

# Vagueness in implicature: The case of modified adjectives

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## 1 Introduction

Vagueness and conversational implicature are both sources of interpretive uncertainty: with vagueness, there is uncertainty about whether a predicate applies to an object (e.g. what heights count as *tall*?); with implicature, there is uncertainty about whether a candidate inference was intended by the speaker (does *some* imply *not all*?). Yet while both topics have been studied extensively from psycholinguistic, model-theoretic, and Bayesian approaches to natural language semantics and pragmatics, to our knowledge, potential interactions between them have not been investigated. In this paper we show that a collection of related contrasts involving gradable expressions are quite naturally explained as direct consequences of an interaction between the semantic property of vagueness and general pragmatic principles regulating conversational implicatures.

As a running example, we will use the contrast between the (vague) relative adjective *tall* and the (non-vague) absolute adjective *late*: *not very late* in (1) is most naturally interpreted with an inference to the positive form (*late*), whereas *not very tall* in (2) usually has no corresponding inference (caveats to follow).

(1) John was not very late.  
     $\rightsquigarrow$  John was late.

(2) John is not very tall.  
     $\nrightarrow$  John is tall.

We argue (in §2.3) that the inference of *late* from *not very late* arises just as other manner implicatures like [*John didn't vote for Nader*]  $\rightsquigarrow$  [*John voted*] do: the predicate *not very late* is strictly weaker than the simpler structural alternative *not late*, and hence (given some Gricean reasoning) implicates its negation – namely *late*. Our main proposal about the more interesting part of the puzzle – why *not very tall* does not behave similarly – is that certain “vague implicatures” fail to be drawn because when combined with a vague assertion, they can result in truth-conditions that have properties of “borderline contradictions” such as *tall and not tall* (terminology from Ripley 2011). Combined with a standard Manner-based explanation of implicatures from restrictive modifiers like *very* in downward-entailing contexts, this explains the difference between (1) and (2): it is easy to find a time that satisfies the strengthened meaning [*late*  $\wedge$   $\neg$ [*very late*]] (just go a tiny distance beyond the threshold for *late*), but because the threshold for *tall* is contextually variable, there is considerably more uncertainty about which heights (if any) satisfy the strengthened meaning [*tall*  $\wedge$   $\neg$ [*very tall*]] in a context. See §4 for details.

If something resembling our proposed mechanism is indeed responsible for the patterns discussed in this paper, we believe that this establishes strong motivation for further investigation into the role that vagueness and scale structure can play in the derivation of conversational implicature and pragmatic inference more broadly.

The paper is structured as follows: after some brief background on vagueness and scale structure (§2.1), we describe *not very* ADJ in more detail, illustrating how it constitutes a genuine semantic puzzle (§2.2). In §2.3 we show that straightforward Gricean reasoning derives a positive implicature from *not very* ADJ and related cases, and then sketch a hypothesis that would prevent the application of this mechanism with vague predicates like *tall*. §2.4 shows that the pattern of inference extends beyond *not very* ADJ to a range of related constructions. §2.5 motivates the experiments to follow, comparing some concrete predictions of our hypothesis to those of an alternative. In §3 we present a first experiment designed to quantify the empirical difference with respect to implicatures between *tall* and *late* in the *not very* ADJ frame. In §4 we develop a (partial) theory of the interaction between vagueness and implicature calculation, based on the idea that implicatures are blocked if they lead to borderline contradictions when conjoined with the literal meaning. We then provide evidence for the proposal based on reconstructed interpretations of logically complex predicates from the response data from Experiment 1. §5 presents a second experiment that generalizes the result of Experiment 1: we compare the interpretive profiles of three relative gradable adjectives (*tall*, *hot*, *fast*) in the *not very* ADJ frame to those same adjectives in the comparative form (*taller*, *hotter*, *faster*) using the frame *not much* ADJ-er than average. Comparison of the response curves for *not* (very) ADJ and *not* (much) ADJ-er than average, as well as analysis of reconstructed predicates, support our theory of the data. §6 concludes.

## 2 A pattern of interaction between vagueness and implicature

### 2.1 Background on vagueness and gradability

Vagueness and gradability are related but distinct concepts. Gradable expressions are (roughly) those that can hold of objects to varying degrees. Vagueness can be characterized in terms of inherent uncertainty about whether an expression applies to an object.

Vagueness arises with diverse categories of linguistic expressions, including (some) gradable adjectives. Gradable adjectives can be subdivided into those with relative standards – like *tall* and *fast* – and those with absolute standards – like *full* and *late*. While the exact nature of this distinction remains a matter of debate, it is often taken for granted that relative gradable adjectives are inherently vague in a way that other adjectives are not.<sup>1</sup>

Semantics for gradable adjectives are typically stated in terms of scales – ordered sets of reified “degrees” – and threshold values on those scales (“degree semantics,” Bartsch & Vennemann 1972; Cresswell 1976; von Stechow 1984; Bierwisch 1989; Heim 1985,2000; Kennedy 1999,2007; Solt & Gotzner 2012; a.o.). In this framework an adjective ADJ applies to an object  $x$  iff  $x$ ’s position on the ADJ-scale exceeds a contextually or compositionally designated value called the “threshold of application” (or “standard of comparison”), written ‘ $\theta_{\text{ADJ}}$ ’. For example John counts as tall just in case John’s position on the tallness scale (i.e. his height) exceeds whatever the context determines is the minimum height required to count as ‘tall’ – i.e.  $\theta_{\text{tall}}$ . Thus the meaning of *John is tall* can be represented in terms of degree semantics as  $\text{height}(\text{john}) > \theta_{\text{tall}}$ .

Following arguments and discussion from Kennedy & McNally (2005a), Kennedy (2007), Solt (2015) and others, we will assume that the relative/absolute distinction can be reduced to roughly the following: relative adjectives are associated with open scales (those without endpoints), and have contextually variable thresholds encoded by a free variable  $\theta_{\text{adj}}$ ; absolute adjectives are associated

<sup>1</sup> Although some have suggested that all gradable adjectives are vague (e.g. Lassiter & Goodman 2014), they at least agree that there are significant differences in the amount of uncertainty introduced by different adjectives.

with closed scales (those with a maximum or minimum boundary or both), and by default have thresholds located at a scalar endpoint, which is encoded as a constant **max<sub>adj</sub>** or **min<sub>adj</sub>**.<sup>2</sup> In what follows we assume familiarity with these and other standard distinctions from degree semantics (see Schwarzschild 2008 for a review).

## 2.2 A puzzle about intensified gradable adjectives

The contrast between *tall* and *late* in (1)-(2) exemplifies a broader pattern: in the frame ‘*not very* ADJ’, minimum standard absolute adjectives tend to pattern like (1), as shown in (3), while relative standard adjectives tend to pattern like (2), as shown in (4).<sup>3</sup>

- |  |   |
|--|---|
| <p>(3) a.      The antenna is not very bent.<br/>                 ↪ The antenna is bent.<br/>             b.      The table isn’t very dirty.<br/>                 ↪ The table is dirty.<br/>             c.      Mary isn’t very sick.<br/>                 ↪ Mary is sick.</p> | <p>(4) a.      John isn’t very smart.<br/>                 ↪ John is smart.<br/>             b.      The supermarket is not very far.<br/>                 ↪ The supermarket is far.<br/>             c.      The line is not very long.<br/>                 ↪ The line is long.</p> |
|--|---|

That the interpretation of intensified adjectives under negation could be sensitive to the relative/absolute distinction has, to our knowledge, not been suggested in the literature. Bolinger (1972) and Horn (1989) pointed to a *not*-Adj interpretation of examples like (2), and proposed that it involves a form of euphemism or is related to politeness. Horn in particular refers to *not very* ADJ as a kind of “negative understatement,” suggesting that its meaning is derived from a “conventionalized strengthening rule” that interprets ‘*not intensifier* ADJ’ as ‘*rather un*-ADJ’ ” (Horn 1989:353-4). The intuition here is well-illustrated by example: in order to avoid saying that someone is not smart, one can say they are *not very smart*, the literal meaning of which leaves open the possibility that they are indeed smart. This is quite similar in spirit to Krifka’s (2007) discussion of “negated antonyms” like *not unhappy*, which seems to express a state that is slightly too low on the happiness scale to count as ‘happy’.

Horn cites pairs like *happy/sad* and *smart/stupid* to argue that the ‘not ADJ’ interpretation is euphemistic: in the frame ‘*not intensifier* ADJ’, the “positive” (in the evaluative sense) predicates of these pairs have the ‘not ADJ’ reading, while the “negative” predicates seem to be more neutral. However, while an explanation in terms of euphemism feels plausible for evaluative adjectives (*smart/stupid*) or adjectives that encode a desirable property (*tall*), it is unclear how it could extend to cases of purely dimensional relative adjectives like *far* in (4b). In fact, looking at the pair of absolute antonyms *early/late* and the pair of relative antonyms *close/far* suggests that there is a double dissociation between “positivity” and the availability of the ‘not ADJ’ interpretation. Indeed, both absolute adjectives *early* and *late* give rise to an ‘ADJ’ inference, while both relative adjectives

<sup>2</sup> Absolute adjectives are also context-dependent, but arguably in a different way: clearly what it means to be *late* or *full* varies by situation (consider *full* for a wine glass versus a beer glass). Many theories of gradability model such non-endpoint oriented readings as a form of imprecision (e.g. as in approximative readings of numerals), which introduces some flexibility into the interpretation (see especially Kennedy 2007 and Lasnik 1999). The exact nature of non-endpoint thresholds in absolute adjectives is a theoretical debate that we do not wish to enter here (see Lassiter & Goodman 2014; Qing & Franke 2014a; Leffel et al. 2016 for some recent studies).

<sup>3</sup> Contraction of negation (*isn’t* versus *is not*) does not seem to make a difference, at least in our judgments. A broader and more important point is that these kinds of judgments are inherently gradient. The factors affecting these judgments are an important topic that deserves systematic investigation in future research.

*close* and *far* are compatible with the ‘*not ADJ*’ interpretation. Because they are antonyms, an explanation based on euphemism would predict differences *within* pairs, but the observed contrast is *between* pairs instead, aligning with the relative/absolute distinction.

