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Speakers Adjust Color Overmodification According to Sensory Capacities of the Listener (Blind/Sighted)

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Abstract

In referring to objects, speakers produce overinformative modifiers (e.g., "the large blue circle") more for color than size and increasingly with scene variation. Does first-person sensory experience establish this overmodification pattern? Do speakers adjust to listeners' perceptual capacities? In a referential communication task, congenitally blind speakers described target shapes to a sighted listener and sighted speakers to a sighted or blind listener. Trials varied in whether color or size alone was sufficient to identify the referent and in number of distractors sharing the redundant property. When talking to a sighted listener, blind and sighted speakers used color more than size and became more redundant as scene variation increased. When talking to a blind listener, sighted speakers' bias toward color disappeared. Blind and sighted speakers were more redundant overall when talking to a listener with different sensory capacities. Speakers flexibly adjust overmodifications to the listener's perceptual capacities, consistent with mentalistic audience-design.

Keywords: blindness; first-person experience; redundant adjectives; referential communication; mentalistic representation

Introduction

Under Paul Grice's (1975) theory of communication, speakers are expected to provide sufficient information to achieve communicative goals while maximizing efficiency and avoiding redundancy. However, speakers often depart from this efficiency constraint and add redundant information—for example, saying "the blue triangle" when there is only one triangle in an array of shapes (Pechmann, 1989; Maes et al., 2004; Koolen et al., 2011). These departures are highly systematic and provide insight into the cognitive mechanisms that support communication and pragmatic inferences in language (Rubio-Fernandez, 2016; Degen et al., 2020).

The use of redundant modifiers varies by modifier type. When features such as size or material are sufficient to uniquely identify a referent, speakers nonetheless often include color information, producing expressions like "the green plastic chair" even when "the plastic chair" alone would have been enough to identify the referent (e.g., Sedivy, 2003; Degen et al., 2020). By contrast, speakers include redundant size and material modifiers less frequently, a marked asymmetry in patterns of overmodification (Pechmann, 1989; Sedivy, 2003; Rubio-Fernandez, 2016; Degen et al., 2020).

Redundant use of color adjectives increases as scenes become more variable (Davies & Katsos, 2013; Degen et al., 2020; Koolen et al., 2013; Rubio-Fernandez, 2016). For example, when size is sufficient to identify the target, speakers are more likely to produce redundant color adjectives as the number of distractors with colors different from the target increases (Degen et al., 2020).

Some evidence suggests that color redundancy is beneficial to the listener in object identification (Arts et al., 2011; Rubio-Fernandez, 2021). Arguably, color is intrinsically perceptually salient. Object color is typically identified more quickly than object size by viewers (Belke & Meyer, 2002). Color adjectives also denote an absolute property that can be determined without reference to other objects, whereas size is inherently relative and depends on a comparison set (e.g., Martin, 1969a, 1969b). As a result, specifying object color may be useful to the listener for rapidly identifying the referent, even if not strictly necessary for doing so (Rubio-Fernandez, 2021).

An open question is whether overredundancy with color modifiers reflects the speaker's own perceptual experience (i.e., the speaker is more likely to specify color because they themselves find it easier to spot the object using color) or whether instead it reflects the speaker's mentalistic understanding of what is most perceptually useful to the listener (i.e., the speaker is more likely to specify color because the speaker thinks this will make it easier for the listener to spot the object) (Rubio-Fernandez et al., 2025). These two alternatives are difficult to distinguish in most cases because speakers and listeners typically share a similar perceptual experience.

Some evidence suggests that referential production can be flexibly adapted to a listener's knowledge on a relatively rapid timescale. Speakers modify object descriptions depending on whether the objects have been previously shared with the specific listener (e.g., Horton & Gerrig, 2002). On the other hand, there is evidence that despite recognizing that another person holds a false belief, speakers do not always use that perspective during communication. Instead, they sometimes interpret the other person's instructions based on their own knowledge rather than what the other person believes (Keysar et al., 2003). Whether

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speakers can rapidly adjust their referential production to accommodate a listener's perceptual experience, particularly when the listener's perceptual capacities are different from their own, remains unknown.

