Using the scale of innovation to study the evolution of language

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1. Introduction

Researchers who are interested in the cognitive basis of various linguistic phenomena often use experiments to examine how participants interact with linguistic stimuli. In language evolution research, much of this work has focused on how cognitive biases that are present in the minds of individuals come to affect population-wide phenomena, like typological regularities and the pathway of language evolution (Culbertson, 2023).

I review results from previous experiments examining the effects of cognitive biases on linguistic structure across syntax and phonology, and show that most of these cognitive biases can be categorised into two groups, either *category-specific* or *system-wide*. Category-specific biases are motivated by factors external to the linguistic domain in which they apply (e.g. affect syntactic structure but are motivated by semantics/processing), and adherence to these biases can be evaluated on an item-by-item basis (i.e. without reference to the wider linguistic system to which they belong). System-wide biases, on the other hand, are motivated by factors internal to the linguistic domain in which they apply, and adherence to these biases must be evaluated in the context of the wider linguistic system. An example of a category-specific bias is the subject (or agent) first bias (Futrell et al., 2015; Meir et al., 2017), as this is motivated by the accessibility of animate entities (Dahl, 2008; Yamamoto, 1999) and affects the syntactic structure of languages by favouring subject initial word orders (Goldin-Meadow, So, Özyürek, & Mylander, 2008). An example of a system-wide bias is the preference for harmonic (or consistent) order between heads and dependents. This bias is motivated by the compression benefits that harmony affords to a grammar (Culbertson & Kirby, 2016), and causes participants to favour harmonic languages (Culbertson, 2012).

2. Proposal

Crucially, the pattern of evidence for the two types of biases shows that the amount of *innovation* involved in the experimental task is predictive of the emergence of behavioural evidence for the two bias types. Category-specific biases tend to

influence participants' behaviour in tasks requiring innovation, whereas system-wide biases are more active in learning-based tasks that require little innovation (Finley & Badecker, 2007; Martin & Peperkamp, 2020; Moreton & Pater, 2012; Motamedi, Wolters, Naegeli, Kirby, & Schouwstra, 2022).

In light of this pattern I introduce the *Scale of Innovation* (see Figure 1) as a conceptual tool for organising experimental contexts and paradigms along a continuum based on the amount of linguistic innovation that is required in each experimental task. On the left are task that rely on learning (low-innovation contexts like memorisation), on the right are tasks that rely on improvisation (high-innovation contexts), and in the middle are tasks that combine learning and improvisation (mixed-innovation contexts like extrapolation). This scale, along with the division of cognitive biases into category-specific and system-wide types, allows researchers to choose appropriate experimental methods to study their chosen cognitive phenomenon.

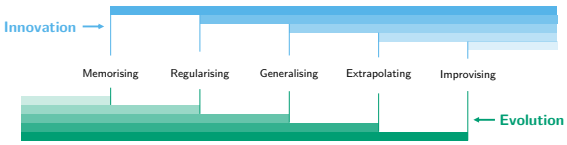

Figure 1. Scale of innovation showing contexts that require more innovation as you move right along the top scale, and the progression of language evolution as you move left along the bottom scale.

To support the order and divisions along the scale I present results from a novel set of artificial language learning experiments that focus on a typological pattern in the noun phrase that exhibits competition between category-specific and system-wide biases (i.e. an instance where the system-wide bias for harmony competes with category-specific biases favouring nonharmonic order). I show that, by manipulating the amount of innovation involved in the experimental task, participants' interaction with this phrase is influenced by either one of the bias types individually (when performing tasks at opposite ends of the scale) or a combination of both (when performing tasks at the centre of the scale).

3. Discussion

In addition to the practical benefits of using the scale during experiment design, there are also potential parallels between the structure of the scale of innovation and different stages of language evolution. This is illustrated in the matched scale at the bottom of Figure 1, where improvisation is matched to the start of language evolution. I discuss these parallels with evidence from language acquisition, studies of young sign languages, and proposed models of language evolution.

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