# Implicit Learning of Verb Selectional Preferences

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## Introduction

Most implicit learning research to date has focused on form-level regularities, e.g. in strings of letters or syllable strings. Some recent research has shown that regularities involving meaning can also be learned implicitly, e.g. the use of semantic information to guide visual attention (Goujon, 2011) or learning arbitrary sequences of semantic categories (Goschke, 2007). However, it is still not clear to what extent meaning can participate in implicit learning of natural language. On the one hand, it has been claimed that referential word meaning is essentially learned explicitly (Ellis, 1994). On the other, intuition suggests that grammatical and collocational aspects of words may be known and acquired implicitly (Paradis, 2004).

The present research examined implicit learning of selectional preferences of novel verbs using a false memory paradigm as an indirect test of learning.

## Experiment 1

### Participants

X native speakers of English with varied L2 learning background .

### Method

Table 1. The verb slection system used in the experiments.

| verb selection preference system | | subjects not told | |
|---|---|---|---|
| | | abstract collocate, e.g. *greatness, power, importance* | concrete collocate, e.g. *vitamins, magnesium, carbohydates* |
| subjects were told | 'increase' | **POWTER** | **MOUTEN** |
| | 'decrease' | **GOUBLE** | **CONNEL** |

### Training Task

64 sentences, 32 critical sentences containing a critical verb. 8 sentences for each one, and 32 filler sentences, without critical verbs, but containing an abstract or a concrete noun.

**Critical**

1. Nightingale worked tirelessly to improve public health and POWTER the status of nurses.
2. The fact that TV is still the most popular medium does not GOUBLE the significance of the radio in shaping public opinion.

**TASK 1**: Indicate whether the word in CAPITALS indicates that something "becomes more of" or "less of", choose -/+

**TASK 2**: Was the information in the sentence relatively important or unimportant to you? (yes or no)

**Fillers**

1. In clinical trials, peptides derived from food proteins have shown an effect on blood pressure.
2. Emergency treatment is indicated if potassium level is very high, or if severe symptoms are present.

**TASK 1:** Was the information in the sentence relatively important or unimportant to you?

### Test task

1. Familiarity judgement task. Did the words occur together in the sentences in the previous task?
2. Indicate confidence in judgement (guess, somewhat confident, very confident).

| condition | n | example | correct answer |
|---|---|---|---|
| New Grammatical (NG) | 16 | CONELL the proteins | no |
| New Ungrammatical (NU) | 16 | POWTER the potassium | no |
| Old Grammatical (OG) | 8 | GOUBLE the significance | yes |

### Post test

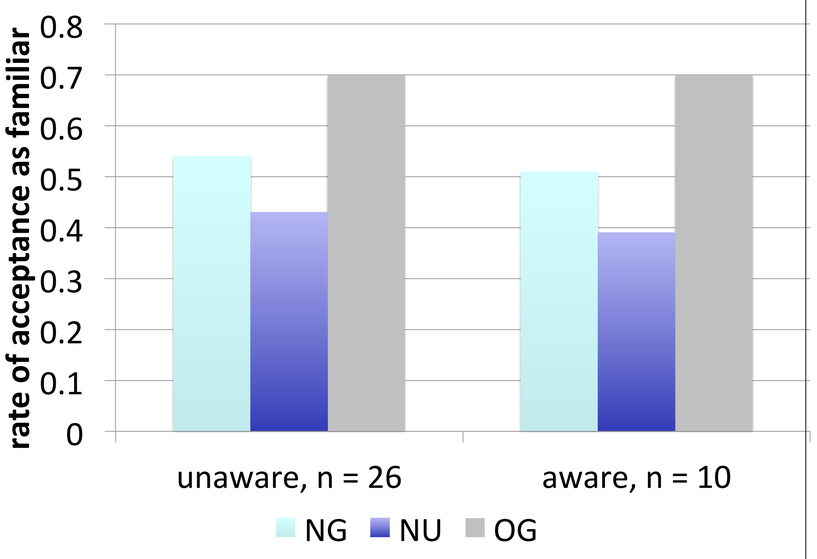
Multiple choice verb selection task using think aloud protocols to assess conscious knowledge of the selection preference rule.

### Predictions

If the selection preference rule has been learned implicitly, erroneous "familiar" judgements will be higher for NG than NU even for participants with no conscious knowledge of the rule.

### Results

*Figure 1. Acceptance rates in Experiment 1*




NG – NU difference significant for aware, $p < 0.05$, $\eta^2 = .43$, AND unaware, $p < 0.01$, $\eta^2 = .29$. Predictions confirmed.

