

# Online Experiments for Language Scientists

Lecture 7: Frequency learning

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Standing business: Any questions about annotated bibliography assessment?

# Ferdinand, Kirby & Smith (2019)

Ferdinand, V., Kirby, S., & Smith, K. (2019).  
The cognitive roots of regularization in  
language. *Cognition*, 184, 53-68.

Large frequency-learning experiment run on  
MTurk

- Do domain (linguistic vs non-linguistic) and  
demand (tracking 1 vs 6 frequency  
distributions) influence **regularization  
behaviour?**



**Vanessa Ferdinand**  
(formerly Edinburgh,  
now Melbourne)



**Simon Kirby**  
(Edinburgh)

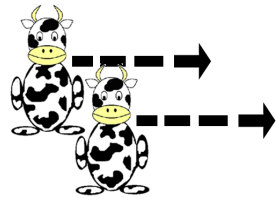
# Variation in language

Languages exhibit variation at all levels (paraphrase, synonymy, allomorphy, allophony), but variation is **constrained**

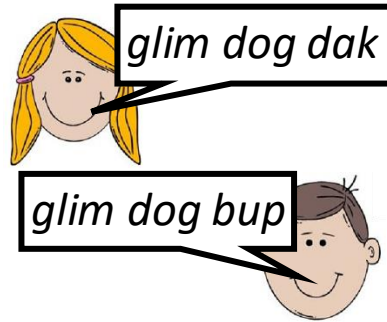
- Languages have lexicons and grammars
- Linguistic (phonological, lexical, syntactic, semantic) or sociolinguistic **conditioning** of alternation
  - English past tense allomorphy: hunt/**ɪd**/ vs fish/**t**/
  - Noun classes: ***la** chaise, **le** sofa, **la** fille, **le** garçon*
  - T-glottaling: glo/**t**/al vs glo/**ʔ**/al

**Why is language like this?**

# Variation-learning experiments



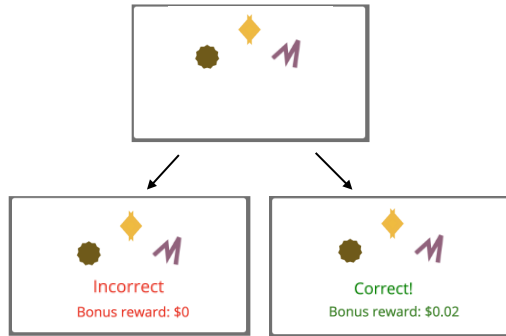
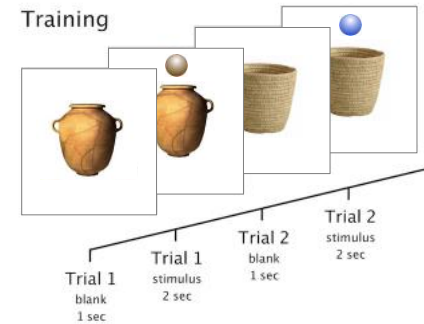
*glim cow fip*  
*glim cow tay*



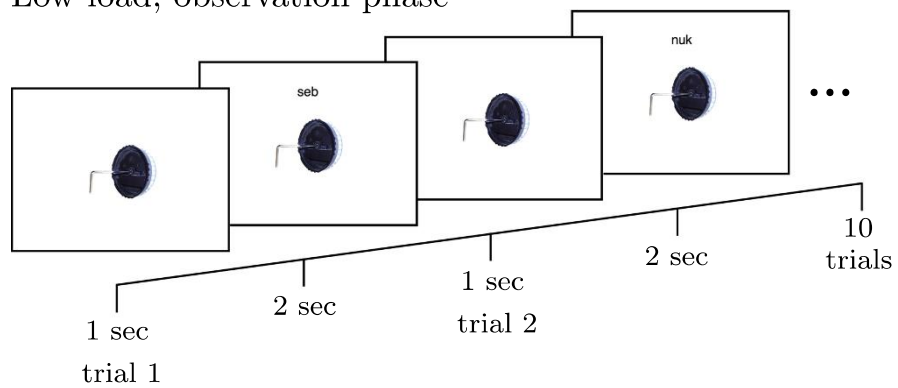
*ooshra buzzo trunko*  
*ooshra trunko tid buzzo*



