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Visual ambiguity predicts adjective ordering preferences in referential contexts

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Abstract. Recent work proposes subjectivity as a possible underlying mechanism for English's canonical adjective order, predicting that ordering adjectives with respect to decreasing subjectivity maximizes communicative success between interlocutors. The present studies aim to contribute to our understanding of the underlying factors guiding adjective order, using two sentence judgment tasks to gather speakers' intuitions about how visual traits might influence adjective ordering preferences. In both studies, participants saw two types of questions: for description-choice items, they chose a description from two provided options to identify a target object (a cake); for image-choice items, they used a given description to choose between two images of cakes. In the second study, context was manipulated such that participants were instructed to imagine they were working with a partner. For both description- and image-choice questions, the images contained some combination of clear and ambiguous traits: cakes were either clearly tall or short and ambiguously fancy, or clearly fancy and of medium height. If participants are gauging the subjectivity of a trait by relying on visual cues and then using this subjectivity to build descriptions that maximize communicative success, they should prefer the clearer, more objective trait in the second position, closer to the noun "cake." In both studies, we find that participants prefer descriptions in which the clearer trait is ordered *first* (furthest from the noun). This suggests that while adjective order can shift systematically based on the subjectivity of visual traits, deviation from the attested order is not consistent with the subjectivity hypothesis' predictions.

Keywords. adjective order; referential communication; subjectivity; psycholinguistics

1. Introduction.

1.1. English Adjective Order. Adjective order in English is both highly constrained and intuitive for native speakers (e.g., Sweet, 1898; Whorf, 1945; Ziff, 1960). For example, for English-speaking adults, (1) is grammatical and (2) is ungrammatical.

(1) I saw a big, green frog.
(2) *I saw a green, big frog.

Many explanations for this attested order have been proposed, some based in syntax and others relying instead on adjective meaning (Cinque, 1994). Hypotheses rooted in semantics argue a range of reasons, from an adjective's inherentness to a noun, to how context-dependent the adjective is, to the absoluteness of the adjective (e.g. Whorf, 1945; Dixon, 1982; Ziff, 1960;

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Sproat & Shih, 1991). A recent hypothesis builds on many of these previously proposed theories, putting forth adjective subjectivity as the underlying mechanism (Scontras et al., 2017).

1.2. THE SUBJECTIVITY HYPOTHESIS. Scontras et al. (2017) propose subjectivity as the driver of English adjective order. They define subjectivity using faultless disagreement, or the likelihood two speakers could disagree on an adjective's application to an object but neither be incorrect. They argue that adjectives that can be faultlessly disagreed upon—and are thus more subjective—occur further from the noun they describe in multi-adjective constructions. Therefore, in (1) and (2) above, "green" is proposed to occur closer to the noun because it is the less subjective trait; speakers could disagree on size, perhaps if they have different experiences with big frogs, but they can only be correct by calling it green.

Relying on the subjectivity hypothesis, Franke et al. (2019) posit that this ordering constraint is driven by communicative efficiency—placing the least subjective adjective closest to the noun leads to clearer communication between interlocutors, ensuring efficient and correct identification of a target by both a listener and speaker. This kind of subjectivity-based ordering creates a unit that can then be modified as a whole; for example, given a set of frogs of different sizes and colors, describing a certain one as *a big, green frog* tells the listener to first restrict the set of possible frogs to only green ones, then to further restrict the pool of possible referents based on Adjective order in English is both highly constrained and intuitive for native speakers (e.g., Sweet, 1898; Whorf, 1945; Ziff, 1960). For example, for English-speaking adults, (1) is grammatical and (2) is ungrammatical.

1.3. DEVIATING FROM PREFERRED ORDERS. There are some environments where speakers have been shown to deviate from the canonical order. For example, to place emphasis on one trait, a speaker may pair a deviation with prosodic cues such as increased stress or volume, or a pause between adjectives (Byrd & Choi, 2010). Such cues signal to a listener why the canonical order has been reversed, and may occur in contexts where a speaker is faced with the task of specifying one item out of a group of similar items.

