**Inferring Comparison Classes from Sentence Structure and Informational Goals**

MH Tessler (MIT), Polina Tsvilodub (Osnabrück University), Roger Levy (MIT)
tessler@mit.edu

Understanding utterances containing gradable adjectives like “That Great Dane is big” requires making reference to a *comparison class* - a set against which the referent is implicitly compared (e.g. big for a dog). But how do listeners determine the comparison class? Simple compositional theories stipulate that the noun the adjective combines with necessarily becomes the comparison class (e.g. “That Great Dane is big” $\rightarrow$ big for a Great Dane) [1], but intuition suggests otherwise [2]: A “rich Fortune-500 CEO” may not be rich *for a Fortune-500 CEO*; therefore, the degree to which the noun of a sentence is a cue to the comparison class might be modulated by other factors like syntax, the physical context, and world knowledge [3].

We propose a functional perspective on comparison class determination: Speakers pursue certain communicative goals when producing an utterance and listeners expect these goals to be achieved by different parts of a sentence, which guides their inferences about the comparison class. For instance, simple Subject–Predicate sentences must accomplish two goals: establishing reference (picking out the target for the listener) and predicating a property of the referent [4]. For a sentence involving a noun (N) and a gradable adjective, the speaker has liberty to place the N either in the subject or the predicate (e.g., “That N is big” vs. “That’s a big N”). If listeners generally expect speakers to accomplish referential goals with the sentence subject, then a N in the predicate would be more likely to convey the comparison class, in contrast to a N in the subject which could potentially be explained away by its referential function.

We find evidence consistent with such a reference-predication trade-off across four experiments (E1: Syntax Rating, E2: NP Production, E3: Comparison Class Inference, E4: Direct Modification (in progress); `tinyurl.com/yb5ogj5g`). In all experiments, referents depicted are members of a saliently-sized subordinate category (e.g., a Great Dane, which is a big dog, though not necessarily big for a Great Dane). In E1-E3 we used the syntactic frames ‘That N is big’ (subject N) or ‘That’s a big N’ (predicate N), where the N could be either a subordinate-level category label (e.g., Great Dane) or a basic-level category label (e.g., dog). Participants significantly dispreferred the subordinate-N in the predicate position, as evidenced by their explicit ratings of sentences (E1, n = 80; syntax-by-N interaction mean and 95% Bayesian CI: $\beta$=-4.0 [-5.8, -2.2], Fig.1 left) and by the Ns they freely-produced given a sentence frame (“That’s a big __”; E2, n = 190; $\beta$ = 2.3 [0.7; 4.0], Fig.1 right). In E3 (n=200), we directly tested comparison class inferences, manipulating the syntactic frame (subject vs. predicate N), visual context (other dogs vs. other Great Danes), and N (“dog”, “Great Dane”, and “one” as a visual-context-effect baseline). Participants paraphrased the critical utterance with an explicit comparison class (“...big relative to other __”). Participants were highly sensitive to the context ($\beta$ = 1.88 [1.49, 2.31]) and, crucially, the syntax for subordinate but not for basic Ns (basic vs. subordinate N-by-syntax interaction $\beta$ = 0.47 [0.02, 0.95]) (Fig.2). In E1-E3, we manipulated the syntactic position of the N, but in service of maintaining simple adjective-noun sentences, confounded syntactic position with direct vs. no modification of the N by the adjective. In an on-going experiment (E4), we aim to deconfound the two by investigating the effect of syntactic position on directly modified nouns. In a pilot study (n = 29), participants read a sentence of the form ‘That big N1 is an N2’ (subject N) or ‘That N2 is a big N1’ (predicate N) where N1 is the subordinate label and N2 describes a visually distinctive feature of the referent (e.g. "That big Great Dane is a prize-winner"). We find preliminary evidence that the syntactic position of the N indeed provides the cue to the comparison class and not just the direct modification of the noun (Fig.3; 80.7% of posterior distribution greater than 0). These results support an inferential account of comparison class determination, driven by listeners integrating how sentence structure maps onto informational goals in communication with other pragmatic cues, ruling out simple syntactic accounts of gradable adjective interpretation.