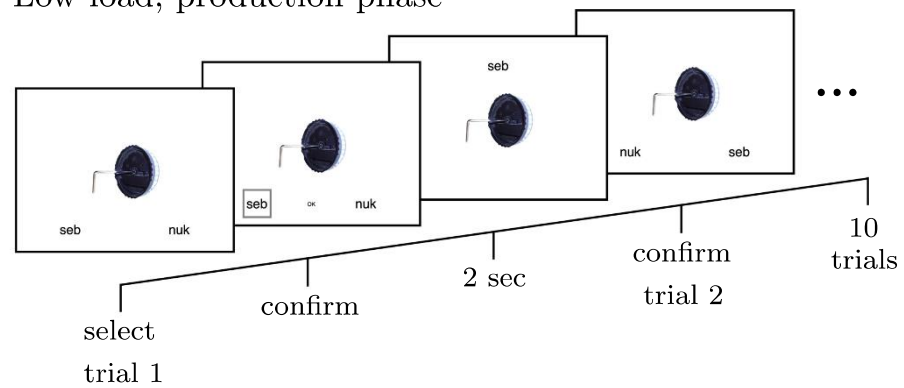
*buv*  
*kal*

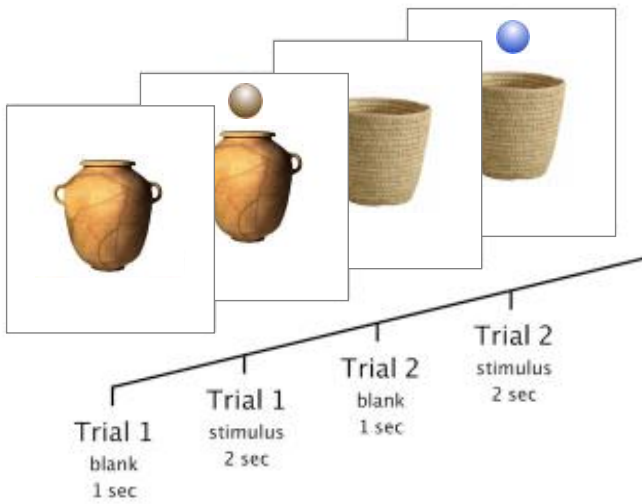
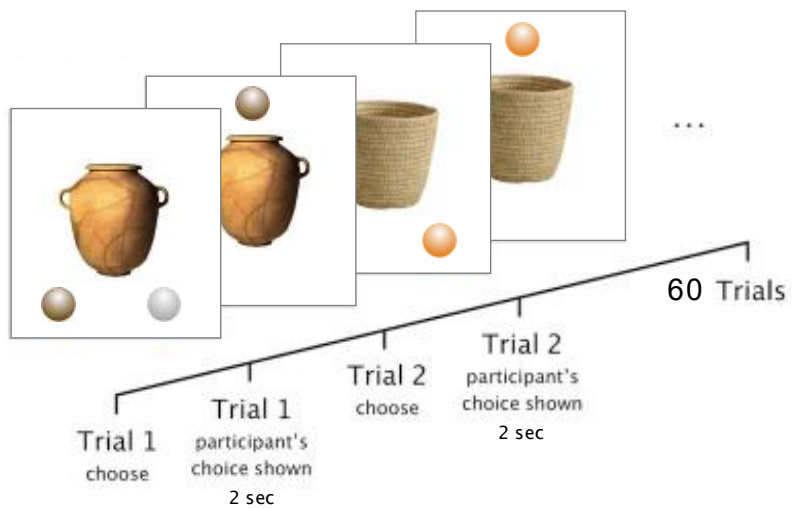


