

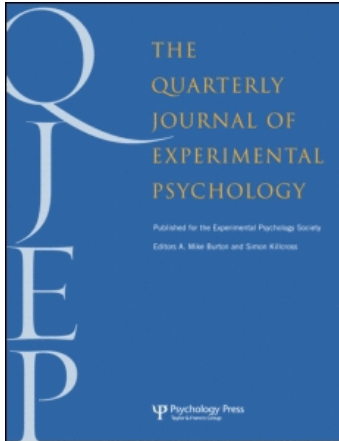
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The use of visual context during the production of referring expressions

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Most theories of reference assume that a referent's saliency in the linguistic context determines the choice of referring expression. However, it is less clear whether cognitive factors relating to the non-linguistic context also have an effect. We investigated whether visual context influences the choice of a pronoun over a repeated noun phrase when speakers refer back to a referent in a preceding sentence. In Experiment 1, linguistic mention as well as visual presence of a competitor with the same gender as the referent resulted in fewer pronouns for the referent, suggesting that both linguistic and visual context determined the choice of referring expression. Experiment 2 showed that even when the competitor had a different gender from the referent, its visual presence reduced pronoun use, indicating that visual context plays a role even if the use of a pronoun is unambiguous. Thus, both linguistic and nonlinguistic information affect the choice of referring expression.

Keywords: Language production; Reference; Saliency; Visual context; Pronoun.

When people refer to an entity in the discourse, they can use highly explicit referring expressions such as definite noun phrases (*the pirate, the princess*) or proper names (e.g., *Mickey, Daisy*), which are informative about their referent, or less explicit expressions such as pronouns (e.g., *he, she*), which provide little information about their referent. What determines the choice of referring expression is an important question for theories of language production, especially in relation to the kind of contextual information that speakers

use. Recent psycholinguistic research has seen a growing interest in language processing in naturalistic settings and in how nonlinguistic factors, in particular visual context, affect both language comprehension (Tanenhaus, Spivey Knowlton, Eberhard, & Sedivy, 1995) and language production (Brown-Schmidt & Tanenhaus, 2006; Ferreira, Slevc, & Rogers, 2005; Gleitman, January, Nappa, & Trueswell, 2007; Griffin & Bock, 2000). In production, an important issue is the extent to which such nonlinguistic factors

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influence linguistic form (Bock, Irwin, Davidson, & Levelt, 2003; Gleitman et al., 2007; Griffin & Bock, 2000; Tomlin, 1997). In this article, we examine whether and how the choice of referring expressions is affected by linguistic and nonlinguistic information when speakers refer to an entity mentioned in the preceding discourse.

Most theories of reference assume that the choice of referring expression is determined by the referent's saliency. When the referent is highly salient in the context, people tend to choose reduced expressions, but when it is contextually less salient, they tend to use more explicit referring expressions (e.g., Ariel, 1990; Chafe, 1976, 1994; Givón, 1983; Gundel, Hedberg, & Zacharski, 1993). Researchers have argued that speakers vary the form of referring expressions to signal the referent's information status in the discourse (e.g., Ariel, 1990; Givón, 1983; Gundel et al., 1993). For instance, according to centring theory (e.g., Brennan, Friedman, & Pollard, 1987; Gordon, Grosz, & Gilliom, 1993; Grosz, Joshi, & Weinstein, 1995) and many other researchers (e.g., Fletcher, 1984; Givón, 1983), speakers use pronouns to signal topic continuity. In contrast, they use fuller referring expressions such as names or definite noun phrases to introduce a new entity into the discourse (Gordon & Hendrick, 1998) or to signal a topic shift (Vonk, Hustinx, & Simons, 1992).

Furthermore, researchers have argued that speakers choose referring expressions to facilitate the identification of the referent by the addressee (e.g., Chafe, 1994; Grice, 1975). Almor (1999) argued that when the referent is less activated, a highly informative referring expression facilitates comprehension, because it provides semantic information to reactivate the referent in the discourse model, whereas such a referring expression slows down comprehension when the referent's semantic representation is already highly active, because the unnecessary semantic information increases working memory demands. Indeed, it appears that pronouns are rarely used without an explicit linguistic antecedent in the text (Gundel, Hedberg, & Zacharski, 2005), suggesting that pronouns are less preferred than fuller noun phrases for introducing a referent into the

discourse, presumably because they carry insufficient information to activate the referent.

But exactly what sources of information affect the referent's saliency in the discourse and thus speakers' choice of a referring expression? Much research has been devoted to the role of prior linguistic context on such decisions. For instance, the more recently the referent is mentioned, the more likely speakers use a reduced referring expression (Ariel, 1990; Givón, 1983). Other factors that have been shown to affect the choice of referring expression are frequency of mention (Ariel, 1990; Givón, 1983), topichood (Anderson, Garrod, & Sanford, 1983; Fletcher, 1984), the referent's structural properties in the preceding sentence (Arnold, 2001; Fletcher, 1984; Fukumura & Van Gompel, 2010; Stevenson, Crawley, & Kleinman, 1994), and the number of competitors in the prior linguistic context (Ariel, 1990; Arnold & Griffin, 2007; Clancy, 1980).

It is less clear whether and how speakers take into account nonlinguistic information during the choice of referring expressions, and many theories of reference have not explicitly considered the role of such information. When speakers refer to an entity, the entity is often situated in a nonlinguistic as well as a linguistic context, so investigating the possible role of nonlinguistic information is critical for our understanding of how people choose different types of referring expressions under such conditions. According to mental models theory, developed by Johnson-Laird (1983), during discourse processing people represent the situation that the discourse is about. This representation is formed on the basis of linguistic information as well as perceptual information derived from the real or imaginary world. Also, Clark (1996) argued that discourse is a joint activity, in which people use language to achieve a common communicative goal. Hence the meaning of an utterance cannot be separated from other activities taking place in the situation. According to Clark, a discourse representation is based on communicative actions including speech as well as on the environment in which the activities take place. This suggests that the choice of referring expression may be

affected not only by linguistic factors that affect saliency, but also by nonlinguistic factors, such as the presence or absence of an entity in the visual context.

