 2 PARADIGM

2) Fixer



EXPERIMENT I PARADIGM

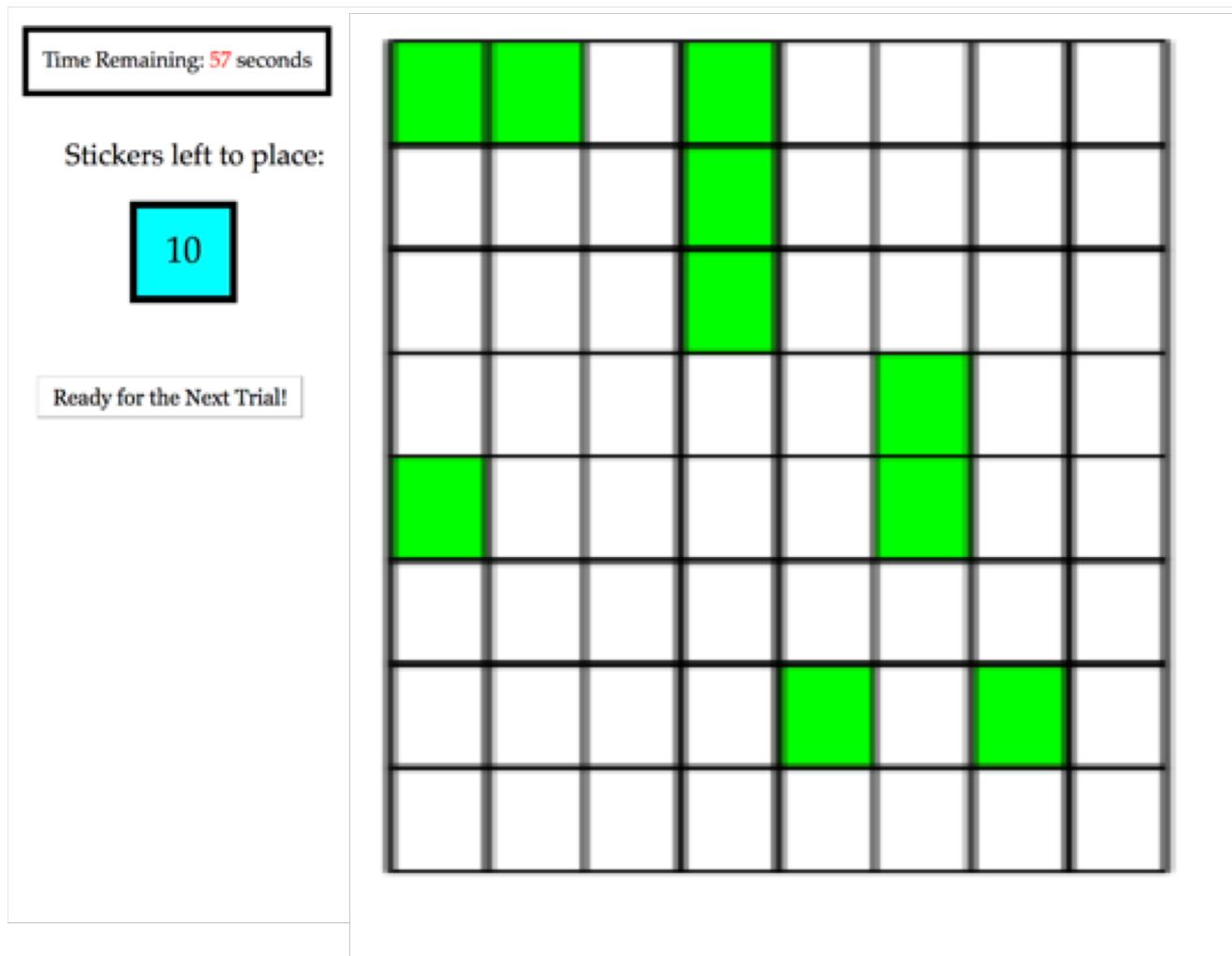


2) Fixer

“your job is to correct errors on the grid patterns to match the target”

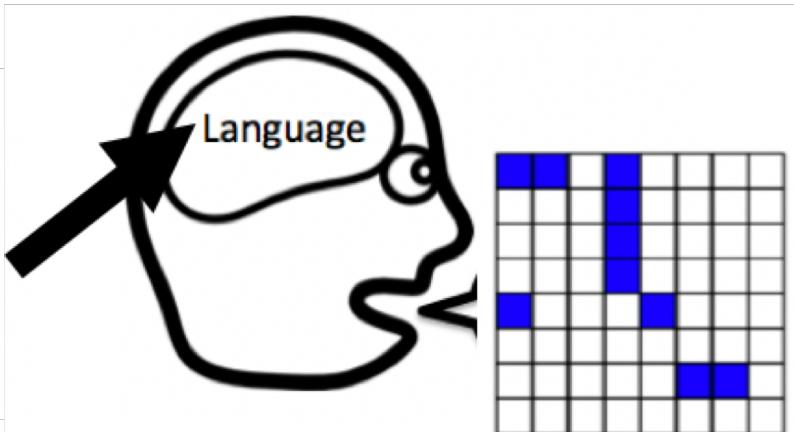
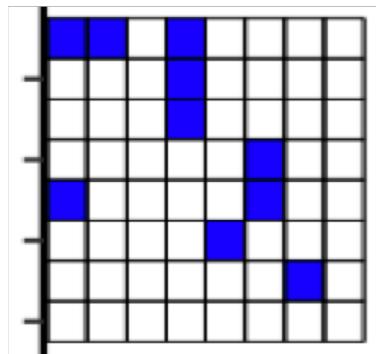
EXPERIMENT I PARADIGM