## Low load, observation phase



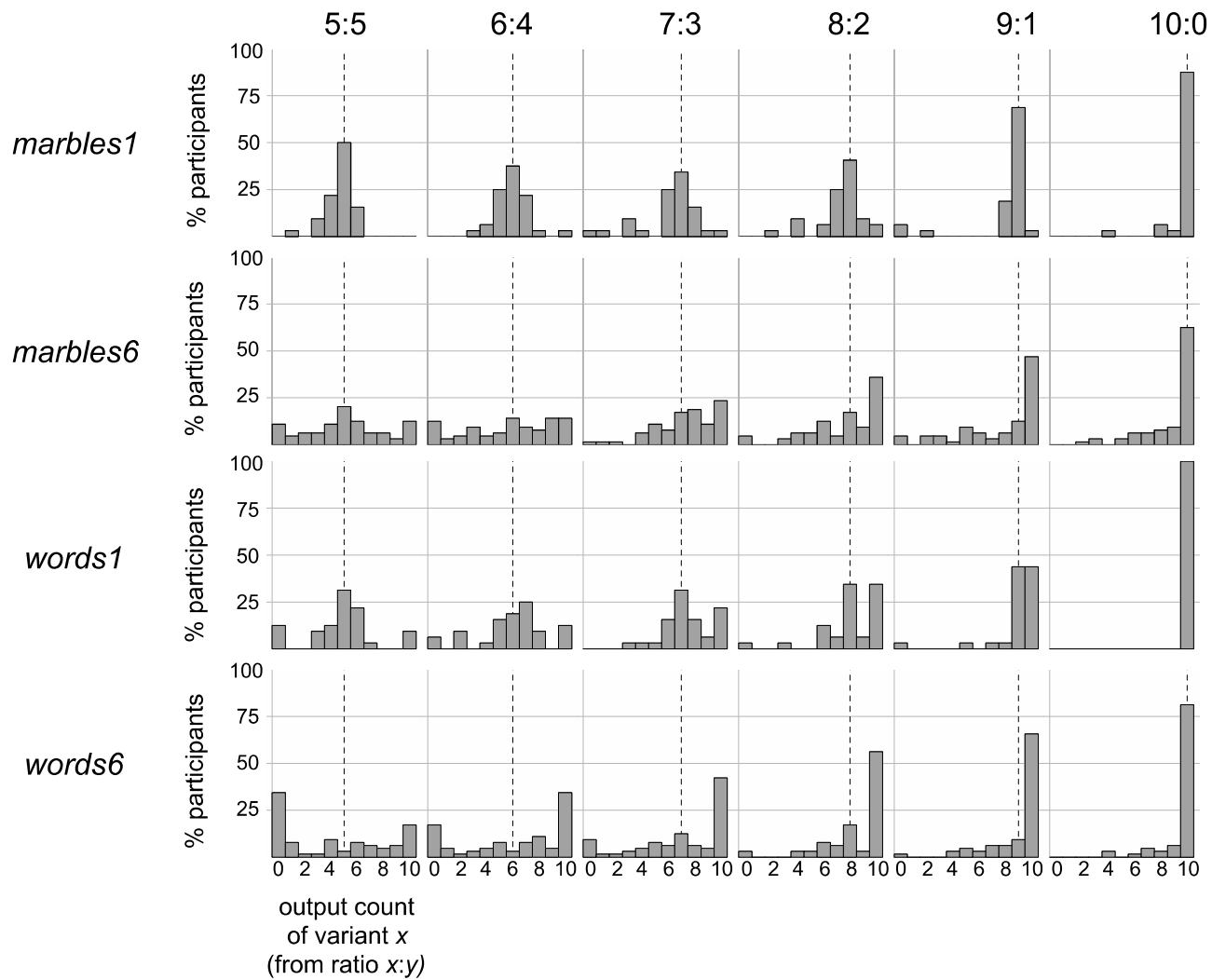
## Low load, production phase

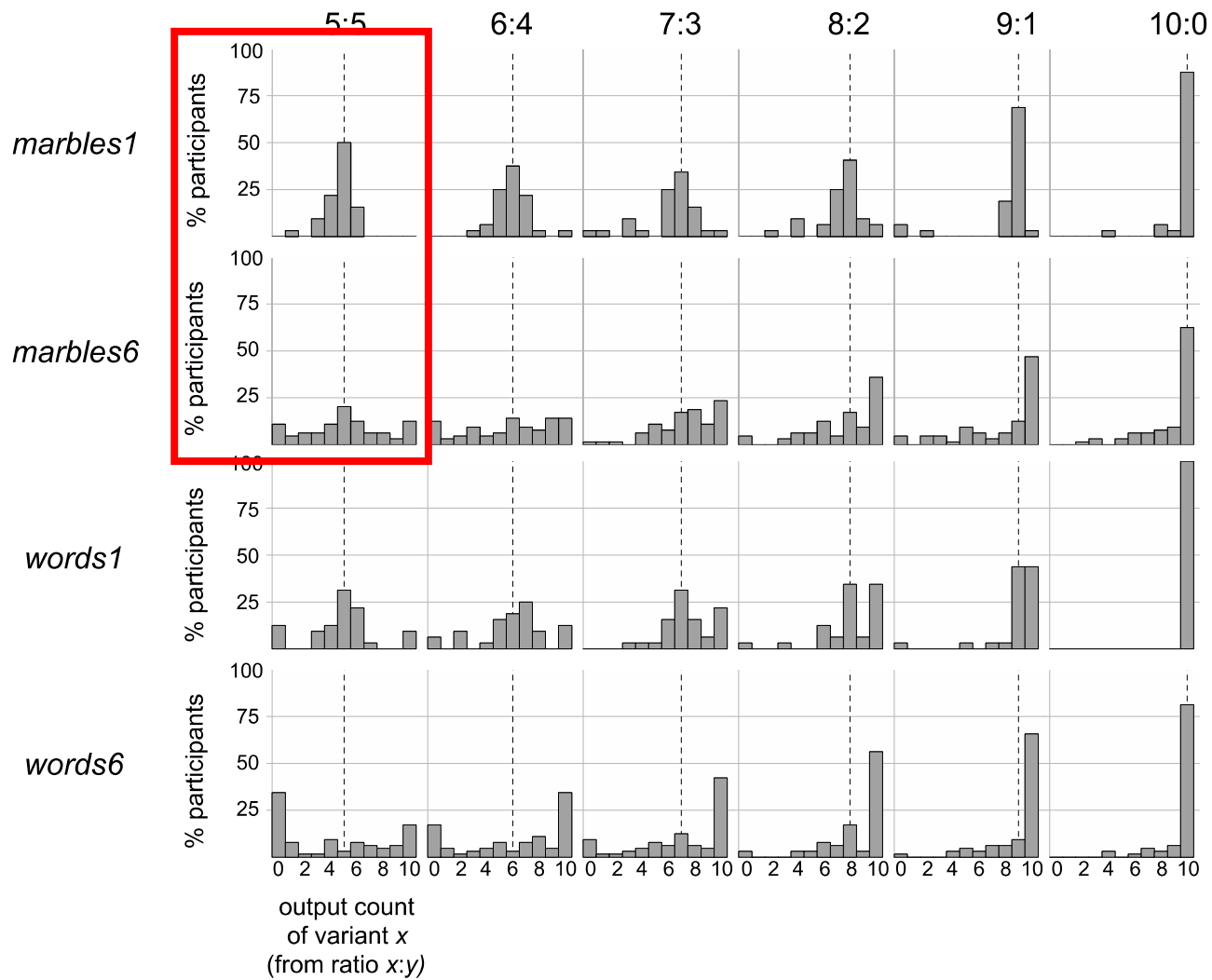


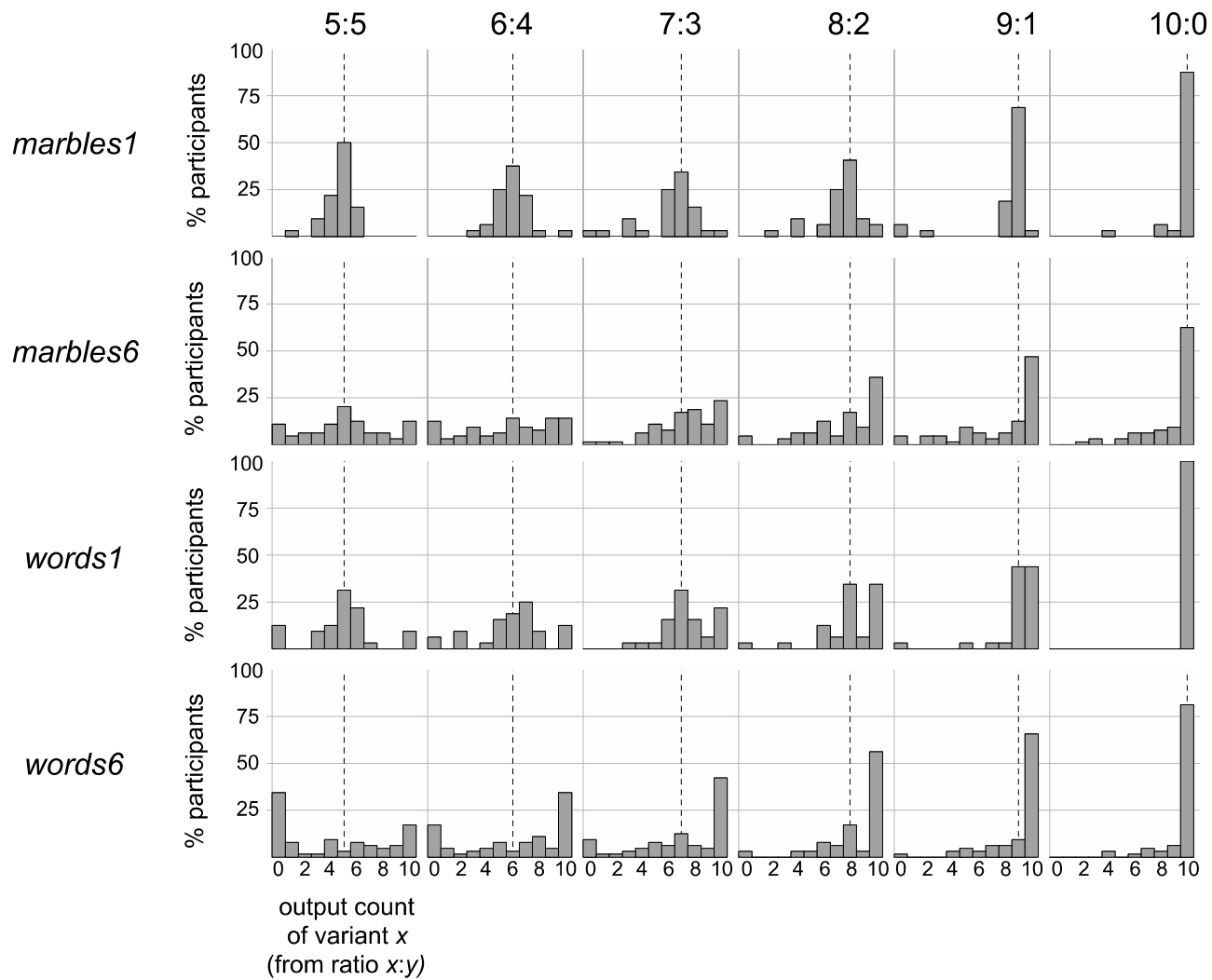


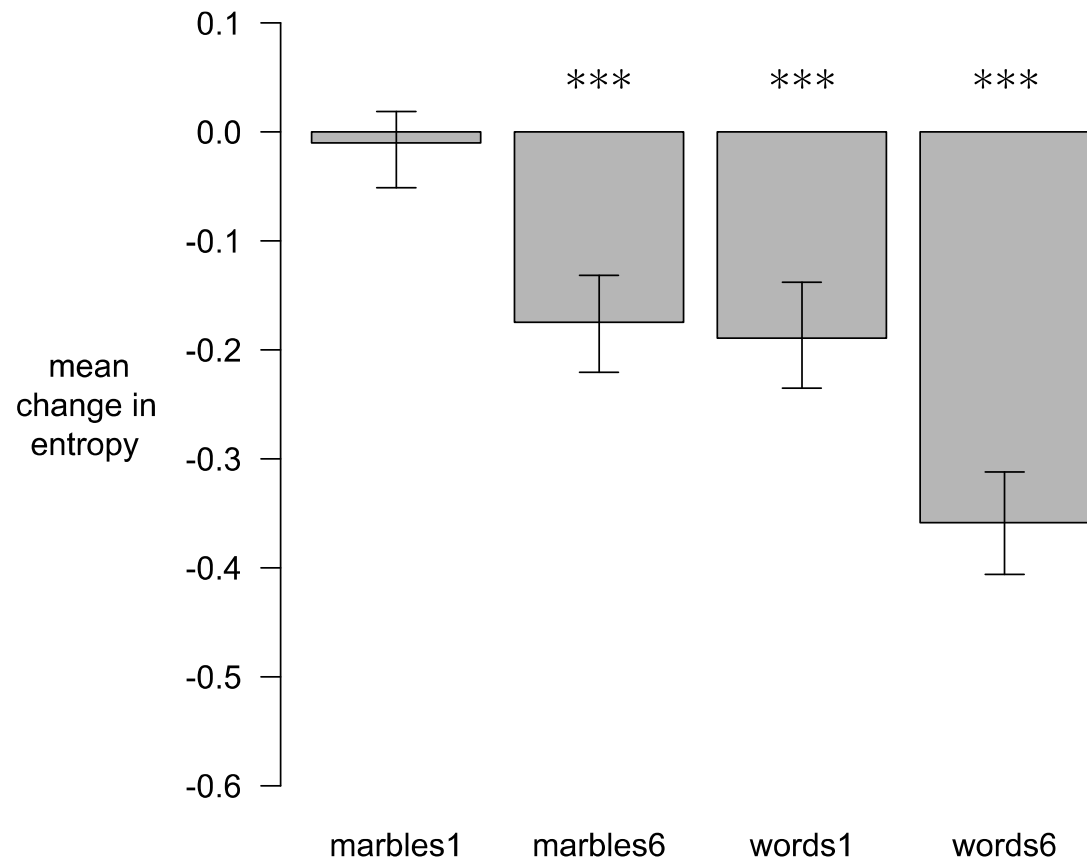
# Sample size, study duration etc

- US-based MTurk workers
- N=512 after exclusions
- 4 minutes (1-item task) or 11.5 minutes (6-item task)
- **\$0.10** (1-item task) or **\$0.60** (6-item task) 😞







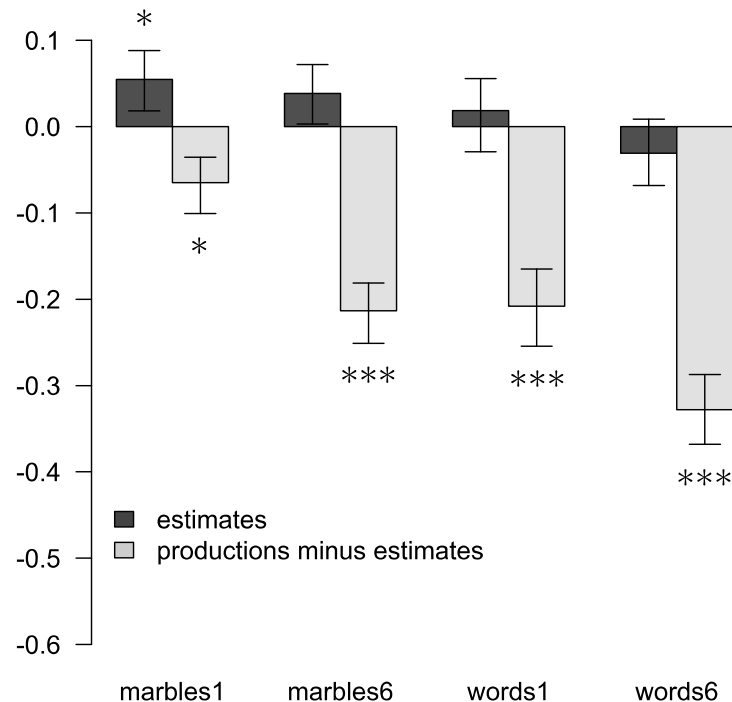


Bonus content in Ferdinand et al. (2019)

# Regularization during encoding, or retrieval?

|                                                                                   |     |     |    |    |    |    |    |    |    |    |    |     |
|-----------------------------------------------------------------------------------|-----|-----|----|----|----|----|----|----|----|----|----|-----|
|  | tef | 0   | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|                                                                                   | gos | 100 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 | 0   |
|   | fud | 0   | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|                                                                                   | pon | 100 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 | 0   |
|  | seb | 0   | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|                                                                                   | nuk | 100 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 | 0   |