The observation that underlying lexical semantics systematically affects whether or not an adjective in the ‘*not very ADJ*’-frame is associated with the positive ‘*ADJ*’ inference shows that Horn’s 1989 characterization of the construction is incomplete. More broadly, this variation between adjective subclasses is problematic for *any* general explanation that does not make reference to the lexical semantics of particular adjectives. This is not to say that euphemism is irrelevant to the pattern, nor to say that other properties of lexical items do not affect how this construction is interpreted. It is instead to say that scale structure has been an overlooked determinant in previous discussions of the phenomenon (see also §4 below).<sup>4</sup>

Importantly, while Horn (1989) aimed to explain the existence of inferences to the *negation of the positive form*, in this paper we aim primarily to explain the *presence or absence* of inference to the *positive form*. Failure of inference to ADJ is a necessary condition for inference to  $\neg$ ADJ, but not a sufficient one – this is especially clear when ADJ is gradable. In the following discussion, we show how standard Gricean reasoning can easily derive the inferential behavior of *not very ADJ* for cases in which ADJ has a determinate threshold (like *late*). We also advance a hypothesis about why corresponding implicatures feel less attractive with vague predicates.

### 2.3 Explaining positive inferences from *not very ADJ*

Grice’s Maxim of Manner states (roughly) that a speaker will not use more words than are necessary to get her point across (Grice 1975 and much subsequent work). In combination with the Maxim of Quality, this can lead to implicatures when a speaker uses an utterance which is both more complex and less informative than a readily available alternative.

Inferences generated in this fashion have received considerable attention in the literature and have been treated as “manner implicatures” or (quasi)-presuppositions (Simons 2001/2013; Schlenker 2008), or simply as quantity implicatures given a theory of alternatives which includes all sentences that are structurally simpler than the asserted one (Katzir 2007,2014; Fox & Katzir 2011; see also Matsumoto 1995; Sauerland 2004; Chemla 2009). A hallmark case of these implicatures involves restrictive modifiers in negative and downward-entailing environments. For example Simons 2001/2013 notes that sentences like (5a) strongly imply that the unmodified alternative sentence (5b) is false – i.e. that John did indeed vote (for someone other than Nader).

- (5) a. John didn’t vote for Nader.  
       b. John didn’t vote.  
       c. John voted.

The inference of (5c) from (5a) can be shown to follow from standard (neo)-Gricean reasoning. The following informal sketch is adapted from Simons 2001/2013 and Katzir 2007.

<sup>4</sup> The status of maximum standard absolute adjectives in the ‘*not very*’-frame is less clear, in part because their thresholds are located (by default) at scalar maxima: how could *very* shift a threshold higher if it is already at the scale maximum? To the extent that *very* occurs felicitously with maximum standard adjectives (e.g. *very full*), a kind of pragmatic weakening seems to be involved whereby *full*’s threshold is relaxed from the strict endpoint (Lasnik 1999), in effect coercing it into a relative adjective (Kennedy & McNally 2005a suggest that *very* is ungrammatical with absolute adjectives except when used in a “relative-like, imprecise” way). Because of these complications, we do not investigate maximum standard adjectives in this paper. The comparison between relative and minimum standard is sufficient for our purposes since they differ semantically from one another with respect to vagueness.

- (i) You, the speaker, assert (5a).
- (ii) I, the addressee, observe that (5b) is a “better” alternative to (5a), since (5b) asymmetrically entails (5a) (Quantity) and contains a proper subset of words (Manner).<sup>5</sup>
- (iii) I observe that you chose not to assert (5b) despite this fact.
- (iv) By Quality, I therefore conclude that you must not believe (5b), because if you did, you would have uttered it instead.
- (v) I assume that if you know John didn’t vote for Nader, then you probably know whether or not he voted (you are an “opinionated authority” in Sauerland 2004 and others’ terms).
- (vi) Given (iv) and (v), it follows that you probably believe (5c).

Implicatures like the one in (5) arise in syntactic environments other than matrix negation, as well. This is because, as Katzir 2007 and others discuss, a modified sentence generally asymmetrically entails its unmodified version in upward-entailing contexts. For example [*Someone signed their name with a pencil*] entails [*Someone signed their name*].

In downward-entailing contexts, entailment relations are reversed, so in such environments we expect an implicature to the negation of the unmodified version from the assertion of the modified one. For instance [*No one signed their name with a pencil*] naturally gives rise to the negation of a simpler alternative as an implicature (i.e.  $\neg$ [*No one signed their name*]). And because (classically)  $\neg\neg\exists \Rightarrow \exists$ , this results in a (potential) inference to [*At least one person signed their name*].

We propose that the puzzle about *not very* in (1)-(4) is partially explained by manner-based pragmatic reasoning parallel to cases like (5). The account runs as follows: a modified sentence like (6a) entails its unmodified counterpart (6b). In other words, *very* is a restrictive modifier on gradable adjectives, so anything that’s ‘very ADJ’ necessarily exceeds the threshold for ADJ.

- (6) a. John was very late.
- b. John was late.

In a downward entailing environment like matrix negation, the entailment relation is reversed, so (7a) is entailed by (7b). And crucially (7b) is structurally less complex than (7a) (uncontroversially so, we believe). Therefore, given reasoning like that in (i-vi) above, (7a) should be associated with an implicature to the negation of (7b) – *John was late*.

- (7) a. John was not very late.
- b. John was not late.

And as we pointed out above, (7a) does seem to suggest that John was late. Similarly, cases like those in (8) conform to this expected pattern.

- (8) a. The kitchen is not/isn’t very dirty.                    $\rightsquigarrow$  The kitchen is dirty.
- b. The chair didn’t get/isn’t very warped.            $\rightsquigarrow$  The chair is warped.
- c. The antenna isn’t very bent.                            $\rightsquigarrow$  The antenna is bent.

A key premise of the analysis is that *very* triggers manner-based reasoning due to its function as a restrictive modifier. It is therefore expected that other restrictive modifiers in this syntactic frame should give rise to corresponding inferences. And indeed the pattern appears to extend to modifiers beyond *very*, including *super*, *really*, and *extremely* (see Bolinger 1972; Horn 1989 for discussion).

<sup>5</sup> However one wants to measure utterance length or structural complexity, it should be clear that (5b) is “briefer” and “simpler” than (5a); see Katzir 2007; Fox & Katzir 2011 for some relevant formalizations of these notions.

For instance our intuition is that *not super late* tends to imply *late*. Additionally, (9) shows that the same inference pattern applies in downward-entailing contexts beyond just matrix negation, further strengthening the parallel between intensified adjectives and implicatures from phrasal modifiers (cf. *I don't think John passed with an A*  $\rightsquigarrow$  *I think John passed*). This generality across different adverbs and types of downward-entailing environment casts doubt on the idea that *not very* ADJ is a frozen expression with idiosyncratic meaning.

- (9) a. I don't think John was very late.  $\rightsquigarrow$  I think he was late.  
 b. None of the students were very late.  $\rightsquigarrow$  At least some of the students were late.

Of course, the simple manner-based account as stated above does not solve the entire puzzle. Because nothing in the derivation proposed for (6)-(7) above depends on the scale structure of *late*, one should expect *all* sentences of the form *X is not very* ADJ to be associated with implicatures of the form *X is* ADJ. As already illustrated for *not very tall*, this does not extend to relative gradable adjectives: without focus intonation on *very*, the sentences in (10) all seem to lack the 'X be ADJ' inferences observed in (8).

- (10) a. John is not very tall.  $\nrightarrow$  John is tall.  
 b. The bed is not very comfortable.  $\nrightarrow$  The bed is comfortable.  
 c. Bill is not very happy.  $\nrightarrow$  Bill is happy.  
 d. John's lifestyle is not very responsible.  $\nrightarrow$  John's lifestyle is responsible.

The positive inference also appears to be absent with intensifiers beyond *very* (e.g. *not super tall*).<sup>6</sup> The same is true for certain other downward-entailing environments, e.g. *I don't think John is very tall/None of the students are very tall*.<sup>7</sup>

The fact that the inference from *not very* ADJ to ADJ targets a specific subclass of gradable adjectives strongly suggests that the underlying cause of the asymmetry is somehow related to scale structure. Next, we briefly review several related syntactic domains that appear to exhibit a similar correspondence between scale structure and inferential attractiveness.

## 2.4 Evidence from similar patterns in related domains

Additional support for the role of scale structure and vagueness in the meaning of *not very* ADJ comes from parallel contrasts in other syntactic environments or with other syntactic categories. In (11)-(15) are examples of contrasts with similar properties to *not very tall/late*, each with a slightly different syntactic nature. The (a)-examples involve predicates with vague, "relative-like" meanings; the (b)-examples involve predicates with more "absolute/minimum standard-like" meanings. In each case, our intuition is that inference to the positive form is much more attractive in the (b)-examples than in the (a)-examples. For instance (13a) does not seem to implicate that many people came to the party; whereas (13b) seems to imply that more than ten did.

- (11) a. This is not a very long stick. *attributive gradable adjectives*  
 b. This is not a very bent stick.

<sup>6</sup> *Extremely* may be an exception, but since the implicature resurfaces in all examples in (10) when *very* receives focus, a natural explanation might be that *extremely* attracts focus. We propose an alternative explanation in fn14.

<sup>7</sup> Intuitions seem less robust in the restrictor of *every*, e.g. it is not obvious whether there is a difference in inferences to the positive form between sentences like *Everyone who was very late was sent to the principal's office* and *Everyone who is very tall will be considered for the basketball team*. We leave this as an open question for future research.

- (12) a. John cannot stay at the party very long. *gradable adverbials*  
 b. John cannot arrive to the party very early.
- (13) a. Not very many people came to the party. *quantificational determiners*  
 b. Not a lot/much more than ten people came to the party.
- (14) a. I am not a huge fan of mayonnaise. *scalar nouns*  
 b. Digging here does not pose a huge risk.
- (15) a. John is not very tall (for an American man). *positive/comparative gradable adj.*  
 b. John is not much taller than the average American man.

These judgments are gradient and heavily dependent upon contextual factors. But even so, at least for the specific cases in (11)-(15), the sentences involving a predicate with a determinate minimum standard (*bent, early, more than ten, risk, taller than average*) seem to imply their positive form more strongly than the corresponding examples involving predicates with inherently variable thresholds (*long, many, fan, tall*).

Of particular relevance to the analysis of *not very* ADJ is example (15): abstracting away from syntactic details, (15a) and (15b) are both instances of an intensified gradable predicate under negation – [*not [very tall]*] and [*not [much taller than average]*], respectively. While both are demonstrably gradable, a clear difference between the two predicates is that the former is *vague* in a way that the latter is not: given knowledge of the average height and of John’s height, one can know with relative certainty whether (15b) is true, but not if (15a) is. Put differently, both *very* and *much* introduce interpretive uncertainty, but *tall* does in a way that *taller than average* does not.