2) Fixer



EXPERIMENT 2 PARADIGM

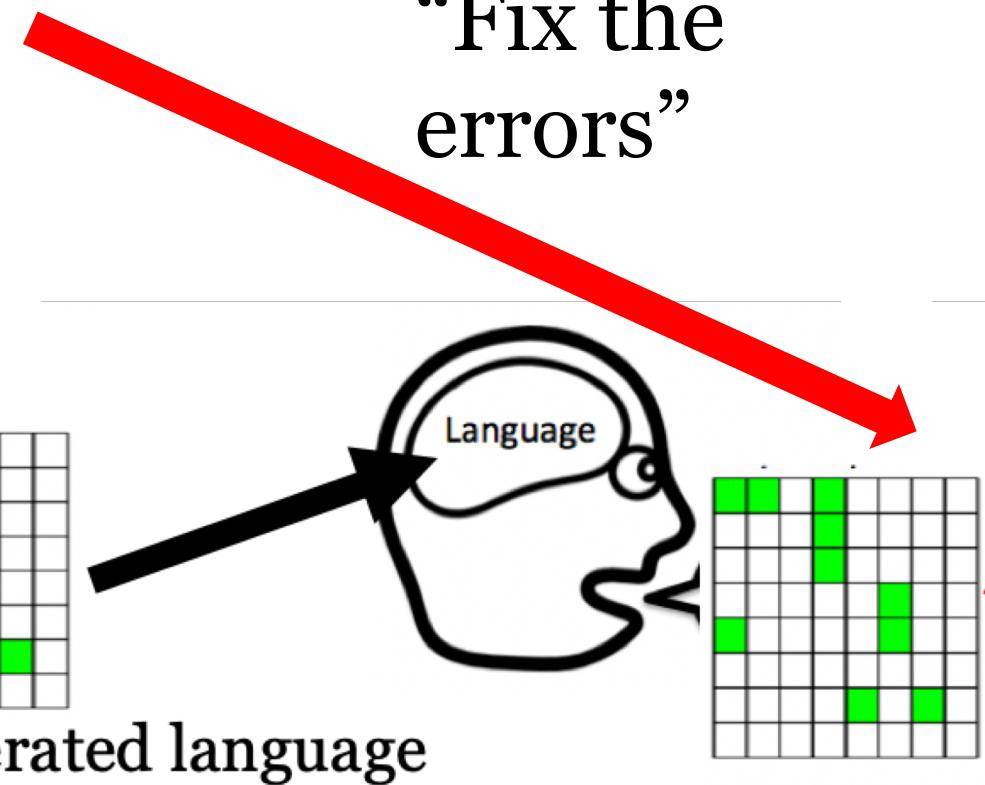
1) Learner



Randomly-generated language

2) Fixer

“Fix the errors”