Indeed, there are circumstances in which speakers use nonlinguistic information. Speakers are more likely to say *the small triangle* (rather than *the triangle*) when the visual context also includes a larger triangle than when it does not (e.g., Beun & Cremers, 1998; Brown-Schmidt & Tanenhaus, 2006; Ferreira et al., 2005; Olson, 1970; Sedivy, 2003). Similarly, Brennan and Clark (1996) showed that speakers used the subordinate-level expression *the loafer* (rather than the basic-level expression *the shoe*) more often when there was another shoe in the visual context than when the loafer was the only shoe. However, these effects may have been due to ambiguity avoidance rather than because the visual context affected the saliency of the referent. For example, *the triangle* is referentially ambiguous when the visual context contains another triangle, whereas it is unambiguous when there is no other triangle. In order to avoid such ambiguity, speakers may have produced *the small triangle* more often when there was a same-category competitor than otherwise. Similarly, in Brennan and Clark (1996), speakers may have used *the loafer* because using *the shoe* was ambiguous in the context of another shoe. In fact, after using the subordinate term *the loafer*, speakers tended to continue using this referring expression even when the subsequent visual context did not contain any other shoe. This may suggest that because *the loafer* was unambiguous, the visual context had no effect. Thus, it is unclear whether the visual context affects the choice of referring expression when the visual context does not create ambiguity.

In addition, in these previous studies, the referent either was not introduced in the previous discourse at all, or was not mentioned in the immediately preceding sentence. In the absence of a recent linguistic context, speakers may use visual context to choose referring expressions, but whether and how speakers use visual context if the referent has been mentioned in the immediately preceding discourse (i.e., during anaphoric reference) remains to be addressed.

A recent study by Arnold and Griffin (2007) indeed suggests that in cases where reference is unambiguous, and the referent has been referred to in the preceding sentence, visual context does not affect the choice of referring expression. In their study, they examined the effects of both linguistic mention and visual presence of a competitor on the choice between a pronoun and name. Participants saw a picture with a male (e.g., *Mickey*) and female (e.g., *Daisy*) cartoon character, heard a context sentence such as (1a) or (1b), and repeated it:

- 1a. *Mickey went for a walk with Daisy in the hills one day.*
- 1b. *Mickey went for a walk in the hills one day.*

They then described a second picture in which Mickey looked tired. Participants produced fewer pronouns (and more repeated names) to refer to *Mickey* when the context sentence mentioned *Daisy* (1a) than otherwise (1b). This suggested that the (linguistic) mention of *Daisy* reduced the saliency of *Mickey*, resulting in fewer pronouns. This extends previous findings by Fletcher (1984) who showed that the mention of a same-gender competitor in the previous context reduces the use of pronouns and zero anaphors. But more interestingly, Arnold and Griffin also found that the proportion of pronoun responses was unaffected by the visual presence of the competitor in the second picture: Participants produced as many pronouns to refer to the referent when the competitor was present in the second picture as when it was not. It is therefore possible that visual context has no effect on anaphoric reference.

However, there are several potential explanations for this lack of an effect. First, the visual manipulation may have been relatively weak: The presence of *Daisy* was manipulated only in the second picture; she was always in the first picture. In addition, when the competitor was present in the second picture, it was much smaller and hence less salient than the referent. Furthermore, Arnold and Griffin's (2007) task was narrative production for a hypothetical addressee. Research using a referential communication task, where the speaker instructed the addressee to pick up the referent in the visual context, suggests that speakers avoid ambiguous

nouns more often when they believe their addressee can see a referential competitor than when they believe the addressee cannot (Horton & Keysar, 1996; Nadig & Sedivy, 2002). Speakers in Arnold and Griffin might have ignored the visual presence of Daisy, because they may have thought that the hypothetical addressee could not see Daisy or because they had no idea what the addressee's task would be. Finally, the referent was always the subject in the preceding sentence. It is possible that the competitor's visual presence did not affect the referent's saliency, because the referent was highly salient in the linguistic context. When the referent is not a subject and therefore less salient in the linguistic context, visual context may be more likely to have an effect.

Thus, in order to determine whether and under what circumstances visual context affects the choice of referring expression, we conducted two experiments to investigate whether the choice of referring expression is determined by the referent's linguistic saliency only or whether referential choice is also affected by other, nonlinguistic factors that affect saliency, such as visual context—that is, whether speakers use *both* linguistic and visual information. In both experiments, we investigated whether the choice of a pronoun or repeated noun phrase to refer to an entity (the *referent*) was affected by whether the visual context included another entity (hereafter *competitor*). Experiment 1 investigated whether the presence or absence of a competitor affected referential choice even in the presence of a linguistic context. In this experiment, the competitor had the same gender as the referent, resulting in ambiguity when speakers used a pronoun. Experiment 2 investigated whether the visual context effect in Experiment 1 was due to ambiguity avoidance, by contrasting the effects of visual context when the competitor had either the same or a different gender from that of the referent.

EXPERIMENT 1

In Experiment 1, we examined whether, even in the presence of a linguistic context, the visual

presence of a competitor resulted in fewer pronouns for the referent. Both entities had the same gender, and so pronouns were ambiguous. Participants first saw a picture (Figure 1), where the referent (e.g., a pirate) was either (a) together with the competitor (e.g., a prince) or (b) without the competitor. At the same time, the participant read aloud a context sentence, which either mentioned (Sentence 2) or did not mention (Sentence 3) the competitor:

- | | |
|--|--------------------------|
| 2. The pirate's carpet had been cleaned by a prince. | Competitor mentioned |
| 3. The pirate's carpet had been cleaned. | Competitor not mentioned |

In order to ensure that the linguistic saliency of the referent was not so high that it would mask any effects of visual context and to ensure that participants did not always produce pronouns, the referent was a possessive modifier of the subject (rather than the subject itself). Next, a second picture appeared below the first, and the participant described the action of the referent toy character (the pirate) to the confederate, who acted out the description. As in the first picture, the competitor was either (a) present or (b) absent.

