Imprecision is pragmatic: Evidence from referential processing

Timothy Leffel, Ming Xiang, Chris Kennedy
The University of Chicago
{timleffel,mxiang,ck}@uchicago.edu

This study addresses the question of whether contextually variable imprecise uses of expressions that otherwise have fixed, precise meanings are semantic or pragmatic in nature. We present experimental evidence that imprecision in absolute gradable adjectives is pragmatic. In a Visual World eye-tracking experiment, we investigated the interaction of context and adjective meaning in a reference resolution task involving definite descriptions with relative and absolute adjectives used as restrictive modifiers. Participants were instructed to *Click on the Adj N* while viewing a visual display containing a referential TARGET and a referential COMPETITOR that differed in object category but shared the same scalar dimension, e.g. a tall cylinder and a tall cube. We manipulated whether the same visual display contained a CONTRAST object (e.g. a short cylinder) or not, as in Sedivy et al. (1999) and related work. We also varied whether the target and competitor satisfied the adjectival property to the same (non-maximal) degree (T=C condition, e.g. both are of the same height), or whether the target had a lower degree than the competitor (T<C condition, e.g. competitor is taller than target). These two manipulations showed different effects on relative versus (maximum standard) absolute adjective trials. Most critically, with absolute adjectives, the presence of a contrast object sped up visual search for the target (when compared to the no-contrast condition), but only when the target instantiated the absolute adjective imprecisely, while the competitor instantiated it precisely (T<C). For relative adjectives, the contrast object had the strongest facilitation effect when T=C. Based on these results, we argue that relative and absolute gradable adjectives interact with context using different mechanisms.

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Question This study addresses the question of whether contextually variable imprecise uses of expressions that otherwise have fixed, precise meanings are semantic or pragmatic in nature: whether such uses indicate that the expressions involved have inherently context-dependent denotations, or whether they instead reflect the workings of a pragmatic mechanism for flexible language use (Lasersohn, 1999; Krifka, 2002). We present experimental evidence that imprecision is pragmatic.

Background Our empirical focus is the distinction between RELATIVE adjectives such as *big, old* and *heavy*, and ABSOLUTE adjectives, such as *flat, straight* and *full* (here we restrict attention to MAXIMUM STANDARD absolute adjectives). Both relative and absolute adjectives are gradable and support comparison, and both also display contextual variability in their non-comparative forms in the degree to which an object must manifest a relevant scalar dimension (degree of height, age, flatness, bend, etc.) in order to be described using the adjective. There are, however, different hypotheses about the origin of contextual variability for these two types of adjectives. In the case of relative adjectives, it is universally accepted that interpretive flexibility arises from essentially context-dependent denotations: relative adjective extensions in context are a function of how a threshold or comparison class variable is fixed, or both (see e.g. Klein, 1980; Kennedy, 2007, inter alia). But in the case of absolute adjectives, there are two opposing accounts of how flexible interpretations arise. On a "semantic" account, absolute adjectives are like relative adjectives in having context-dependent denotations; their more restricted behavior emerges either from linguistic or non-linguistic factors that constrain their valuations in context (Lassiter & Goodman, 2013), or from the fact that they invoke different kinds of comparison classes from relative adjectives (Toledo & Sassoon, 2011). On a "pragmatic" account, absolute adjectives differ from their relative counterparts in having context-invariant denotations that require their arguments to be maximal along the relevant scalar dimension, and their flexibility comes from an independent pragmatic mechanism for imprecision (Kennedy, 2007; Burnett, 2012). Below we report a Visual World eye-tracking study designed to distinguish between these two accounts.