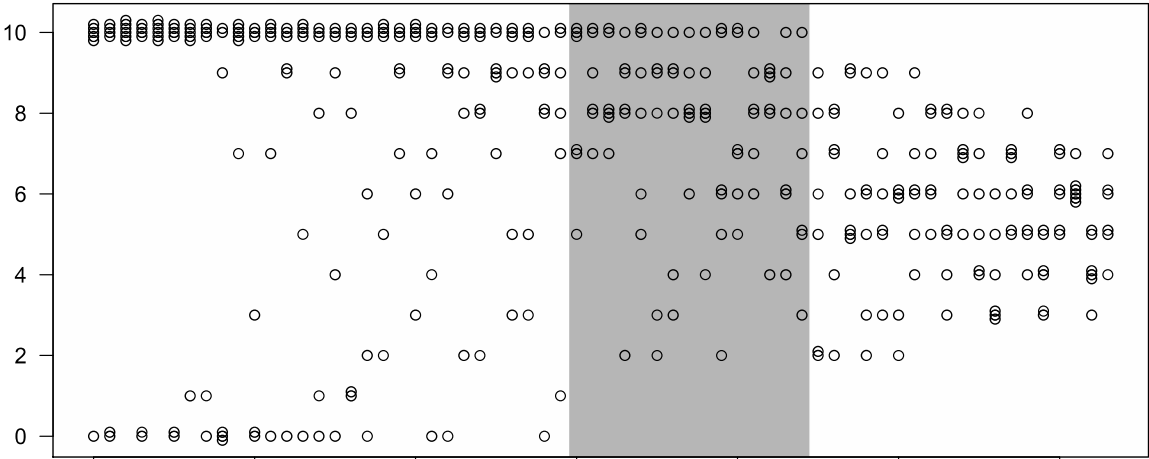
mean  
change in  
entropy



# Individual differences

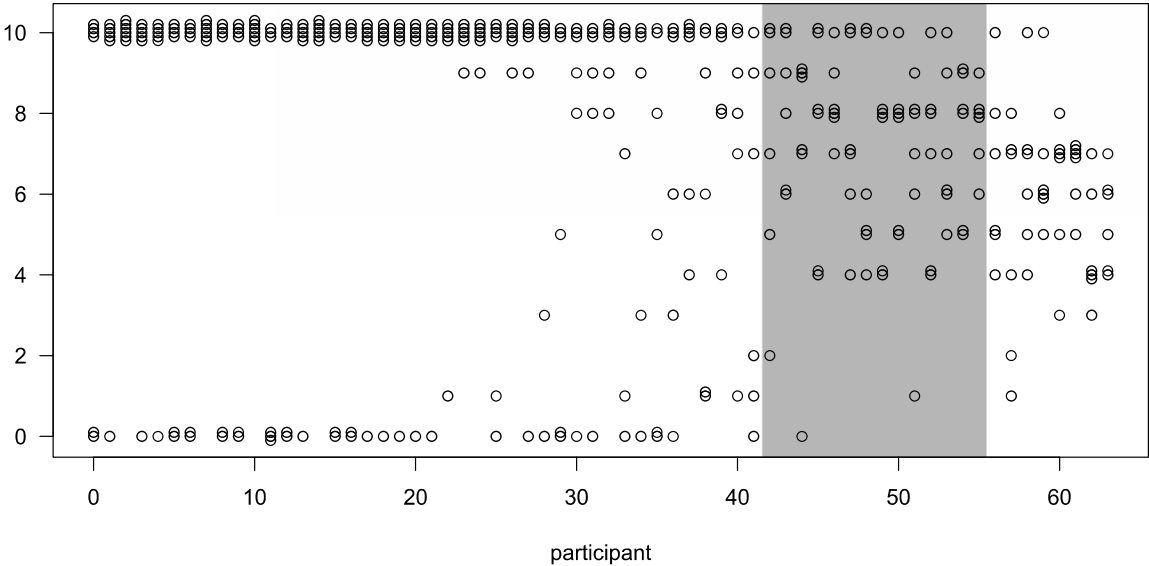
*marbles6*

output count  
of variant x



*words6*

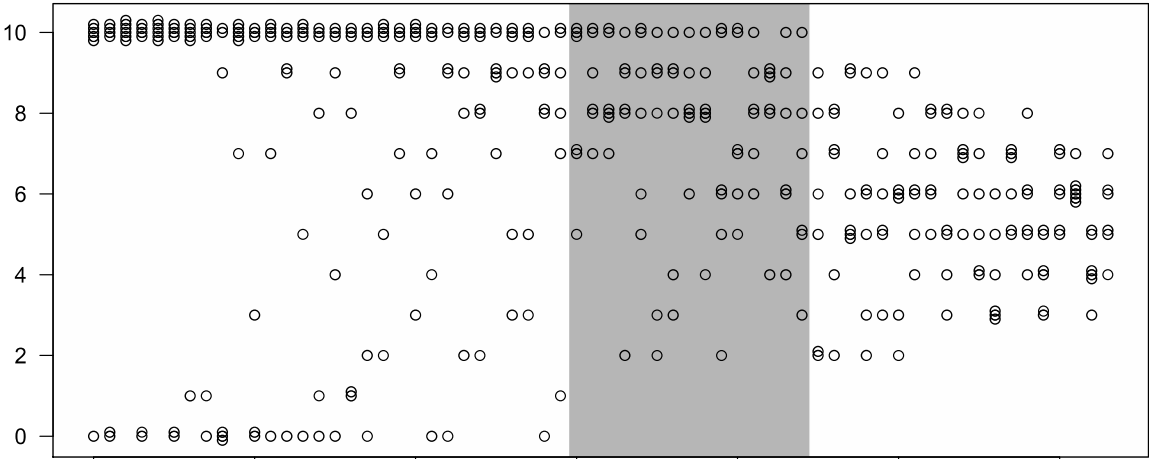
output count  
of variant x



# Minority regularizers

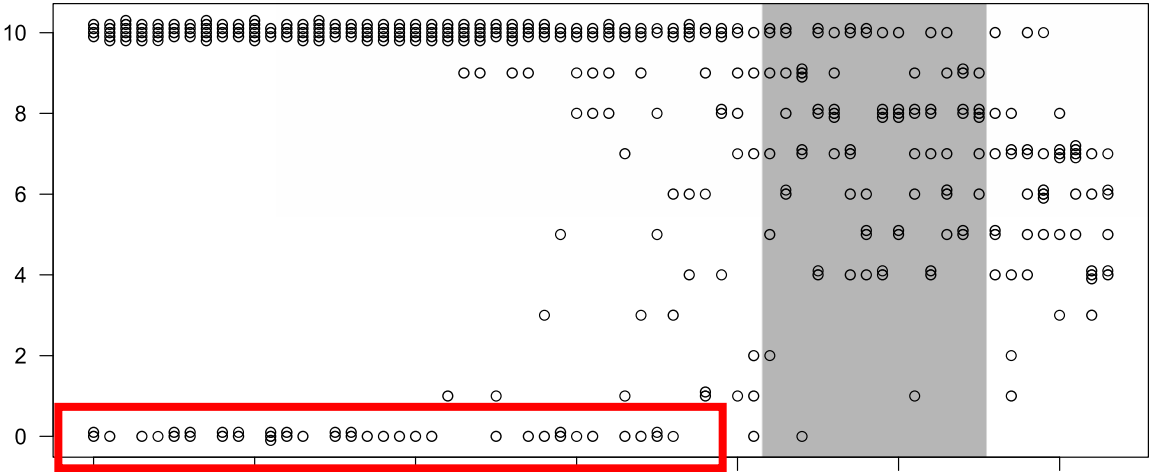
*marbles6*

output count  