We examined whether participants used a pronoun or a repeated definite noun phrase to

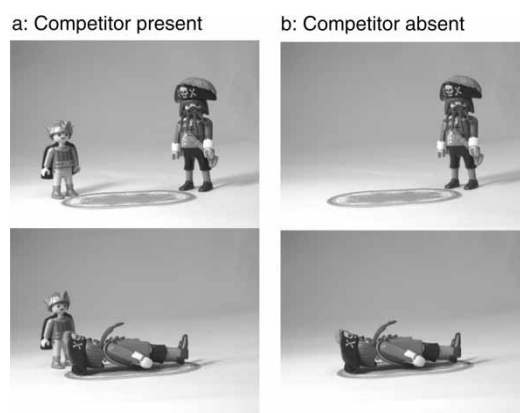


Figure 1. Example pictures in the competitor-present and the competitor-absent conditions in Experiment 1. (With kind permission of Geobra Brandstätter GmbH & Co. KG, Germany. PLAYMOBIL is a registered trademark of Geobra Brandstätter GmbH & Co. KG, for which also the displayed PLAYMOBIL toy figures are protected.)

refer to the pirate. If the linguistic mention of the competitor affects the choice of referring expression, then participants should use fewer pronouns (relative to repeated noun phrases) to refer to the pirate when the prince was mentioned than otherwise. Most interesting, if the visual presence of the competitor has a similar effect, then participants may also use fewer pronouns when the prince is visually present than otherwise.

Method

Participants

A total of 24 students from the University of Dundee who were native speakers of British English (aged 18–30 years) took part in return for payment or course credit. None of them reported to be dyslexic.

Materials

We constructed 24 experimental item sets. Each version of an item consisted of two photographs of miniature toy characters (such as a king, a queen, a pirate, or a mermaid) and a context sentence (see Appendix). Figure 1 illustrates an example photograph set: In the figure, (a) represents the competitor-present condition, in which the referent (the pirate) and the competitor (the prince) were visually present, whereas (b) represents the competitor-absent condition, in which only the pirate was present. Both versions included an additional object (e.g., a carpet). The bottom half of each panel depicted a simple action by the referent using the object (e.g., lying on the carpet). The competitor character did not engage in any action. The positions of the referent and the competitor characters were counterbalanced between items.

The linguistic mention of the competitor was varied in the context sentence. The referent character (e.g., the pirate) was always the first-mentioned noun phrase and the possessive modifier of the subject, and it had a definite article. In the competitor-mentioned condition (2), the competitor (e.g., the prince) was the last-mentioned noun phrase, occupying the role of the agent in the *by*-phrase passive sentence, and it had an indefinite article. In the competitor-not-mentioned

condition, the *by*-phrase was removed from the full passive sentence used for the competitor-mentioned condition. The gender of the competitor character was the same as that of the referent. The object (the carpet) was mentioned after the referent character in both conditions. Sentences were in the pluperfect and in the passive voice. The sentence structure was chosen on the basis of pilot experiments, which showed that participants had no strong preference for pronouns rather than repeated noun phrases when referring to the referent.

We used 14 male and 10 female toy characters, each appearing in two items, once as the referent and once as the competitor. The nouns describing the characters were usually gender unambiguous (see Appendix), and in cases where they were not, the appearance of the characters was a clear indicator of their gender (e.g., a bearded gardener).

In addition, we constructed 4 practice items and 29 filler items, which were presented in the same way as the experimental items. The number of characters appearing in the photographs or mentioned in the context sentence for these items was varied. Specifically, the fillers included the following: 10 items with two human characters (7 with different genders, 3 with the same gender) that were both visually present and mentioned (in these fillers, the second-mentioned character was the agent of the action depicted in the second pictures, so that unlike the experimental items, the first-mentioned character was not the target referent); 12 items with one human character that was linguistically introduced and visually present (3 of these items contained an additional human character linguistically introduced but visually absent); and 7 items that included animal characters (in 4 of these, the animal characters were the agent).

Design

In the context sentence, the competitor was either mentioned or not mentioned. In the pictures, the competitor was either visually present or absent. This resulted in a 2 (linguistic context: competitor mentioned vs. not mentioned) \times 2 (visual context: competitor present vs. absent) within-participants and within-items design. Together with the 29

filler items, the 24 sets of experimental items were distributed across four lists, each containing one version of each item and 6 experimental items from each condition. A total of 6 participants were randomly assigned to each list. The items of each list were presented in a fixed quasi-random order, with the constraint that the same character did not appear in consecutive items.

Procedure

Before the experiment, both the participant and the confederate were told that the experiment was about how people communicate verbally when they cannot see each other. The experimenter treated the confederate as a genuine participant throughout, and a postexperimental questionnaire showed no evidence that participants realized that the confederate was not a participant. The participant and the confederate drew lots to determine who was the speaker and the addressee, but the experimenter ensured that the participant always got the speaker role. Next, the experimenter explained the tasks in detail, and four practice trials followed before the experiment started.

During the experiment, the participant and the confederate sat side by side at a table, each facing a computer screen, and the experimenter sat behind them. A board between the participant and the confederate prevented them from seeing each other. Visual stimuli (a context sentence and the two photographs) were presented on the screens using DMDX software (Forster & Forster, 2003). Each participant's speech was recorded on a MiniDisc, which was later used for coding. At the beginning of each trial, both the participant and the confederate saw a photograph of miniature toy characters on their screen. The confederate received the toys from the experimenter to recreate the visual scene depicted in the photograph on the table such that the participant sitting on the other side of the board could also see the toys. To ensure that the participant was aware of what was on the table, the participant checked whether the scene on the table matched the one on the computer screen before pressing a computer mouse key to proceed. A context sentence then appeared below the first photograph on the participant's computer

screen (the confederate did not see this sentence or the following photograph). The participant read aloud the context sentence and pressed a key. The sentence was then replaced by a second photograph appearing below the first picture. The participant described the photograph to the confederate, who acted out the description using the toys. When participants produced a pronoun in the presence of two characters, the confederate always used the referent character for the action, but except for this, the confederate always followed the participant's description literally. The experiment took around 45 minutes.