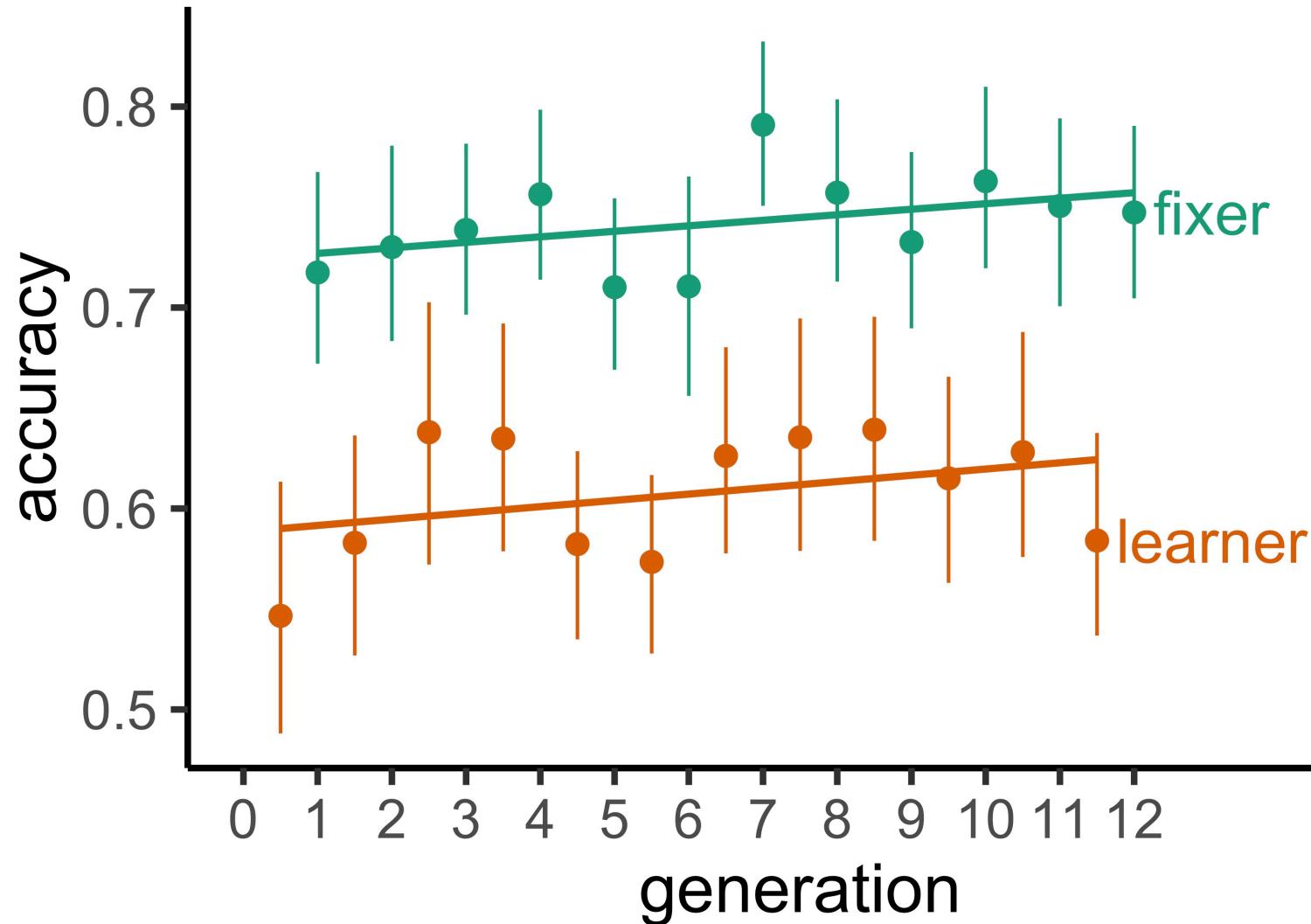


Randomly-generated language

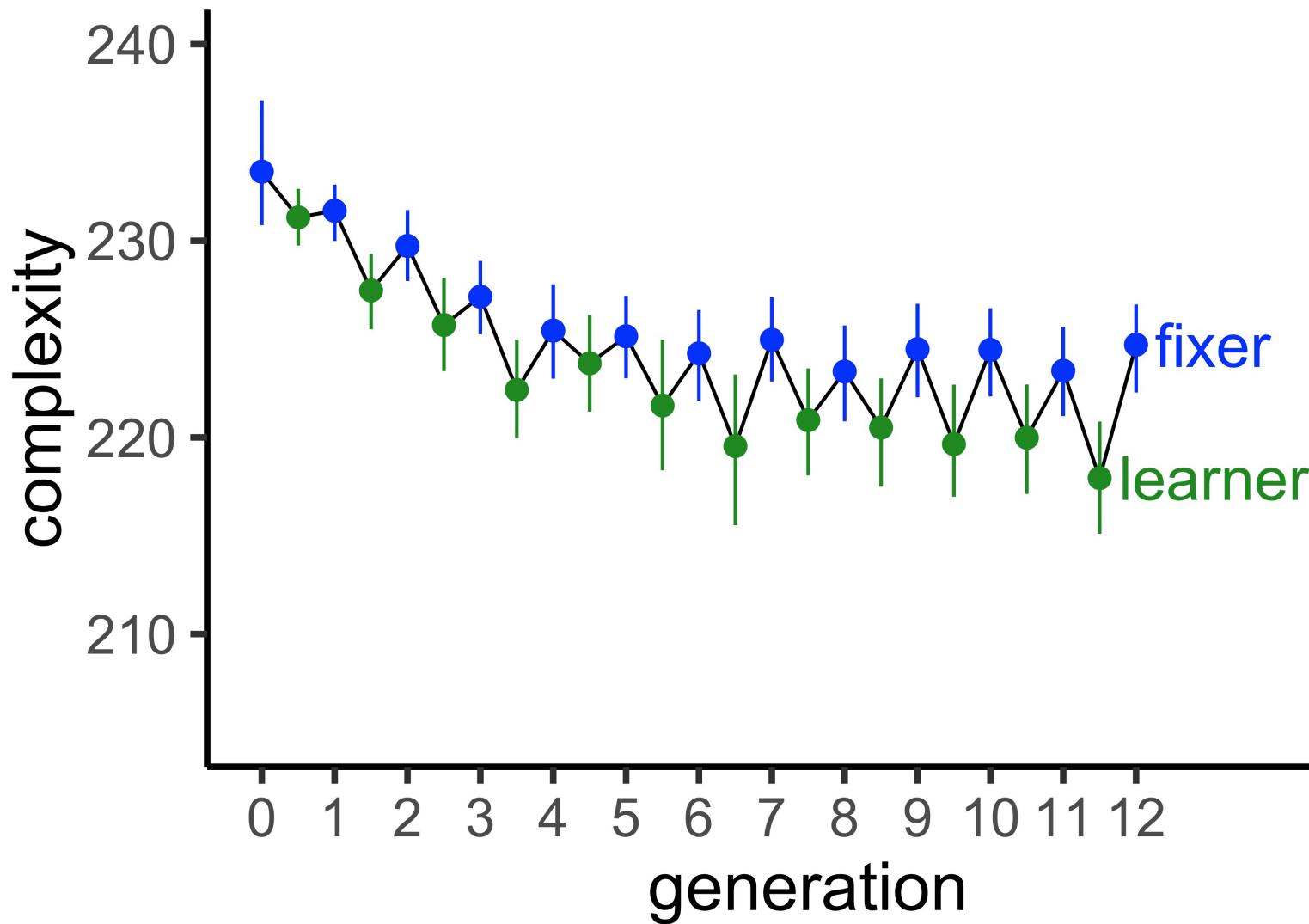
EXPERIMENT 2: ADULT-ADULT DYAD

- 960 adults on Amazon Mechanical Turk
 - 480 Learners, 480 Fixers
 - 40 separate chains of 12 generations

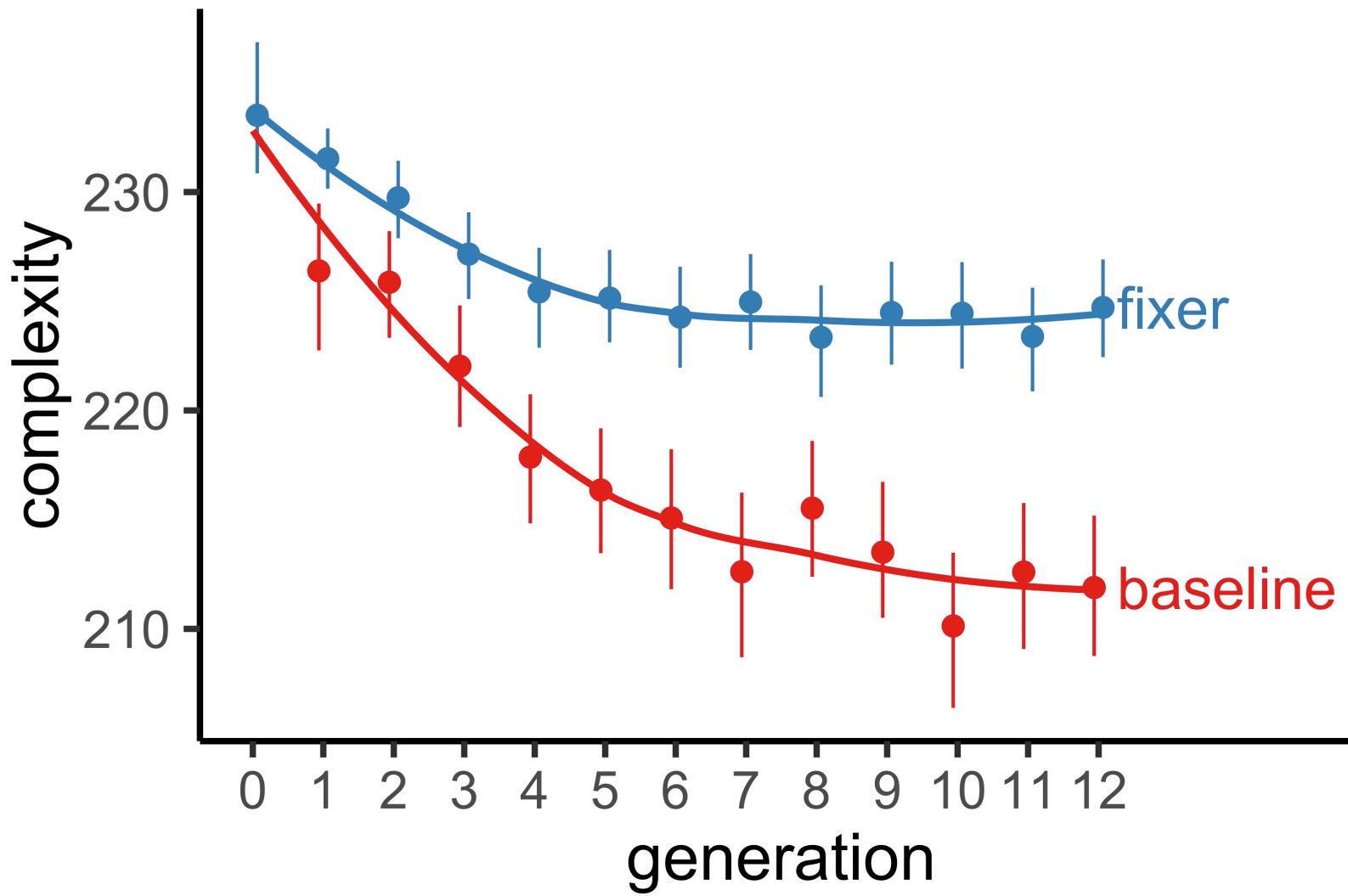
DYAD ACHIEVES CONSISTENT LEVELS OF ACCURACY



