



## Original Articles

## Extremely costly intensifiers are stronger than quite costly ones

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## ABSTRACT

We show that the wide range in strengths of intensifying degree adverbs (e.g. *very* and *extremely*) can be partly explained by pragmatic inference based on differing cost, rather than differing semantics. The pragmatic theory predicts a linear relationship between the meaning of intensifiers and their length and log-frequency. We first test this prediction in three studies, using two different dependent measures, finding that higher utterance cost (i.e. higher word length or surprisal) does predict stronger meanings. In two additional studies we confirm that the relationship between length and meaning is present even for novel words. We discuss the implications for adverbial meaning and the more general question of how extensive non-arbitrary form-meaning association may be in language.

## 1. Introduction

How do different words get their meanings? For instance, why is an “extremely good paper” better than a “quite good paper”? The traditional answer (De Saussure, 1916) is that different meanings have been arbitrarily and conventionally assigned to the different word forms. This view has been challenged by a number of examples in which word meaning appears to be non-arbitrarily related to properties of the word. In some cases, the phonetic form of a word is systematically related to its meaning, for example rounded vowels and voiced consonants tend to refer to round objects (Davis, 1961; Holland & Wertheimer, 1964; Khler, 1970; Ramachandran & Hubbard, 2001). In other cases, orthographic form is diagnostic of meaning, for example, speakers of Hebrew who have never seen Chinese characters are nonetheless above chance at matching them to their corresponding Hebrew words (Koriat & Levy, 1979). Similarly, the length of words predicts aspects of their meanings: across languages longer words refer to more complex meanings (Lewis, 2016). Open questions remain about the systematic factors that can influence meaning and the source of these effects.

In this paper, we explore adjectival intensifiers,<sup>1</sup> like *extremely* and *quite*, as a case study in which to empirically explore the relationship of meaning to factors like word form and distribution of usage. Intensifiers form a good case study because they are amenable to simple quantitative measures of

meaning: Many adjectives correspond to concrete numeric scales, and an intensifier’s strength can be measured as the numeric extent to which it shifts the interpretation of such a scalar adjective. Intensifiers are of interest because theoretical considerations, which we lay out below, suggest a relationship between intensifier meaning and their communicative cost (i.e. frequency and length). This account of intensifier meaning adds to a growing body of literature exploring how principles of recursive, rational communication shape language interpretation (e.g. Bergen, Levy, & Goodman, 2014; Franke, 2011; Frank & Goodman, 2012; Goodman & Stuhlmüller, 2013; Grice, 1975; Kao, Wu, Bergen, & Goodman, 2014b; Russell, 2012).

In the next section, we discuss a minimal semantics for intensifiers, building off of previous work on scalar adjectives. We show how pragmatic effects predict systematic variation in the meanings of intensifiers: the meanings of intensifiers are expected to be influenced by their form (in length) and their distribution (frequency) of usage. We formalize this semantics in Appendix A, and derive the prediction that the interpreted strength of an intensified phrase should be linearly related to communicative cost (i.e. length and frequency) of that phrase. The impact of word length is reminiscent of the results of Lewis (2016), who studied noun categories. While word frequency is known to have major effects on sentence processing (e.g. Levy, 2008), the prediction that frequency should affect meaning is more surprising.

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<sup>1</sup> Intensifiers are adverbs that modify scalar adjectives so that the interpretation of the intensified adjective phrase is more extreme than the interpretation of the bare adjective phrase. The word “intensifier” is often used to denote the full range of degree adverbs, be they “amplifiers”, or “downtoners” (Quirk, Greenbaum, Leech, & Svartvik, 1985). The “intensifiers” we are looking at in this paper are, according to this typology, “amplifiers” because they increase (rather than decrease) the threshold associated with a gradable predicate. This typology also distinguishes between two different kinds of amplifiers: those that increase an adjective maximally (e.g. *completely* and *utterly*) and those that merely increase (e.g. *greatly* and *terribly*). We do not make this distinction. The word “intensifier” is sometimes used for a completely different linguistic phenomenon, where a reflexive is used for emphasis, e.g. “The king himself gave the command,” which we do not analyze in this paper.

We confirm, in our first series of studies (Studies 1a, 1b, and 2), that English intensifiers in adjective phrases are indeed interpreted as much stronger for less frequent intensifiers. This holds in quantitative judgments of meaning and in forced comparisons, and across a number of adjectival dimensions. With the more sensitive dependent measure of Study 2, we also find an additional effect of length above and beyond surprisal. In our second set of studies (Studies 3 and 4), we replicate this finding, and extend it to novel intensifiers, showing that length is a significant predictor of the strength of an intensifier's meaning even in the absence of any conventional meaning. We conclude with a discussion of different interpretations of these phenomena and future directions.

## 2. The semantics of intensifying degree adverbs

Our paper focuses on intensifying degree adverbs applied to scalar adjectives.<sup>2</sup> Scalar adjectives have been described as having a threshold semantics (Kennedy, 2007), where, for example, *expensive* means “having a price greater than  $\theta$ ” and  $\theta$  is a semantic variable inferred from context (e.g., \$100). Above the threshold degree  $\theta$ , the adjective is true of an object, and below, the adjective is false. Lassiter and Goodman (2013) build on the Rational Speech Acts (RSA) framework (Frank & Goodman, 2012; Goodman & Stuhlmüller, 2013) to give a formal, probabilistic model of how this threshold might be established by pragmatic inference that takes into account statistical background knowledge (such as the distribution of prices for objects). We return to this model below and present a full model in Appendix A.