Scoring

We scored whether participants produced a pronoun or a repeated noun phrase in cases where they referred to the referent character as the subject in the first sentence they produced. We excluded 21 trials where participants did not refer to the referent character as the subject, including 2 cases where participants mistakenly referred to the competitor. We also excluded 7 trials where participants used a different noun phrase instead of a repeated noun phrase (such as *the boy* rather than *the prince*), including 1 trial where a stewardess was referred to as a *captain* (a noun phrase with a different gender bias) and 2 trials where the stewardess was referred to with a pronoun with the wrong gender. In total, 30 trials (5% of all responses) were excluded.

Results

Figure 2 presents the mean percentages of pronouns out of all pronoun and repeated noun phrase responses by condition.

We conducted two analyses of variance (ANOVAs) on arcsine-transformed proportions of pronoun responses (Winer, 1971), one on the participant means (F_1) and one on the item means (F_2). The ANOVAs included linguistic context (competitor mentioned vs. competitor not mentioned) and visual context (competitor present vs. competitor absent) as within-participants and within-items variables and participant/item list (I–IV) as a between-participants and

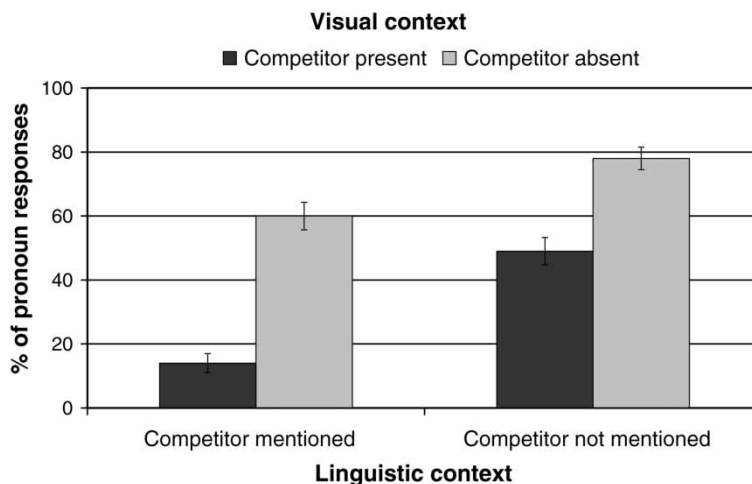


Figure 2. Percentages of pronoun responses out of all pronoun and repeated noun phrase responses by linguistic and visual context in Experiment 1. Bars represent standard errors.

between-items variable in order to remove variability due to differences between the lists (Pollatsek & Well, 1995).

First, there was a main effect of visual context, with fewer pronoun responses when the competitor was visually present (31%) than when it was absent (69%), $F_1(1, 20) = 51.17$, $MSE = 0.252$, $p < .001$; $F_2(1, 20) = 227.77$, $MSE = 0.064$, $p < .001$. Second, there was a main effect of linguistic context: Participants produced fewer pronouns when the competitor was mentioned (37%) than when it was not (63%), $F_1(1, 20) = 55.81$, $MSE = 0.116$, $p < .001$; $F_2(1, 20) = 44.63$, $MSE = 0.168$, $p < .001$. The interaction between linguistic and visual context was marginally significant by participants and significant by items, $F_1(1, 20) = 3.37$, $MSE = 0.159$, $p = .081$; $F_2(1, 20) = 6.33$, $MSE = 0.112$, $p = .021$, suggesting that the effect of competitor presence was larger when the competitor was mentioned (46%) than when it was not (29%). Importantly, the simple effect of visual context was significant in both linguistic contexts: Planned comparisons using two separate one-way ANOVAs showed that the presence of the competitor resulted in fewer pronoun responses in both the competitor mentioned condition, $F_1(1, 20) = 40.05$, $MSE = 0.233$, $p < .001$; $F_2(1, 20) = 202.11$, $MSE =$

0.054, $p < .001$, and in the competitor-not-mentioned condition, $F_1(1, 20) = 22.98$, $MSE = 0.178$, $p < .001$; $F_2(1, 20) = 36.06$, $MSE = 0.123$, $p < .001$.

Discussion

Experiment 1 examined whether speakers used visual context when referring to an entity that had already been linguistically introduced into the discourse. The results provided clear evidence that they did: Participants produced 38% fewer pronouns when the competitor was visually present than otherwise. The effect of visual context was found both when the competitor was linguistically introduced and when it was not. That is, even when the competitor was not linguistically introduced, its visual presence reduced pronoun use. This suggested that the competitor can become part of the discourse representation even though it has not been linguistically mentioned. In addition, participants produced 26% fewer pronouns when the competitor had been mentioned than otherwise. This is similar to the effect of linguistic competitor observed by Arnold and Griffin (2007), where the presence of a linguistic competitor was manipulated by either including a prepositional phrase mentioning the

competitor (e.g., *with Daisy*) or not. In our experiment, the competitor was part of a passive *by*-phrase, indicating that the linguistic competitor effect occurs across different structures.

