THE EFFECT OF IMPROVISATION AND LEARNING ON WORD ORDER PREFERENCES

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Background In this study we hypothesise that certain typological patterns may have evolved as a result of competition between cognitive biases that tend to be active during different stages of language evolution. Research has shown that some cognitive biases influence linguistic behaviour under conditions where language structure is improvised (Culbertson, Schouwstra, & Kirby, 2020; Goldin-Meadow, So, Özyürek, & Mylander, 2008; Schouwstra & Swart, 2014), whereas other biases influence learning behaviour, meaning some linguistic structures are favoured or disfavoured during learning (Culbertson, Smolensky, & Legendre, 2012; Fedzechkina, Jaeger, & Newport, 2011; Hudson Kam & Newport, 2009). This research can be thought to represent two stages of language evolution, such that the biases that affect improvisation are active during language creation, and biases that influence learning affect language evolution only once there is a linguistic system for learners to acquire. However, recent research suggests that the influence of some biases may persist from improvisation into learning tasks (Motamedi, Wolters, Naegeli, Schouwstra, & Kirby, 2021). The possibility of these biases being active simultaneously means that competition between different biases could shape language typology.

We focus our investigation on a possible example of such competition, namely an exception to the typological tendency towards harmony, whereby languages tend to order dependents on the same side of the head (Greenberg, 1963; Hawkins, 1990). The exception concerns how adjectives (e.g. '*big house*') show a typological tendency for postnominal order (N-Adj = 879 vs Adj-N = 373, Dryer, 2013a) whereas genitives (e.g. '*The child's toy*') tend to be prenominal (N-Gen = 468 vs Gen-N = 685, Dryer, 2013b), despite a harmonic tendency among other nominal modifiers. We report results from an experiment where participants had to chose an order to expressing descriptive (adjective) and possessive (genitive) meanings in the absence of a language system. The second experiment explores if the ordering preferences identified in the first experiment continue to shape participants' linguistic behaviour in a learning task, where previous research has found that participants tend to have a preference for harmonic orders (Culbertson et al., 2012).

Experiment 1 Participants in experiment 1 were randomly assigned to either an *adjective* condition (N=160) or a *genitive* condition (N=160). They saw images signifying meanings such as *striped book* (adjective condition) or *cyclops' hat* (genitive condition) accompanied by two gesture videos. In one of the videos the meaning of the image was conveyed with a prenominal gesture order (adjective/genitive-noun) and in the other with a postnominal gesture order (noun-adjective/genitive). Participants each saw a single such trial, and were instructed to choose the video they thought best conveyed the meaning of the image. Results from this experiment show that participants preferences generally align with those seen in typology, namely that they prefer postnominal orders for adjectives (β = 0.51, SE. = 0.16, z = 3.02, $p < 0.01$) and prenominal orders for genitives (β = 0.56, SE = 0.16, z = 3.43, $p < 0.001$).

Experiment 2 In experiment 2 participants were randomly assigned to one of four conditions which differed in the word order used to convey adjective and genitive meanings. Each condition had a majority order shown 75% of the time, and a minority word order shown 25% of the time during training for each dependent type. In the natural condition the majority order for genitive trials was prenominal and for the adjective trials it was postnominal (i.e., following the preferences identified the typology, and replicated in experiment 1). The unnatural condition was the opposite of this. In the remaining two conditions the majority order was shared across both modifier types–either majority pre-nominal or post-nominal–and thus was harmonic. In the test phase, participants were shown an image to be conveyed along with two videos featuring pre- or post-nominal order and had to choose which they preferred, as in experiment 1. The results showed that participants generally learned the majority orders they were trained on (β = 1.34, SE = 0.12, z = 11.24, p $<$ 0.001). Further, there was an overall tendency to regularise (i.e., use one order for a given dependent type more consistently than in the input) which was captured as reduction in conditional entropy (β = -0.10, SE = 0.02, t = -8.74, p $<$ 0.001) and a tendency to harmonise (i.e., choose the same order across the two modifier types) which was measured as reduction in Shannon entropy (β = -0.22, SE = 0.02, t = -5.15, p $<$ 0.001). Crucially, there was no evidence that the preferences identified in experiment 1 for specific modifier types continued to influence people's linguistic behaviour in this learning task (β = -0.14, SE = 0.10, z = -1.40, p = 0.16). For example, participants did not learn more successfully, or regularise the majority order more, in the natural condition.

Discussion While participants showed a strong preference for postnominal adjectives and prenominal genitives when the task involved choosing an expression of descriptive and possessive meanings, this preference did not carry over to the learning task in experiment 2. The results suggest that this exception to harmony is not be caused by continuous competition between biases during learning. Future studies will examine if competition between these biases exist in language tasks which involve both improvisation and learning, such as extrapolation tasks.

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