One type of study where deviations from expected order are common is a referential communication task, where participants work with a partner to describe objects from a given scene. In these types of tasks, participants often prefer the discriminating descriptor (i.e., the most informative one) to appear first, or further from the noun being described (e.g., Danks & Schwenk, 1972; Fukumura, 2018). They show faster reaction times when asked to identify items which have been described with the more discriminating adjective placed first, and are also sensitive to visual saliency, preferring more available adjectives placed earlier (Eberhard et al., 1995; Belke, 2006). This order allows speakers and listeners to identify the critical referent as efficiently as possible, because the set of possible referents has been narrowed early linearly; in these types of tasks, participants tend to maximize discriminatory efficiency (Fukumura, 2018).

Franke et al.'s (2019) prediction that subjectivity-based ordering maximizes communicative success seems to stand at odds with prior referential communication results, which indicate that, in a communicative context, people prefer the more informative adjective first, or further from the noun. In cases when the objective trait is also the discriminating one, which pressure will win out—the desire to form the nuclear unit that the pattern of subjectivity-based ordering suggests is useful for clear communication, or the desire to place the objective adjective in the first position to facilitate more efficient identification of the target by the listener?

1.4. THE PRESENT STUDIES. While there have been proposals linking subjectivity and adjective order, there is currently little research investigating the interaction between adjective order and

visual input, as well as the connection between visual cues and subjectivity. It is unclear whether people systematically map different orders onto different meanings, and, if they do, whether these mappings align with visual subjectivity.

The present studies aim to answer these questions by employing two judgment tasks, one introducing a referential communication context, to determine if visual cues can influence speakers' adjective order preferences. We test judgments of phrases containing multiple adjectives paired with images that depict traits of varying levels of ambiguity in order to gauge speakers' flexibility in their ordering preferences.

If speakers systematically use visual cues to judge the subjectivity of a trait, and subjectivity-based ordering maximizes communicative success, we expect participants to prefer orders based on decreasing subjectivity. That is, we expect the adjective placed closest to the noun to denote the clearer trait, and the one placed further to be the ambiguous, subjective trait. We might also expect that in mapping descriptions onto images, participants will perceive the clearer trait as belonging in the second, closer position. If speakers are not sensitive to visual input when evaluating subjectivity of adjectives used in their utterances, they may show little flexibility in preferences, instead always choosing a consistent order.

2. Study 1. Study 1 was an image-sentence judgment task with two types of items. On description-choice (DC) trials, participants were given a target image and were asked to choose between two possible descriptions to distinguish that target. On image-choice (IC) trials, participants were provided a description and chose from two possible images which was being targeted.

2.1. PARTICIPANTS. Participants were 83 undergraduate students recruited from introductory Linguistics and Psychology courses at William & Mary. They were given course credit for their participation.

2.2. STIMULI. Stimuli were 9 unique images of cakes generated using PowerPoint. Cakes were three possible sizes (tall, medium, or short), and two possible fanciness levels (clearly fancy and ambiguously fancy). Each cake had one clear and one ambiguous trait. Therefore, the fancy cake was always the medium, two-tiered height, while the tall (three-tiered) and short (single-tiered) cakes were always the ambiguous-fancy option. All cakes also came in three colors (green, blue, and pink) to increase the number of judgments extracted from each participant. Cakes of the same color were always paired. See Figure 1 for examples of cake images.

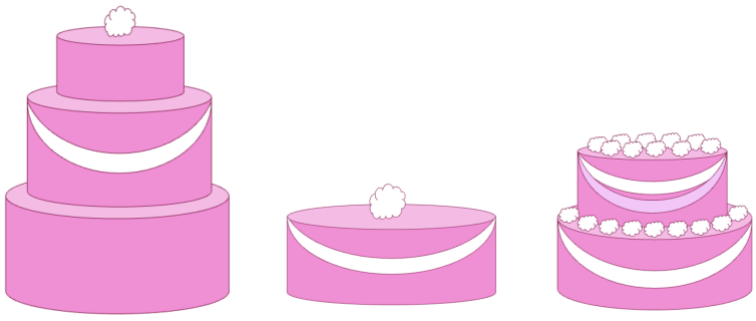

Figure 1. Cake heights and levels of fanciness

All sentences in the study contained descriptions of cakes with two adjectives: *tall*/*short* and *fancy* (3)-(6).