Communication across widely differing sensory experiences provides a naturalistic test case of communication flexibility. Although congenitally blind individuals lack first-person visual experience, they interact with a sighted majority. Previous work suggests that congenitally blind individuals acquire and use color adjectives (Landau & Gleitman, 1985; Marmor, 1978; Shepard & Cooper, 1992; Saysani et al., 2018, 2021). Blind individuals understand relationships among colors (for example, that orange is visually more similar to yellow than to blue) (Saysani et al., 2018) and some use Braille color labels e.g., on clothing. People born blind also have a sophisticated understanding of how color is used and perceived (e.g., in artifact design) (Hauptman et al., 2025).

We investigate whether preference for color modifiers reflects speakers' own perceptual experience or their mentalistic understanding of the listener's needs by asking congenitally blind and sighted adults to verbally describe target geometric shapes to a sighted or a blind listener in a referential communication task. If color overmodification does not (only) rely on the speaker's egocentric perceptual salience of color but rather reflects the speaker's consideration of what information is most perceptually useful for their interlocutor, we might expect to observe color overmodification in congenitally blind speakers. By contrast, if color overmodification depends on first-person perceptual experience of color, then blind people should not show the same pattern of color overmodification as sighted speakers.

A related open question is whether sighted people can adjust their referential communication to a blind listener. Even if blind speakers produce redundant color modifiers for sighted listeners, it remains unclear whether it requires extensive experience communicating with sighted individuals, which blind people have. Alternatively, speakers may rapidly tailor their overmodification patterns to a listener's differing perceptual experience, even without substantial prior interaction with that listener group. The answer to this question would shed light on the adaptability of mentalizing processes in referential production.

Experiment 1

Method

Participants Seventeen congenitally blind (CB) adults (12 female, 5 male; age range: 26–70 years; age mean = 42.29 years, SD = 12.24) and nineteen sighted control (SC) participants (17 female, 2 male; age range: 18–23 years; age mean = 19.52 years, SD = 1.34) took part in the experiment. Blind participants had little to no light perception from birth. Blindness was caused by pathology of the eye or optic nerve, not of the brain. Blind participants completed the study in person, either at the National Federation of the Blind National Convention or on the Johns Hopkins University (JHU) Homewood campus and were compensated for their time. Sighted control participants completed the study in person on the JHU Homewood campus for credit. The JHU Institutional Review Board approved the research procedures.

Materials On each trial, participants were presented with a display containing one target object and four distractor objects, for a total of five objects per scene. All objects varied along three dimensions: size (big vs. small), color (e.g., red vs. blue), and shape (e.g., circle vs. star) (Figure 1). For blind participants, the objects consisted of raised posterboard cutout shapes arranged horizontally on a cardboard base, allowing their shape and size to be readily perceived through touch. Color was indicated by a Braille label – a common way blind individuals experience object color (e.g., on one's own clothing). For sighted participants, the objects matched those used for blind participants but were not raised and presented in color. The target object was uniquely identifiable based on a single sufficient dimension, which rendered one additional dimension redundant. Across trials, the sufficient dimension was either size (size-sufficient condition) or color (color-sufficient condition). Accordingly, the redundant dimension was color in the size-sufficient condition and size in the color-sufficient condition. Shape was held constant within trials but could vary across trials.

The number of distractors sharing the redundant feature with the target was manipulated while holding the total number of distractors constant at four. This manipulation yielded four experimental conditions, labeled 4-1, 4-2, 4-3, and 4-4, corresponding to one, two, three, or four distractors sharing the redundant feature with the target, respectively. Following Degen et al. (2020), scene variation was operationalized as the proportion of distractors that differed from the target along the redundant dimension. Given the fixed number of distractors, scene variation took one of four discrete values: 0, 0.25, 0.50, or 0.75. The experiment comprised 16 trials, evenly split between size-sufficient and color-sufficient conditions. Each scene-variation level occurred twice within each condition.

