

# Speaking the Mind: Investigating the Association between Sensorimotor Learning and Model-Based Estimations of Forgetting Rate

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## BACKGROUND

- Recent work has implicated **cognitive factors** in **sensorimotor learning** during speech [1, 2, 3, 5].
- The exact way in which cognition impacts sensorimotor learning is unclear.
- Individual differences in cognition can be quantified using model-based estimations of learning and forgetting rates [4, 6].
- Here, we will investigate the relationship between **sensorimotor learning rate** during speech and **memory capacities**.
- The results may have key implications for the development of speech-based interventions that aid learning and memory.

## METHODS

A total of 28 participants completed the experiment. A preliminary analysis based on 9 female participants is reported here.

### ADAPTIVE MEMORY MEASUREMENTS

- Participants completed a 12-minute session, learning the names of cities in the USA from a map, with the MemoryLab adaptive learning system (Fig. 1).
- For each participant and item, the system estimated the rate at which the learner is forgetting the item (Fig. 1).

### SENSORIMOTOR LEARNING

- Participants were instructed to read prolonged, steady, words ('BID', 'BED', 'BAD') from a computer screen, while receiving perturbed auditory feedback.
- After practice trials, participants completed a *baseline phase* (unperturbed feedback); a *ramp phase* (0-30% perturbation), a *hold phase* (30% perturbation) and an *after-effect phase* (unperturbed feedback).

