Foundations of Language Science and Technology – Cognitive Foundations Tutorial

Setting up a Simple Experiment[1]

Consider the following two sentences:

1a. *The doctor cured by the treatment needed several weeks to recover.*

1b. *The patient cured by the treatment needed several weeks to recover.*

In both cases, 'cured' is a past participle and introduces a reduced relative clause. However, intuitively at least, the sentences seem to differ in how likely they are to be misanalysed. In (1a), "The doctor cured…" suggests a reading in which the doctor is the Agent of the sentence and that 'cured' is the verb of a main clause. In (1b), on the other hand, this garden-path reading appears less probable because a patient is more likely to be cured then to cure someone — in linguistic terms, it is more likely to be the Patient of curing than its Agent.

Imagine that you wanted to use an online method (e.g., self-paced reading, eye-tracking) to investigate whether the semantic properties of the sentential subject can immediately affect the type of syntactic structure built by the parser (the interactive hypothesis), or whether the syntactic parser is autonomous and semantic processing only occurs after the syntactic structure is built (the modular hypothesis).

The goal of this tutorial is to give you some hands-on exposure to creating materials for such an experiment, including how to norm the materials via an offline pre-test, and how to control for extraneous factors before running the main experiment.

Please do as many of the steps below before the tutorial on Friday. Bring your laptop to class and we will do the remaining steps together:

1. **Hypotheses and Predictions**
   Formulate H_0 and H_1 for the main experiment. What predictions with respect to reading times does the modular account make? What predictions does the interactive account make?

2. **Materials for Main Experiment**
   Create 4 more items that could be used as materials for such a study by following the pattern shown in 1a and 1b. Use your personal intuition to find appropriate verbs and nouns for the stimuli. Each item should pair a verb (e.g., 'cured') with two subject nouns (e.g., 'doctor', 'patient'). Choose these nouns so that when in company of the given verb, one noun should be rated as likely to perform the action, and the other noun rated should be rated as unlikely to perform the action. Do not repeat any nouns or verbs across items.

Materials for Main Experiment	
1a	*The doctor cured by the treatment needed several weeks to recover.*
1b	*The patient cured by the treatment needed several weeks to recover.*
2a	
2b	

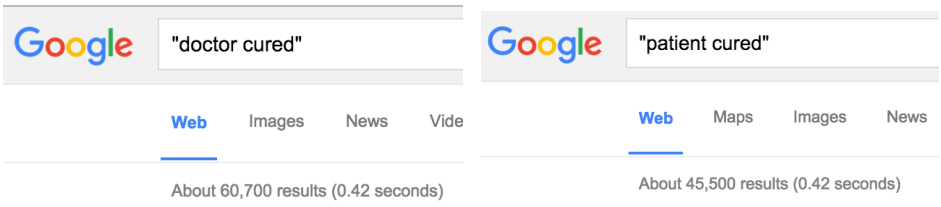
[1] This tutorial is adapted from previous tutorials given by Garance Paris and Francesca Delogu

3a	
3b	
4a	
4a	
5a	
5b	

3. **Norming**
Now, you are ready to norm these materials using a plausibility judgment task. You would like to confirm your intuitions about the likelihood of each noun as Agent of the verb that is has been paired with. In this task, participants will be asked to indicate on seven-point Likert scale how likely it is for each noun to perform the action specified by the verb. Modify the items you created above for the pre-test:

	Materials for Pre-Test
1a	*How likely is it for a doctor to cure someone?*
1b	*How likely is it for a patient to cure someone?*
2a	
2b	
3a	
3b	
4a	
4a	
5a	
5b	

4. **Controlling for Frequency**
We know that frequency can influence language processing. In order to ensure that frequency effects are not confounded with your independent variable, you need to balance frequency across conditions. Use Google to get an approximation for the frequency of occurrence for each noun-verb combination by entering each combination (between quotes) in Google's search field. Write down the number of documents found for each combination.



5. **Confirm with *t*-test**
Use a *t*-test to check whether the mean frequency of occurrence for the two conditions are significantly different from each other.

(If you were really going to use these items for an experiment, the results of the *t*-test would have to be non-significant, indicating that the items in the two conditions were balanced. However, since this is only an exercise, continue with the following steps even if the *t*-test shows that the means are significantly different from each other.)

6. **Other Extraneous Factors**
   Make a list of other extraneous factors that might influence processing in this study and suggestions on how to control for them.

7. **Create Lists**
   Using a "latin-square", create the lists for presentation of the stimuli to the participants, assuming a within-subjects design. In other words, every participant should see each item, but in only one condition — otherwise the second time a verb is presented, the participants' rating might be influenced by the fact that the same verb was presented previously. Create your lists using a spreadsheet program (e.g., Microsoft Excel).

8. **Add Fillers**
   Create filler stimuli to intersperse between your experimental items so that participants won't be able to guess what the experiment is about. All fillers should also start with "How likely is it...", and it should be possible to rate them on the same Likert scale as above. Do not use any of the nouns or verbs that were used in the experimental conditions. It is ok (maybe even preferable) to vary the kinds of sentence structure used in the filler sentences. Create at least 10 fillers (twice as many as experimental items), plus three for the beginning of the experiment so the participants can get used to the task before they see any experimental items.

9. **Pseudo-randomization**
   Finally, pseudo-randomize the lists to avoid "runs" and effects of presentation order.