Experiment Our experiment investigated the interaction of context and adjective meaning in a reference resolution task involving definite descriptions with relative and absolute adjectives used as restrictive modifiers. Previous studies using the Visual World eye-tracking paradigm (Sedivy et al., 1999; Tanenhaus et al., 1995) showed that the use of a relative adjective as a restrictive modifier facilitates referential processing. In a visual context containing a referential TARGET and a referential COMPETITOR that differed in object category but were equal along a scalar dimension, for example, a glass and a pitcher of equal size, subjects fixate on the glass upon hearing *the tall glass* more quickly when there is a CONTRAST (a smaller glass) in the display than when there is no contrasting item. In particular, in the contrast condition, subjects fixated on the target even before the noun was processed, indicating that an interpretation of the adjective as applicable to the target, combined with the contrast object, was sufficient for reference determination. Such results can be explained in pragmatic terms, as an interaction of the Maxims of Quantity and Manner, which together dictate that a cooperative speaker should say no more than is required for the purpose of communication, using as simple a form as possible. Participants in these experiments were very sensitive to the pragmatic inference that the more complex (modified) form is (only) used when the simpler variant without the modifier is insufficient to pick out the intended referent, which is the case when the context includes more than one object that satisfies the property denoted by the noun.

Using the same methodology, Aparicio et al. (2015) demonstrated that when the definite descriptions contain absolute adjectives as modifiers, the contrast inference, although still present, is much delayed in its overall timing, which Aparicio et al. speculate is due to obligatory processing

of pragmatic imprecision in all uses of absolute adjectives, which in itself is a costly computation. However, all crucial stimuli items in Aparicio et al. involved objects that satisfied the precise meanings for absolute adjectives, so it did not directly examine such expressions on their imprecise uses.

Our study aimed to investigate the processing of imprecise absolute adjectives directly. We used the same Visual World methodology as Aparicio et al. to compare the processing of definite descriptions containing relative vs. absolute modifiers. Subjects were shown series of displays containing four objects apiece, and directed by audio recordings to click on one of the four objects while their eye-movements were recorded by a Tobii T60 eye-tracker (40 experimental trials and 80 fillers per subject). One crucial modification of Aparicio et al.'s design is that in the present study, target objects for absolute adjective descriptions satisfied the adjective meaning only imprecisely. For example, when subjects were instructed via auditory prompts to *Click on the straight line*, the target object was a (very) slightly bent line. In half of the critical trials (the **Contrast condition**) the visual display contained a target, a competitor (an object satisfying the adjective but not the noun in the prompt), a contrast object (an object satisfying the noun but not the adjective), and a distractor; in the other half (the **No-contrast condition**), a second distractor was included instead of a contrast item. In order to compare the semantic vs. pragmatic accounts of imprecision sketched above, we included a further (between-subjects) manipulation: roughly half of the subjects ($n = 32$) saw displays in which target and competitor had equal but non-maximal degrees of the relevant scalar property (**T=C**), resulting in imprecision for absolute items; the other subject group ($n = 35$) saw displays in which the competitor had a higher degree of the property than the target (**T<C**). Specifically, in the case of relative adjective stimuli, the competitor was longer, bigger, etc. than the target in T<C trials. But in absolute stimuli, the competitor—but *not* the target—satisfied the adjective in the prompt precisely in T<C trials. Example stimuli are shown in Figure 1 (p. 4). We followed Aparicio et al. (2015) in using geometric shapes as stimuli in order to minimize the potential influence of prior world knowledge about scalar distributions within object categories.