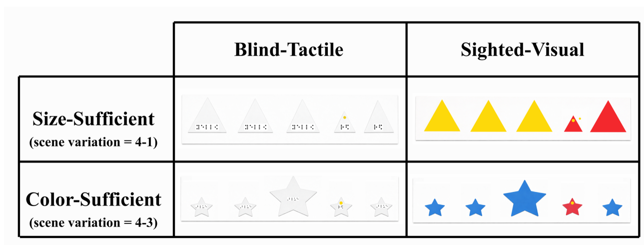

Figure 1: Sample objects are displayed across participant groups and conditions. Each cell shows a representative trial with five shapes arranged horizontally and a single target object (marked with a raised dot). For the CB group, shapes were colorless and labeled with Braille color words. For the SC group, shapes were unlabeled but colored. Across all conditions, speakers were instructed to describe the target

object without using spatial information, such that the listener could identify it based on object properties alone.

Procedure Participants were assigned the role of speakers, and a sighted confederate served as the listener. On each trial, participants were instructed to produce a referring expression that would allow the listener to uniquely identify the target object. Responses were coded as a binary dependent variable indicating whether the redundant dimension (color or size, depending on condition) was mentioned in the referring expression (1 = redundant modifier present, 0 = absent).

Sighted-Visual: On each trial, participants were presented with five posterboard cutout shapes arranged horizontally on a cardboard base. One of the five objects was marked with a yellow raised dot sticker designating it as the target object. While the speaker looked at the objects, the listener faced away from the table and could not see the objects. Once the speaker indicated readiness to describe the target object, the experimenter removed the sticker and asked the listener to turn and view the objects. The speaker's task was to describe the target object so that the listener could uniquely identify it. The speaker and listener were allowed to communicate freely, except that the speaker was explicitly instructed not to refer to spatial location (e.g., "second from the left"). The speaker could re-explore the objects with the listener facing away again and/or provide additional descriptions, but the listener was permitted to make only one selection at the end. The experimenter provided accuracy feedback before the pair proceeded to the next trial. Speaker descriptions were audio-recorded for later analysis.

Blind-Tactile: Blind participants explored the objects tactilely. Each shape was labeled with a color adjective (e.g., green, red) in Braille. All other aspects of the procedure were identical to those for sighted participants.

Each participant completed all 16 trials in one of two pseudorandom orders, with color-sufficient and size-sufficient conditions interleaved. Prior to the experimental trials, participants completed a comprehension check consisting of a series of questions about the procedures, followed by two practice trials.

Analysis To test the effects of scene variation, color/size condition, and participant group (blind/sighted) on redundant modifier production, we fit a generalized linear mixed-effects model with a logit link function. The dependent variable was the binary redundancy indicator. Fixed effects included centered scene variation (i.e., proportion of distractors that differed from the target along the redundant dimension), condition (size-sufficient vs. color-sufficient), participant group (Blind-to-Sighted vs. Sighted-to-Sighted), and all interactions among these predictors. A random intercept for participants was included to account for repeated measurements within individuals. No random slopes were included, as models with more complex random-effects structures failed to converge or yielded near-zero variance estimates.

The model was estimated using maximum likelihood via the glmer function in the lme4 package, with optimizer settings adjusted to ensure convergence. Statistical significance of fixed effects was assessed using Wald z-tests, and effect sizes are reported as odds ratios with 95% confidence intervals.