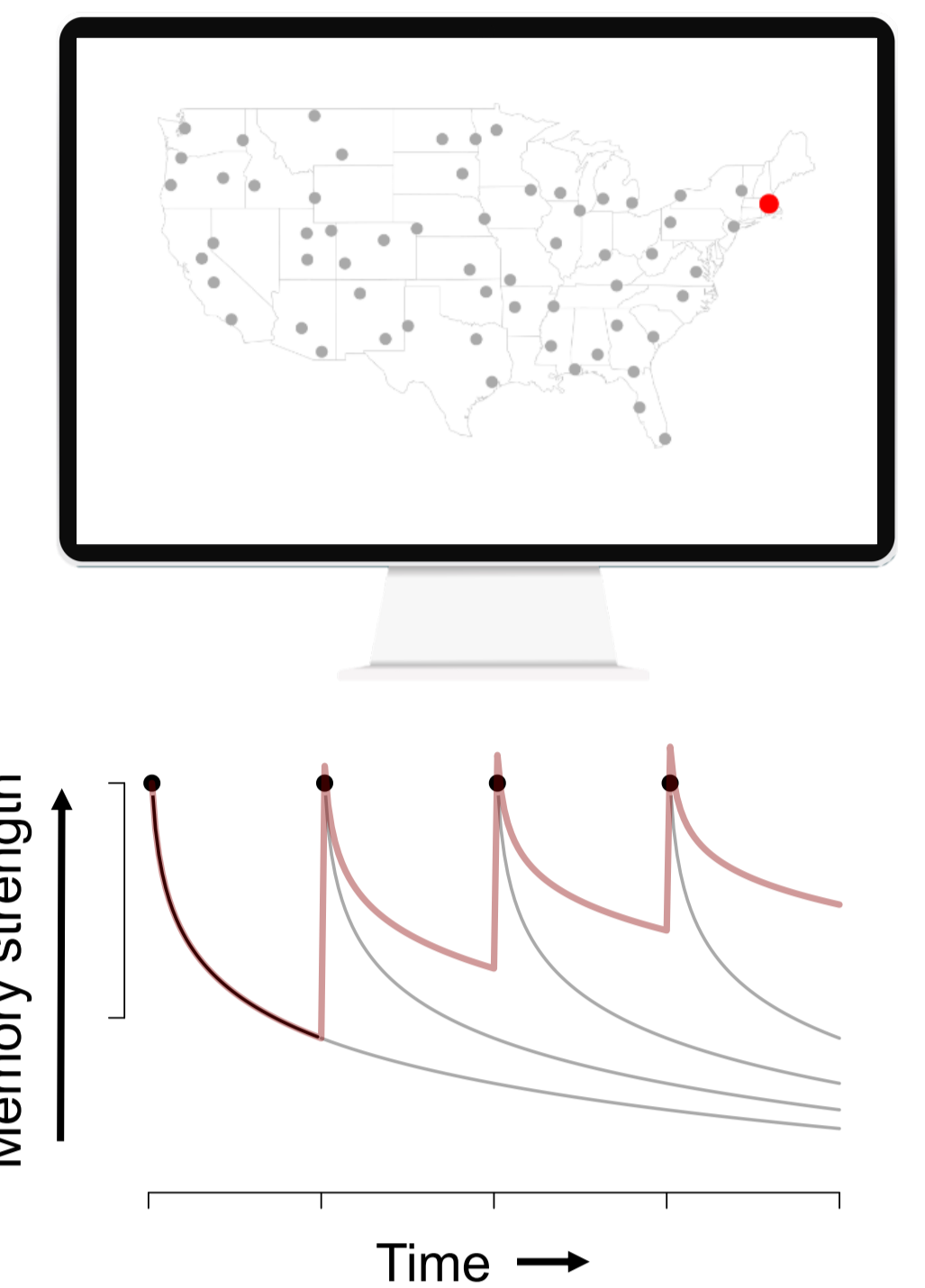


Fig. 1: (top) Participants studied the names of cities in the USA. (bottom) Based on their responses, the MemoryLab adaptive learning model estimated the rate at which memory strength for each item declined over time.

## RESULTS

### MEMORY MEASUREMENTS

- MemoryLab's adaptive algorithm estimated the rate at which the learner forgot each item during the learning session (Fig 2).

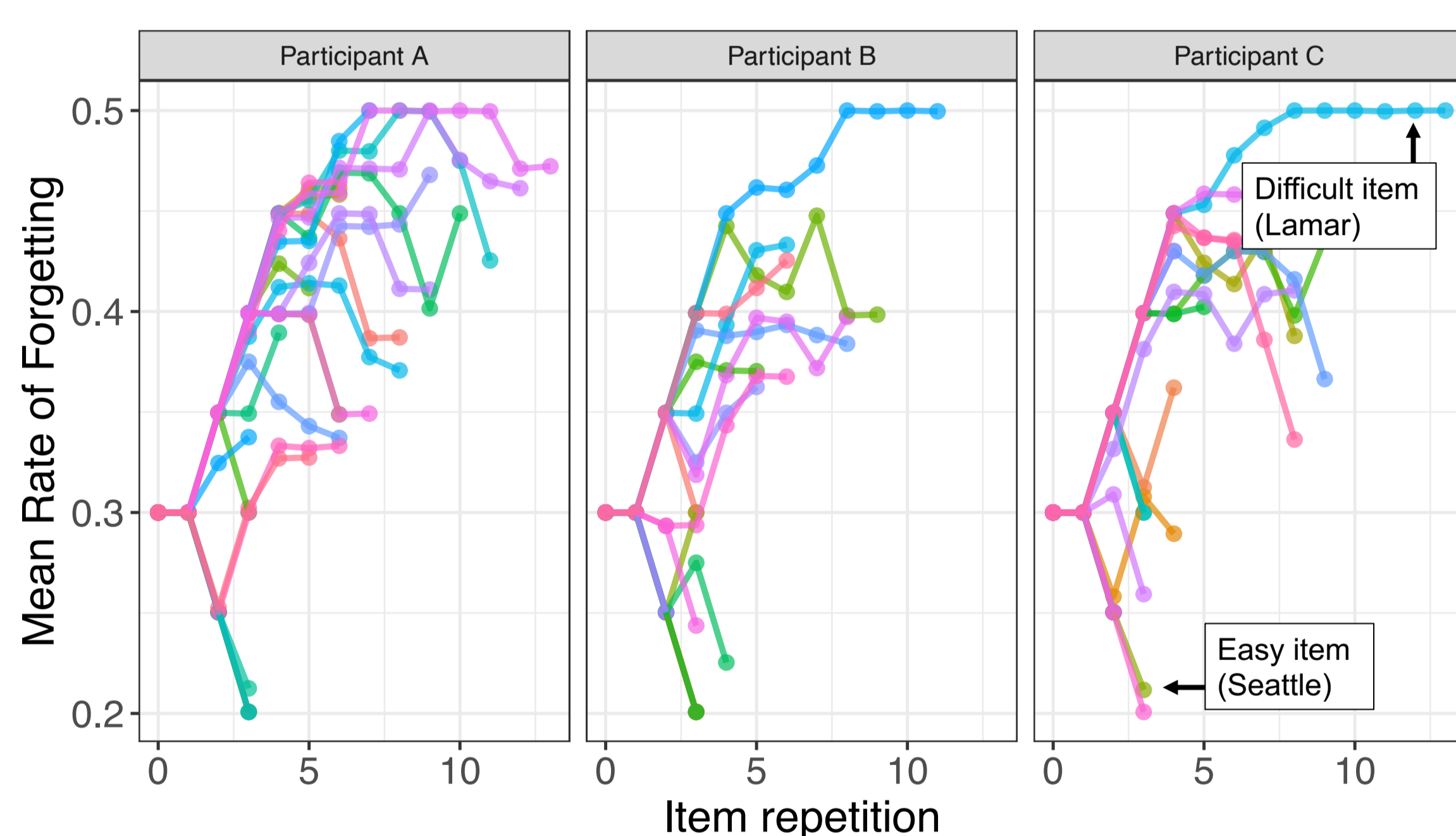


Fig. 2: Mean rate of forgetting over repetitions during the learning session for three participants. Lines show individual items.