Previous researchers have proposed that adjective phrases modified by intensifiers have the same semantics as unmodified adjective phrases, except with new, higher thresholds (Kennedy & McNally, 2005; Klein, 1980; Wheeler, 1972). That is, some threshold, inferred from context, exists above which objects are *expensive* and below which they are not, and the intensifier *very* determines a new, higher threshold for the adjective phrase *very expensive*. These researchers suggest that the intensified thresholds are determined by first collecting the set of objects in the comparison class for which the bare adjective is true, and then using that as the comparison class to infer a new threshold, i.e. *very expensive laptop* means “expensive for an expensive laptop”. This analysis results in the expected intensification of adjectives (“expensive for an expensive laptop” has a higher threshold for being true than simply “expensive for a laptop”) and is appropriately sensitive to different domains (e.g. the absolute difference in price between thresholds for *expensive* and *very expensive* is much higher in the context of “That space station is very expensive,” than in the context of “That coffee is very expensive.”). However, this proposal does not distinguish between the graded strengths of different intensifiers, for example, *very expensive* and *phenomenally expensive*.

Intuition suggests that different intensifiers do have different strengths (e.g. *outrageously* seems stronger than *quite*), and we provide further evidence of this in our studies, where participants interpret and compare different intensifiers. It could be that the degree of strength of different intensifiers is conventionally specified by the lexicon. But the semantics must then specify how these entries affect the very flexible threshold of the relevant adjective. In addition, the multitude of intensifiers (Bolinger, 1972) and their apparent productivity<sup>3</sup> suggest a more parsimonious solution would be welcome. That is, having a lexically determined meaning for each different intensifier might overlook the similarity among words of this class. In the account that follows, we build minimally on existing models of adjective interpretation and rational communication to articulate a model of intensified adjective phrase interpretation.

<sup>2</sup> Some of these intensifiers can also apply to verbal and nominal predicates, and different restrictions apply for different intensifiers, e.g. *I truly like carrots* is an acceptable utterance, whereas *I very like carrots* is not. See Bolinger (1972) for a discussion.

<sup>3</sup> For example, *altitudinously expensive* is not in common usage, but one can easily interpret *altitudinously* as a novel intensifier.

### 2.1. Intensification as an M-implicature

We explore the idea that an adjective phrase with an intensifying degree adverb derives much of its meaning from a M(arkedness)-implicature (Levinson, 2000): more marked (costly to utter) versions of an adjective phrase will be interpreted as implicating higher values (e.g. in case of the adjective *expensive*, higher prices). Given two possible utterances a speaker could say to communicate the same meaning, a speaker will usually choose the less costly utterance. If the speaker instead chooses a more costly utterance (e.g. “I got the car to start” as opposed to “I started the car”), they may be doing so in order to communicate something more distinct, intense, or unusual (e.g. “I got the car to start, but it was unusually difficult”). In other words, the marked form corresponds to the marked meaning. If scalar adjectives include a free threshold variable inferred from context, then the speaker's use of a longer, intensified adjective phrase could lead the listener to infer that the threshold for this adjective phrase is unusually extreme relative to other, less costly phrases that the speaker could have used.

To realize such an M-implicature, we suggest extending (Lassiter & Goodman, 2013)'s probabilistic model of scalar adjective interpretation slightly. We assume that each time a scalar adjective is used, in each phrase, it introduces a free threshold variable—a new token threshold is inferred for each access of the lexical entry of the adjective. The set of thresholds, for the actual sentence and all alternative sentences, is then established by a pragmatic inference that takes into account the differing costs of the sentences. The intensifiers themselves do not contribute to the semantics but increase the cost of the utterance, thus affecting pragmatic inferences. This model is described in detail in Appendix A. As in previous RSA models that include utterances with similar semantics but different costs (Bergen et al., 2014; Bergen, Goodman, & Levy, 2012), we find an M-implicature, such that more costly intensifiers result in stronger adjective phrases. As illustrated in Appendix A this relationship is expected to be approximately linear, resulting in a straightforward quantitative hypothesis that we evaluate against empirical data in our studies.

We view this model as an illustrative caricature of intensifier meaning: In this model intensifiers contribute *nothing* to the literal, compositional semantics. Yet, pragmatic interpretation yields a spectrum of effective meanings for the intensifiers, determined by their relative usage costs. This predicts an empirically testable systematic variation in meaning as a function of cost. It is very likely that the meaning of individual intensifiers includes idiosyncratic, conventional aspects in addition to these systematic factors. This would be expected to show up as residual variation not predicted by cost, but would not nullify the hypothesized relationship between cost and meaning. This account applies straightforwardly only to intensifying degree adverbs; “de-intensifying” adverbs that effectively lower the threshold will require further work to explain.

### 2.2. Factors affecting utterance cost

We have identified an intensifier's cost as a potentially critical determiner of its interpreted meaning. To connect this prediction to empirical facts, we still must specify (at least a subset of) the factors we expect to impact cost. The most natural notion of cost is the effort a speaker incurs to produce an utterance. This could include cognitive effort to access lexical items from memory, articulatory effort to produce the sound forms, and other such direct costs. Speakers might also seek to minimize comprehension cost for their listeners, resulting in other contributions to cost. For the purposes of this paper, we restrict ourselves to the most obvious contributors to production cost and use proxies that are straightforward to quantify: length (longer utterances are more costly)<sup>4</sup> and frequency (rarer intensifiers are harder to retrieve

<sup>4</sup> We measure length in number of syllables, although length in characters (which might be a more relevant source of utterance cost in a written format) has similar predictive power to syllable length in all of our analyses.

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