Thus, both linguistic mention and visual presence of the competitor led to fewer pronouns. Interestingly, the effects of linguistic and visual context were not independent: The visual context effect was somewhat larger when the competitor was mentioned than when it was not, as indicated by the near-significant interaction between visual and linguistic context. This suggests that when the competitor was not mentioned, the referent was highly salient in the linguistic context, so whether or not the competitor was present in the visual context played a smaller role in determining the relative saliency of the two entities. But when the competitor *was* mentioned, the linguistic saliency of the referent and competitor differed less, so the competitor's visual presence had a greater impact. This finding suggests that speakers took into account linguistic and nonlinguistic information simultaneously when choosing a referring expression.

EXPERIMENT 2

The results of Experiment 1 showed that the visual presence of a same-gender competitor results in fewer pronouns to refer to an entity introduced in the immediately preceding sentence, indicating that speakers use visual context even when there is a preceding linguistic context. One possibility is that effects of a same-gender competitor are due to ambiguity avoidance. Research has shown that speakers use fewer pronouns when the linguistic context includes a competitor that has the same gender as the referent (Arnold, Eisenband, Brown-Schmidt, & Trueswell, 2000; Arnold & Griffin, 2007) than when it does not contain a same-gender competitor. In a similar way, speakers may avoid pronouns when the visual context contains a competitor with the same gender. In Experiment 1, when the same-gender competitor was visually present, a pronoun could refer to either the referent or the competitor in the visual

context and was therefore ambiguous. In contrast, when the competitor was absent, there was only one entity in the visual context that could be referred to by the pronoun. Therefore, the effects may not generalize to cases where the presence of a competitor does not affect the ambiguity of the pronoun.

Alternatively, it is possible that the visual context effect in Experiment 1 was not due to ambiguity avoidance, but occurred because the visual presence of the competitor reduced the saliency of the referent, and this reduction occurred regardless of ambiguity. Arnold and Griffin (2007) argued that the presence of a competitor in the prior linguistic context reduces the saliency of the referent, because it competes for attentional resources with the referent. Similarly, the presence of a competitor in the visual context may also reduce the saliency of the referent, and, therefore, participants may use more explicit referring expressions in the competitor-present than in the competitor-absent condition, even when there is no ambiguity. Hence, visual presence of the competitor should result in fewer pronouns even if the competitor has a different gender from that of the referent.

Of course, the visual context effect in Experiment 1 may have been due to a combination of the referent's saliency and ambiguity avoidance. Experiment 2 therefore contrasted the effects of competitor presence when the use of a pronoun was ambiguous versus when it was unambiguous, using context sentences such as (4) and (5):

- | | |
|--|---|
| 4. The pirate's carpet had been cleaned by a prince. | Same gender
(pronoun ambiguous) |
| 5. The pirate's carpet had been cleaned by a princess. | Different gender
(pronoun unambiguous) |

Following the context in Sentence 4, the use of a pronoun to refer to *the pirate* is ambiguous, because the competitor (the prince) has the same gender as the referent, whereas following Sentence 5, a pronoun is unambiguous because the referent and competitor (the princess) have a different gender. If the effect of visual context in Experiment 1 is entirely due to ambiguity avoidance, participants should produce fewer pronouns for the pirate when the prince is present than when he is absent in the visual context, but the

presence of the princess should not affect how participants refer to the pirate. In contrast, if the effect of visual context occurs because the visual presence of the competitor reduces the saliency of the referent, the visual presence of the competitor (the princess) should have an effect even if it has a different gender from the referent. Finally, if the visual context effect is both due to the competitor's influence on the referent's saliency and due to ambiguity avoidance, we should observe an effect of the competitor's visual presence in both gender conditions, but the visual context effect should be larger in the same-gender than in the different-gender condition, resulting in an interaction between visual context and the competitor's gender.

Method

Participants

A total of 24 further students from the same population as that in Experiment 1 took part for payment or course credit. Data from 1 additional participant, who guessed that the confederate was not a genuine participant, were replaced by data from another participant.

Materials

As in Experiment 1, we constructed 24 experimental item sets in four versions, each comprising a pair of photographs and a context sentence. Figure 3 illustrates an example photograph set for one item: In the figure, (1a) and (1b) represent the same-gender conditions, in which the referent (the pirate) and the competitor (the prince) have the same gender, whereas (2a) and (2b) represent the different-gender conditions, in which the referent and the competitor (the princess) have a different gender. In both gender conditions, the competitor was either present (a) or absent (b). In the context sentence, the competitor was always mentioned, but the gender of the competitor was manipulated, as in Sentences 4 and 5. For both gender conditions, we paired 12 male and 12 female competitors with similar character roles (see Appendix). The competitor character always had a gender-unambiguous character name (e.g., *the king*, *the queen*), so the gender of each competitor character was linguistically marked. For the referent character, we selected 14 male and 10 female character roles whose gender had never been misunderstood in Experiment 1 (the stewardess character, whose gender was misunderstood

1: Same gender (ambiguous)

a: Competitor present

b: Competitor absent



2: Different gender (unambiguous)

a: Competitor present

b: Competitor absent



Figure 3. Example pictures in the same-gender (ambiguous) and different-gender (unambiguous) conditions for both the competitor-present and -absent conditions in Experiment 2. (With kind permission of Geobra Brandstätter GmbH & Co. KG, Germany. PLAYMOBIL is a registered trademark of Geobra Brandstätter GmbH & Co. KG, for which also the displayed PLAYMOBIL toy figures are protected.)

by 2 participants in Experiment 1, was replaced by a more feminine-looking stewardess), so that there was no confusion about the gender of the characters. The actions depicted in the second picture were identical to those in Experiment 1, except one action (falling off the chair), which was replaced because participants often did not refer to the referent as the subject of the first sentence in their target descriptions.

As in Experiment 1, we had 4 practice items and 29 filler items. Unlike Experiment 1, the competitor in the experimental items was always mentioned in the context sentence, so it seemed possible that the overall likelihood of pronoun use might be lower in the current experiment. Therefore, 4 out of the 11 filler items from Experiment 1 in which two characters were both visually present and mentioned were replaced by items in which only a single character was visually present and mentioned.