If, as Horn (1989) suggests, the reason *tall* is not an attractive inference from *not very tall* has to do with euphemism, then one should expect the inference of *taller than average* from *not much taller than average* to be similarly unattractive – given the presumably similar evaluative profiles of *taller than average* and *tall*. Our judgments are that (15b) quite strongly implicates that John is taller than average, whereas (15a) does not. If correct, this would provide evidence in favor of an explanation in terms of scale-structure, and against one based purely on euphemism. In Experiment 2, we evaluate this claim directly by measuring judgments of agreement involving *tall* and *taller than average* in a range of different contexts (people’s heights) and syntactic configurations.

## 2.5 Empirical predictions and motivation for experiments

We have argued that (i) the inference from *not very* ADJ to ADJ (when it exists) is licensed by manner-based Gricean reasoning. We additionally hypothesize that (ii) a set of cases where the inference is unattractive (e.g. with *tall*) can be explained in part by their *vagueness*: the strengthened meaning [*tall and not [very tall]*] has vague extension boundaries “on both sides,” whereas (e.g.) the set of times counting as [*late and not [very late]*] is vague only on its upper boundary (due to the presence of *very*). We flesh out this idea in more detail in §4 and §5.5.

In the following sections we present two experiments designed to quantify the interpretations of vague and non-vague gradable predicates, including in the *not very* ADJ frame. In Experiment 1, we collect gradient judgments about predication involving the relative adjective *tall* and the absolute adjective *late*, across a range of scale points (e.g. if John is 6ft 2in would you agree that *John is (not) (very) tall?*). In Experiment 2, we compare judgments involving three relative gradable adjectives in their positive forms (*tall, hot, fast*) against those same adjectives in a comparative structure (*taller/hotter/faster than*), again across a range of relevant scale points.

The statement in (i) derives *late* as an implicature of *not very late* on the basis of structural alternatives. This directly predicts that *not late* is a strictly stronger alternative to *not very late*, and hence that the two forms should compete. In the context of Experiment 1, this means that there should be no regions of the lateness scale where *not late* and *not very late* are simultaneously deemed true.<sup>8</sup> Additionally, if the positive form inference is indeed generated as an implicature of *not very* ADJ, then we expect to see more uncertainty – in the form of greater variance – in judgments of truth within contexts that make the literal reading true (“less than very late”) but the strengthened reading false (“late but not a lot”) – since implicatures are themselves gradient and not always computed. Because the derivation relies on *not late* being strictly more informative than *not very late*, we also expect to find differences in the opposite direction on higher scale points (i.e., times which can count as *not very late*, but not as *not late*). If we are correct that *not very tall* does not trigger an implicature to the positive form, then we don’t expect to see its acceptability drop when *not tall* becomes maximally acceptable, nor do we expect greater variance in this region. A theory like Horn’s (1989) predicts that we will not find differences on higher scale points either, if *not very tall* does indeed trigger an inference to the truth of *not tall*.

Combined with (ii), which we develop in more detail in §4 below, our proposal also predicts that for vague relative adjectives, phrases of the form *not much* ADJ-*er than average* should give rise to an implicature in a way that *not very* ADJ should not. As discussed in §2.4 above, this contrasts with the “negative understatement” view. Without further qualification, this theory leads to no expectation about an inference to the positive form; it also leads to a natural expectation that *not very tall (compared to average)* and *not much taller than average* should have similar interpretations.

Another goal of Experiment 1 is to verify our intuitions about the patterns, by measuring whether language users do indeed interpret *not very tall* differently from *not very late*. Experiment 2 then generalizes the result by extending the paradigm to a wider set of cases.

## 3 Experiment 1

### 3.1 Design

We estimated speakers’ interpretations of gradable expressions by creating continua of ordered degrees on scales and then eliciting gradient judgments of (dis)agreement with statements about objects located at various scale positions (e.g. is a 6ft-tall man “tall”?). We investigated *tall* and *late*, which for current purposes we took to be representative of the classes of relative standard gradable adjectives and minimum standard absolute gradable adjectives, respectively. Because the two adjectives required different background contexts, adjective type was a between-subjects factor.

### 3.2 Methods

#### 3.2.1 Participants

Experimental participants were recruited via Amazon Mechanical Turk in two survey versions. 35 participants took part in the *tall*-version, and 36 in the *late*-version (age range: 19–60). One participant in the *late*-version was excluded from the analyses because their self-reported native language was not English. We checked whether participants understood the task by looking at their responses to ADJ and *not* ADJ at extreme scale points, which should have been uncontroversial. Responses on the “wrong” side of the slider were considered errors (e.g., below 50% agreement to

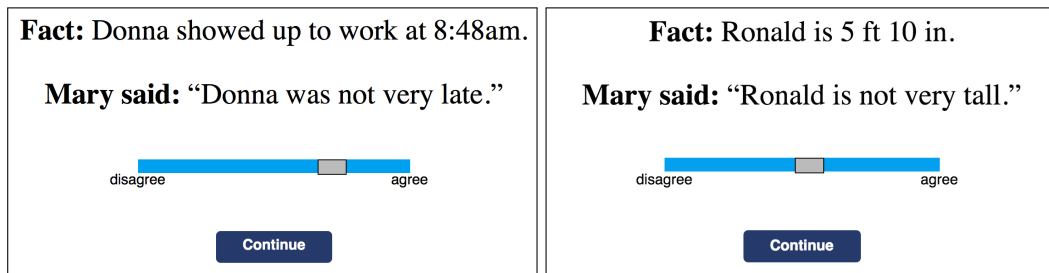
<sup>8</sup> Deemed true to some reasonably high degree, at least. By analogy, while logically speaking *all* entails *some*, situations where *all* is true are less likely to elicit judgments that *some* is true, due to its natural implicature to *not all*.



“John is tall” when John’s height is maximal on the scale, here 6ft 10in). No participant performed worse than chance according to this measure, so no participants were excluded.

### 3.2.2 Materials and procedure

In each trial, a participant was presented with a fact concerning the height or arrival time of a different person (in the *late*-version, initial instructions provided global context by specifying that newly hired employees were expected to arrive at 9am for their first day at work). The fact was paired with a statement, uttered by a character named Mary, involving one of seven different adjective constructions. The participant’s task was to indicate whether they agreed or disagreed with Mary by adjusting a slider whose position was encoded as a value ranging from 0% to 100%, where 100% is interpreted as complete agreement/acceptance, 0% as complete disagreement, etc.; see Figure 1 for sample displays.



**Figure 1:** Sample displays for *late* (left panel) and *tall* (right panel)

In the *tall*-version, participants evaluated Mary’s statements about men of different heights.<sup>9</sup> We tested the following seven constructions: “X is tall,” “X is not tall,” “X is very tall,” “X is not very tall,” “X is short,” “X is not short,” and “X is neither tall nor short,” paired with 13 different heights ranging from 5ft 3in (160cm) to 6ft 10in (208cm). The complete scale is presented in 1. In the *late*-version, Mary made statements about newly hired employees, who were all expected at 9:00am for their first day of work. Participants evaluated the following seven constructions: “X was late,” “X was not late,” “X was very late,” “X was not very late,” “X was early,” “X was not early,” and “X was on time,” at 13 arrival times ranging from 8:39am to 9:48am. Each participant saw all possible combinations of scale points and constructions twice (with a different name in each repetition), totaling in 182 trials per experiment version. Trials were presented in a different random order for each participant.

<i>tall</i>	The average American adult male is 5ft 10in (178cm)												
scale point	5ft 3in	5ft 6in	5ft 8in	5ft 9in	5ft 10in	5ft 11in	6ft	6ft 1in	6ft 2in	6ft 3in	6ft 5in	6ft 7in	6ft 10in
deviation from 5ft 10in	-7	-4	-2	-1	0	1	2	3	4	5	7	9	12
<i>late</i>	All employees were expected at 9:00am												
scale point	8:39	8:48	8:54	8:57	9:00	9:02	9:05	9:08	9:14	9:21	9:27	9:36	9:48
deviation from 9:00	-21	-12	-6	-3	0	2	5	8	14	21	27	36	48

**Table 1:** The scales used in Experiment 1, with each point’s distance from the average height (for *tall*) or the expected arrival time of 9am (for *late*). Only the latter was presented directly to participants in Experiment 1.

### 3.3 Results

Figure 2 shows judgments averaged over participants and items for all constructions, for the *late*-experiment (right panel) and the *tall*-experiment (left panel). The curves associated with *tall* and

<sup>9</sup> We used only unambiguous male names to keep the comparison class for tallness as homogeneous as possible.

*late* can be seen as visualizations of scale structure: acceptance of the predicate *tall* follows an approximately sigmoidal shape, increasing as height increases for nearly the entire interval of heights. This reflects uncertainty about the exact value of the tallness threshold. For *late*, acceptance remains relatively constant and close to zero prior to 9am, and then shows a rapid increase as time moves beyond 9am, eventually leveling off near 100% acceptance. This reflects the virtual certainty that the threshold for lateness is located at 9am.<sup>10</sup>

Under the assumption that acceptability reflects (degree of) truth,<sup>11</sup> entailment relations between expressions can be visualized by relative height on the coordinate system: if two curves in Fig. 2 have similar shapes but one has consistently lower agree-%, then it follows that whenever the lower one is true (to a certain degree), the higher one is true (to the same degree or higher). In other words, when a curve dominates another one across the scale, the lower one *entails* the higher one. For example *very tall* has a quite similar shape to *tall*, but *very tall* has consistently lower values than *tall* across all heights: whenever someone counts as *very tall*, they a fortiori count as *tall*. This reflects the fact that the former entails the latter. Similar remarks apply to *late* versus *very late*. In general, the results depicted in Fig. 2 are consistent with pre-theoretical expectations about the respective meanings of the constructions involved.