Results

Redundant adjective use was significantly more frequent for color than for size across groups (main effect of condition color vs size: $B = 2.02$, $SE = 0.39$, $p<0.001$; Figure 2). Additionally, in both groups, the probability of producing a redundant adjective increased with scene variation (main effect of scene variation: $B = 3.36$, $SE = 0.93$, $p < 0.001$) (Figure 2). Speakers were more likely to include redundant information as the proportion of distractors differing along the relevant dimension increased.

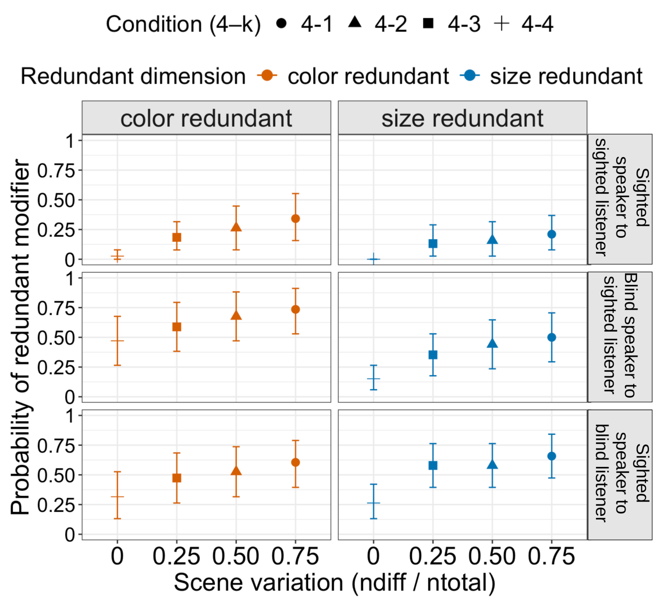

Figure 2: Proportion of redundant color (orange) and size (blue) modifiers across different scene variations in Experiment 1. Panels show results separately responses of sighted speakers to a sighted listener (top), blind speakers to a sighted listener, and sighted speakers to a blind listener (bottom). Error bars represent 95% bootstrap confidence intervals computed by resampling participants.

There was a condition-by-group interaction ($B = -1.23$, $SE = 0.57$, $p = 0.03$), indicating that the effect of condition (color vs. size) varied across groups. Separated analyses within each group revealed that the preference for color over size redundancy was robust in the blind group ($B = 2.1$, $SE = 0.4$, $p < 0.001$), but weaker and marginally significant in the sighted group ($B = 0.76$, $SE = 0.41$, $p = 0.06$). This pattern suggests that when addressing sighted listeners, blind speakers show even stronger color overmodification over size compared to sighted speakers. No scene variation-by-group interaction was found (B = −0.08, SE = 1.47, p = 0.95), indicating that the effect of scene variation on redundant modifier use was similar for both congenitally blind and sighted control participants. The interaction of scene variation-by-condition (color vs size) was also not significant (B = −0.26, SE = 1.31, p = 0.83). Lastly, the three-way interaction involving scene variation, condition (color vs size), and group (sighted vs. blind) was not significant (B = 0.79, SE = 1.98, p = 0.68). This suggests that color and size overmodification increased with scene variation across groups to the same degree. Finally, overall blind participants showed a higher probability of producing redundant adjectives than sighted controls (main effect of group: B = -1.98, SE = 0.89, p = 0.02).

In sum, both blind and sighted speakers were more likely to be redundant with color than with size. Both groups also showed increased use of redundant modifiers with greater scene variation, with congenitally blind speakers producing more redundant modifiers overall.

Experiment 1 Discussion

It has been suggested that color is stated redundantly more often in referential communication because it is particularly salient and uniquely identifiable (Arts et al., 2011; van Gompel et al., 2019). But more useful for whom? The speaker or the listener? Our results suggest that color overmodification does not (only) reflect speakers' own perceptual experience. Color is not a highly salient perceptual property for blind speakers and yet blind speakers preferentially overmodify with color when speaking to a sighted listener. As noted in the introduction, prior research suggests that people who are blind have nuanced knowledge of how sighted people use color e.g., in designing artifacts (Kim et al., 2019, 2021; Hauptman et al., 2025). We hypothesize that people who are blind overmodify with color when talking to sighted people, because, like sighted speakers, blind speakers understand color to be a highly salient perceptual feature for the sighted. These results suggest that direct experience of a perceptual feature is not required for referential use that is tailored to the listener.

We also find that when talking to a sighted listener, blind speakers use more redundant adjectives than sighted speakers overall. This overall enhancement in modification could reflect a blind speaker's greater uncertainty about the perceptual access of a sighted listener compared to a blind listener.

Together these results suggest that modification in a referential context reflects, at least in part, the speaker taking into account what is most perceptually useful for the listener, even when what is useful to the listener is different from what is useful to the speaker themselves. In other words, speakers adjust their referential behavior according to their estimate of the perceiver's sensory experience. These results are consistent with the role of mentalistic 'audience design' in pragmatic language use and suggest that this capacity is highly flexible and adjusted to the sensory capacities of the listener (Rubio-Fernandez et al., 2025).

The present results leave open a number of possible alternative interpretations. First, in the current study, colors are presented as verbal labels to blind participants and as perceptual qualities to the sighted. It is possible that verbal labels are more salient than perceptual qualities. On this account, blind people overmodify with color because verbal labels are more salient (for the speaker) and sighted people overmodify with color because colors are more salient (for the speaker) than size or shape. No speaker-specific mentalizing or speaker-specific audience design is required.

Even if blind individuals consider a sighted listener's perceptual experience when overmodifying with color, how have they come to do so? One possibility is that blind speakers learn through repeated interactions with sighted individuals that color is frequently treated as an informative and communicatively useful property in reference. Overmodifying according to a listener's preference could require practice talking to that type of listener. Alternatively, speakers might rapidly adjust their referential behavior to the listener's lifelong perceptual experience.

To distinguish between these alternative possibilities, we turn the tables and ask sighted speakers to describe objects to a blind listener (author SYS). While blind speakers have a great deal of experience talking to sighted people, most sighted people have never met a person who is blind. If speakers can flexibly adjust their referential communication to the sensory capacity of the listener on the fly, sighted speakers may reduce color overmodification when talking to a blind listener, since unlike size or shape, color is not directly perceptible to people born blind.

Experiment 2

Methods

Participants Nineteen sighted control (SC) participants (14 female, 1 male, 1 non-binary; age range: 18-23 years; age mean = 19.73 years, SD = 1.24) took part in the experiment for credit.

Materials The blind-tactile and sighted-visual displays were identical to those used in the previous experiment. Shapes were presented in color to the sighted speakers, while color was labeled in Braille for the blind listener. The sighted speaker's visual displays had the sticker indicating which of the five objects was the target object in each trial, whereas the blind-tactile displays did not. A vertical barrier was positioned between the sighted participant and a blind confederate who sat across the table. This minimized the possibility that sighted speakers would come to understand the blind listener's perceptual access during the experiment itself.

Procedure Sighted participants were assigned the role of speaker and a blind confederate served as the listener. Sighted participants were explicitly informed that the listener was blind and were shown the tactile-visual display (with braille labels) of the blind confederate prior to the practice trials. The vertical barrier was then placed between the participant and the blind listener to prevent the participant from viewing the listener's tactile display during the trials.

On each trial, the visual display (including the target sticker) was presented to the sighted participant at the same time that the blind listener received the tactile display (without the target sticker). As in Experiment 1, participants were instructed to produce a referring expression that would allow the listener to uniquely identify the target object, without referring to its location. The blind listener explored the tactile display by touch and indicated their choice by pointing. The experimenter verified the correctness of the choice before proceeding to the next trial.

Results

When talking to a blind listener, sighted speakers were no more likely to modify with color than with size (main effect of condition: color vs. size; $B = -0.27$, $SE = 0.29$, $p = 0.3$; Figure 2). The likelihood of producing a redundant adjective increased with scene variation for both color and size adjectives (main effect of scene variation: $B = 3.25$, $SE = 0.8$, $p < 0.001$) (Figure 2). There was no variation-by-condition interaction ($B = -0.73$, $SE = 1.08$, $p = 0.4$).When sighted-to-sighted (from Experiment 1) and sighted-to-blind groups were compared directly, there was interaction between condition and group ($B = 1.04$, $SE = 0.51$, $p = 0.04$) i.e. sighted participants only overmodified more with color when talking to a sighted listener. Sighted participants also produced overall more redundant adjectives when talking to a blind listener, in both color-redundant and size-redundant conditions (main effect of group (sighted-to-sighted vs. sighted-to-blind: $B = -3.27$, $SE = 0.76$, $p<0.001$).

No scene variation-by-group interaction was found ($B = 0.01$, $SE = 1.39$, $p = 0.9$), suggesting that effect of scene variation on redundant modifier use was similar when a sighted speaker describes an object to a sighted or a blind listener. The interaction of scene variation-by-condition (color vs size) was also not significant ($B = -0.72$, $SE = 1.09$, $p = 0.5$). Lastly, there was no three-way interaction between scene variation, condition (color vs. size), and group (sighted listener vs. blind listener) ($B = 1.2$, $SE = 1.84$, $p = 0.51$).

Experiment 2 Discussion

While sighted speakers overmodify more with color than size when talking to a sighted listener, this asymmetry is absent when communicating with a blind listener. This suggests that during referential communication speakers can adjust on the fly to another person's differing perceptual capacities even in the absence of extensive prior communicative experience. As mentioned in the introduction, speakers dynamically build listener-specific linguistic shortcuts, showing flexible adaptation across very short interaction timescales (Horton & Gerrig, 2002). Our finding extends prior work by showing that referential adaptation can go beyond interaction-specific learning to accommodate differences in perceptual experience between speaker and listener. As sighted speakers are unlikely to have developed highly practiced conversational routines specifically tailored to blind interlocutors based on prior experience, this suggests that referential adaptation can be guided not only by learned conversational routines but also by more immediate mentalistic representations of a listener's perceptual access.

Just as blind speakers increase their overall redundancy when speaking to a sighted rather than a blind listener in Experiment 1, sighted speakers likewise produce more redundancy when addressing a blind listener compared to a sighted one. In other words, both blind and sighted speakers provide more redundant information when communicating with a listener whose sensory capacities differ from their own. Prior evidence shows that speakers produce more detailed and explicit descriptions when the intended audience is a stranger rather than a friend or familiar other, or compared to themselves, indicating that reduced certainty about audience knowledge leads to more informative descriptions during referential communication (Fussell & Krauss, 1989). Our results corroborate this idea by showing that speakers increase overall informativeness when communicating with listeners who have different perceptual experiences. When representing the listener's perceptual capacities, speakers may be uncertain about which information will be most useful and therefore provide more detail, even when redundant, to support successful reference.

Conclusion

Effective communication involves a balance between efficient production and flexibly increasing informativeness when additional detail may benefit the listener (Grice, 1975; Degen et al., 2020). In this study, we find that during referential communication, blind speakers treat color as particularly informative for sighted listeners, whereas sighted speakers reduce the privileged status of color over size when communicating with blind listeners. Both blind and sighted speakers also increase overall informativeness when interacting with an interlocutor who has a different perceptual experience. Taken together, our findings suggest that speakers' overmodification can take into account the listener's perceptual capacities, even when these conflict with the speaker's own and when the speaker has not had long-term communicative experience with interlocutors who have different perceptual access. These results are consistent with flexible interaction of linguistic and mentalizing capacities in communication (e.g., Rubio-Fernandez, 2016; Degen et al., 2020; Papafragou & Grigoroglou, 2025).

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