Design

The referent and competitor had either the same or a different gender, and the competitor was either present or absent in the visual context. In addition, we divided the experiment into two halves and manipulated the order in which the two blocks were presented. This was done to explore the possibility that the effects of ambiguity and visual context changed over time and were different between the first and the second half of the experiment. Thus, we used a 2 (ambiguity: same gender vs. different gender) \times 2 (visual context: competitor present vs. absent) \times 2 (experiment half: first vs. second half) repeated measures design. This resulted in eight item lists. Together with the 29 filler items, the 24 experimental items were distributed across the eight lists, each list having 3 experimental items in each condition, with one version of each item. The items of each list were presented in a fixed quasi-random order, subject to the constraint that the same character should not occur consecutively. A total of 3 participants were randomly assigned to each list.

Procedure

This was the same as that in Experiment 1.

Scoring

We scored the responses in the same way as in Experiment 1. We excluded 6 trials on which participants did not refer to the referent as the subject of their first target sentence, 6 trials on which participants used noun phrases other than a repeated noun phrase (e.g., *the child* rather than *the girl*), and 1 trial on which the participant produced a pronoun with the wrong gender (due to misreading the context sentence). In total, 13 trials (2% of all responses) were excluded.

Results

Figure 4 presents the mean percentages of pronouns out of all pronoun and repeated noun phrase responses by condition.

We conducted ANOVAs on the arcsine transformed proportions of pronoun responses out of all pronoun and repeated noun phrase responses, with ambiguity and visual context as within-participants and within-items variables and participant/item list (I–VIII) as a between-participants and between-items variable. There was no main effect of experiment half nor did it interact with any other variable, so we collapsed across this variable.

We found a main effect of visual context: Participants produced fewer pronouns when the competitor was present (22%) than when it was not (57%), $F_1(1, 16) = 44.42$, $MSE = 0.278$, $p < .001$; $F_2(1, 16) = 170.16$, $MSE = 0.072$, $p < .001$. There was also a main effect of ambiguity, with fewer pronoun responses when the gender of the two characters was the same (31%) than when it was different (48%), $F_1(1, 16) = 17.48$, $MSE = 0.163$, $p = .001$; $F_2(1, 16) = 48.11$, $MSE = 0.058$, $p < .001$. In addition, there was a significant interaction between ambiguity and visual context, $F_1(1, 16) = 6.83$, $MSE = 0.084$, $p = .019$; $F_2(1, 16) = 9.90$, $MSE = 0.056$, $p = .006$, indicating that the visual context effect was larger in the same-gender condition, when a pronoun was ambiguous (43%), than in the different-gender condition, when it was unambiguous (27%).

Importantly, however, planned comparisons using two separate one-way ANOVAs showed that the effect of visual context was significant in

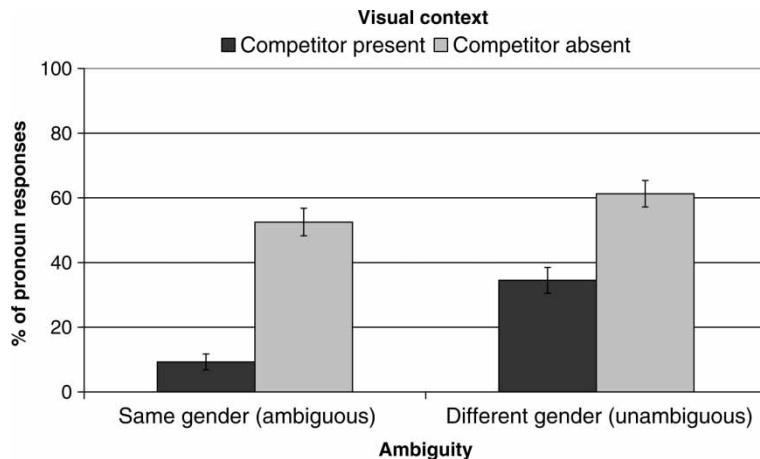


Figure 4. Percentages of pronoun responses out of all pronoun and noun phrase responses by visual context and ambiguity in Experiment 2. Bars represent standard errors.

both the different-gender conditions, $F_1(1, 16) = 16.23$, $MSE = 0.221$, $p = .001$; $F_2(1, 16) = 56.01$, $MSE = 0.067$, $p < .001$, and the same-gender conditions, $F_1(1, 16) = 62.11$, $MSE = 0.141$, $p < .001$; $F_2(1, 16) = 148.78$, $p < .001$, $MSE = 0.060$. In other words, participants produced fewer pronouns in the competitor-present than in the competitor-absent condition, both when pronouns were unambiguous and when pronouns were ambiguous.

Discussion

The results from Experiment 2 showed that participants used 27% fewer pronouns for the referent character when the visual context contained a competitor character of a different gender than when there was no competitor in the visual context. Because pronouns were not ambiguous in either visual context, the effect in the different gender conditions cannot be due to ambiguity avoidance. Rather, the results from these conditions suggest that the visual context effect occurred because the visual presence of the competitor reduced the saliency of the referent, resulting in fewer pronouns when the competitor was visually present than when it was absent.

However, we also found that ambiguity avoidance contributed to the visual context effect: The

visual context effect was larger in the same-gender than in the different-gender conditions, as indicated by the interaction between visual context and ambiguity. In the different-gender conditions, pronouns were always unambiguous, because they could only refer to the referent, regardless of whether the competitor was present in the visual context. In contrast, in the same-gender conditions, pronouns were always ambiguous, but the presence of the competitor in the visual context affected the *interpretability* of the pronoun. When the competitor was present, the visual context contained two entities that the pronoun could refer to, but when the competitor was absent, the visual context contained only one entity to which the pronoun could refer, so pronouns may have been seen as sufficiently interpretable in the competitor absent conditions. As a result, the visual context effect was larger in the same gender than in the different-gender conditions.

