The role of standards in scalar implicature processing of adjectives: A web-based visual world eye-tracking study

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Sedivy et al. (1999)'s influential work showed that listeners interpret scalar adjectives (*tall*) incrementally, taking rapidly into account contextually-defined contrast: Given a temporarily ambiguous instruction including a scalar adjective (*tall*), listeners are faster at converging on a target (tall glass) when presented with a contrast object (short glass) in the immediate visual context than without such an object. Aparicio et al. (2016, 2018) further showed that these referential contrast effects (RCEs) arise due to the lexical semantics of adjectives like *tall* that require a standard of comparison to be set contextually, whereas adjectives without this requirement (*bent*) do not exhibit RCEs.

The present study explores the role of standard in the incremental processing of scalar implicatures (SIs) of adjectives. One key distinction in the semantics literature of adjectives is the one between relative and absolute adjectives, which differ in the type of standard of comparison they invoke: For relative adjectives (*tall, warm*) the standard of comparison is contextually determined, whereas for absolute adjectives (*bent, breezy*) this is a fixed, context-invariant value (Kennedy & McNally, 2005). In line with this difference, we hypothesize that only relative adjectives depend on contextual information to resolve their meaning, thus displaying RCEs. Specifically, we predict differential RCEs for relative and absolute adjectives during incremental interpretation.

Methods—We conducted a web-based eye-tracking experiment in English on PCIbex (N=241) using a referential communication task à la Sedivy et al.'s whereby the instruction is temporarily ambiguous between two referents: Target vs. Competitor (cf. Figure 1). Importantly, the SI triggered by the critical adjective in the instruction (warm$\rightsquigarrow$'warm but not hot', Figure 1a/b) is false of the Competitor. This is because the Competitor presents a higher degree of the property encoded by the adjective (cf. *warm*) and is normed to represent a stronger scale-mate (e.g., *hot*; van Tiel & Pankratz, 2021). If one were to disambiguate between Target and Competitor by generating the SI of the critical adjective, this should be reflected in a high(er) proportion of looks to Target over Competitor. We manipulated the Adjective Type used in the instruction (relative/absolute) and the presence/absence of a contrast object in the visual scene (ContrastCond: contrast/no contrast).

Results—Figure 2 shows the proportion of looks to each of the four images of the display over time per condition. A logistic mixed-effects regression analysis predicting Target over Competitor looks in terms of Time (scaled & centered), Adjective Type and ContrastCond (both sum-coded) revealed a significant 3-way interaction in the disambiguation window (Time*AdjectiveType*ContrastCond: $\beta = 7.62, SE = 2.75, z = 2.78, p < 0.01$), reflecting ongoing processing of ambiguous information. More precisely, this effect reveals that participants converge on the Target faster in the contrast than in the no-contrast condition of relative adjectives, while this difference is smaller for absolute ones. We further split up the disambiguation window into sub-windows, and the 3-way interaction was found to be highly significant in the *with the* ambiguity window ($\beta = 51.25, SE = 12.90, z = 3.97, p < 0.0001$). Crucially, it took participants about 600ms after critical adjective onset until they settled their gaze on the Target of unambiguous trials (cf. Degen et al., 2021; Slim & Hartsuiker, 2022), suggesting noun information processing during the *with the* sub-window (see Figure 2).

Conclusions—The above finding is in line with our hypothesis: Relative adjectives rely on contextual information to resolve their meaning, while absolute adjectives like *breezy* do so independently of context. We further argue that our finding aligns with recent results in the scalar diversity literature (van Tiel et al., 2016; Gotzner et al., 2018), highlighting the significance of semantic distance between weak and stronger scale-mates in SI calculation. Overall, the present study demonstrates that lexical-semantic properties of adjectives are essential to SI processing, and more generally that semantics and pragmatics are highly intertwined during incremental adjective interpretation. We also conclude that web-based eye-tracking may yield fine-grained enough data, advocating for

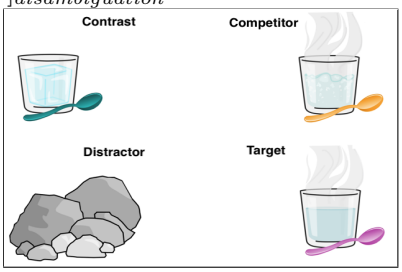
its application in the experimental semantics-pragmatics as well as in the psycholinguistic research.

Selected references: - Aparicio, H., M. Xiang and C. Kennedy (2015). *SALT* 25, 413-432. **- Aparicio, H., C. Kennedy and M. Xiang (2018).** *The Semantics of Gradability, Vagueness, and Scale Structure*, 199–220. **- Kennedy, C. and L. McNally (2005).** *Language* 81, 345–381.

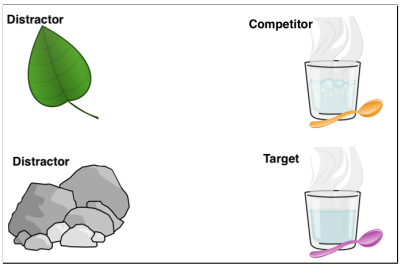
Figure 1: Example item of relative and of (minimum-standard) absolute adjective scale in contrast and no-contrast conditions.

• *Relative adjective scale* <*warm*, *hot*>

Auditory instruction: [**Click on the picture of the**]$_{baseline}$ [**warm**]$_{adj}$ [**water**]$_{noun}$ [**with the purple spoon.**]$_{disambiguation}$



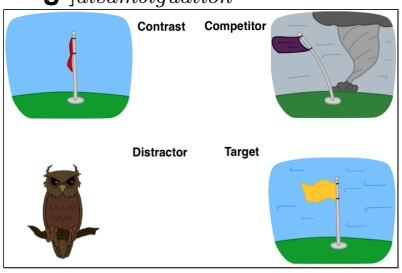
(a) Contrast condition.



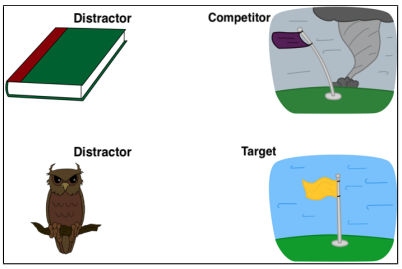
(b) No-contrast condition.

• *Absolute adjective scale* <*breezy*, *windy*>

Auditory instruction: [**Click on the picture of the**]$_{baseline}$ [**breezy**]$_{adj}$ [**weather**]$_{noun}$ [**with the yellow flag.**]$_{disambiguation}$



(c) Contrast condition.



(d) No-contrast condition.

Figure 2: Proportion of looks to objects on the visual display over time per condition.