

## Property subjectivity predicts adjective ordering preferences

Cross-linguistically stable preferences for adjective ordering have been widely documented, yet the factors that determine these preferences are still poorly understood. Our approach to the investigation of adjective ordering preferences synthesizes strategies from the *psychological approach*, probing the principles that underlie these preferences [1, 2, 3, 4, 5, 6], and from the *grammatical approach*, using descriptive semantic classes of adjective to structure and inform our hypotheses [7, 8, 9, 10].

**Exp. 1 (corpus study).** For 26 adjectives from seven different classes (size, quality, age, texture, shape, color, material; see Table 1 for the full list of adjectives), we extracted all cases of phrases with either two or three adjectives (e.g., “a good green color” or “some big new red cloaks”) from the Switchboard and the British National Corpus (for a total of 39,199 cases). For each adjective, we computed its mean distance from the modified noun. Means by adjective class are shown in Fig. 1 (corpus). Pairwise Bonferroni-corrected comparisons between classes on the mean distance-from-noun scores yields the following ordering preferences, which closely track the previous reports in the literature [8, 7]:  $size \geq quality > age > texture > shape > color > material$ .

**Exp. 2 (n=50)** used behavioral measures to closely replicate these inferred ordering preferences. We elicited naturalness judgments on adjective-adjective-noun object descriptions, permuting the relative order of the adjectives. We used the same adjectives from the corpus experiment, paired at random with a set of ten nouns describing either food or furniture (see Table 1 for the full list of words). Participants indicated which ordering of an adjective-adjective-noun object description sounded more “natural,” using a sliding scale with endpoints labeled with the competing object descriptions (e.g., “the big red apple” vs. “the red big apple”). On the basis of these naturalness ratings, we computed for each adjective-adjective pairing its preferred, canonical order (i.e., the order with the highest naturalness rating). We then determined how often an adjective from a given semantic class occurred first in a preferred adjective-adjective-noun configuration; Fig. 1 (preference) plots these mean distance-from-noun scores, where a value of 1 signals that a class’s adjectives always occur first in preferred adjective-adjective-noun orderings.

Having established the robustness of ordering preferences both in production (Exp. 1) and in comprehension (Exp. 2), we then shifted focus to the source of these preferences. While researchers disagree about the details, psychological explorations of ordering preferences have converged on the idea that aspects of adjectives’ meaning (e.g., specificity, context-sensitivity, reliance on comparison) determine their relative order [1, 2, 3, 4, 5, 6]. We distilled the proposals that precede us into a single feature: the subjectivity of the property named. In each of the observed preferred orderings, intuition suggests that less subjective adjectives appear closer to the modified noun.

**Exp. 3 (n=45)** tested this subjectivity hypothesis by estimating the subjectivity of adjectives (and the classes to which they belong) using a faultless disagreement measure. Participants evaluated the potential for faultless disagreement between two differing descriptions of an object. For example, an experimental trial would have Mary assert “that apple is old,” then have Bob counter with “that apple is not old.” To the extent that both Mary and Bob can be right in their descriptions of the apple, “old” admits that degree of faultless disagreement. Thus, the extent to which two people can disagree about a description without one necessarily being wrong determines the subjectivity of that description. We validated the faultless disagreement measure in a separate paradigm (n=30), in which participants rated the “subjectivity” of object descriptions directly; the results of these two methods were highly correlated ( $r^2 = 0.89$ ), suggesting that faultless disagreement is a good proxy for subjectivity. Fig. 1 (subjectivity) plots mean faultless disagreement ratings for adjectives and their respective classes. Based on pairwise comparisons of these aggregate scores, we inferred the following adjective class subjectivity ranking:  $quality \geq size > texture \geq age > color \geq shape \geq material$ . This ranking closely tracks the inferred order preferences from Exps. 1 and 2.

To evaluate the power of subjectivity in predicting adjective order, we compared naturalness ratings (Exp. 2) to faultless disagreement scores (Exp. 3). We computed a subjectivity difference score for each class configuration (i.e., an ordered pairing of two adjective classes, CLASS1-CLASS2) by subtracting the mean faultless disagreement score for CLASS2 from the mean faultless disagreement score for CLASS1. Higher difference scores indicate that the adjective class closer to the noun is less subjective than the class farther away. Fig. 2 plots naturalness ratings against these faultless disagreement difference scores; the two measures are highly correlated ( $r^2 = 0.81$ ), strongly supporting the hypothesis that less subjective adjectives occur more closely to the noun.

