

Cross-species AGL meta-analysis protocol (#21351)

Author(s)

Antony Scott Trotter (Univeristy College London) - t.trotter@ucl.ac.uk
Padraic Monaghan (Lancaster University) - p.monaghan@lancaster.ac.uk
Gabriël Beckers (Utrecht University) - g.j.l.beckers@uu.nl
Morten Christiansen (Cornell University) - christiansen@cornell.edu

Created: 03/26/2019 07:20 AM (PT)

Public: 03/30/2019 12:16 PM (PT)

1) Have any data been collected for this study already?

It's complicated. We have already collected some data but explain in Question 8 why readers may consider this a valid pre-registration nevertheless.

2) What's the main question being asked or hypothesis being tested in this study?

Artificial grammar learning is an important tool for investigating aspects of language acquisition, and whether the underlying abilities might be unique to humans. However, it remains unclear whether participant performance reflects grammatical acquisition or sensitivity to other regularities in the input.

We hypothesise that the variance of effect sizes resulting from artificial grammar learning studies – in a meta-analysis of studies - will be influenced by the following variables; the structural and surface properties of the artificial language, the training and testing regiment, and the population tested.

3) Describe the key dependent variable(s) specifying how they will be measured.

The effect size and variance of effect size was calculated as Hedge's g , in accordance with Borenstein et al. (2009). For studies reporting the percentage correct/endorsed/responded to, the effect size was computed against chance; a one sample difference from chance. In serial reaction time studies, the effect is measured as an increase in RT between presentations of a trained vs. untrained structure. Hence, the effect size is a one sample difference from 0 (no disruption). In go-nogo studies, the effect size is the within-subjects, standardized mean difference between the proportion of go responses to a grammatical structure compared to responses to an ungrammatical structure, corrected for correlations between measures. In cases where correlations are not reported, we will assume the correlation is 1 to be conservative, in line with Witteloostuijn et al. (2014).

4) How many and which conditions will participants be assigned to?

In the meta-analysis, we will test for effects of homogeneity. If homogeneity is significant, then we will test the following distinctions between studies to test their contribution to the variation in effect size.

(1) Population variables:

Species tested, in the case of humans encoded whether the study was on children (<18 years) or adults. We will also investigate the class of animal, distinguishing primates from non-human primates, distinguishing adult and child human participants and avians.

(2) Properties of the language structure:

Whether the language contained adjacent dependencies (encoded as 1 vs. 0), or non-adjacent dependencies (encoded as 1 vs. 0) to be learned, and whether the study contained repetitions in the test items.

(3) Surface properties of the language:

Testing modality (auditory or visual only, auditory-visual), vocabulary size (total number of unique words), and the number of categories in the language (e.g. an ABn grammar with 4 A and 4 B category words, the grammar has 2 categories, and a vocabulary size of 8)

(4) Characteristics of training and testing:

How much training participants receive (in term of the number of stimuli from the grammar), and the type of test response; Yes vs. No judgement, go or no-go, scale judgement, forced choice test between two or more alternatives, or serial reaction time. These will be clustered into responses that require reflection on the task, or just processing of the grammar.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

Multi-level meta-analytic regression partitioning the variance of effect sizes according to the moderator variables in (4). As some articles contained more than one study which cannot be assumed to result in effect sizes independent from one another, we encoded article as a nested multilevel variable in the analysis, and will incorporate this into the test of the overall effect size using the metafor package in R.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

The exclusion criteria are as follows:

(1) Studies must include behavioural results. As a result, review articles, neuroimaging and computational modelling studies not including behavioural data will not be included.

(2) Data will only be taken from typical populations. Therefore, where studies on atypical populations (e.g. aphasic patients) that do not include a control

group, they will not be considered further for analysis.

(3) Due to language constraints, we will not include studies that are not in a language known to the researchers.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.

The sample is generated by a literature search in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). The literature search was conducted on the SCOPUS database (Scopus, 2019) of articles published up to March 2019. We focus on studies that referred to the modality of presentation of stimuli in artificial grammar learning studies. We therefore used the following keywords for the search; “artificial grammar learning”, and “vision” or “visual”, and “artificial grammar learning” and “auditory” or “audio” appearing in the titles, abstracts, or keywords of articles within the database. The search resulted in 91 records, 11 of which were duplicates, resulting in a set of 80 records. These 80 were then submitted to the exclusion criteria in (6).

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

We have conducted a literature search, but have not yet analysed the data. This pre-registration involves a protocol for a meta-analysis, defining the inclusion and exclusion criteria, how the effect sizes will be computed from the studies, and the methods of analysis to be performed on the data set in advance of these stages being conducted on the literature search.

This research is supported by the International Centre for Language and Communicative Development (LuCID) at Lancaster University, funded by the Economic and Social Research Council (UK) [ES/L008955/1], the Consortium on Individual Development (CID), which is funded through the Gravitation Program of the Dutch Ministry of Education, Culture, and Science and the Netherlands Organization for Scientific Research (NWO; grant number 024.001.003). These funders had no contribution to defining the protocol of this meta-analysis.