**Experimental Protocol**

Across the project, we ran 26 experiments, which were variants of the same basic experimental protocol, shown in Figure 1. In all experiments, required sample sizes were calculated from known (or estimated) effect sizes, to ensure that we had sufficient power to detect an effect with at least 80% probability.

Across experiments, variation in the number of study items, or their presentation duration, was based upon previous work, together with pilot testing to ensure performance was adequate to detect experimental effects (i.e. above floor, below ceiling).

There were two main experimental phases (Study and Test) in every experiment, but the specific materials used, and the test formats used varied across studies, as described below.

**Phase 1: Study Phase**

Participants studied a set of paired-items in two formats, using a within-subject design that randomly intermixed items. Pairs were either simply presented together under the instruction that the pair should be learned, or there was an initial pre-test in which Participants were first asked to guess what the second part of the pair might be, before being shown the answer to be learned.

Across experiments, we varied the nature of the materials to be studied, but it was always one of the following formats, and participants were always aware of the material they would be studying:

Semantically related words*: e.g. Bucket – water*

Semantically unrelated words: *e.g. Piano – grass*

Rare English word definitions: *e.g. roke - mist*

Foreign word – English translations. *E.g. Onnellinen – happy*

Rare general knowledge facts: e.g. In which American city was Coca-Cola invented: Atlanta

Face image – personal facts: e.g.  *likes cheese*

**Phase 2: The test phase**

All experiments involved a final test phase for the information that had been studied. This involved individual responses to the study items (and new items in recognition tests). The format of the test differed across experiments, taking one or more of the following formats:

Cued recall: *e.g. Bucket - ?*

Recognition: *e.g. Did you study this item: grass?*

Multiple choice recognition: *e.g. What is the meaning of roke? a) Tool, b) Sweet, c) Mist*

Associative recognition: *e.g. Was this a pair that you studied? Onnelinnen – grass*

Precise details for each experiment can be found in the published outputs.

**Figure 1: Schematic Generic Experimental Protocol**

Pre-experimental phase

Analysis

Comparison of study-only and pre-testing conditions on correct test performance (and errors where appropriate) using ANOVA, t-tests and associated Bayes Factors

Instructions for study phase

Data recorded: the accuracy of each response to the pre-test question. Trials with correct guesses were excluded from final analysis.

Participant debrief

Post experimental phase

Data recorded: the accuracy of each response to the each test item, split by nature of test where appropriate.

Test items presented in randomised order and responses recorded

Test phase

(Test format varies across studies)

Half of study list in study only condition

Half of study list in pre-test condition

Study phase

(Materials vary across studies)

Brief and Consent form

Online -recruitment

Instructions for study phase

Pairs of items presented in randomised order