Adjective ordering preferences have received considerable attention throughout the history of generative grammar and cognitive psychology, owing to its remarkable stability within and across languages. Something so robust, the reasoning goes, must evidence a deep principle of the cognitive architecture that shapes language. Yet while descriptions of the phenomenon abound, an explanation continues to prove elusive. Our findings serve to narrow the space of possible explanations: rather than representing these preferences as a fully specified ranking according to semantic classes or syntactic projections, our results demonstrate that ordering preferences more likely emerge from a desire to place more informative, less subjective content closer to the substantive head of a nominal construction (i.e., closer to the modified noun).

**References:** [1] Sweet (1898), *A New English Grammar*; [2] Ziff (1960), *Semantic Analysis*; [3] Martin (1969), *Semantic Determinants of Preferred Adjective Order*, J. of Verbal Learning and Verbal Behavior, 8, 697–704; [4] Martin (1969), *Some Competence-Process Relationships in Noun Phrases with Prenominal and Postnominal Adjectives*, J. of Verbal Learning and Verbal Behavior, 8, 471–480; [5] Martin (1970), *Adjective Order and Juncture*, J. of Verbal Learning and Verbal Behavior, 9, 379–383; [6] Kemmerer, Tranel & Zdzansczyk (2009). *Knowledge of the semantic constraints on adjective order can be selectively impaired*, J. of Neurolinguistics, 22, 91–108; [7] Dixon (1982), *Where have all the adjectives gone?, and other essays in semantics and syntax*; [8] Sproat & Shih (1991). *The cross-linguistic distribution of adjective ordering restrictions*, Interdisciplinary approaches to language: Essays in honor of S.-Y. Kuroda (1991), 565–593; [9] Cinque (1994), *On the evidence for partial N-movement in the Romance DP*, Paths towards Universal Grammar. Studies in honor of Richard S. Kayne, 85–110; [10] Scott (2002), *Stacked adjectival modification and the structure of nominal phrases*, The Cartography of Syntactic Structures, 91–120.

Table 1: The adjectives and their classes tested in all experiments, and the nouns and their classes tested in the behavioral experiments.

adjective	class	adjective	class
old	age	good	quality
new	age	bad	quality
rotten	age	round	shape
fresh	age	square	shape
red	color	big	size
yellow	color	small	size
green	color	huge	size
blue	color	tiny	size
purple	color	short	size
brown	color	long	size
wooden	material	smooth	texture
plastic	material	hard	texture
metal	material	soft	texture
noun	class	noun	class
apple	food	chair	furniture
banana	food	couch	furniture
carrot	food	fan	furniture
cheese	food	TV	furniture
tomato	food	desk	furniture

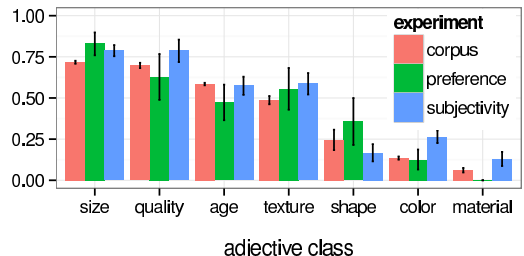


Fig. 1: Mean distance from noun (corpus), mean preferred distance from noun (preference), and mean faultless disagreement scores (subjectivity) for adjectives by their semantic class.

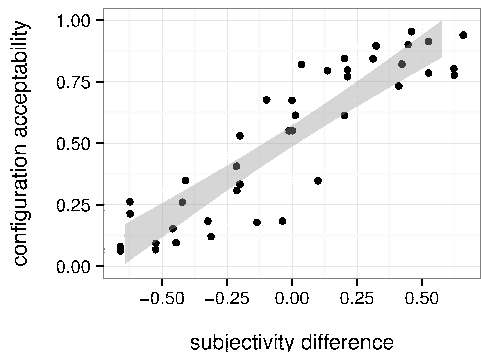


Fig. 2: Class-level order preferences plotted against faultless disagreement difference scores.

# References

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- [2] P. Ziff, *Semantic Analysis* (1960).
- [3] J. E. Martin, *Semantic Determinants of Preferred Adjective Order*, *Journal of Verbal Learning and Verbal Behavior*, 8 (1969), pp. 697–704.
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