The purpose of the T=C/T<C manipulation was to pit the contrast inference against a general HIGH STANDARD PREFERENCE to fix the denotation of a context-dependent adjective as restrictively as possible, relative to its domain (see Van Deempter, 2006). In T=C trials, the high standard preference does not conflict with the contrast inference, since both target and competitor will meet the same standards. In T<C stimuli, however, the high standard preference conflicts with the contrast inference: on the one hand the competitor (which has the higher degree of the property) is a better candidate than the target object to count as having the adjective property, but on the other hand the contrast inference favors the target object. For relative adjectives, then, we expect a slowdown of referential processing in the T<C stimuli relative to the T=C stimuli in the contrast condition, and possibly an elimination of the contrast/no-contrast distinction entirely. If imprecise interpretations of absolute adjectives also involve fixing a context-dependent interpretation, we expect to see the same pattern that we see for relative adjectives; in fact, we might expect the effect to be even stronger, given that the competitor satisfied the adjective precisely. If, on the other hand, imprecise interpretations of absolute adjectives are pragmatic, we do not expect a slowdown for absolute adjectives in the T<C stimuli, since on this view the actual (precise) denotation of the adjective is not assumed to be the intended meaning in the first place. Instead, the intended meaning is based on pragmatic reasoning about tolerance of imprecision, which is a distinct computation from the valuation of semantically context-dependent expressions, and is subject to pragmatic considerations of communicative intent—just like the contrast inference (cf. Lasersohn, 1999; Krifka, 2002).

Results In Figure 2 we plotted proportions of looks to each object in the visual display in each

of the eight experimental conditions (relative/absolute × Contrast/No-Contrast × T=C/T<C), as a function of time (in ms) after the onset of the adjective in the auditory prompt *Click on the Adj Noun*. From the onset of the adjective, three consecutive 150ms time windows were analyzed: W1: 350-500ms; W2: 500-650ms; and W3: 650-800ms. The onset of W3 roughly aligns with the onset of the noun in the audio instruction (≈650ms, as marked by the blue dashed line in Figure 2, which is offset 200ms to account for eye-movement planning; see Altmann & Kamide 2004). W1 and W2 therefore contain information about looks to the target attributable to the adjective alone, since the noun information is not yet available to participants. For each window, we performed two-way ANOVAs, followed by pair comparisons, on proportions of looks to the Target (T) and Competitor (C) under the Contrast and the No-Contrast conditions. The most important finding is that the referential contrast effect interacts with both adjective type (relative vs. absolute) and the target-competitor degree matching (T=C vs. T<C).

In **T=C** conditions, the referential contrast effect is present for relative adjectives. No effect is found in W1, but in W2 the Target/Competitor by Contrast/No-Contrast interaction is significant ($p < 0.05$). The same interaction continued into W3, albeit slightly weaker ($p < 0.07$). For absolute adjectives, the Contrast condition did not show any advantage over the No-Contrast conditions. These results replicate the findings from Aparicio et al. (2015), with the referential contrast effect present for RELATIVE adjectives, but significantly delayed and weaker for ABSOLUTE adjectives. In the crucial **T<C** conditions, the referential contrast effect disappeared for RELATIVE adjectives. For both the Contrast and the No-Contrast condition, looks to the Target did not differ from looks to the Competitor in any of the three time windows we analyzed (all *p*s> 0.2). For ABSOLUTE adjectives, however, a contrast effect emerged strongly: looks to the Target start to surpass looks to the Competitor in the Contrast but not in the No-Contrast condition as early as W1; the difference becomes even larger in W2 and W3. The Target/Competitor by Contrast/No-Contrast interaction is not significant in W1 ($p > 0.1$), but is highly significant in W2 ($p < 0.001$) and marginal in W3 ($p < 0.09$).

