Property subjectivity predicts adjective ordering preferences

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]. We first conducted a corpus study to measure, for 26 adjectives from seven different classes (size, quality, age, texture, shape, color, material; see Table 1 for the full list of adjectives tested), what their mean distance from the modified noun is in phrases with either two or three adjectives (e.g., "a good green color" or "some big new red cloaks"). We extracted all such cases from the Switchboard corpus, as well as from both the written and spoken portions of the British National Corpus (for a total of 39,199 cases). Mean distance from the noun for each adjective class is shown in Fig. 1 (corpus). Conducting pairwise Bonferroni-corrected comparisons between classes on the average distance-from-noun scores calculated in Fig. 1 yields the following ordering preferences, which closely track the previous reports in the literature [8, 7]:

$$size \geq quality > age > texture > shape > color > material$$

We closely replicated these inferred ordering preferences in a behavioral experiment, where 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; the full list of words appears in Table 1. Participants (n=50) 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. 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 average distance 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 (measured in our corpus experiment) and in comprehension (measured in our naturalness rating experiment), we then shifted focus to the source of these preferences. While researchers may disagree about its details, the psychological explorations of ordering preferences converge on the idea that aspects of adjectives' meaning (i.e., specificity, context-sensitivity, reliance on comparison, etc.) determine their relative order. On the basis of the preferred orderings we observed both in the corpus and in our behavioral experiment, we distilled the proposals that precede us into a single feature, the subjectivity of the property named, as the single best predictor of ordering preferences. That is, in each of the observed preferred orderings, our intuitions, which we tested experimentally, suggested that less subjective adjectives appear closer to the modified noun.

To measure the subjectivity of adjectives and the broader classes to which they belong, we ran a second behavioral experiment. Participants (n=45) 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 our faultless disagreement measure in a separate paradigm, which explicitly asked about the potential "subjectivity" of object descriptions; the results of these two methods were highly correlated ($r^2 = 0.89$), suggesting that the measures they invoked converge in their estimation of adjective subjectivity.

Fig. 1 (subjectivity) plots average faultless disagreement ratings for adjectives and their respective classes. Based pairwise comparisons of these aggregate scores, we inferred the following adjective class subjectivity raking, which tracks the inferred order preference from the other experiments:

$$quality \geq size > texture \geq age > color \geq shape \geq material$$

To evaluate the predictive power of subjectivity in determining adjective order, we compared acceptability ratings from the preference experiment with faultless disagreement scores. We calculated a subjectivity difference score for each class configuration (i.e., an ordered pairing of two adjective classes, class1-class2) by subtracting the average faultless disagreement score for CLASS1 from the average faultless disagreement score for CLASS2. Higher difference scores indicate that the adjective class closer to the noun is less subjective than the class farther away. Fig. 2 plots acceptability ratings against these faultless disagreement difference scores; the two measures are highly correlated ($r^2 = 0.81$), strongly supporting our 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).

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

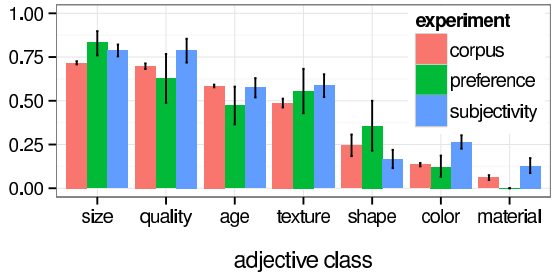

Fig. 1: Average distance from noun (corpus), average preferred distance from noun (preference), and average faultless disagreement scores (subjectivity) for adjectives by class.

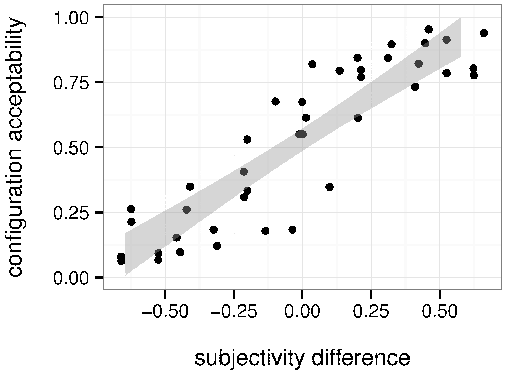

Fig. 2: Class-level order preferences plotted against faultless disagreement difference scores.

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