of variant x



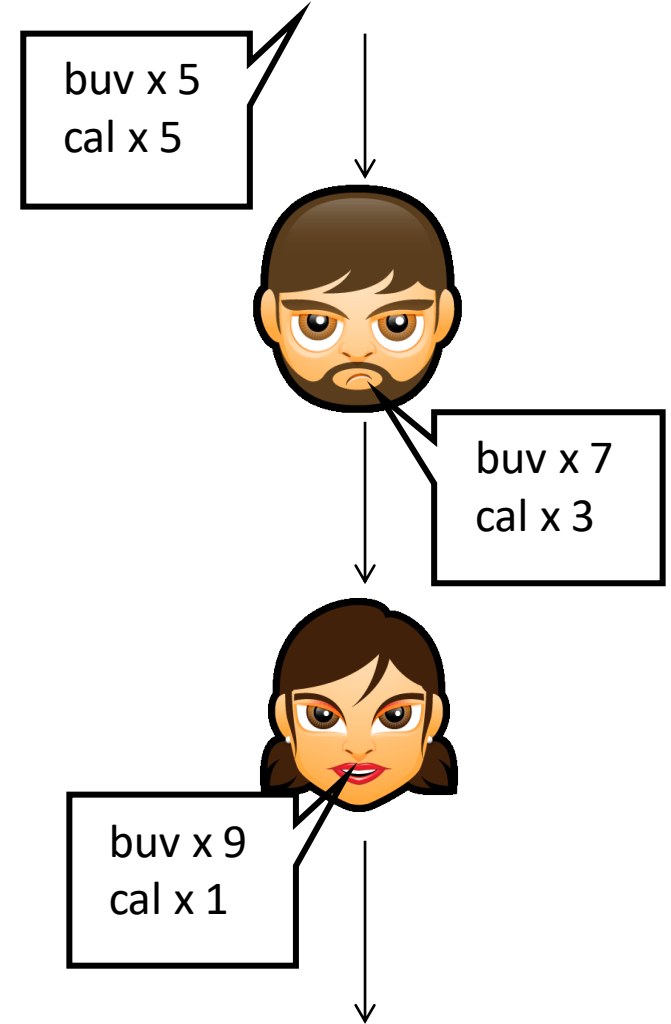
*words6*

output count  
of variant x



participant

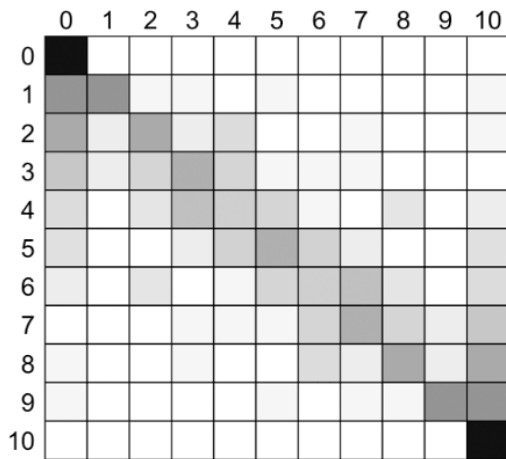
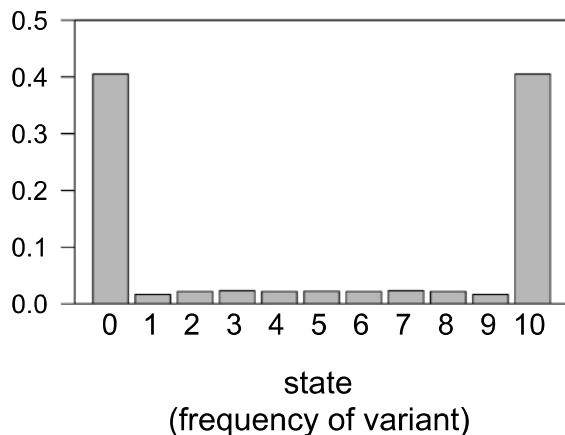
# Simulating person-to-person transmission (iterated learning)



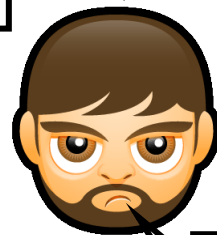
# Simulating person-to-person transmission (iterated learning)