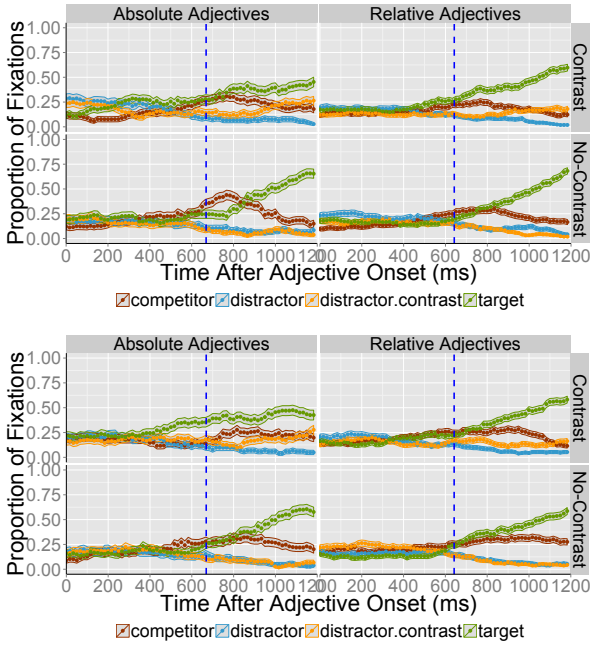

Figure 2: Results for T=C (top) and T<C (bottom)

Discussion The fact that the referential contrast effect disappeared for relative adjectives in the **T<C** condition is expected given the context dependence of relative adjectives combined with a preference for assigning denotations with high thresholds. In contrast, we claim that the fact that the contrast effect was strongly in place for absolute adjectives in the **T<C** condition indicates that the mechanism for assigning absolute adjectives imprecise interpretations is pragmatic in nature (and does not involve a high standard preference): if a single semantic mechanism was responsible for fixing the threshold of relative and absolute adjectives, then the same neutralization of the contrast effect observed for relative adjectives in **T<C** would also be present for absolute adjectives.

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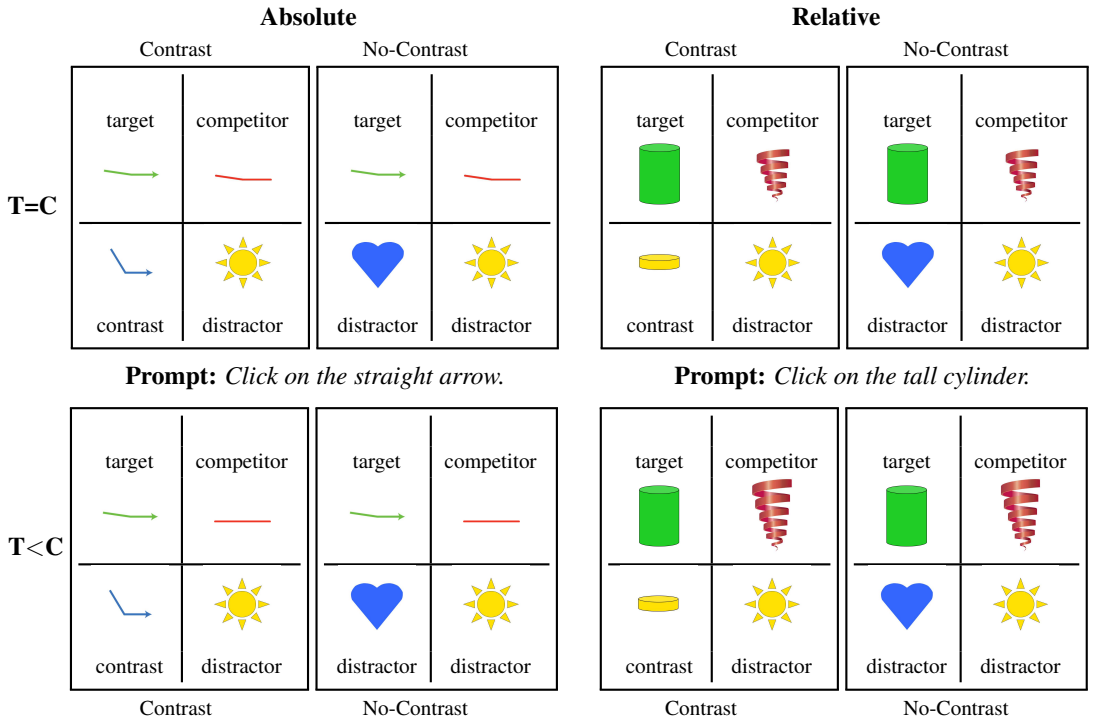

Figure 1: Example displays for each condition