Essentially, the interaction between visual context and ambiguity indicates that participants avoided gender ambiguous pronouns more often when the competitor was present, and hence the referent was less salient in the visual context. This suggests that the extent to which speakers avoid ambiguity may be determined by the difference in saliency between the referent and competitor. That is, the higher the saliency of the competitor

relative to the referent, the more strongly the competitor competes for attentional resources with the referent. The stronger the competition, the more likely it is that speakers avoid ambiguity.

Furthermore, the fact that visual context and ambiguity interactively affected the choice of referring expressions indicated that the effect of visual context on choice of referring expression in Experiment 1 did not simply occur because the presence of a visual competitor increased the visual complexity of the referential context. Instead, the effects appear to be at least partly driven by whether the pronoun's gender allowed reference to the competitor.

GENERAL DISCUSSION

Experiment 1 showed that even in the presence of a linguistic context, visual context affects the choice of referring expression: Participants used fewer pronouns when a same-gender competitor was present than when it was absent in the visual context. The effect of visual context was significant even when the competitor was not linguistically introduced, but the effect was smaller than when the competitor was linguistically introduced. Experiment 2 showed that the effect of visual context was not limited to cases where the use of a pronoun was ambiguous. Even when the competitor had a different gender from the referent (so pronouns were unambiguous), the competitor's visual presence resulted in fewer pronouns, suggesting that the visual presence of a different-gender competitor reduced the saliency of the referent. In addition, we found that visual context and ambiguity of the pronoun interacted, indicating that speakers avoided gender ambiguous pronouns more often when the competitor was present than when it was absent in the visual context.

Our results differ from Arnold and Griffin (2007) in that we found an effect of visual competitor, whereas they did not. As discussed in the Introduction, we ascribe the difference to three main factors. First, the visual manipulation in Arnold and Griffin was much weaker than ours. In their study, the visual presence of the

competitor was varied only in the second picture; the competitor character was always present in the first picture, whereas in our study, it was varied in both pictures. In addition, when the competitor was present, its size in the second picture was much smaller than the size of the referent. Second, the referent was the subject in the linguistic context in Arnold and Griffin, whereas in our experiments it was not. The referent's high linguistic saliency may have weakened the effect of visual context in their experiment. Third, participants in Arnold and Griffin's study were asked to describe the pictures as if telling stories to a hypothetical addressee, whereas in our study, participants were asked to describe the pictures when the addressee had to act out the description by using real objects. As discussed earlier, the presence of a referential competitor appears to play a stronger role in ambiguity avoidance in a referential communication task if the addressee also sees the competitor than otherwise (Horton & Keysar, 1996; Nadig & Sedivy, 2002). We suggested that the presence of a different-gender competitor did not significantly influence the use of pronouns in Arnold and Griffin's study, not only because it was unclear whether the visual context should be taken as shared or privileged information, but also because there was no clear task for the addressee in their experiment.

Whether and to what extent each of these variables contributed to the patterns of results we found are questions for future investigation. For example, we think it is plausible that the impact of a visual context varies depending on the referent's saliency in the prior linguistic context, because it is consistent with our finding from Experiment 1 that the effect of a visual competitor is smaller when the competitor is not mentioned in the linguistic context than when it is: The more salient the referent is in the linguistic context, the weaker the impact of its visual saliency is.

We might also wonder whether there was any strategic component with respect to the effects of visual competitor we found. Because the addressee had to manipulate the objects in the real world in our experiment, speakers may have adopted a task-specific strategy to minimize ambiguity for

their addressee. We think it is possible that the presence of an acting-out task might have heightened speakers' sensitivity to the visual competitor. However, such task-oriented reference occurs commonly in daily conversations—whether it is to ask someone to pick up the table salt or to direct a car driver to get to the right destination—and is presumably more natural or representative of most language use than is speaking to a hypothetical addressee (e.g., Clark, 1996). Our participants knew that real communication was taking place, and we suspect that this was the main reason why they made considerable effort to be clear and paid particular attention to the presence of a competitor in the referential context. In other words, in situations where speakers are less concerned about the communicative consequences of their choice of referring expression (for example, they assume that the addressee does not have to identify their intended referent), they may be less attentive to the presence of a referential competitor.

The finding that the visual context affected the choice of referring expressions even when there was a prior linguistic context and even when the use of a pronoun was unambiguous supports the idea that linguistic and nonlinguistic factors together determine the referent's saliency in the discourse and speakers' choice of referring expression. Speakers used pronouns more frequently and definite noun phrases less frequently when the referent was more salient in the visual context. This is similar to the way linguistic saliency affects the choice of referring expression: Experiment 1 and several other studies (Arnold, 2001; Arnold & Griffin, 2007; Fletcher, 1984; Stevenson et al., 1994) have shown that language producers use more pronouns and fewer explicit referring expressions when the referent is salient in the linguistic context than when it is not. Thus, although current theories of referential choice often do not explicitly consider the role of visual context, they can straightforwardly be extended to account for visual effects.

Previous research has suggested that language producers use pronouns for linguistically salient referents because pronouns are more reduced

than definite noun phrases and hence signal that the referent is highly prominent in the linguistic context (e.g., Brennan, 1995; Gordon et al., 1993; Grosz, et al., 1995). We assume that, for the same reasons, speakers also prefer pronouns over definite noun phrases when the referent is highly salient in the visual context (i.e., when there was no visual competitor in our experiments). Using fuller referring expressions such as definite noun phrases for a referent that is highly salient in either the linguistic or visual context may lead the addressee astray because they signal that the referent's saliency is low (Ariel, 1990; Givón, 1983; Gordon & Chan, 1995; Gordon et al., 1993) or provide unnecessary semantic information that slows down processing (Almor, 1999). In contrast, if the referent is not salient in the linguistic context, speakers tend to use definite noun phrases. It has been argued that this is done to provide richer semantic information that facilitates the identification of the referent (e.g., Almor, 1999; Chafe, 1994; Grice, 1975) and bring the referent into the centre of attention (Brennan, 1995). The effects of visual context can be explained in a similar way: Speakers use definite noun phrases when the referent is not very salient in the visual context (i.e., when it is a visual competitor) in order to facilitate its identification.

