**The evolutionary pressure for subjectivity-based adjective ordering preferences**

Michael Franke (Osnabrück), Gregory Scontras (Irvine), Mihael Simonič (Ljubljana)

There are strong, cross-linguistically attested preferences on the ordering of adjectives when they modify a noun (e.g., *big brown bag* vs. *brown big bag*). [3] provide empirical evidence that adjective order in multi-adjective strings is reliably predicted by the subjectivity of the adjectives involved: less subjective adjectives are preferred closer to the modified noun. However, the reasons for that finding were not clear. This paper argues for an evolutionary rationale for these ordering preferences. Building on [2] and [4], we argue that there is a communicative advantage to ordering adjectives by their subjectivity. The main intuition is that more subjective adjectives are prone to incur more inter-interlocutor disagreement about whether the adjective applies to a given object or not. Therefore, to minimize coordination error in referential communication, a particular way of ordering adjectives is less error prone. We use mathematical modeling to flesh out this basic intuition in a novel way, and resort to numerical simulations to demonstrate the intuited difference in expected communicative success when averaging over a large number of randomly-generated contexts.

**Semantics.** We adopt a context-dependent threshold-based semantics for gradable adjectives, which [1] showed was the simplest highly-successful predictor of human judgements. The set $[\![\text{tall}]\!]^C$ of objects in context $C$ that count as tall in $C$ are those whose degree of tallness exceeds the threshold $\theta = k(\text{tallest}(C) - \text{shortest}(C))$ (where $k$ is a free parameter in our modeling and tallest($C$) / shortest($C$) are the heights of the tallest and shortest elements in $C$). Following [2] and [4], we assume that iterated adjectival modification triggers *sequentially intersective context updates*. Adjectives syntactically farther from the noun are interpreted relative to contexts that are already restricted by closer adjectives. For example, the denotation of "[$\text{adj}_\text{i}$ [$\text{adj}_\text{j}$ $N$]]" given a shared context $C$ of potential referents is $[\![[\text{adj}_\text{i}\ [\text{adj}_\text{j}\ N]]]\!]^C = [\![\text{adj}_i]\!]^{[\![\text{adj}_j]\!]^{C \cap [\![N]\!]}}$. The effect is that adjectives closer to the noun will operate over a larger context (i.e., one that is less restricted).

**Simulations.** We use Monte Carlo simulation to estimate the expected referential success, $\text{ES}(o) = \int P(C)\ \text{RefSuc}(ord, C)\ \text{d}C$, of different orderings $o$ of adjective sequences when applied across many contexts $C$. We fix two adjectival properties; one is more subjective than the other. We randomly generate contexts $C$ repeatedly (varying context size, difference in subjectivity etc.). Interlocutors have noise-perturbed representations of $C$. The more subjective a property is, the bigger the difference to the actual $C$. Interlocutors base their interpretation of phrases on their individual subjective representations of the context. Based on this setup, we show that ES($o$) is reliably and robustly higher for a sequence like "big brown bag" than for"brown big bag". This suggests that a simple, empirically-motivated semantics can lead to increased communicative success when multi-adjective strings are ordered with respect to decreasing subjectivity. We thus have an answer for the question of why subjectivity should matter in adjective ordering: ordering adjectives by decreasing subjectivity increases communicative success.

[1] Laura A. Schmidt et al. "How Tall Is *tall*? Compositionality, Statistics, and Gradable Adjectives". 2009.

[2] Gregory Scontras et al. "On the grammatical source of adjective ordering preferences". to appear.

[3] Gregory Scontras et al. "Subjectivity predicts adjective ordering preferences". 2017.

[4] Mihael Simonič. "Functional explanation of adjective ordering using probabilistic programming". 2018.