... WHILE EDITORS REINTRODUCE COMPLEXITY



EDITORS HELP RETAIN A HIGHER LEVEL OF COMPLEXITY



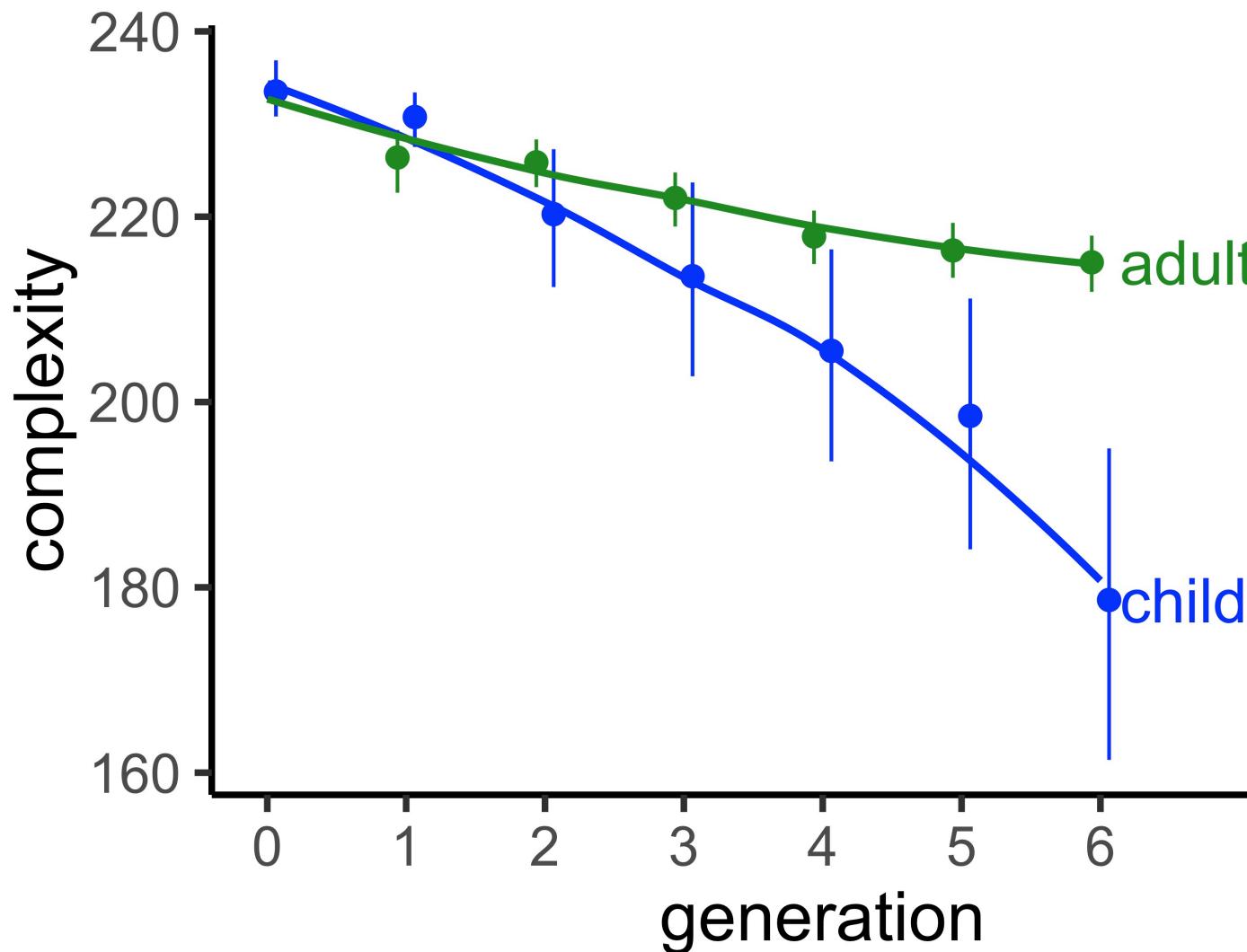
PRELIMINARY CONCLUSIONS

- These languages seem to be reaching a stable level of complexity
 - Balance between descriptiveness and simplicity/learnability
- The presence of an editor helps retain more complexity than an individual learner alone
 - Reduces memory load
- This paradigm can be used to answer questions about the effects of transmissibility pressures

ONGOING WORK

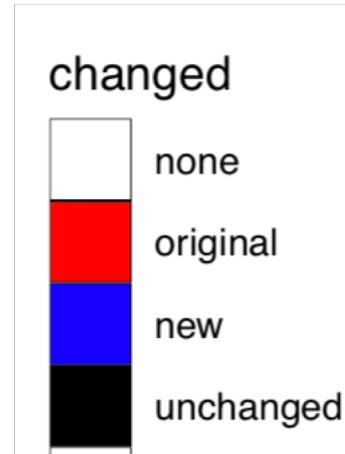
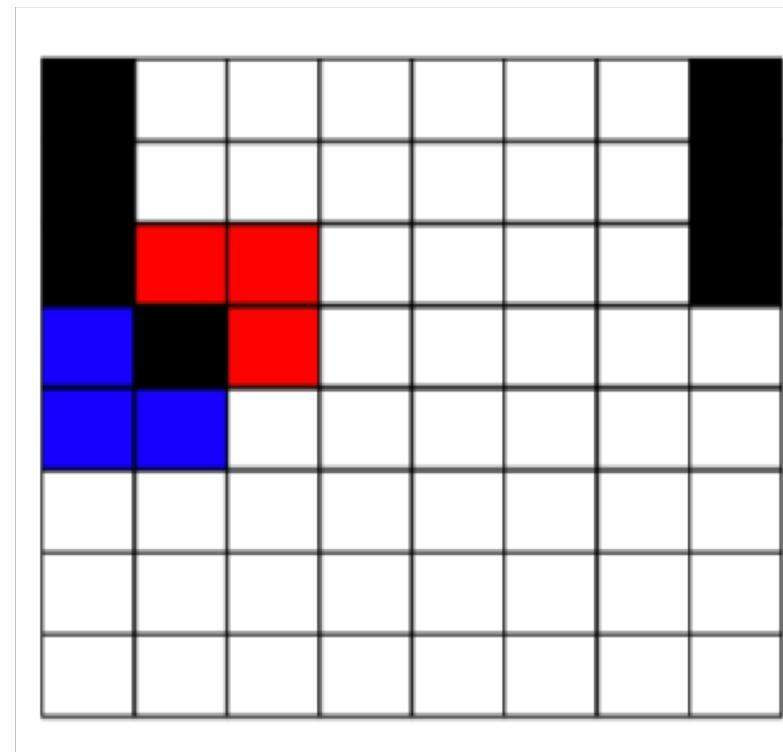
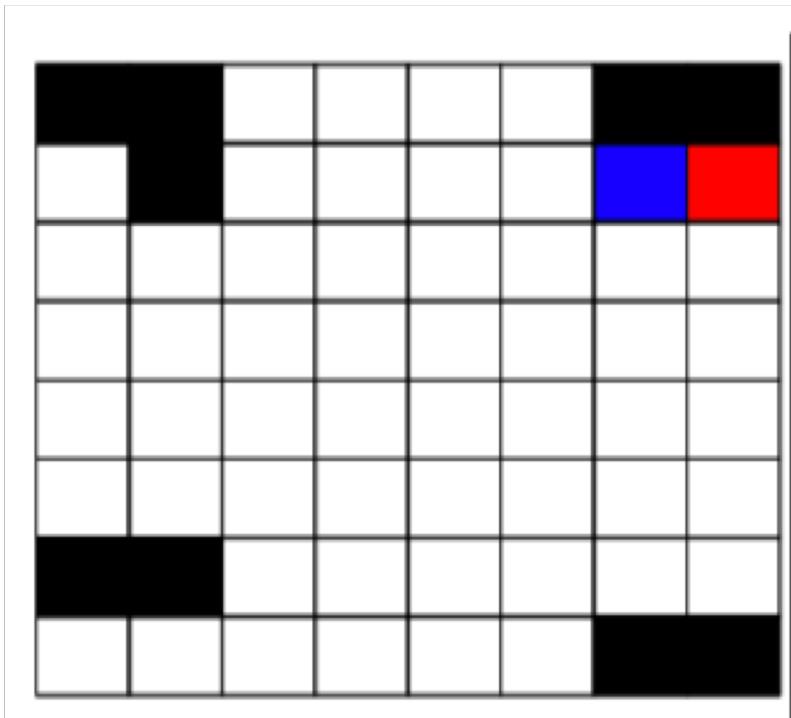
- Collecting data in Experiment 1 and 2 (baseline & dyad) conditions with children ages 6-8 at the Museum of Science and Industry
 - Children are “learners” and adults (online) are “fixers”
 - ~60 / 240 data points collected so far