*words1*

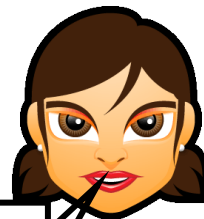
output frequency



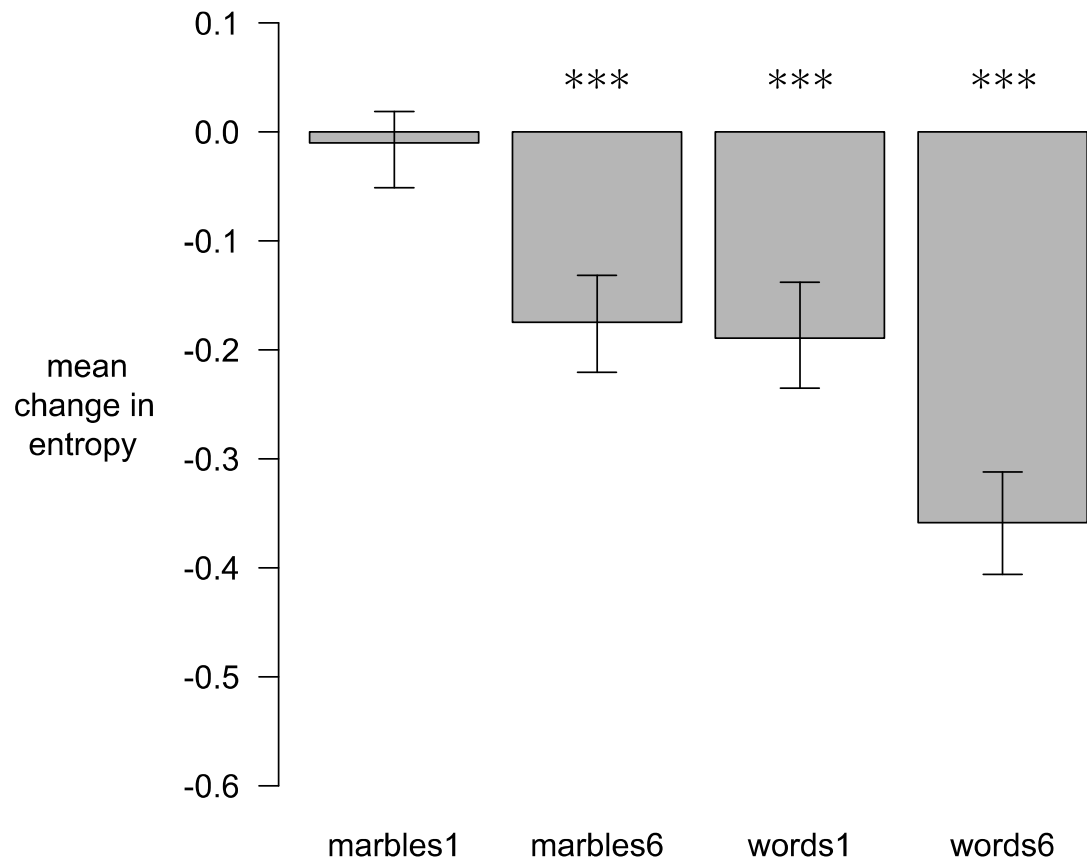
buv x 5  
cal x 5



buv x 7  
cal x 3



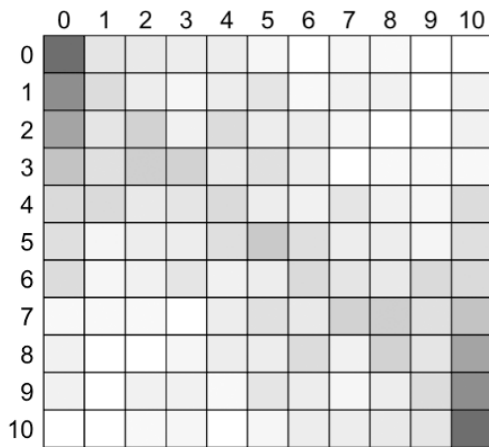
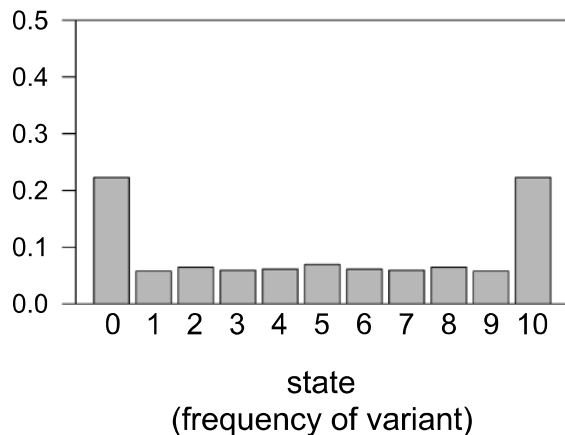
buv x 9  
cal x 1



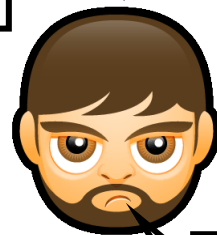
# Simulating person-to-person transmission (iterated learning)

*marbles6*

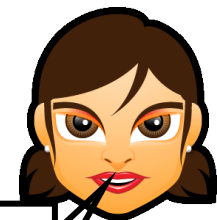
output frequency



bu v x 5  
cal x 5



bu v x 7  
cal x 3



bu v x 9  
cal x 1

# Ferdinand et al.'s conclusions

Effects of domain and demand on regularization

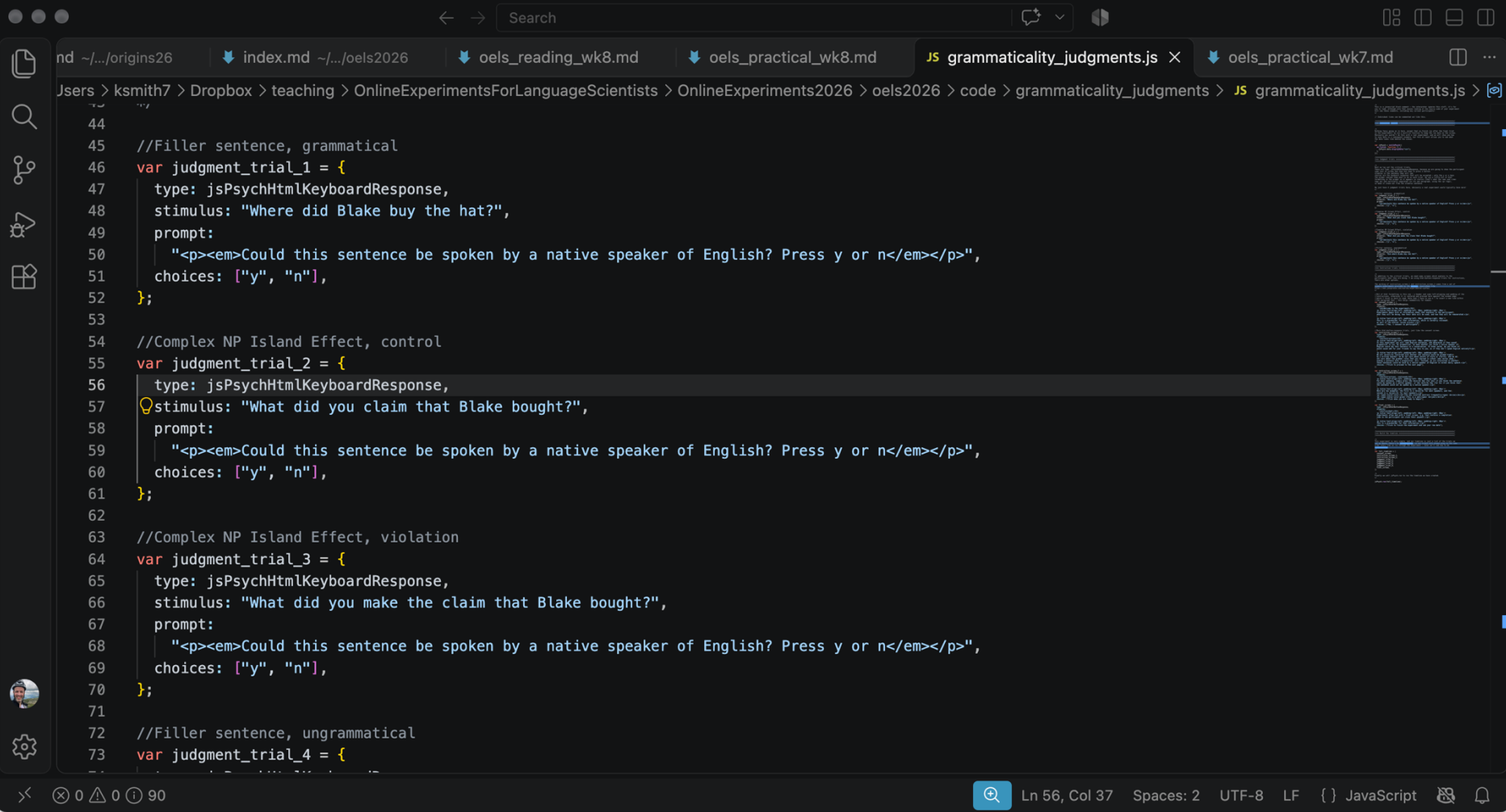
- More regularization on linguistic than non-linguistic tasks (why?)
- More regularization when under greater cognitive load

Regularization effects mainly in recall (not encoding)

Simulation of iterated learning can reveal additional differences in regularization (cf. marbles6 vs words1)

Time for Q&A/discussion on this week's reading

Coming up in labs: functions that create trials



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Jsers > ksmith7 > Dropbox > teaching > OnlineExperimentsForLanguageScientists > OnlineExperiments2026 > oels2026 > code > grammaticality\_judgments > JS grammaticality\_judgments.js > [e]

```
44
45 //Filler sentence, grammatical
46 var judgment_trial_1 = {
47   type: jsPsychHtmlKeyboardResponse,
48   stimulus: "Where did Blake buy the hat?",
49   prompt:
50     "<p><em>Could this sentence be spoken by a native speaker of English? Press y or n</em></p>",
51   choices: ["y", "n"],
52 };
53
54 //Complex NP Island Effect, control
55 var judgment_trial_2 = {
56   type: jsPsychHtmlKeyboardResponse,
57   stimulus: "What did you claim that Blake bought?",
58   prompt:
59     "<p><em>Could this sentence be spoken by a native speaker of English? Press y or n</em></p>",
60   choices: ["y", "n"],
61 };
62
63 //Complex NP Island Effect, violation
64 var judgment_trial_3 = {
65   type: jsPsychHtmlKeyboardResponse,
66   stimulus: "What did you make the claim that Blake bought?",
67   prompt:
68     "<p><em>Could this sentence be spoken by a native speaker of English? Press y or n</em></p>",
69   choices: ["y", "n"],
70 };
71
72 //Filler sentence, ungrammatical
73 var judgment_trial_4 = {
```



← → Search



nd ~/.../origins26

index.md ~/.../oels2026

oels\_reading\_wk8.md

oels\_practical\_wk8.md

JS grammaticality\_judgments.js X

oels\_practical\_wk7.md



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```
44
45 //Filler sentence, grammatical
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48   stimulus: "Where did Blake buy the hat?",
49   prompt:
50     "<p><em>Could this sentence be spoken by a native speaker of English? Press y or n</em></p>",
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69   choices: ["y", "n"],
70 };
71
72 //Filler sentence, ungrammatical
73 var judgment_trial_4 = {
```



# Functions

- A reusable block of code that performs a task
- We can provide values to the function through its **parameters**
- A function can **return a value** for us to use elsewhere

# Define a function

```
function make_judgment_trial(sentence) {  
  var judgment_trial = {  
    type: jsPsychHtmlKeyboardResponse,  
    stimulus: sentence,  
    prompt:  
      "<p><em>Could this sentence be spoken by a native speaker of English? Press y or n</em></p>",  
    choices: ["y", "n"],  
  };  
  return judgment_trial;  
}
```

# Call the function

```
var judgment_trial_1 = make_judgment_trial("Where did Blake buy the hat?");  
var judgment_trial_2 = make_judgment_trial("What did you claim that Blake bought?");  
var judgment_trial_3 = make_judgment_trial("What did you make the claim that Blake bought?");
```

# Next up

## Lab

- A frequency learning experiment

## Next week:

- Perceptual learning, audio stimuli
- The end of the “basics”