### SENSORIMOTOR LEARNING

- Eight out of nine participants showed minimal change or a compensatory response to the perturbation (Fig. 3). One participant showed a response following perturbation (data not included in analysis).

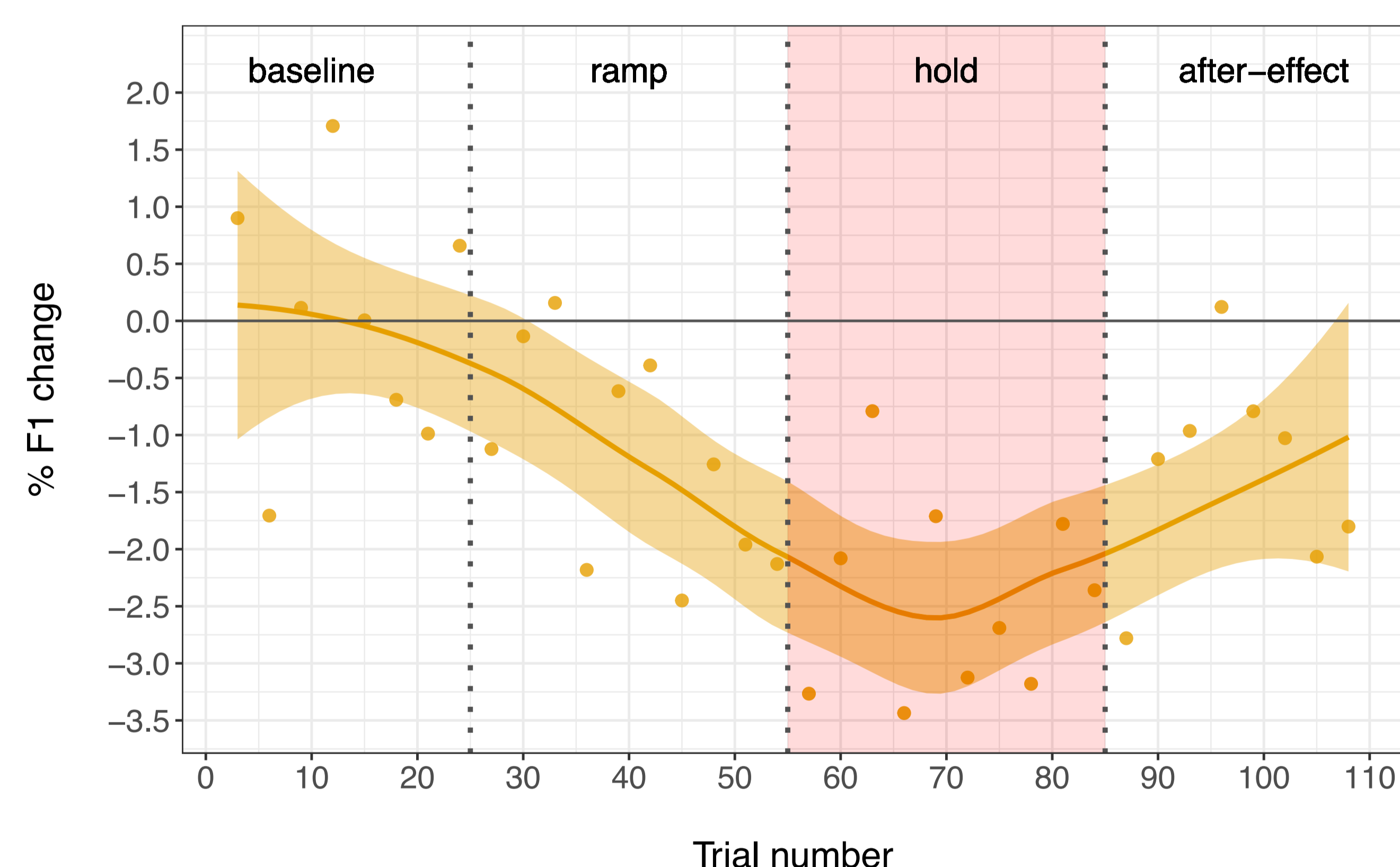
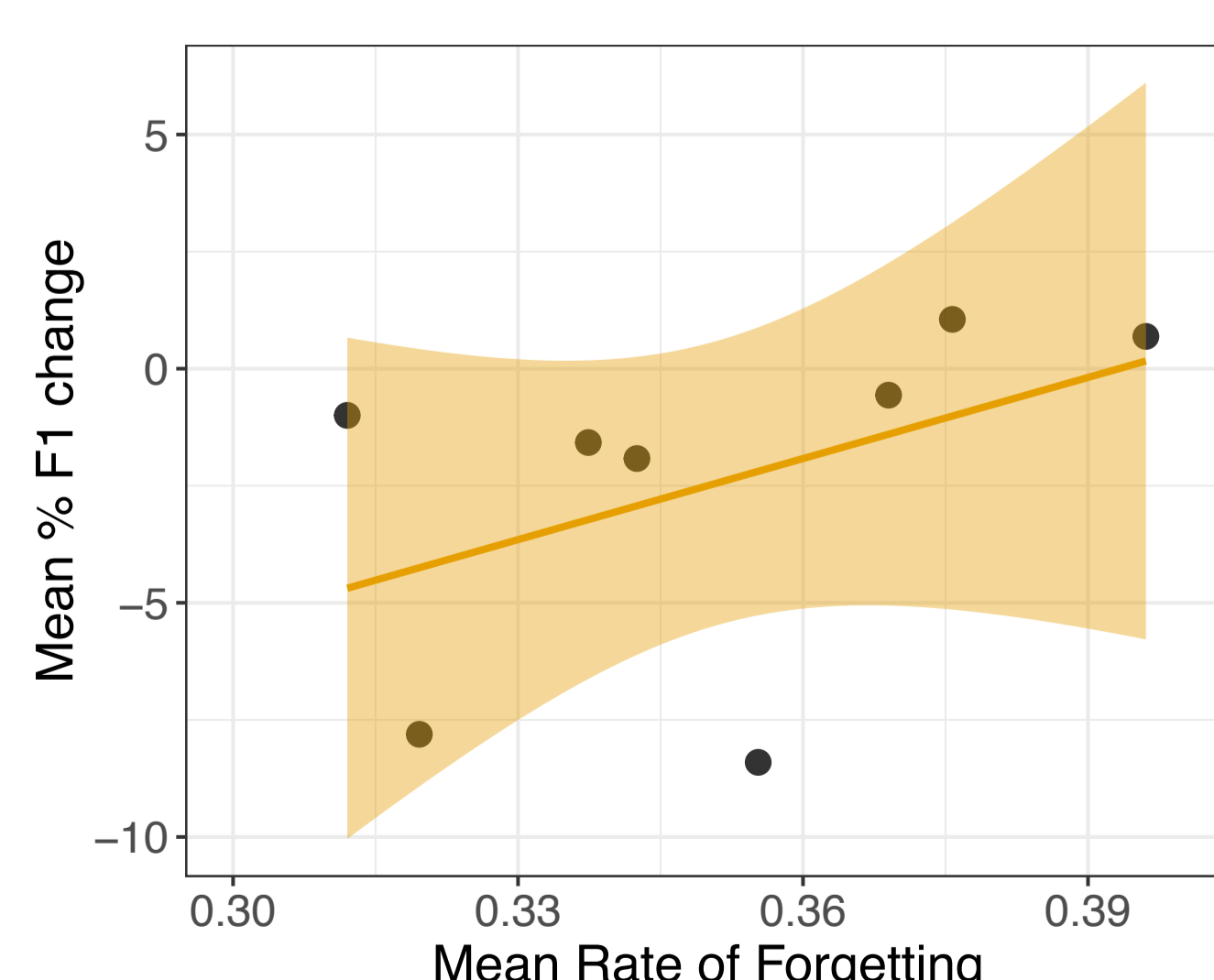


Fig. 3: Percent F1 change during the four stages of the experiment. Dots show average change over each three-word pair ('BID', 'BED', 'BAD'). Shaded area represents the 95% confidence interval.

### FORGETTING RATE AND SENSORIMOTOR LEARNING

We found a positive association between average Rate of Forgetting, and the amount of F1 compensation during the hold phase (Fig 4,  $R = 0.454$ ,  $p = 0.258$ ).

Fig. 4: the association between mean F1 change during hold phase and mean rate of forgetting. Dots represent individual participants, shaded area represents the 95% confidence interval.



## DISCUSSION

- Preliminary analyses of the data suggest that **the amount of sensorimotor learning** is associated to **forgetting rate** in a learning task.
- Less F1 compensation in the perturbation task was associated with more forgetting in the learning task.
- These results suggest that general, trait-like differences in cognition may be associated to individual differences in speech production.

LEARN MORE

[www.memorylab.nl/en/](http://www.memorylab.nl/en/)

<https://aburlab.web.rug.nl>

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