PRELIMINARY CHILD BASELINE RESULTS

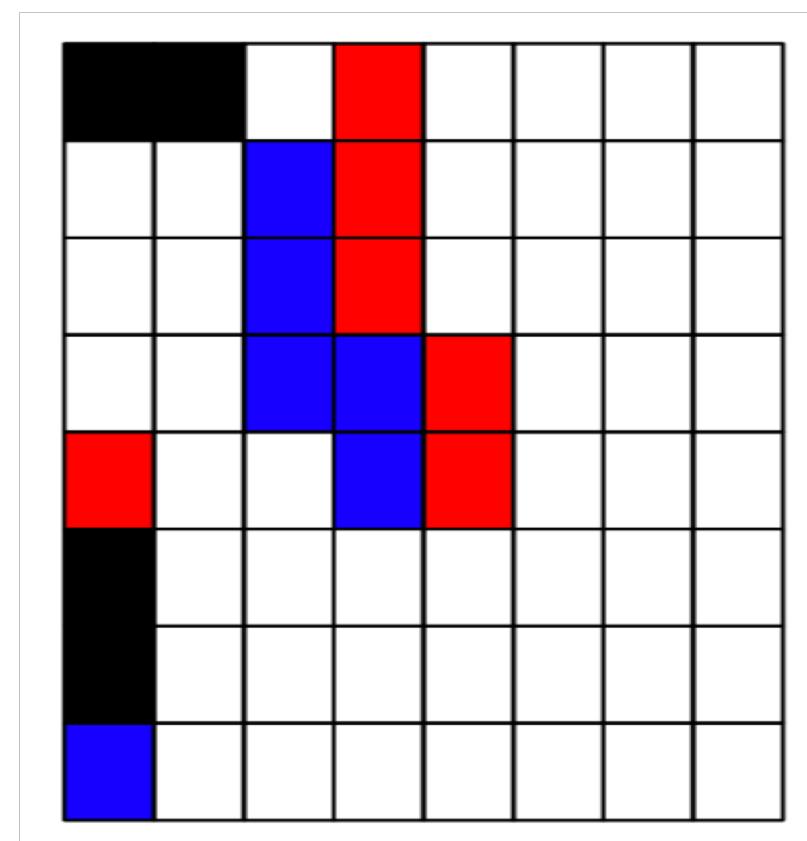
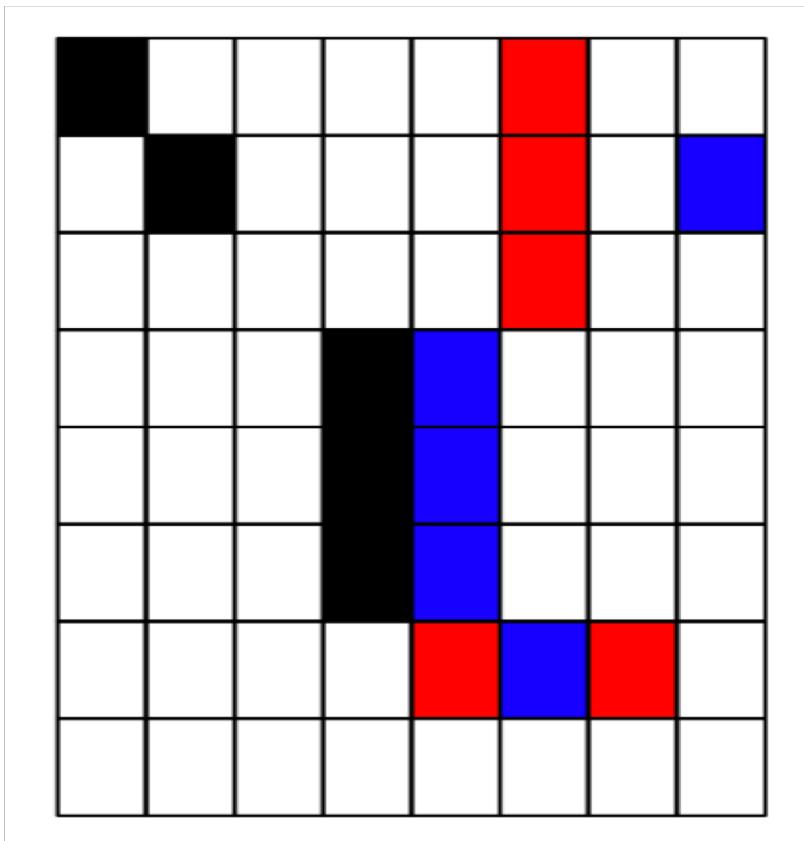


QUALITATIVE ANALYSIS

- Are children just making more errors, or are they making different errors
 - Develop coding scheme to identify these differences