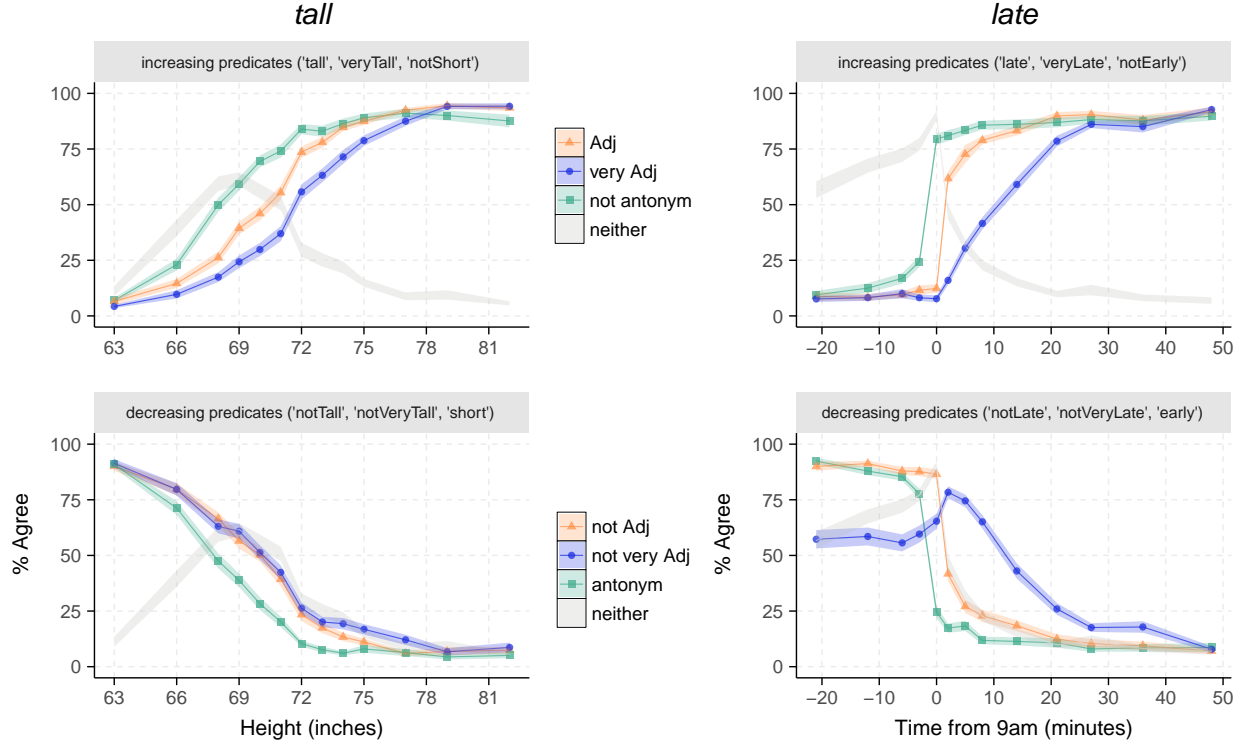
The comparison of interest for determining the meaning of *not very* ADJ is between the mean agree-% of *not very* ADJ and that of *not* ADJ. Figure 3 plots participants' mean judgments for only the critical constructions *not very* ADJ and *not* ADJ, across varying degrees of height or arrival time. As can be seen from the plots, *not late* shows a sharp decline in acceptance in the region just beyond the threshold (9:00am), the very same region in which *not very late* shows the highest acceptance rate. Meanwhile, *not very late* is degraded in the region of the scale where *not late* is the most acceptable. On the other hand, *not very tall* displays virtually the same response profile as *not tall*. While acceptance of the predicate *very tall* increases with height (Fig. 2, top left), a roughly mirror-image pattern is present for *not very tall* (Fig. 3, left). This approximates the expected relationship between an expression and its negation (cf. *tall/not tall* or *late/not late* in Fig. 2).

To analyze the responses for *not very* ADJ and *not* ADJ statistically, we used a non-parametric test to find significant differences in agreement % along the scales. Direct comparison at each scale point would run into serious multiple comparisons problems, while applying a Bonferroni correction would be too conservative since responses to adjacent scale points tend to be highly correlated. We therefore adopted a more sophisticated method traditionally used in eye-tracking and EEG studies (treating the curves along the scale as a “signal”).

We adapted the cluster analysis proposed by Maris & Oostenveld (2007), treating the degree scales as our continuous dimension (instead of time). The first step is to look for clusters of point-wise significant differences between two sets of curves (before correction for multiple comparisons)

<sup>10</sup> In fn2 we mentioned that although scalar endpoints serve as default thresholds for absolute adjectives, in reality thresholds vary marginally across contexts. And indeed we observe that 2min late is not judged as perfectly ‘late’, with 62% (26) mean agree (*sd*). However, note that this uncertainty only extends to times *after* 9am, and crucially not to times before 9am (with the reverse pattern for *early*). This suggests that the underlying mapping from arrival times to degrees of lateness treats all times earlier than 9am as  $\mathbf{min}_{late}$ . In other words, even though there is no lower endpoint on the “physical scale” (time), the abstract degree scale for *late* is indeed lower-bound so that here,  $\theta_{late} = \mathbf{min}_{late} = 9\text{am}$

<sup>11</sup> This assumption does not hold if other factors affect acceptability. Two possible deviations comes to mind: ungrammaticality (which should not be an issue here, as all constructions involved are presumably well-formed), and pragmatic effects. An example of the latter can be seen with *not very late*, where we argue that a drop in acceptability reflects the violation of an implicature rather than semantic effects.

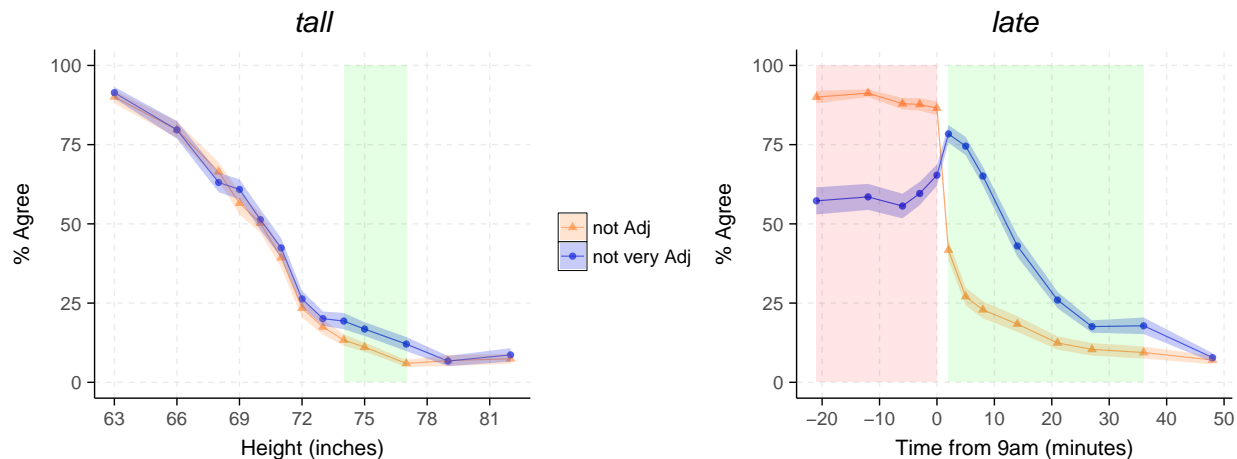


**Figure 2:** Mean % agree by construction across degrees, for the predicates *tall/late*, *very tall/late*, *not short/early*, and *neither tall nor short/on time* (top), and the predicates *not tall/late*, *not very tall/late*, *short/early*, and again *neither tall nor short/on time* for reference (bottom). Left panel: *tall*. Right panel: *late*. Ribbon width shows bootstrapped standard error of the mean at each scale point (here and for all figures throughout).

and to attribute to each cluster a size (typically, the sum of the relevant test statistic for each point in the cluster). In our case, we ran a mixed-effect model at each scale point with Construction as a fixed effect and random subject intercept, and took the  $t$ -value associated with the effect of Construction as our representative statistic. We recorded clusters of  $t$ -values above 2 or below  $-2$  and defined cluster size as the sum of absolute  $t$ -values (including “clusters” of one value). When no such values could be found, we simply recorded the maximum absolute  $t$ -value as the “biggest cluster size” (this was useful to estimate  $p$ -values for non-significant clusters).

After extracting clusters of differences between the two sets of curves, the second step was to evaluate how likely we would be to find similar clusters by partitioning the whole set of curves randomly rather than by Construction. For this purpose, responses from each participant were grouped into two curves for each Construction (corresponding respectively to the first and second occurrences of that construction at each scale point). We then randomly re-assigned the labels *not very ADJ* and *not ADJ* to each curve, extracted clusters following the same procedure as with the actual data, and saved the size of the largest cluster. This was repeated 10,000 times in order to get a precise distribution for cluster sizes, from which a  $p$ -value could be computed for each of the clusters we found in the actual data (see Ernst 2004 for an accessible introduction to permutation testing techniques).

We found two significant clusters for “late”: from 21min early to exactly 9:00am, *not very late* is significantly degraded compared to *not late* (59% (32) versus 89% (16) mean rating ( $sd$ ), respectively); and from 2min late to 36min late, we observed the opposite (46% (34) versus 20%



**Figure 3:** Mean % agree by construction across degrees. Left panel: *not late* (orange) and *not very late* (blue). Right panel: *not tall* (orange) and *not very tall* (blue). Significant clusters are indicated in green when *not very* ADJ is above *not* ADJ and in red otherwise. Ribbon width represents standard error.

(23); see Fig. 3, left panel). Both clusters were larger than anything obtained from the 10,000 random permutations, hence  $p < .0001$ .

For “tall,” acceptability of the constructions *not very tall* and *not tall* coincided in most intervals. But the analysis revealed a small significant cluster from 6ft 2in (188cm) to 6ft 5in (196cm), during which *not very tall* was more acceptable than *not tall* (16% (20) versus 10% (13); see Fig. 3, left panel), with  $p = .0003$ .

### 3.4 Discussion

Our results show that speakers clearly distinguish between the meanings of *not late* and *not very late*, and provide strong support for the hypothesis that the latter is interpreted with an implicature to the negation of the former. The signature of this implicature is visible in the results in three ways.

First, in the range of (strictly) late arrivals, participants treat *not very late* as more acceptable than *not late*, with the largest difference in acceptability – as well as the highest rate of agree-% for *not very late* – occurring in the region just after 9am. This shows that, in this range, *not very late* is strictly less informative than *not late*. This is a pre-condition for the derivation of an implicature from *not very late* to *late* (see step (ii) of the derivation proposed in §2.3)

Second, for early arrivals, *not very late* is instead degraded relative to *not late* – crucially in spite of the fact that early arrival should be perfectly compatible with the literal meaning of *not very late*, given the clear unacceptability of *very late*. This is strong evidence for the inference in (1): the fact that *not very late* is degraded precisely when *not late* is most acceptable suggests that the two expressions are in competition, as expected if *late* is an implicature of *not very late*.