In sum, our experiments demonstrate that speakers use both linguistic and visual, nonlinguistic saliency when choosing referring expressions in discourse. First, the visual presence of a competitor reduces the saliency of the referent, which makes pronoun use less frequent. Second, visual saliency affects ambiguity avoidance: Speakers are more likely to avoid ambiguous pronouns when a same-gender competitor is present than when it is absent in the visual context. These findings indicate that speakers use both linguistic and nonlinguistic information in a way that facilitates effective communication with the addressee.

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APPENDIX

Context sentences used in the experiments and events depicted in the target pictures

Events depicted in the target pictures are in capitals. In Experiment 1, inclusion of the phrase in parentheses created the competitor-mentioned condition, and omission of this phrase created the competitor-not-mentioned condition. In Experiment 2, the gender of the competitor was manipulated, with the same-gender condition before the slash and the different-gender condition after the slash.

Experiment 1

The cowboy's gun had been used (by an Indian). COWBOY PICKING UP GUN.

The mermaid's shell had been found (by a woman). MERMAID PUTTING SHELL ONTO HER CROWN.

The boy's canoe had been transported (by a pirate). BOY SITTING DOWN IN CANOE.

The king's sink had been repaired (by a plumber). KING TURNING ON TAP.

The stewardess's slippers had been washed (by a princess). STEWARDESS PUTTING ON SLIPPERS.

The gardener's car had been moved (by a policeman). GARDENER GETTING INTO CAR.

The witch's treasure chest had been opened (by a queen). WITCH CLOSING LID.

The admiral's map had been returned (by a firefighter). ADMIRAL LOOKING AT MAP.

The sheriff's chair had been assembled (by a gladiator). SHERIFF FALLING OFF CHAIR.

The princess's plants had been watered (by a nun). PRINCESS TAKING PLANTS OUT OF POT.

The footballer's ball had been found (by a cowboy). FOOTBALLER KICKING BALL.

The woman's sofa had been vacuumed (by a girl). WOMAN SITTING DOWN ON SOFA.

The pirate's carpet had been cleaned (by a prince). PIRATE LYING DOWN ON CARPET.

The lady's roses had been pruned (by a stewardess). LADY TOUCHING ROSES.

The Indian's binoculars had been discovered (by a gardener). INDIAN LOOKING THROUGH BINOCULARS.

The nanny's camera had been damaged (by a mermaid). NANNY PUTTING CAMERA OVER HER SHOULDER.
 The firefighter's megaphone had been donated (by a king). FIREFIGHTER PICKING UP MEGAPHONE.

The gladiator's helmet had been repainted (by a boy). GLADIATOR PUTTING ON HELMET.

The girl's wheelchair had been donated (by a witch). GIRL SITTING DOWN IN WHEELCHAIR.

The plumber's tea had been served (by an admiral). PLUMBER PICKING UP CUP.

The nun's diary had been published (by a lady). NUN TAKING DIARY AWAY.

The policeman's balloon had been found (by a footballer). POLICEMAN PICKING UP BALLOON.

The queen's candle had been dusted (by a nanny). QUEEN TAKING CANDLE AWAY.

The prince's fountain had been repaired (by a sheriff). PRINCE STANDING ON FOUNTAIN.

Experiment 2

The Indian's gun had been given by an admiral/countess. INDIAN PICKING UP GUN.

The queen's candle had been lit by a nanny/cowboy. QUEEN TAKING CANDLE AWAY.

The king's sink had been repaired by a gentleman/lady. KING TURNING ON TAP.

The woman's slippers had been washed by a princess/prince. WOMAN PUTTING ON SLIPPERS.

The boy's canoe had been transported by a wizard/witch. BOY SITTING DOWN IN CANOE.

The gardener's car had been moved by a policeman/police-woman. GARDENER GETTING INTO CAR.

The admiral's map had been returned by a groom/bride. ADMIRAL LOOKING AT MAP.

The countess's roses had been pruned by a stewardess/pilot. COUNTESS TOUCHING ROSES.

The witch's treasure chest had been opened by a queen/king. WITCH CLOSING LID.

The sheriff's chair had been assembled by a pirate/mermaid. SHERIFF STANDING UP FROM CHAIR.

The footballer's ball had been found by a priest/nun. FOOTBALLER KICKING BALL.

The woman's sofa had been vacuumed by a girl/boy. WOMAN SITTING DOWN ON SOFA.

The pirate's carpet had been cleaned by a prince/princess. PIRATE LYING DOWN ON CARPET.

The Indian's binoculars had been discovered by a pilot/stewardess. INDIAN LOOKING THROUGH BINOCULARS.

The nanny's camera had been damaged by a pirate/mermaid. NANNY PUTTING CAMERA OVER HER SHOULDER.

The firefighter's megaphone had been donated by a king/queen. FIREFIGHTER PICKING UP MEGAPHONE.

The gladiator's helmet had been repainted by a boy/girl. GLADIATOR PUTTING ON HELMET.

The princess's plants had been watered by a nun/priest. PRINCESS TAKING PLANTS OUT OF POT.

The plumber's tea had been served by a groom/bride. PLUMBER PICKING UP CUP.

The gladiator's sword had been found by a policeman/police-woman. GLADIATOR PICKING UP SWORD.

The mermaid's shell had been found by a lady/gentleman. MERMAID PUTTING SHELL ONTO HER CROWN.

The prince's fountain had been repaired by a cowboy/nanny. PRINCE STANDING ONTO FOUNTAIN.

The girl's wheelchair had been donated by a witch/wizard. GIRL SITTING DOWN ON WHEELCHAIR.

The nun's diary had been published by a countess/admiral. NUN TAKING DIARY AWAY.