### Confidence judgement analysis

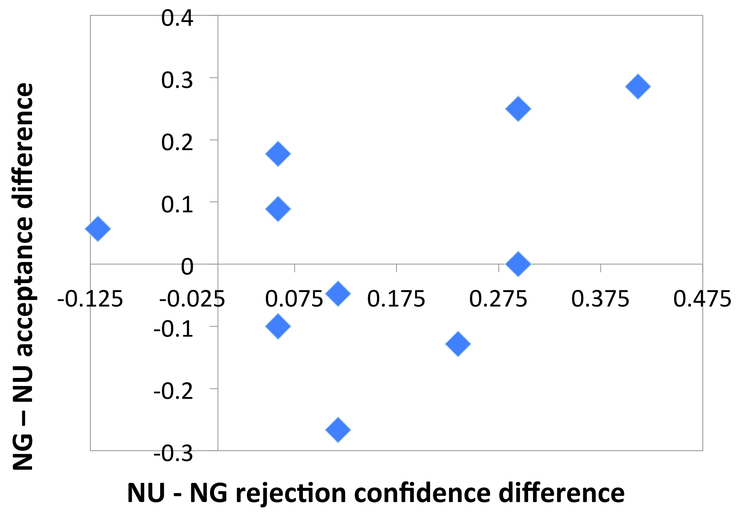
**Logic:** Participants are rating their confidence in familiarity decisions, NOT grammaticality (cf. use of confidence scales by Dienes, e.g. Dienes, 2008). But conscious knowledge could lead to confident rejections of NU items (if the item is not grammatical it must be new).

*Measure of conscious knowledge*: NU – NG rejection confidence difference.
*Measure of learning effect*: NG – NU acceptance difference.

Correlation between confidence difference and learning effect:
Unaware group: r = -0.04
Aware group: r = 0.32, ns.

Correlation for aware due to points 1 and 2 (Figure 1). These were the only participants who accurately reported the whole system in the post-test.

*Figure 2. Correlation between confidence difference and learning effect. Aware group. Experiment 1.*




| | **Experiment 2** Internet-based replication | **Experiment 3** Internet-based, heterogeneous word sets* |
|---|---|---|
| NU – NG diff Unaware | 6%, n = 33<br>$p < .05$, $\eta^2 = .30$ | 5%, n = 61<br>$p < .05$, $\eta^2 = .09$ |
| NU – NG diff Aware | 18%, n = 11<br>$p < .05$, $\eta^2 = .54$ | 21%, n = 7<br>$p = .055$, $\eta^2 = .48$ |
| Confidence correlation Unaware | r = 0.089 | r = - 0.33<br>p < 0.01 |
| Confidence correlation Aware | r = 0.59,<br>p = .056 | r = 0.79<br>P < 0.05 |

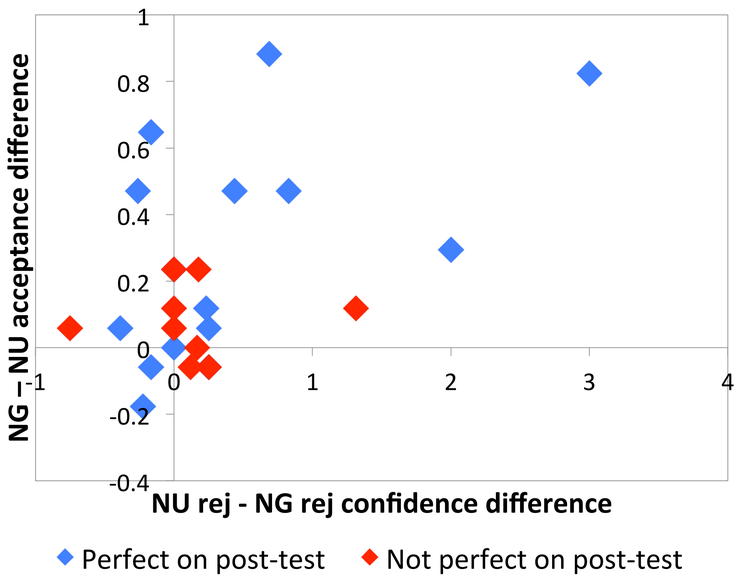
*Training items heterogeneous, and less similar to test items than in Expt 1 & 2. E.g. *happiness, wisdom, impact, understanding*, vs. *chocolate, luggage, metal and paper*.

## Experiment 4

Participants told the selection preference rule prior to training phase. Experiment 3 materials used.

NU – NG diff = 19%, $p < 0.01$, $\eta^2 = 0.32$, n = 24
Confidence correlation, r = 0.50, $p < 0.05$

*Figure 3. Correlation between confidence difference and learning effect. Experiment 4.*




## Conclusion

- Implicit learning of an abstract semantic generalisation in language.
- Effect size reduced as heterogeneity of exemplars is increased (cf. Expt 2 and 3), but only for unaware. Therefore, more restricted generalisations probably learned in Expts 1 and 2 (not abstract/concrete as such).
- Explicit knowledge can influence judgements in this task, but this is strategic, and only in the most highly aware participants. False memory a good way to assess implicit knowledge.