Third, note that mean agreement rating for *not very late* is only at 58% prior to 9am – the region in which the literal reading is true but the strengthened reading is false. Variance is also higher for *not very late* than for all other constructions in this region ( $sd = 33\%$ , compared to the average  $sd$  of 18% for all others; difference visible from relative width of error ribbons). This pattern demonstrates uncertainty about whether being early counts as ‘not very late’, which is expected since the literal meaning is compatible with being early but the strengthened meaning is not. Again, this provides evidence for the *late* implicature of *not very late*.

A different picture emerges from the results of the *tall* conditions. The constructions *not tall*

and *not very tall* are treated almost completely alike by participants, with no indication of the implicature *tall* from *not very tall*. The close similarity of the curves for *not tall* and *not very tall* confirms our intuition that the implicature to the positive form is not drawn from *not very tall* in the way it is drawn from *not very late*. Unlike the results for *late*, we found no evidence for competition between these two expressions – there is no interval during which acceptance of one spikes while acceptance of the other drops – and thus no evidence that an implicature would be derived from an assertion of one expression via reasoning about the non-asserted one. Moreover, the fact that the meaning of *not very tall* is almost identical to the meaning of *not tall* provides evidence not only for the lack of an implicature, but also for a meaning stronger than the mere negation of *very tall*.

Going back to the two puzzles outlined in §1, our results provide strong evidence that (i) unlike *not very late*, *not very tall* does not give rise to the positive inference ‘tall’; and (ii) *not very tall* seems to be further strengthened to have a meaning very close to *not tall*, even though the positive forms *tall* and *very tall* were clearly distinguished.

Two final points relating to this aspect of the results: first, Horn’s (1989) proposed interpretation for *not very tall* (‘rather short’) was not precise enough for a predictive theory. Our data, however, precisely characterizes the relationship between the interpretations of *not very tall*, *not tall*, and *short*: as can be seen from visual inspection of Fig. 2, we found that *short* is consistently interpreted as stronger than *not very tall*, with mean agreement of 26% for the former versus 38% for the latter (collapsed over heights).

Second, we found that the response profiles for *not tall* and *not very tall* coincide for nearly the entire range of heights evaluated in the present study. Nonetheless, there is one exception: in the interval between 6ft 2in and 6ft 5in, *not very tall* is slightly more acceptable than *not tall* (16% versus 10% mean rating, respectively). In some sense this is unsurprising, as these heights intuitively correspond to someone who would be tall, but less than very tall. Albeit small in magnitude and range, this difference could be an indication that *not very tall* is still marginally weaker than *not tall*, and hence that the “strengthening” of *not very tall* to *not tall* is more of a gradient phenomenon than has been assumed in the past.

An anonymous reviewer pointed out that the experiment was very long, and that judgments on vague items may be affected by this (as participants may accommodate a metalinguistic QUD, such as “does 6ft 1in count as *tall*?”). If this had an effect, it would most likely be stronger for later trials, hence we decided to test order effects. We observed very limited order effects, and crucially, they did not affect judgments on vague items.<sup>12</sup> In Experiment 2, order effects were completely obviated by showing each combination of construction and scale point only once.

In the next section, we propose a theoretical account of our results, which will be supported by a post-hoc analysis of the results of this first experiment. We follow with a second experiment which further tests the proposal and addresses some shortcomings of the first experiment.

<sup>12</sup> For each adjective, we fit a model at each scale point with Construction (7 levels, sum-coded), Order (2 levels corresponding to first and second occurrence of a given construction at a given scale-point, sum-coded) and their interaction as fixed effects. We included random slopes for Construction and Order but not for their interaction (this would have saturated the model). The random effect structure was then simplified to avoid over-fitting using the procedure proposed in Bates et al. (2015). We observed no significant effect of Order in any of the constructions from the ‘tall’ version (highest  $\chi^2(7) = 13, p = .07$ ), but we found an effect in the ‘late’ version at 8:54am ( $\chi^2(7) = 21, p = .004, p = .048$  after Bonferroni correction for 13 comparisons). Further inspection with a treatment-coded model showed that ‘early’, ‘late’, ‘not early’, ‘very late’, and ‘not very late’ were unaffected by Order (all  $t < 1$ ), but ‘on time’ was judged slightly higher on its second occurrence ( $t = 1.6$ ) while ‘not late’ was slightly degraded ( $t = -1.4$ ).

## 4 A proposed model of vagueness-implicature interactions

In the results of Experiment 1, we found that a sentence like (16a) is interpreted with an inference to the negation of (16b). By contrast, a sentence like (17a) is interpreted as approximately synonymous with (17b) – with the caveat discussed in the previous section.

- |                                 |                                |
|---------------------------------|--------------------------------|
| (16) a. John was not very late. | (17) a. John is not very tall. |
| b. John was not late.           | b. John is not tall.           |

In §2.3 we argued that the first case can be explained as a standard structural (manner) implicature triggered by competition between (16a) and (16b), and our experimental results confirmed this view. We have also seen that euphemism may partially explain how it is that (17a) can be used to communicate something that approximates (17b), instead of simply “less than very tall”. But the explanation is inherently incomplete: euphemism cannot not explain why (minimum standard) absolute adjectives do not follow the same pattern, nor does it explain why reasoning about euphemism dictates meaning *instead of* the kind of manner-based Gricean reasoning that explains the interpretation of (16a). The remaining puzzle, then, essentially boils down to the question of why (17a) does not give rise to a *tall* implicature parallel to the *late* implicature of (16a).

Since the difference between adjectives that do implicate the positive form in *not very* ADJ and those that don’t systematically aligns with the distinction between minimum standard and relative standard gradable adjectives, we believe that the explanation must be sought in the interaction between vagueness – the semantic dimension along which the two classes vary – and the derivation of structural implicatures – the pragmatic mechanism that accounts for the positive form inference from *not very* ADJ (when present).

### 4.1 Deriving the relative/absolute asymmetry

We propose that the asymmetry in implicature to the positive form between *not very tall* and *not very late* follows directly from basic facts about relative versus absolute scale structure, combined with a novel constraint on the derivation of implicatures. Ripley (2011) defines a borderline contradiction as a conjunction of the form  $(Fa \wedge \neg Fa)$ , where  $F$  is a vague predicate and  $a$  is a borderline case for  $F$  (meaning it is not clear whether  $a$  is  $F$  or non- $F$ ). Such constructions have been shown to be more acceptable than ordinary contradictions, but still clearly degraded (Alxatib & Pelletier 2011; Serchuk et al. 2011; Egré et al. 2013; Zehr 2014). We propose to generalize this notion to the case of two (possibly) distinct but related predicates, using the definition in (18).

- (18) **Definition** If  $F$  and  $G$  are gradable predicates on the same scale and with the same polarity:  $(Fa \wedge \neg Ga)$  is a *borderline contradiction* iff  $a$  is a borderline case for both  $F$  and  $G$ .

Using the notion of a borderline contradiction as defined in (18), we propose the following novel constraint on implicature calculation:

- (19) **Constraint on vague implicatures**  
If a sentence  $S$  has an alternative  $S'$ , the potential implicature  $\neg S'$  is not drawn if  $S \wedge \neg S'$  would necessarily be a *borderline contradiction*.

The intuition here is that borderline contradictions are generally infelicitous – or at least unlikely to be true – and therefore if there is an option to not interpret a sentence with a borderline-contradiction

implicature, then such a strategy should be preferred. Similar constraints have been proposed in more restricted forms: for example Fox & Hackl (2006) argue that implicatures are not derived if they lead to contradiction when combined with the literal meaning. (19) simply extends this idea to the generalized notion of borderline contradiction in (18): avoid deriving an inference if there is uncertainty as to whether the resulting meaning would *ever* be satisfiable.<sup>13</sup>

Our explanation of §3's results in terms of (19) runs as follows. Consider first the case of *not very late*. The meaning conveyed by the assertion with its implicature can be paraphrased as "late but not very late." Treating *late* as *F* and *very late* as *G* in the definition (18), we predict that the implicature is derived only if there are arrival times which do not lead to borderline contradictions. Because *late* is minimum-standard, any time shortly after 9am counts as clearly late, and by getting sufficiently close to 9am, there will be some times which also count as clearly less than very late. Since there are times which clearly count as late but not as very late, there is no borderline contradiction and hence (19) does not prevent an inference from being drawn; manner-based reasoning can then apply and the implicature may be drawn.

By contrast, the constraint (19) could block the derivation of the implicature for *not very tall* in the following way. For the implicature to be derived, we would need to find individuals which are simultaneously clearly tall and clearly less than very tall. However, in this case both predicates are vague. We argue that in general there are simply no heights which clearly satisfy both predicates at the same time, because *very* does not increase the threshold enough to make *not very tall* clearly compatible with *tall*.<sup>14</sup> Thus a borderline contradiction arises and the implicature is blocked by (19).

## 4.2 Evidence from further data analysis

Our theory of *not very* ADJ relies upon the crucial assumption that the conjunction of "tall" with "not very tall" is a borderline contradiction in a way that the conjunction of "late" with "not very late" is not. However, we have not justified this claim beyond intuition thus far. We will now do exactly this. Establishing the claim essentially reduces to showing that the phrase *tall but not very tall* is significantly less acceptable ("more contradictory") than *late but not very late*, which has a determinate lower-bound and hence should not give rise to borderline contradictions.

The most direct way to evaluate this assumption would be to elicit judgments about the acceptability of ADJ and *not very* ADJ. This strategy, however, is clearly problematic: the phrase *late and not very late*, for instance, seems pragmatically deviant, presumably because of lexical competition between *and* and *but* (cf. also *some but/and not all*). One could then consider using *but* to conjoin ADJ with *not very* ADJ, since *but* has a similar (enough) truth-functional meaning to *and* but is a more natural connective in this context. However, doing so would be equally problematic for the following reason: using *but* to conjoin ADJ and *not very* ADJ introduces an implication<sup>15</sup> that the

<sup>13</sup> A similar proposal is advanced by Chemla & Romoli (2015), who argue that implicatures are not derived if the probability of the implicature given the assertion is substantially lower than the probability of the implicature alone.

<sup>14</sup> This suggests that if we replace *very* with *extremely*, the implicature should resurface, given that it is easier to find heights which are clearly tall without being anything close to *extremely* tall. This feels intuitively correct: *John is not extremely tall* seems to suggest that John is tall to a greater degree than does *John is not very tall*.