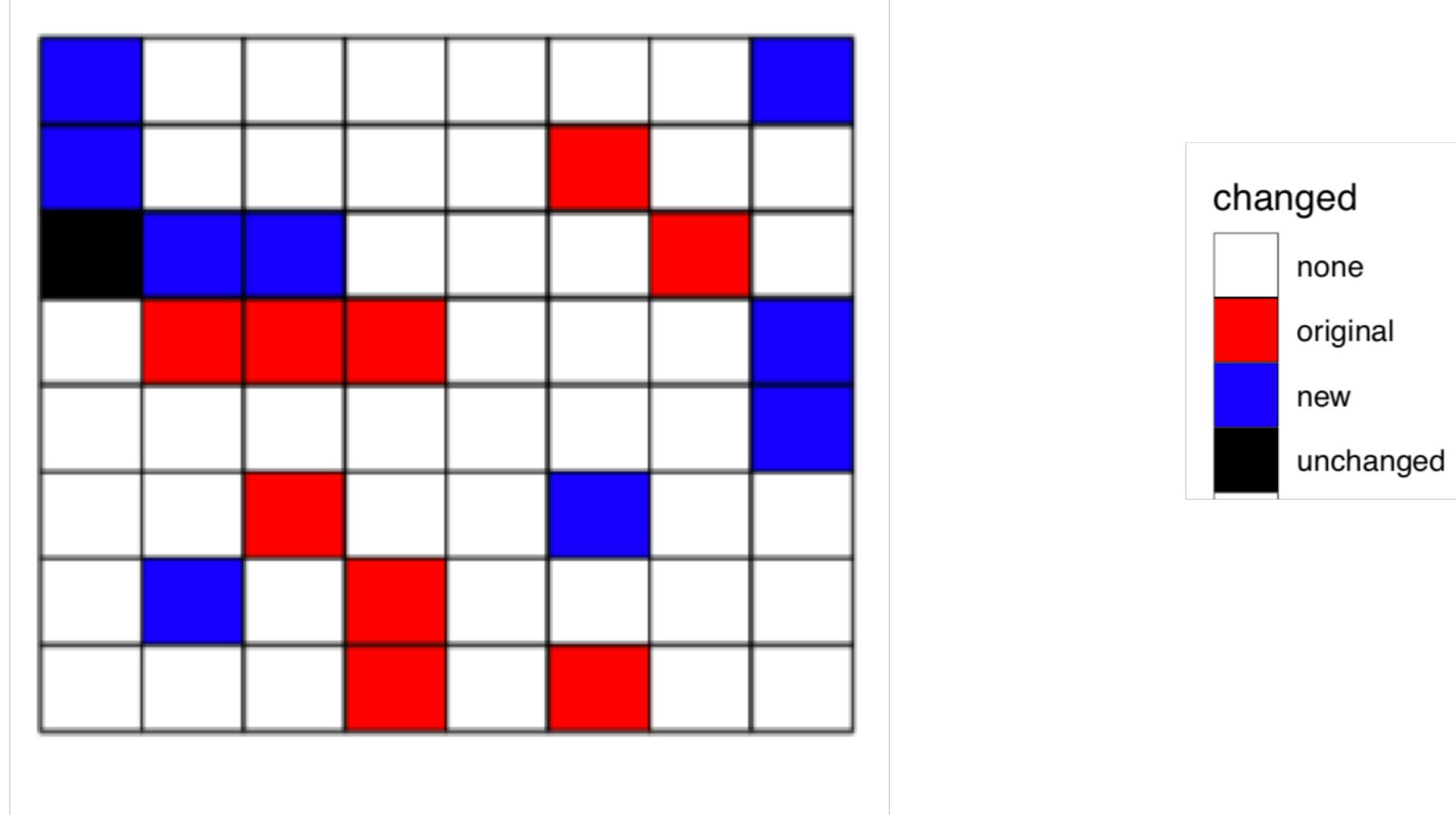
QUALITATIVE ANALYSIS



changed

none
original
new
unchanged

QUALITATIVE ANALYSIS

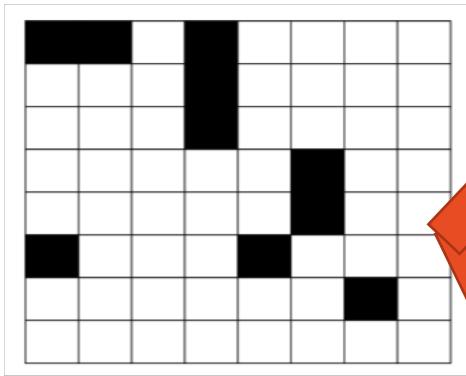


STRUCTURE TASK

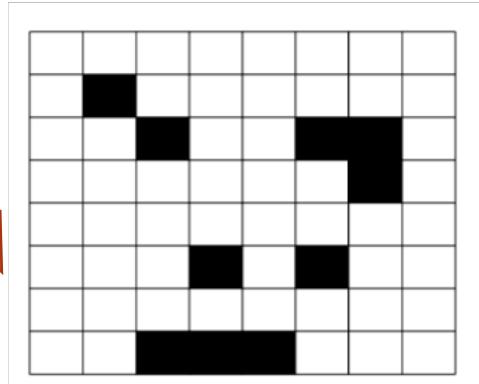
- Compare grids from different trials within a chain to see if structure is emerging across the “language” as a whole
- Turk similarity task