(3) This is a tall, fancy cake.
(4) This is a fancy, tall cake.
(5) This is a short, fancy, cake.
(6) This is a fancy, short cake.

We chose these specific sets of adjectives for two reasons. First, they represent traits that can be easily visually manipulated. Height is directly determined by the number of tiers: three tiers was clearly a "tall" cake, one tier was clearly a "short" cake, and two tiers was visually ambiguous (taller than some cakes but shorter than others in this context). We could similarly manipulate the level of fanciness: some cakes were clearly fancy with the maximum level of embellishment, while others had some embellishment but less than the clearly fancy items. The second reason we chose these two categories of adjectives is that previous studies indicate that they have similar levels of subjectivity (Gotowski et al., 2026). If participants' baseline representation of subjectivity was similar for height and fanciness, they may be sensitive to visual cues in deciding on-line which was more "subjective." This sets us up well to test the question of whether participants use real-time subjectivity judgments in determining adjective order.

2.3. DESIGN. Each participant saw 48 total items: 24 DC and 24 IC items. For DC items, participants chose from two descriptions which was the better option to apply to a target image. The descriptions were the same save for the order of the adjectives: in one option, *fancy* was presented in the position closer to the noun, while in the other, the height adjective (either *tall* or *short*) occupied the closer position (for example (3) v. (4)). For IC items, participants used a given description to choose between two images (see Figure 2 below for item examples).

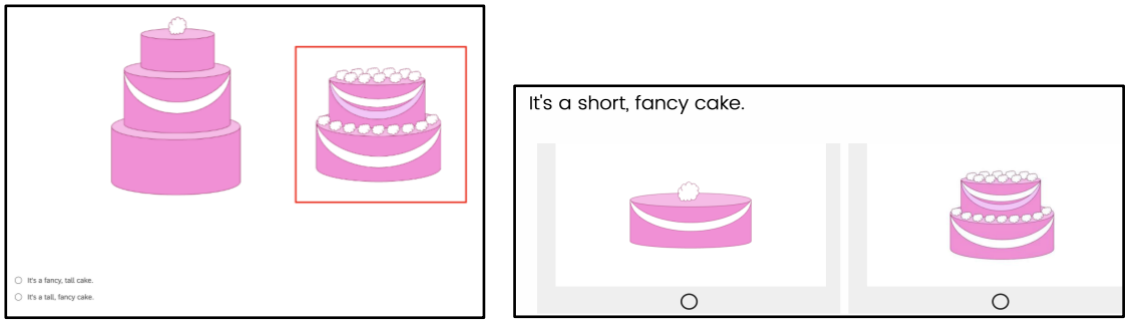

Figure 2. Description-choice item (left) and image-choice item (right)

2.4. PROCEDURE. Participants completed the study remotely through Qualtrics.

2.5. RESULTS. Participants showed a clear pattern of responses linking visual clarity with adjective order in both item types. On the DC items, participants reliably chose the description in which the clear trait was ordered first (Figure 3): when the target image was clearly fancy, participants reliably chose the *fancy*-first option; when the target item had a clear height, participants reliably chose the *tall/short*-first option.