<sup>15</sup> There is no current consensus among researchers about the exact nature of the contrastive implication from *but*. Traditionally it was viewed as a "conventional implicature" (Grice 1975). But influential arguments by Bach (1999) and Potts (2005) conclude that the contrastive inference from *but* is actually a kind of "ancillary entailment," so that the truth-conditional contributions of *but* and *and* are not even identical. See also Karttunen (2016) and Blakemore & Carston (2005).

two conjuncts “contrast” with one another, and thus – since their main predicates are identical – would attract focus to the modifier *very*.

As we noted earlier, focal stress on *very* has the effect of forcing the derivation of the positive form implicature, thus avoiding contradiction (perhaps because stress has the effect of pushing the threshold further to the right, by increasing the strength of the intensification). Therefore, using *and* would make the conjunction of ADJ with *not very* ADJ infelicitous for independent pragmatic reasons, while using *but* would affect focus structure and hence provide judgments about a meaning that is probably distinct from the logical conjunction of the relevant predicates (the problem is even worse if one accepts Bach’s (1999) and Potts’s (2005) arguments that *and* and *but* are not even truth-conditionally equivalent in the first place).

Instead of collecting explicit judgments, we employed an indirect strategy that allowed us to estimate the interpretation of the abstract construction “ADJ  $\wedge \neg$  *very* ADJ,” while avoiding the focus-related confound, as well as the confound introduced by pragmatic competition between *and* and *but*. In the following, we describe a post-hoc analysis on the data from Experiment 1 establishing that *tall*  $\wedge \neg$  *very tall* does indeed have a degraded interpretation when compared to *late*  $\wedge \neg$  *very late*, as hypothesized in §4.1 above.

By combining data about ADJ and data about *very* ADJ, we were able to “reconstruct” estimated agree-%’s for complex expressions of the form ADJ  $\wedge \neg$  *very* ADJ, and test whether they behaved like borderline contradictions. We used the definitions of negation and conjunction from fuzzy logic (Zadeh 1965), presented in (20), which is the standard for vagueness. Where  $v(A) \in [0, 1]$  represents the fuzzy truth-value of proposition A:

(20) **Definitions of logical operators for reconstructing gradable pseudo-predicates:**

- a.  $v(\neg A) =_{\text{def}} 1 - v(A)$  (negation of proposition A)
- b.  $v(A \wedge B) =_{\text{def}} \min(v(A), v(B))$  (conjunction of propositions A, B)

In other words, if a participant’s mean rating for *Bill is tall* when Bill is 6ft is 70%, then we can infer their mean rating of  $\neg(\textit{Bill is tall})$  to be around  $1 - 70\% = 30\%$ . And indeed, this “artificial” meaning almost completely coincides with participants’ actual judgments about the sentence *Bill is not tall*. The conjunction  $A \wedge B$  is defined as the proposition with value equal to the minimum of  $v(A)$  and  $v(B)$ .<sup>16</sup>

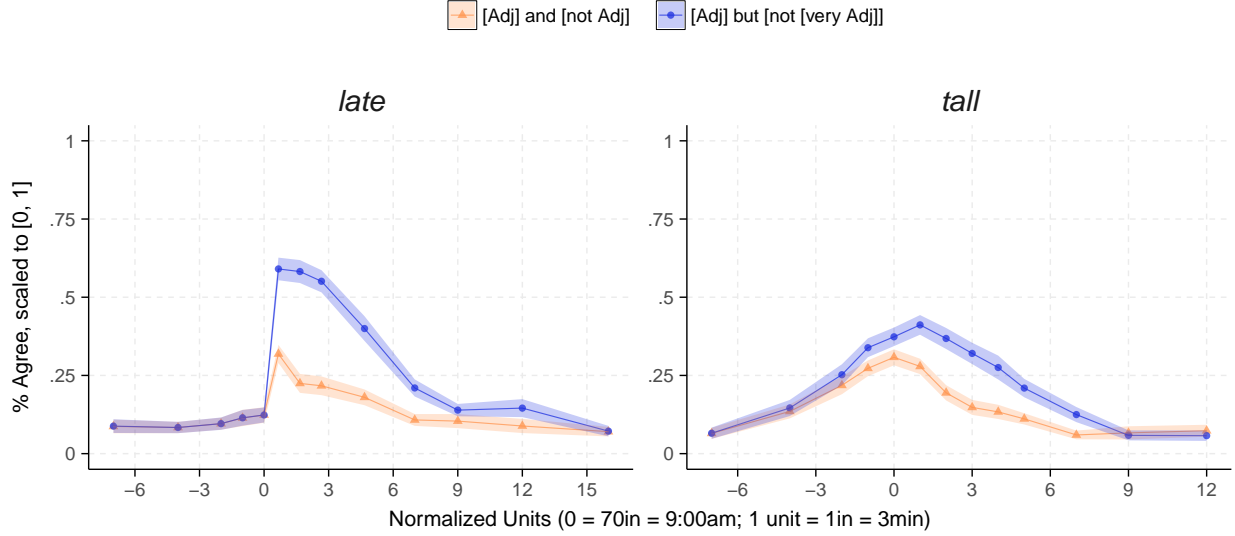
Using these definitions, we can estimate interpretations of propositions of the form ADJ  $\wedge \neg$  *very* ADJ for each participant and scale point (e.g. someone’s judgment about the degree to which a 6ft-tall man counts as ‘tall and not very tall’) as follows: we first take the actual judgments for ADJ and for *very* ADJ, dividing each by 100 (scaling them to the interval  $[0, 1]$ ). We then take, for each participant and each height/time, whichever of the following two quantities is smaller: the mean value of their judgments about ADJ, and 1 minus the mean value of their judgments about *very* ADJ.<sup>17</sup> This allows us to compare estimated meanings of logically complex predicates in order

<sup>16</sup> While the operation for negation is uncontroversial, several definitions for conjunction are possible in fuzzy logic. The min operator (also called Zadeh-conjunction or Gödel t-norm) is the most common, especially in the literature on vagueness, but one may imagine that there could be better options. We validated the choice of min by comparing ratings for ‘neither tall nor short’ to ‘ $\min(1 - \text{tall}, 1 - \text{short})$ ’. Not only was it a very good approximation, but if anything it slightly underestimated the actual agreement with ‘neither tall nor short’. Since the min operator is the point-wise largest t-norm, no other choice of a conjunction function would have yielded better results (in particular not the product or the Łukasiewicz t-norms, which are salient alternative options).

<sup>17</sup> Crucially, we used the judgments for  $1 - \text{very ADJ}$  and not those for *not very* ADJ – the data we aim to explain – as



to evaluate our assumption about the role of borderline contradictions in the present phenomenon. We also calculated estimates for ‘ $\text{ADJ} \wedge \text{not ADJ}$ ’ (using the actual judgments for *not ADJ*) as a reference point, since they are known cases of borderline contradictions.



**Figure 4:** Estimated interpretations of complex expressions which would be potentially problematic to explicitly ask for judgments about. *ADJ and not ADJ* is defined as  $\min(\text{ADJ}, \text{not ADJ})$ , *ADJ and not very ADJ* as  $\min(\text{ADJ}, 1 - \text{very ADJ})$ . The units are normalized so that 0 is 9am for *late*-predicates, and 5ft 10in for *tall*-predicates (the average adult American male height). Ribbon width represents standard error.

Estimated mean agree-%s for each of the four reconstructed predicates are plotted in Fig. 4. Visual inspection suggests that *tall*  $\wedge$   $\neg$ very *tall* is clearly degraded compared to *late*  $\wedge$   $\neg$ very *late*, and is qualitatively closer to known borderline contradictions. To assess this quantitatively, we looked at the highest value a reconstructed predicate took across the whole scale.<sup>18</sup> We fit a linear mixed effect model on the peak values of the constructions ‘ $\text{ADJ} \wedge \neg \text{ADJ}$ ’ and ‘ $\text{ADJ} \wedge \neg \text{very ADJ}$ ’ with Construction, Adjective (‘tall’ or ‘late’) and their interaction as fixed factors, and a random intercept for participant (with only two data points per participant, we could not include a slope for Construction). This showed a significant interaction between Adjective and Construction ( $\chi^2(1) = 9.6, p = .002$ ), establishing that *late*  $\wedge$   $\neg$ very *late* was significantly more acceptable than *tall*  $\wedge$   $\neg$ very *tall*.

Furthermore, while 17 of the participants agreed that the position of the peak for *late*  $\wedge$   $\neg$ very *late* was 9:02am, no more than 8 participants agreed on a single peak value for *tall*  $\wedge$   $\neg$ very *tall* (most frequent was 5ft 11in, 180cm).

In sum, the interpretive difference between *not very tall* and *not very late* follows from the fact that deriving the inference from *not very tall* would result in too much uncertainty and lack of

the latter strategy would have been circular.

<sup>18</sup> A borderline contradiction should maintain low acceptability across the scale, whereas a non-contradictory proposition should have at least some range in which it has a reasonably high acceptability rate. Note that a perfectly acceptable predicate with a very specific meaning would have a very small range of high acceptability ratings, and close-to-zero ratings elsewhere, while a borderline contradictions is expected never to reach high agreement, but can in principle be rated higher than a clear contradiction across all scale. This shows that peak value is a more appropriate measure of borderline contradictoriness than area under the curve, which would not necessarily distinguish between these two hypothetical cases.

consensus among speakers, whereas the absolute nature of *late* ensures agreement on at least a part of the resulting strengthened interpretation: while few (if any) heights seem to count as ‘tall but not very tall’, and there is variation in what exactly those heights are, it is clear that 2min *late* qualifies as ‘late but not very late’. In §5.5 we show that the response data from Experiment 2 yield parallel patterns across the board when subjected to this same reconstructed predicate analysis.

Finally, we should note that while the proposal above explains why inference to the positive form is not derived for relative adjectives, it does not fully explain why the interpretation of *not very tall* is stronger than the mere negation of *very tall*. This missing piece of the puzzle could potentially be where evaluativity and understatement become relevant (Krifka 2007; Horn 1989), but assessing this possibility would require investigation of a much larger set of lexical items.

## 5 Experiment 2

### 5.1 Goals

Experiment 1 showed that the adjectives *tall* and *late* give rise to different inferences in the *not very* ADJ construction. We have argued that the difference between the two is driven by the underlying scale structure and vagueness associated with the semantics of these adjectives. In this second experiment, we address some limitations of Experiment 1 and confirm the role of vagueness.