STRUCTURE TASK

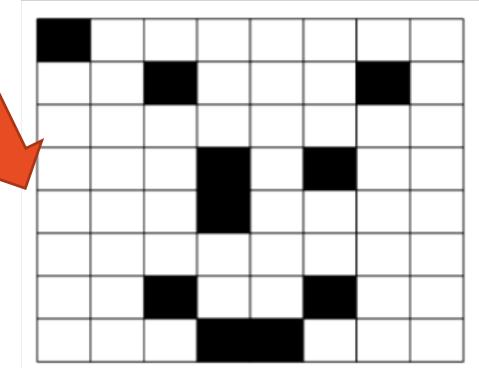
Chain 1, Trial 1, Generation 1



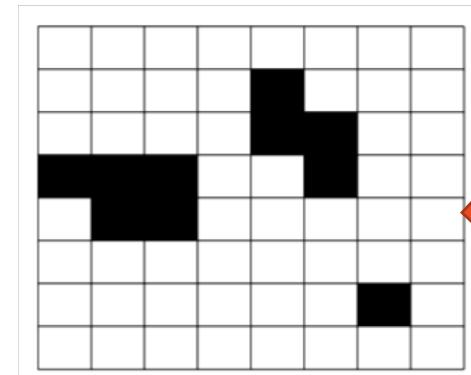
Chain 2, Trial 2, Generation 2



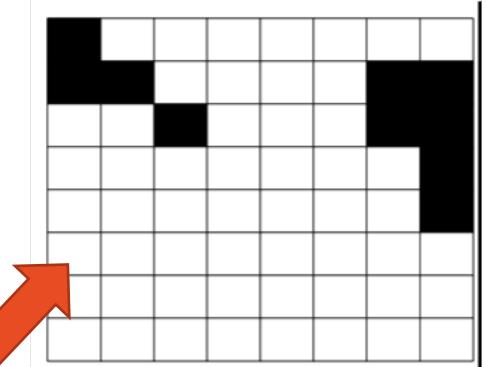
Chain 1, Trial 2, Generation 2



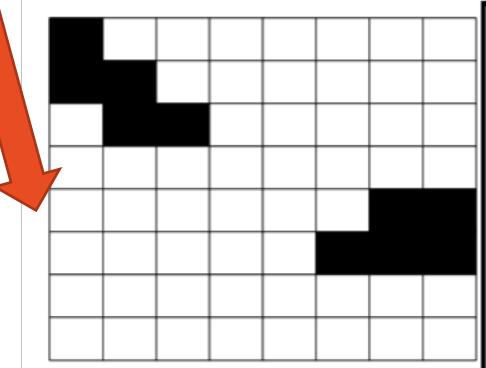
Chain 1, Trial 1, Generation 5



Chain 2, Trial 2, Generation 6



Chain 1, Trial 2, Generation 6



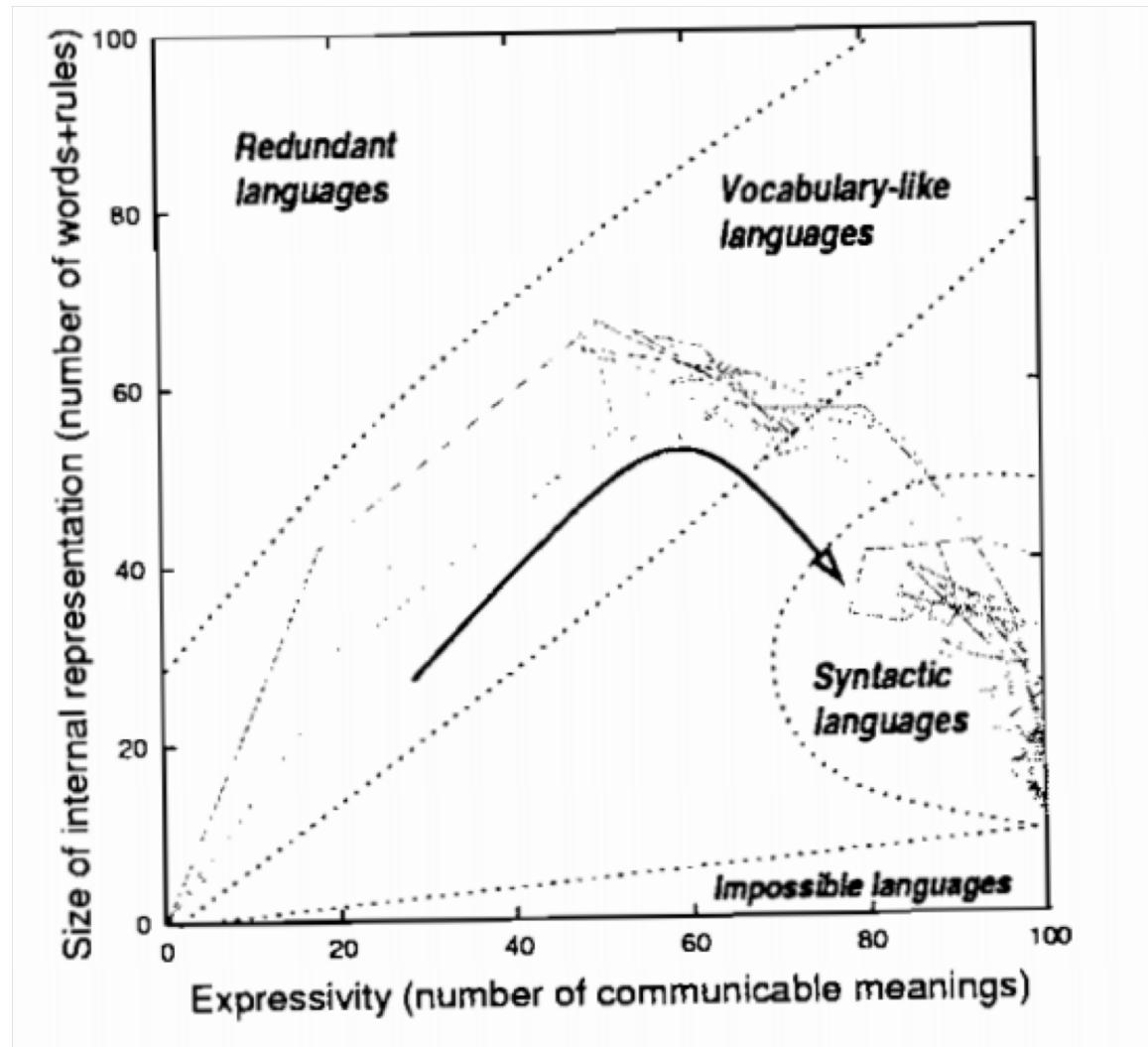
THANK YOU!



ALGORITHMIC COMPLEXITY MEASURE CTD.

- Kolmogorov-Chaitin Complexity (based on Coding Theorem Method)
 - Length of shortest program that outputs a string to describe pattern on a Universal Turing machine
 - Calculate for 4x4 patterns

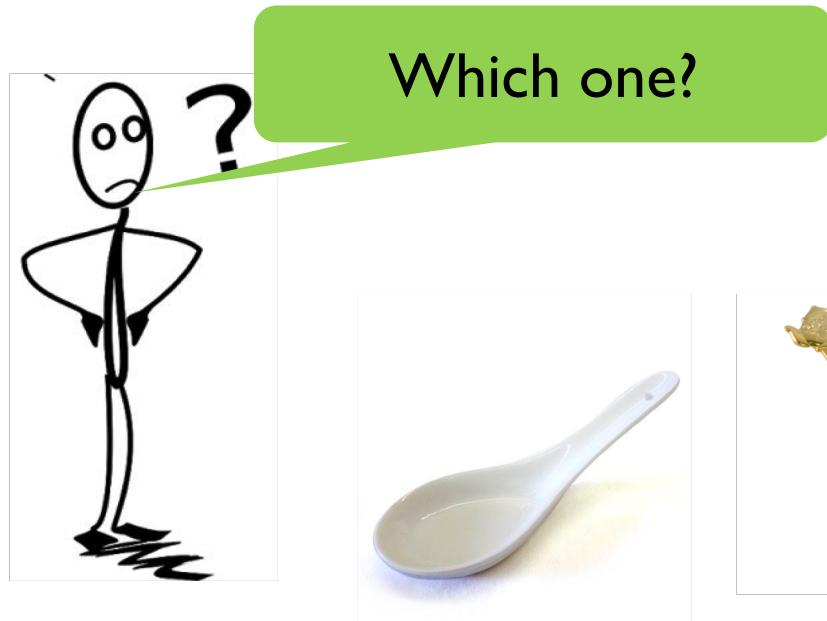
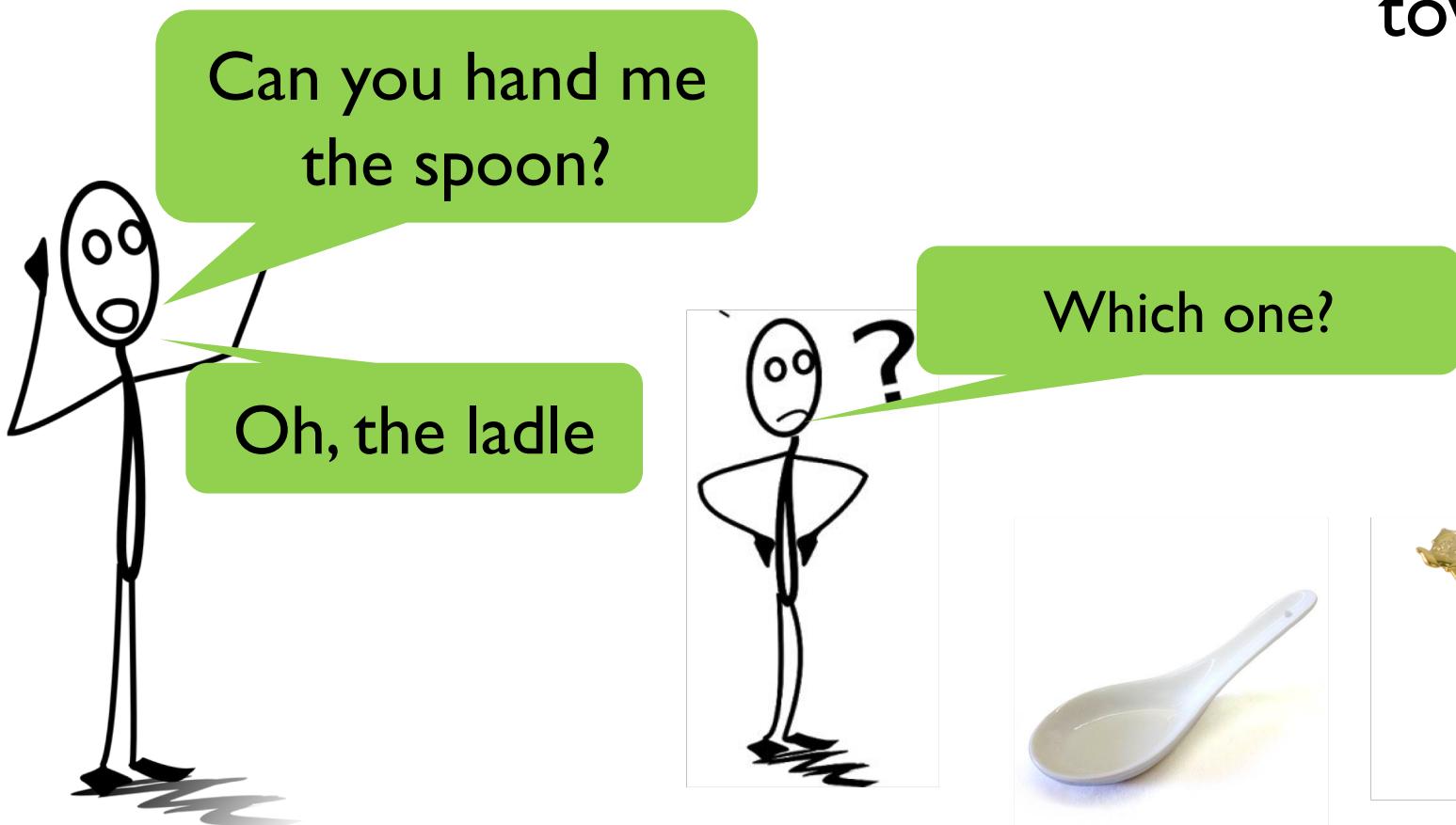
LANGUAGES SHOW THE EFFECTS OF THESE PRESSURES