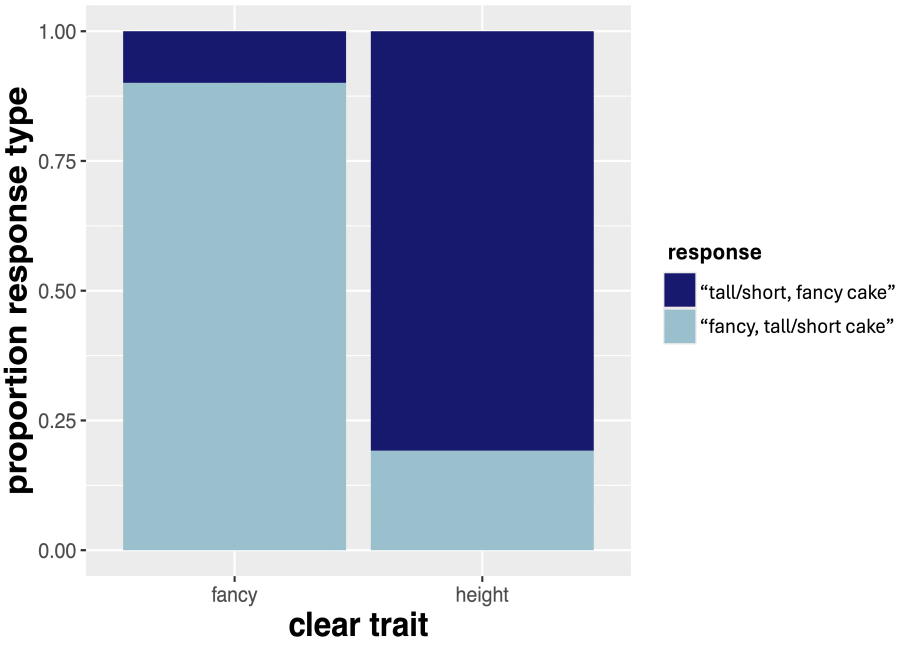

Figure 3. Study 1: Description choice based on clear trait

On the IC items, participants chose the image in which the first adjective in the description was the clear trait (Figure 4): when the target description was *fancy*-first, they chose the clearly fancy cake; when the target description was *tall/short*-first, they chose the image for which the height was the clear trait.

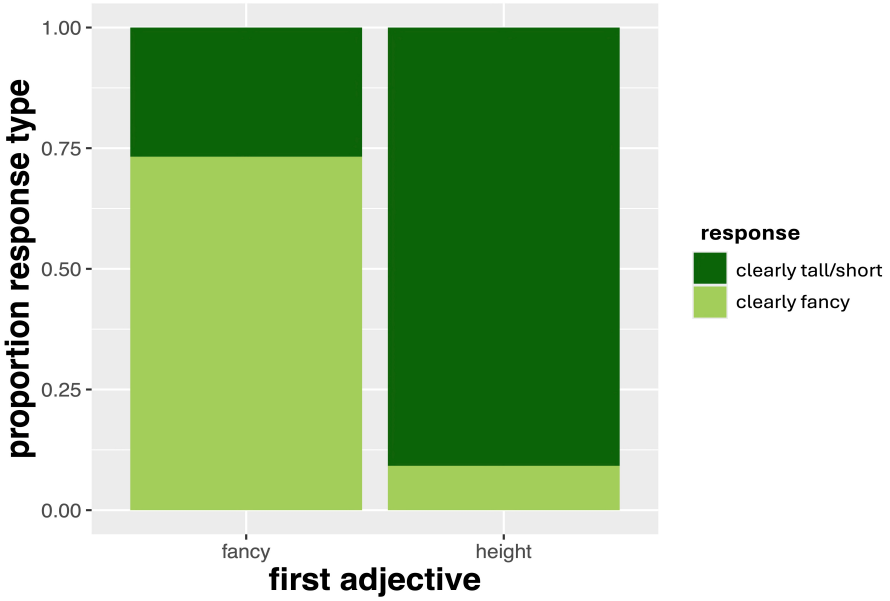

Figure 4. Study 1: Image choice based on adjective order

Overall, we see the same pattern across both types of items: participants prefer a visually clearer trait to be in the first position of a multi-adjective description.

Statistical models support our findings for both types of items. For the DC items, the results were analyzed in R (R Studio Team, 2020; R Core Team, 2021) using a generalized linear mixed effects logit model with adjective order as DV, clear trait as a fixed variable (fanciness v.

height), and subject as a blocking variable. We find a main effect of clear trait [$X^2_{(1)} = 662.4$, $p < 0.0001$]: participants were significantly more likely to choose the description in which the clear trait was in the first position. For the IC items, we also ran a generalized linear mixed effects logit model in R, with clear trait as DV, adjective order (*fancy*-first v. *tall/short*-first) as a fixed variable, and subject as a blocking variable. We find a main effect of adjective order [$X^2_{(1)} = 600.8$, $p < 0.0001$]: participants were significantly more likely to choose the image in which the first adjective of the description was the clear trait.

2.6. STUDY 1 DISCUSSION. We find that participants are flexible in ordering the adjectives *tall/short* and *fancy*—they choose both orders at similar rates on the DC task—and that the different orders convey different meanings. Perhaps surprisingly, we do not find that judgments align with the order predicted by Franke et al. (2019); rather, we find that participants—as both speakers and as comprehenders—prefer the clearer adjective *first,* further from the noun, in a multi-adjectival description of an image.

There are several reasons we might have seen this pattern emerge. One possibility is that an adjective's subjectivity is not tied directly to visual traits, or is not visually manipulatable. Perhaps the default order of adjectives is driven by something related to subjectivity, or subjectivity is stored as a fossilized, inalienable property of each adjective or class of adjective as we learn, and is thus not calculated in the moment based on visual cues. A second possibility is that since it has been argued that these ordering preferences are driven by communicative efficiency, perhaps we only see the predicted pattern emerge in communicative contexts. Our second study will address this latter possibility.

3. Study 2. Study 2 was nearly identical to that study 1, except that in this case participants were paired with an imagined partner. This change was made in order to elicit judgments in which speakers intended to maximize communicative success.

3.1. PARTICIPANTS. Participants were 83 undergraduate students recruited from introductory Linguistics and Psychology courses at William & Mary. They were given course credit for their participation.

3.2. STIMULI. Stimuli were the same 9 unique images of cakes from Study 1 (Figure 1).

3.3. DESIGN. As in Study 1, participants completed 48 total trials, including 24 each of the same two types of items (description-choice (DC) and image-choice (IC)). On DC trials, participants were given a target image and asked to choose between two possible descriptions to distinguish that target for an imagined partner—one in which *fancy* was first and an alternative in which *tall* or *short* was first (for example (3) v. (4)). On IC trials, participants were provided a description (one of the sentences in (3)-(6)) by an imagined partner and then asked to choose from two possible images which was being targeted: one in which the fanciness was clear and a second in which the height was clear. Presentation of the target image and the provided description with the imagined partner are given below in Figure 5.

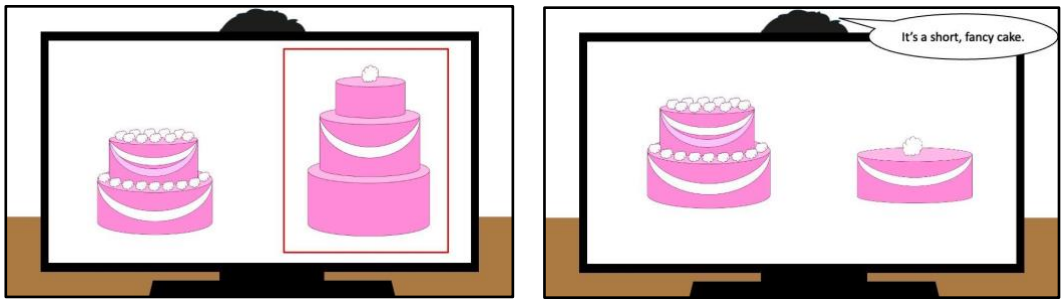

Figure 5. Description-choice item (left) and image-choice item (right)

3.4. PROCEDURE. Participants completed the study remotely through Qualtrics.

3.5. RESULTS. Participants showed the same pattern of responses as in Study 1, mapping the first adjective in the description onto the clearer trait. On DC items, they reliably chose the description in which the clear trait in the image was ordered first (Figure 6).

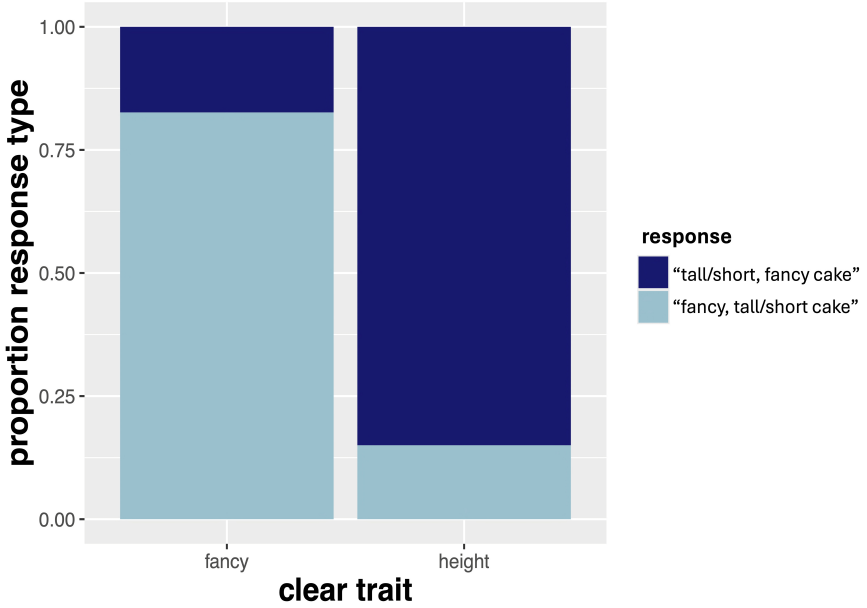

Figure 6. Study 2: Description choice based on clear trait

On IC items, participants reliably chose the image in which the first trait in the description was the clear trait (Figure 7).

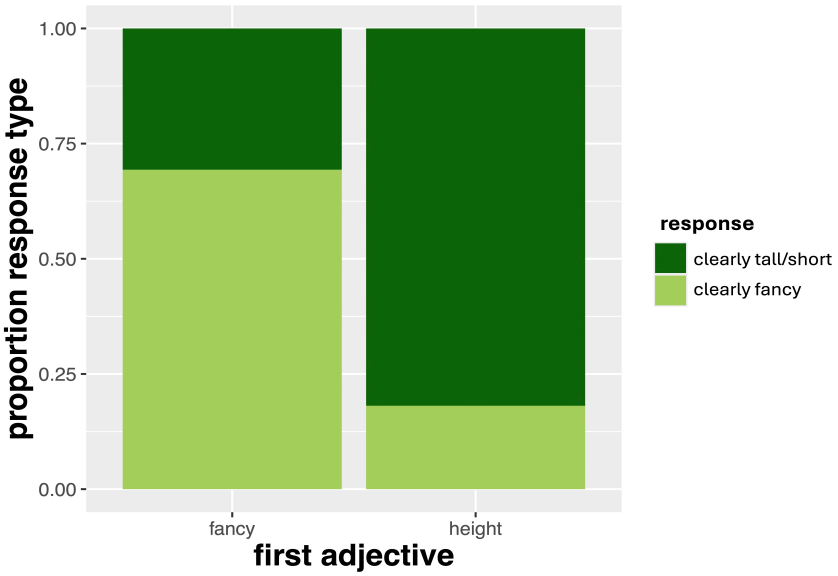

Figure 7. Study 2: Participant responses on image choice questions

Again, statistical models support the findings. For the DC items, we ran a generalized linear mixed effects logit model in R with adjective order as DV, clear trait as a fixed variable (fanciness v. height), and subject as a blocking variable. Like in study 1, we find a main effect of clear trait [$X^2_{(1)} = 771.7$, $p < 0.0001$]: participants were significantly more likely to choose the description in which the clear trait was in the first position. For the IC items, we also ran a generalized linear mixed effects logit model, with clear trait as DV, adjective order (*fancy*-first v. *tall/short*-first) as a fixed variable, and subject as a blocking variable. We find a main effect of adjective order [$X^2_{(1)} = 454.3$, $p < 0.0001$]: participants were significantly more likely to choose the image in which the first adjective of the description was the clear trait.

3.6. STUDY 2 DISCUSSION. In this study, we introduced a more explicit communicative context by pairing participants with an imaginary partner. If the results in Study 1 (where participants did not adhere to subjectivity-based ordering constraints in the manner previously predicted) were driven by the task not including an element of communication, we would expect a different performance in Study 2. Instead, we found that while performance in Study 2 aligned with Study 1. Participants showed systematic flexibility in their ordering preferences, mapping different meanings onto different orders, again preferring the clearer trait in the first position in descriptions containing multiple adjectives. This suggests that communicative efficiency is not the main driving force for the codified, attested order in which speakers prefer the less subjective adjectives to be ordered closer to the noun.

4. General Discussion. This work aimed to investigate whether speakers show systematic preferences for the order of multi-adjective phrases based on the visual clarity of the traits to which these adjectives refer, and if so, to in turn better understand how adjective order is linked with visual input. This contributes to a body of research investigating the relationship between adjective order and subjectivity. Adjectives which are more subjective should be more susceptible to variation in clarity across different examples. In this case, we have used visual clarity as a way to try to manipulate speakers' real-time judgments of subjectivity. If speakers are using visual cues to gauge subjectivity in the moment, the subjectivity hypothesis predicts that

speakers should prefer the adjective order in which the clearer trait is closest to the noun. Previous studies on referential communication, however, have demonstrated that speakers prefer the clearer adjective in the first position. Our studies aimed to test these conflicting predictions.

Across two studies, we find that participants do have ordering preferences that are systematically related to the visual clarity of traits, reliably preferring an order in which the adjective describing the visually clearer trait is first in a multi-adjective sequence. This was true both in a neutral sentence-image judgment task (Study 1), as well as in a referential communication task (Study 2). These judgments align with previous findings from other referential communication tasks, but do not align with the predictions of the subjectivity hypothesis.

While these studies have interesting implications for understanding the role of subjectivity in adjective ordering preferences, several questions remain. First, more work is needed to understand the nature of the relationship between visual ambiguity and subjectivity speakers' judgments of subjectivity. We have attempted to use visual ambiguity to induce variation in subjectivity. It is possible, however, that this relationship is not so straightforward. Perhaps speakers do not use the ambiguity of visual traits to judge subjectivity in real time. Rather, subjectivity may be related to order in the manner proposed by the subjectivity hypothesis, and ordering constraints may be fossilized based on a general representation of subjectivity, instead of flexible in real-time based on visual cues.

Another possibility is that the nature of our task has masked any potential real-time subjectivity calculations. Choosing two traits and manipulating them in a very constrained way (clear levels of height and fanciness in the context of the images in our task) allowed us to cleanly investigate the relationship between order and visual traits. However, it may have had the disadvantage of stripping these adjectives of their true subjectivity. Faultless disagreements are likely to arise in contexts in which traits are gradient and complex (how fancy does something have to be to count as "fancy"?), or in which speakers have personal preferences or are personally invested in the categorization (I can find something "delicious" even if you don't), or in which the categorization of something is based on a personal reference point (I am "tall" compared to a toddler but not a professional basketball player). The contexts in our study reduced these properties down to categories, in contexts where the speakers are unlikely to have strong or differing personal judgments.

Despite these remaining questions, the participants in our study showed clear and consistent preferences with respect to the relationship between visual ambiguity and adjective ordering. Future studies will focus on further exploration of the relationship between visual input and judgments of subjectivity.

5. Conclusion. The present studies sought to quantify sensitivity to visual subjectivity as it relates to English adjective order. Participants completed two kinds of sentence judgment tasks, deciding on descriptions to uniquely identify a target image and using given descriptions to choose between two possible targets. We find that participants do have systematic judgments about the relationship between adjective order and visual ambiguity. Across two studies, they consistently prefer the adjective referring to the clearer trait to be in the first position of a multi-adjective phrase. This was true both when they were asked to choose the best image for a description, and when they were asked to choose the best description for an image. It was also robust across a neutral (Study 1) as well as a more explicitly communication-focused task (Study 2). This finding demonstrates that speakers are, under certain circumstances, flexible in the ordering of adjectives, and that the clarity and ambiguity of visual properties in a scene is one

component which contributes to the choice of adjective order. Future work will continue to explore the relationship between subjectivity, visual cues, and adjective order.

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