Besides vagueness there are a number of other differences between *tall* and *late* and it is unclear whether the judgment patterns we have observed are idiosyncratic to the adjectives we tested. In order to establish a more general role of vagueness in implicature derivation, we conducted a second experiment with the adjective *tall* and two additional relative adjectives *fast* and *hot*. Instead of comparing relative and minimum standard adjectives, we tested the same relative adjectives in the positive form and in a comparative construction (*taller than the average American man*, *faster than the average mid-sized sedan*, and *hotter than the average summer day in Citytown*).<sup>19</sup> This allowed for a minimal comparison between a vague and non-vague condition using the same measurement scale. That is, while the positive form of relative adjectives involves borderline cases, there is a fixed minimum reference point in the comparative construction. For example, the comparative *taller than the average American man* is true of any individual whose height exceeds the degree denoted by the average (assuming the average is known). This is similar to the fact that any degree exceeding the threshold counts as ADJ in the case of minimum standard adjectives.<sup>20</sup> By using comparatives, we were able to test a continuous scale with scale points below the threshold, which is the region where the implicature can be observed (evidenced by the curve for *not very* ADJ dropping to a low agreement when that of *not* ADJ reaches full acceptability).<sup>21</sup> Comparing positive and comparative forms of an adjectives also obviated any remaining issue regarding evaluativity and euphemism, as discussed with example (15) in §2.4.

In Experiment 2, we provided an explicit reference in all conditions (as opposed to Experiment 1, where a 9:00am threshold was supplied for *late*, but none was supplied for *tall*). Specifically, in each trial the average measure of ADJ was provided as additional context (relative to a specific scenario,

<sup>19</sup> We are grateful to Stephanie Solt for this idea.

<sup>20</sup> See especially Kennedy & McNally (2005b) for a unified analysis of comparative and minimum standard adjectives.

<sup>21</sup> This worked well with the minimum standard adjective *late* since its physical scale extends below the threshold (even though the conceptual scale seems to map all ‘early’ times to **min**<sub>late</sub>, as discussed in fn10). Nevertheless, it is difficult to find other minimum standard adjectives which behave the same in this respect, since their physical scale usually has a minimum too (as an example, there is no negative amount of precipitation which would make the implicature of ‘not very rainy’ as visible as that of ‘not very late’).

which was held constant within each adjective). Moreover, we provided an explicit comparison class in the critical sentence. For comparatives, the average provided in the context sentence was used in a than-phrase and for adjectives in the positive form, we used for-phrases (e.g., *tall for an American man*). Crucially, relative adjectives are gradable in both their positive and comparative forms, allowing similar constructions (the main difference is that the natural intensifier for comparatives is not ‘very’ but ‘much’). In analogy to the previous experiment where we compared *not (very) tall* to *not (very) late*, here we are comparing ‘*not (very) ADJ for an X*’ to ‘*not (much) ADJ-er than the average X*’.

To sum up, we pursued three main goals in Experiment 2: (i) replicating the finding for *tall* in a context that provides a precise and explicit reference point and a comparison class, (ii) establishing the same pattern for two additional relative adjectives and (iii) establishing that the vague/non-vague distinction plays a more general role in implicature derivation (rather than being a particular property of positive adjectives) by looking at comparatives.

## 5.2 Design

Experiment 2 used the same task and continua of degrees as Experiment 1. We simplified the design by dropping antonyms and constructions such as ‘neither tall nor short’. Participants judged four different constructions for the same adjective in both the positive form (ADJ, not ADJ, very ADJ, not very ADJ) and the comparative (ADJ-er, not ADJ-er, much ADJ-er, not much ADJ-er). We created three analogous experiment versions for the adjectives *tall*, *fast* and *hot*. In short, the new design was 3 (Adjectives, between-subjects)  $\times$  2 (positive or comparative Form, within-subject)  $\times$  4 (Constructions, within-subject).

## 5.3 Methods

### 5.3.1 Participants

Participants were recruited via Amazon Mechanical Turk in three survey versions. In total, 135 participants took part in the Experiment (45 in each survey version, age range: 21–64). Two participants in the *tall*-version were excluded from analyses because they performed below chance on the measure of performance defined in Experiment 1 (based on answers to extreme scale points).

### 5.3.2 Materials and procedure

In each trial, participants were presented with a context sentence providing an explicit reference point, which was constant throughout the experiment (e.g., the average height of American men). Then, a fact placing an individual at one of 13 possible scale points was presented together with a statement involving this individual as the subject of a particular construction, in reference to a comparison class. For example, in the *tall*-experiment participants judged the statement *John is tall for an American male* after reading that John was 6ft 2in. The task was the same as in Experiment 1, that is participants had to indicate whether they agree with the statement on a continuous scale. The eight sentences resulting from combining two Forms (positive vs. comparative) and four Constructions followed the patterns: “*x is ADJ/very ADJ/not ADJ/not very ADJ for an X*” and “*x is ADJ-er/much ADJ-er/not ADJ-er/not much ADJ-er than the average X*”. Examples with the positive form of *hot* and the comparative form of *fast* are given in Figure 5.

In the case of *tall*, the comparison class and scale points were identical to Experiment 1 (American males, ranging from 5ft 3in to 6ft 10in). In the *fast*-version, statements were about cars with respect to mid-sized sedans, the top speed of which ranged from 85mph to 161mph

**Fact:** On an average summer day, the temperature in Citytown reaches 83 degrees fahrenheit.

The temperature reached 93 degrees in Citytown today (July 19).

**Mary said:** “Today was not very hot for a summer day in Citytown.”

disagree

agree

Continue

**Fact:** An average mid-sized sedan can reach a top speed of 113 miles per hour (mph).

Karen's car can reach a top speed of 109 mph.

**Mary said:** “Karen's car is not much faster than the average mid-sized sedan.”

disagree

agree

Continue

**Figure 5:** Sample displays from Experiment 2: positive *hot* item (top), comparative *fast* item (bottom).

(average 113mph). In the *hot*-version, utterances were about summer days in the made-up city of Citytown, which could range from 66°F to 113°F (average: 83°F). Each participant saw all possible combinations of scale points and constructions once for a single adjective, totaling in 104 trials per experiment version.<sup>22</sup> Trials were presented in a different random order for each participant.

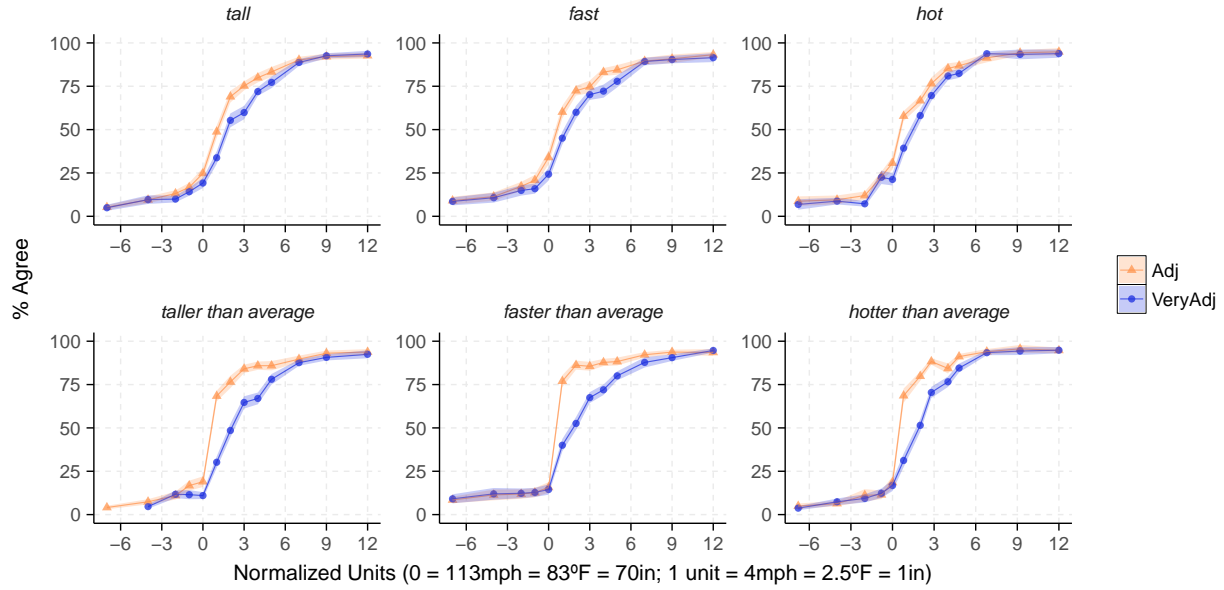
## 5.4 Results

The results for the ADJ and *very* ADJ constructions for all three adjectives in both positive and comparative forms are presented in Figure 6. A quick visual inspection confirms that unlike the positive forms of relative gradable adjectives, the comparative forms have clear thresholds. Figure 7 presents the results for the crucial *not* ADJ and *not very* ADJ constructions. As predicted, we observe that the vague positive forms show no trace of implicature, while the non-vague comparative forms show the same two effects as ‘late’: *not much* ADJ-ER does not drop as fast as *not* ADJ-ER after the threshold, but is degraded in the region below the threshold.

We submitted the results to a cluster analysis similar to that of Experiment 1. The only difference resided in the way we obtained *t*-values: with only one item per participant and condition, we replaced the mixed-effects models with simple linear models. The analysis confirmed the first observation: none of the positive forms showed any significant cluster (*fast*:  $p = .88$ ; *hot*:  $p = .11$ ; *tall*:  $p = .43$ ), while all comparative forms had a cluster of negative *t*-values before the threshold (*faster*: 85 – 109 mph; *hotter*: 66–83°F; *taller*: 5ft 3in – 5ft 10in; all  $p < .0001$ ) and a cluster of positive *t*-values after the threshold (*faster*: 117 – 129 mph; *hotter*: 85–90°F; *taller*: 5ft 11in – 6ft 3in; all  $p < .0001$ ).

We followed up with the analysis we proposed in §4.2, testing the contradictoriness of the potential implicature for each construction tested in Experiment 2. The predicates ADJ and *not* ADJ and ADJ(er) and *not very/much* ADJ(er) were reconstructed following the same procedure (see

<sup>22</sup> We didn’t present each combination twice as in Experiment 1, because we were worried the experiment would become too long.



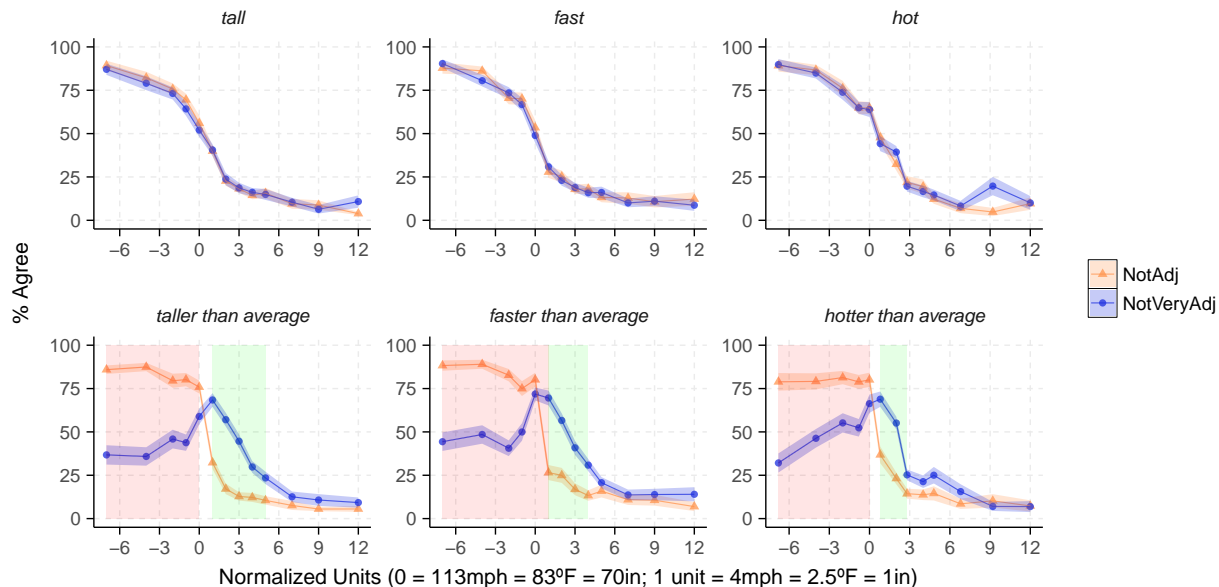
**Figure 6:** Mean % agree by construction across degrees. Top: *tall* for an American man, *fast* for a mid-sized sedan, and *hot* for a summer day in Citytown, with and without *very*. Bottom: *taller than the average* American man, *faster than the average* mid-sized sedan, and *hotter than the average* summer day in Citytown, with and without the intensifier *much* (in place of *very* for syntactic reasons).

Figure 8). The peak values for each Construction and each Form (positive or comparative) were extracted for each participant (resulting in 4 data points per participant). We ran a mixed-effects linear model with Construction, Form, Adjective (sum-coded), and all their interactions as fixed effects, and random intercept and slopes for Construction and Form by participant. The resulting random effects structure was simplified following the procedure of Bates et al. (2015) to avoid over-fitting. We observed an interaction between Form and Construction ( $\chi^2(1) = 15, p = .0001$ ), which indicated that ADJ-*er* and *not much* ADJ-*er* was less contradictory than ADJ and *not very* ADJ (w.r.t. the baseline Construction ADJ(*er*) and *not* ADJ(*er*)). We also observed a triple interaction ( $\chi^2(4) = 11, p = .025$ ), indicating that there was some variability between the three adjectives. Note however that all positive forms were clearly more contradictory than any comparative forms.

As in the previous case, there was less agreement between participants regarding the peak for the vague ADJ and *not very* ADJ constructions (at most 13, 17, and 13 participants agreeing for *fast*, *hot*, and *tall* respectively) than with the non-vague ADJ-*er* and *not much* ADJ-*er* constructions (up to 20, 22, and 20 participants agreeing for *faster*, *hotter*, and *taller* respectively).

## 5.5 Discussion

In this experiment, we replicated and extended the results of the first experiment. First, we replicated the results with *tall*, and obtained very similar results with two other (vague) relative gradable adjectives, *fast* and *hot*. We showed that even when providing the comparison class explicitly with a *for*-phrase and mentioning an explicit reference point (the average value in the comparison class), these predicates remained vague and still showed no trace of an implicature from *not very* ADJ to ADJ. Second, we generalized the results with ‘late’ to other non-vague constructions. Using the comparative form of the relative adjectives, we showed that the implicature resurfaced as soon as vagueness disappeared. Crucially, the use of comparative forms allowed us to address a number of



**Figure 7:** Mean % agree by construction across degrees for the target *not very* ADJ/*not much* ADJ-er, compared to its alternative *not* ADJ/*not* ADJ-er. Significant clusters of positive differences are indicated in green (*not very* ADJ above *not* ADJ); clusters of negative differences in red. Ribbon width represents standard error.

potential worries regarding Experiment 1. In particular, the same participants could be tested on the positive and comparative form of a given adjective, and the scale points were exactly the same.

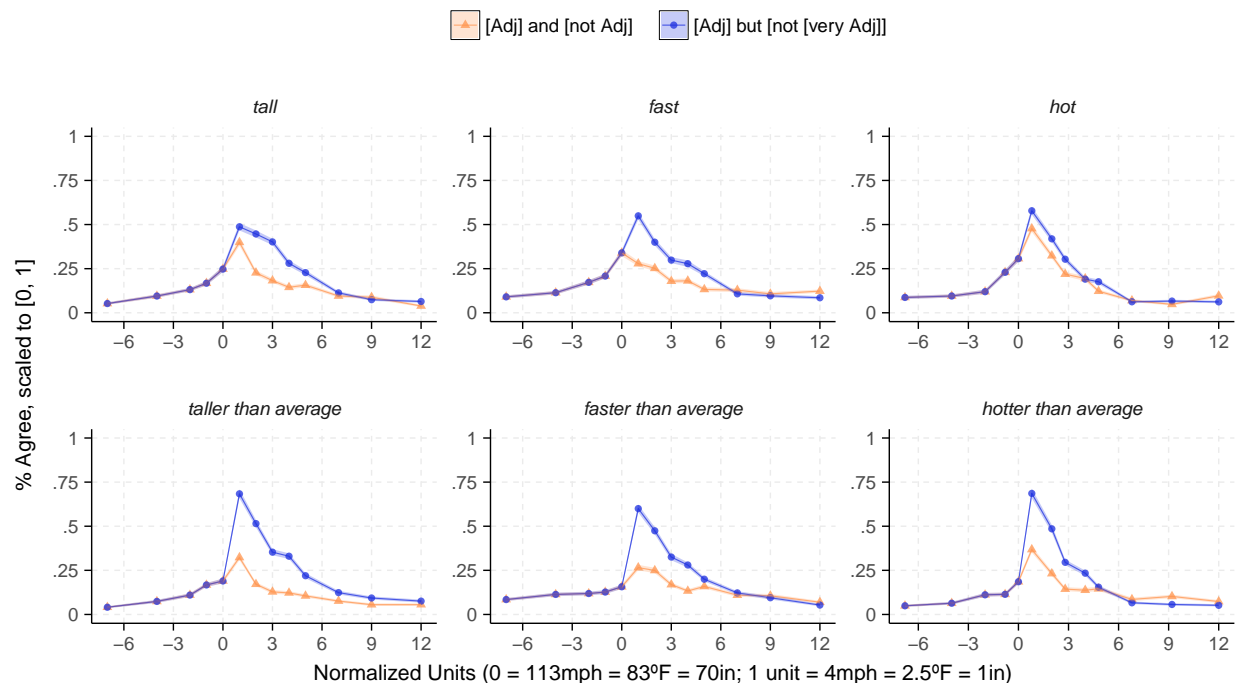
Since the positive and comparative forms of a given adjective are likely to share the same evaluative value, any proposal which would explain the effect as purely euphemistic cannot account for the results of this experiment. It is indeed unclear how such a theory would explain the difference between “John is not very tall for an American man” and “John is not much taller than the average American man”.

We also replicated the results of the post-hoc analysis we had run on the data from Experiment 1: we confirmed that the missing implicatures from positive forms (ADJ and *not very* ADJ) would have been more contradictory than the attested implicatures from comparative forms (ADJ-er and *not much* ADJ-er).

## 6 General Discussion and Conclusion

In two experiments, we showed that (a) the inference to ‘ADJ’ from *not very* ADJ is sensitive to the scale structure associated with ADJ, being far more attractive when ADJ has a determinate threshold (as in absolute adjectives or explicit comparatives) than when ADJ is vague (as in relative adjectives in the unmarked/positive form). Furthermore, we showed that (b) when present, the positive inference has the hallmarks of a structural implicature derived from manner-based Gricean reasoning. Finally, we showed that (c) this pattern seems to hold not just for relative versus absolute gradable adjectives, but also for other sets of predicates that differ primarily in the availability of a concrete, determinate threshold (here, morphologically unmarked relative adjectives versus their comparative forms).

Because of the systematic nature of the difference between vague relative predicates and non-vague/“precise” ones, we argued that the phenomenon should be accounted for as an interaction between the mechanisms at the source of implicature and the semantic property of vagueness. The



**Figure 8:** Estimated interpretations of complex expressions we could not explicitly ask for judgments about. ADJ and not ADJ is defined as  $\min(\text{ADJ}, \text{not ADJ})$ , ADJ and not very ADJ as  $\min(\text{ADJ}, 1 - \text{very ADJ})$ . Ribbon width represents standard errors.

theoretical analysis in Section 4 holds that implicatures are not drawn if they lead to meanings that are borderline contradictions. This constraint explains the core patterns in our experimental data – that intensified gradable predicates under negation implicate the unmodified predicate if it has minimum-standard semantics, but not if it has relative semantics. Perhaps more importantly, the constraint we advanced is a theoretically well-motivated hypothesis from which clear empirical predictions can be derived (provided clear definitions of the notions involved).

In conclusion, this paper has illustrated how uncertainty in one interpretive domain – the application of gradable predicates to objects – can systematically affect uncertainty in another domain – whether a meaning should be strengthened via an implicature. This study probably only scratches the surface of phenomena at the intersection of vagueness, scale structure, and the derivation of conversational implicature. We suspect that there are other interactions between vagueness and implicature from which further insights can be extracted and more sophisticated models developed. One potentially promising direction for future research is the integration of behavioral data like those collected here with linguistically-oriented computational modeling frameworks like RSA (Frank & Goodman 2012; Lassiter & Goodman 2014; Lassiter & Goodman 2017; a.o.) and evolutionary game-theoretic models (Qing & Franke 2014a; Qing & Franke 2014b; a.o.).

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