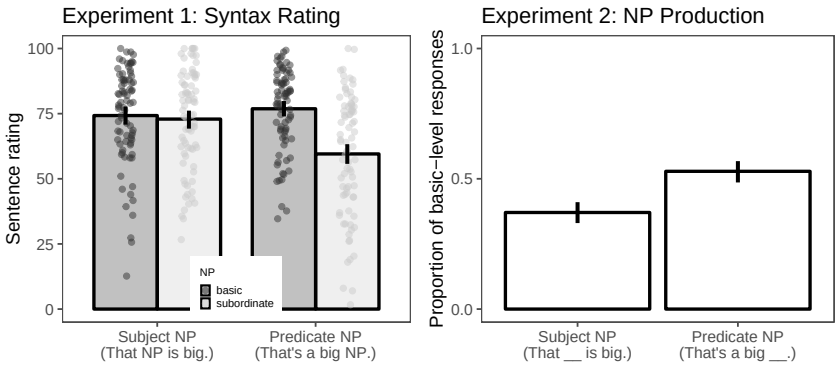


Figure 1: E1 (left): Means and 95% bootstrapped confidence intervals (in all plots) of ratings (on a scale ranging 0-100) for how well a sentence with the adjective “big” (or “small”) describes a member of a subordinate category (normal-sized compared to other members of the same category in the context picture) when different nouns (color) appear in different syntactic frames (x-axis). Points represent participant means within condition.
E2 (right): Basic-level referent label productions (e.g., “dog” when the referent is a normal-sized Great Dane) in different syntactic frames (x-axis).

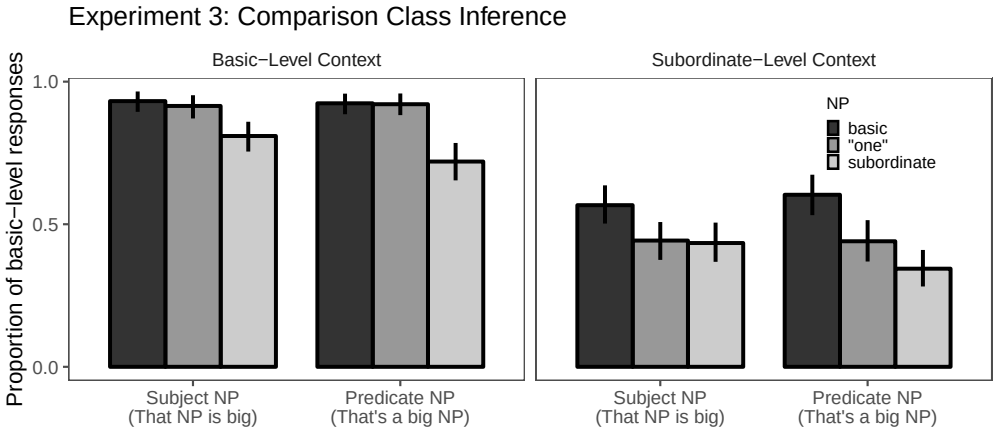


Figure 2: Inferred basic-level comparison classes (e.g. “...big relative to other *dogs*”) when the referent (e.g., a Great Dane) appears in basic-level visual context (left panel) or in subordinate context (right panel) from a sentence where the N is “one”, the subordinate (“Great Dane”) or the basic-level (“dog”) label of the referent (colors), appearing in different syntactic positions (x-axis).

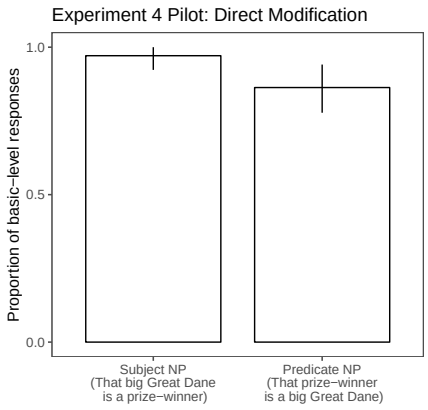


Figure 3: Pilot Results: Inferred basic-level comparison classes (e.g. ‘...big relative to other *dogs*’) when the directly modified subordinate N (‘big Great Dane’) appears in different syntactic positions (x-axis).

**References:** [1] Kamp, J., In *Formal semantics of natural language*, 1975 [2] Kennedy, C., *Linguistics and Philosophy, 30(1)*, 2007 [3] Tessler, M. H.; Lopez-Brau, M.; Goodman N. D., In *39th annual meeting of the Cognitive Science society*, 2017 [4] Reboul, A., In *Language typology and language universals, an international handbook, vol.1*, 2001