Kirby, S., & Hurford, J. R. (2002).

DESCRIPTIVENESS PRESSURE

Pushes language towards **complexity**

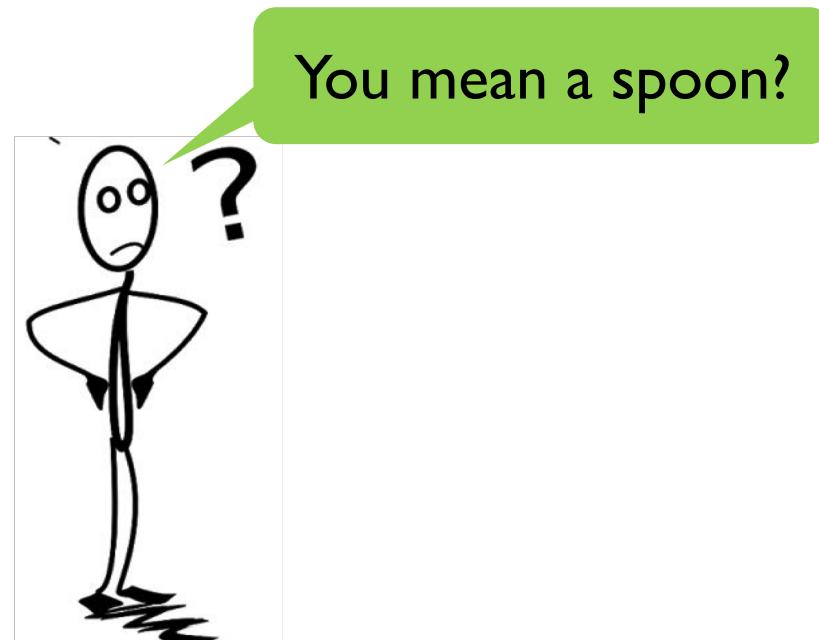


TRANSMISSIBILITY PRESSURE



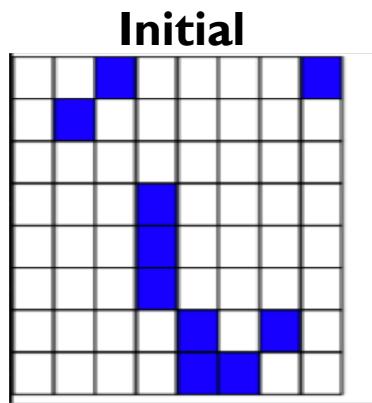
This is a
spoonandiferadoja

Pushes language
towards **simplicity**

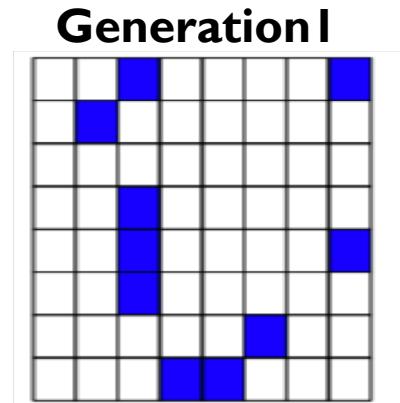


You mean a spoon?

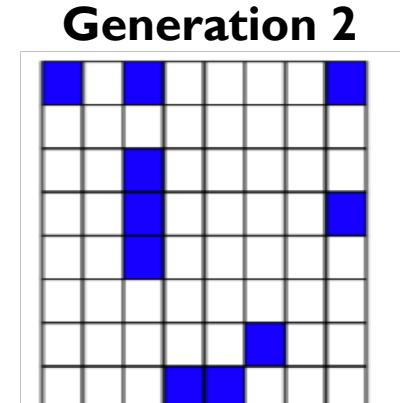
EXPERIMENT I RESULTS



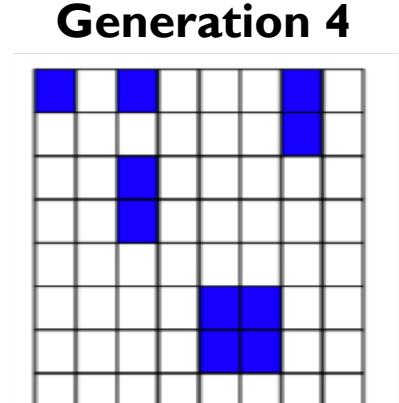
Complexity: 231



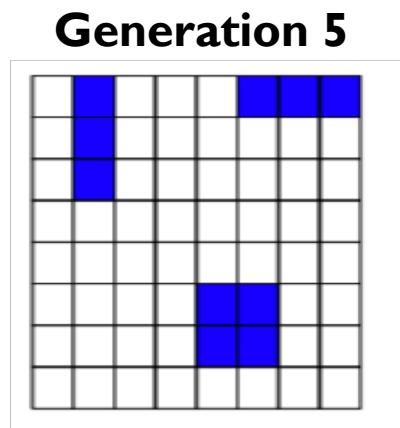
Complexity: 235



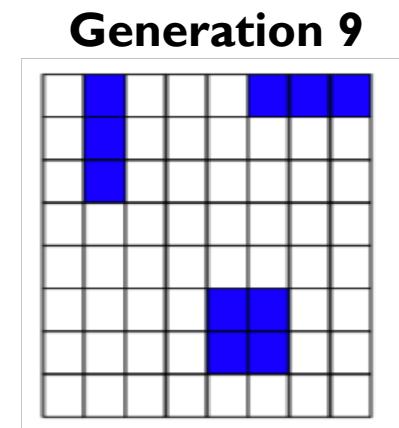
Complexity: 243



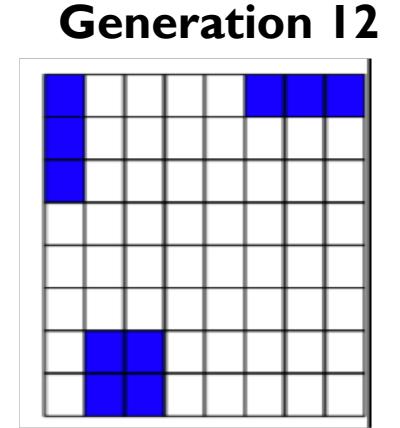
Complexity: 211



Complexity: 229



Complexity:



Complexity: