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Gender representation in different languages and grammatical marking on pronouns:

When beauticians, musicians and mechanics remain men

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## Abstract

Gygax et al. (2008) showed that readers form a mental representation of gender that is based on grammatical gender in French and German (i.e., masculine supposedly interpretable as a generic form), but based on stereotypical information in English. In the present study, a modification of their stimulus material was used to examine the additional potential influence of pronouns. Across the three languages pronouns differ in their grammatical gender marking: the English “they” is gender neutral, the French “ils” is masculine, the German “sie” though interpretable as generic is morphologically feminine. Including a later pronominal reference to a group of people introduced by a plural role name significantly altered the masculine role name’s grammatical influence only in German, suggesting that grammatical cues that match (as in French) do not have a cumulative impact on the gender representation, while grammatical cues that mismatch (as in German) do counteract one another. These effects indicate that subtle morphological relations between forms actually used in a sentence and other forms have an immediate impact on language processing, even though information about the other forms is not necessary for comprehension and may, in some cases, be detrimental to it.

Key words: Gender stereotypes, Language, Generic Masculine, Gender representation.

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A reader of the sentence “The singer had caught a cold” cannot be sure whether it is about a man or a woman. Nevertheless, research has shown that people elaborate their mental representation of the singer to include gender. This representation is part of a mental model of the text, more specifically part of the situation level of the mental model, which contains information about the people, settings, actions and events described either explicitly or implied by the text (Garnham & Oakhill, 1996; Zwaan & Radvansky, 1998).

In English, gender representations from role names (i.e., any name that incorporates features used to describe a person or a group of persons, such as names indicating hobbies or pastimes, e.g. soccer fan, or occupations, e.g. dentist, actor or student) are influenced by gender stereotypes (e.g. Carreiras, Garnham, Oakhill & Cain, 1996; Duffy & Keir, 2004; Garnham, Oakhill, & Reynolds, 2002; Kennison & Trofe, 2003; Sturt, 2003). Using a sentence evaluation paradigm (Tanenhaus & Carlson, 1990), in which participants have to judge whether a sentence is a sensible continuation of the preceding text, Garnham et al. (2002), for example, found that participants had most trouble with, and took longer to respond to, sentences that were incongruent with the stereotypical gender of the role names in the preceding text. In a later study Oakhill, Garnham, and Reynolds (2005) asked participants to judge whether two words (e.g. “nurse” and “uncle”) could apply to the same person. They found that when the experimenters attempted to suppress participants' use of such information, for example by reminding them that many professions that were traditionally performed by one sex are now performed by both, mental representations of gender were still stereotyped, though the effects were reduced.

While English readers rely on stereotypical gender, readers of corresponding material in a language in which nouns carry grammatical gender might also use grammatical

information to infer the protagonist's gender. In grammatically gender-marked languages, such as German, French, or Spanish, the gender of a character in a text is often explicitly represented by the form of the determiner and by the morphologically feminine or masculine form of the noun. Thus, in German, the sentence "Die Sangerin (= feminine form) hatte sich erkaltet" [The (female) singer had caught a cold] unequivocally signifies that a woman is referred to. Carreiras et al. (1996, Experiments 2-4) showed that, in Spanish, a clash between a determiner's grammatical gender and the stereotyped gender of a noun (e.g., "la carpintera", the (female) carpenter (male stereotype, female noun form, cf. "el carpintero", the (male) carpenter) had an immediate effect, even if the noun was not itself morphologically marked for gender (e.g. "la futbolista", the (female) footballer (male stereotype, form used for both males and females, cf. "el futbolista", the (male) footballer). Furthermore, a later pronoun that mismatched the role noun's stereotypical gender did not cause any additional problems (e.g., "La carpintero...Ella...", the (female) carpenter...She...). In many ways this effect is to be expected, given the close (spatial and grammatical) relations between noun and determiner and the fact that the two together form an expression that refers to a single person.

In the Carreiras et al. (1996) materials the noun phrases were intended to refer to specific individuals, both for masculine and feminine forms. However, there is a complication in the use of feminine and masculine forms in many gender-marked languages. While the use of feminine forms of role names is unequivocal, the same is not true for the masculine forms, as those forms are used in two different ways: specifically, i.e. referring to male persons, and generically, i.e. referring to a group of persons of both sexes, or referring to a person or a group of persons of unknown sex and in contexts where the sex of a person is irrelevant. This generic use of the masculine is governed by explicit grammatical rules (Acad mie Franaise, 2002; Baudino, 2001). However, recent versions of the influential German grammar (Duden, 2009) refer to the generic merely as one of two

“Gebrauchsweisen” (“uses”) of masculine nouns. Nevertheless, although there are guidelines on how to avoid the use of the masculine only in official announcements, the masculine is still commonly used as a generic in spoken as well as in written language. The basis on which readers decide whether a masculine form is intended as a generic or as a specific remains unclear. However, generic uses are more common in the plural, and the issue of possible generic interpretation did not arise in the materials used by Carreiras et al. (1996).

Empirical research on the use of the masculine as generic in German (for a review: Braun, Sczesny & Stahlberg, 2005), French (e.g., Brauer & Landry, 2008; Chatard, Guimond, & Martinot, 2005; Gygax & Gabriel, 2008) and Norwegian (e.g., Gabriel, 2008; Gabriel & Gygax, 2008) indicates that the use of the masculine evokes concepts of men, thus eliminating women as potential referents in what should be generic uses (for a review, see Stahlberg, Braun, Irmen & Sczesny, 2007). These findings support the idea that readers of gender-marked languages tend to interpret masculine forms as specific, at least in situations where no other linguistic or non-linguistic information suggests otherwise.

In a language such as German, the mental representation of gender derived from the use of masculine role names is also affected by stereotype information (Braun et al., 1998; Irmen & Roßberg, 2004; Rothmund & Scheele, 2004), as in English, and supplemental grammatical information (i.e., grammatical markings on pronouns and determiners: Rothmund, 1998). Rothmund (1998) investigated the mental representation of singular and plural masculine-as-generic (GM) phrases in short texts that also included coreferential pronouns. Surprisingly the authors found a male bias for the interpretation of singular GM phrases but a female bias for the plural GM phrases. Rothmund suggested an influence of the plural determiner (i.e., *die*) and pronoun (i.e., *sie*), both of which have the same form as the feminine singular.

Gygax, Gabriel, Sarrasin, Oakhill and Garnham (2008) investigated the interplay of

gender stereotypicality and grammatical form (nouns and determiners) in the representation of gender in English, French and German. Using role names from a questionnaire study by Gabriel, Gygax, Sarrasin, Garnham and Oakhill (2008), also used in this present research (and shown in Table 1), Gygax et al. (2008) asked participants to read pairs of sentences, in which the first sentence included a role name as subject (e.g., The spies came out of the meeting room), and the second sentence contained explicit information about the characters' gender (e.g., It was obvious that one of the women was really angry). Participants had to decide whether the second sentence was a sensible continuation of the first (Tanenhaus & Carlson, 1990, argue that this task is specially suited to the study of anaphoric processing). The sentences were identical in meaning in each of the three languages, but in German and French the role names were in the masculine form, which according to grammatical rules should be interpreted as a generic.

The results showed that, in English, participants' gender representations of the role names were in line with the role names' stereotypicality. Participants responded "yes" more often when the role name's stereotypicality matched the gender of the character in the second sentence (e.g., nurses followed by women). In French and German, however, the representations were equally male biased across all stereotypicality conditions. Participants responded "yes" more often when the characters were men, independently of stereotypicality. Participants' answers in French and German were therefore strongly influenced by the grammatical form of the noun, but there was no support for an influence either of gender stereotypicality or of supplemental grammatical cues. Based on Rothermund (1998), Gygax et al. (2008) had initially hypothesized that the plural determiner in German (die), which is morphologically identical to the feminine singular determiner, would counteract a male bias introduced by the role name. It did not.

The role of gender marking on pronouns, particularly following referential noun

phrases that might be interpreted either generically or specifically, has not been properly investigated. One type of theory would suggest that gender marking on pronouns is used in co-reference processing, but, providing a match is found, does not have further effects on intermediate to long-term representations of the text, which might depend simply on the reactivated representation of the antecedent phrase. A different type of account suggests that subtle aspects of the gender information carried by the pronoun, for example whether its form is identical to other pronominal forms in the language (as in German, where “sie” is both plural and feminine singular), can affect the (reactivated) representation of the referent originally introduced by the role noun and its determiner. Note that, like stereotype information, information about the relation between an actually occurring form and other forms in the language, is not only not necessary for comprehension, it might also interfere with comprehension, for example if a German plural “sie” is used to refer to a group of all males. As Rothermund's (1998) experiment could not differentiate between the influence of the determiners and the influence of the pronouns, one possible explanation for Gygas et al.'s (2008) failure to replicate the findings of Rothermund (1998) is that in the original experiment the effect was triggered by the pronominal anaphors and not by the determiners.

In the experiment presented here, we further investigated this issue by evaluating the extent to which adding pronouns can alter readers' representation of gender. More specifically, we drew upon the fact that the three languages differ not only in the gender-markedness of the plural determiners but also in their pronoun systems.

In English, as well as in French, the plural definite determiner is gender neutral (“the” and “les”) whereas in German the plural definite determiner (“die”) is morphologically identical with the feminine singular determiner (e.g., singular feminine: die Wissenschaftlerin; plural masculine: die Wissenschaftler; plural feminine: die Wissenschaftlerinnen). Furthermore, in English, the neutral pronoun “they” is used to refer to

a group of only women, only men or to a mixed group. In French, different plural pronouns exist to describe a group of only women (elles) and a group of only men (ils), but it is the masculine plural pronoun that is used as to refer to a mixed group. In German, reference to a mixed group is entirely different: the generic plural pronoun (sie) is morphologically identical to the singular feminine (sie), but different from the masculine singular (er). To summarize, when reference is made to a mixed group, in English the pronoun is gender neutral, in French it is masculine, and in German it is identical to the feminine singular.

Since referential pronouns are gender-marked, we hypothesized that in German and French they might have different implications for readers' mental representation of gender. In line with the notion that subtle aspects of morphological marking on pronouns (i.e. the relation between the form used and other forms in the same language) affect gender representation, we hypothesized that:

(1) In English, the mental representation of gender should remain biased, as in Gyga et al. (2008), by stereotyped information only.

(2) In French, the male bias found in Gyga et al. (2008) should be maintained, and possibly enhanced, by the additional generic use of the masculine pronouns.

(3) In German, however, the male bias found in Gyga et al. (2008) should be weakened by the use of the generic pronouns that are morphologically identical to the feminine singular ones.

Alternatively, if these subtle morphological relations do not affect gender representations, we would expect similar results in the current study to those of Gyga et al. (2008). Both outcomes are broadly compatible with the mental models framework, which is primarily concerned with eventual representations of content. However, it is clear that the construction of the correct mental model does not require the use of the subtle morphological relations referred to above, so a result indicating that this information is used shows that

considerations other than the construction of mental models determine the architecture of the language processing system.

## Method

### Participants

**English sample.** Thirty-six students (5 men and 31 women<sup>1</sup>) from the University of Sussex took part in this experiment (Mean age: 22.03; SD: 3.78). Each participant was paid 4 pounds or received course credits.

**French sample.** Thirty-four students (2 men and 32 women) from the University of Fribourg took part in this experiment (Mean age: 22.30; SD: 4.67). The participants received course credits or took part voluntarily in the study.

**German sample.** Thirty-six students from the University of Bern (all women) took part in this experiment (Mean age: 22.43; SD: 3.54). The participants received course credits.

### Material and Design

The materials and design were based on those of Gygax et al. (2008). For that study thirty-six experimental passages were constructed in English, French and German. Each passage comprised two sentences. The first sentence introduced a group of people using a role name in the plural form, and the second sentence specified that there were some (but not exclusively) men or some women in the group (i.e., it provided a partial constraint on the sex of the people in the group). The participants' task was to read each passage, presented one sentence at a time, and to decide, for each sentence pair, whether the second sentence was a sensible continuation of the first one. The dependent variables were, therefore, the time to make a judgment of whether the continuation was sensible (only data for "yes" responses were analyzed) and the proportion of "yes" responses. An example of a passage is:

1st sentence: The electricians were walking down the street.

2nd sentence: Since sunny weather was forecast several of the women [men] weren't wearing a coat.

In each language, there were twelve stereotypically female role names, twelve stereotypically male and twelve neutral (chosen from the norms collected by Gabriel et al., 2008). In French and German the role names appeared in the masculine form, which is supposed, as a grammatical rule, to be interpreted as generic and not as specific. Six different content types were used for the first sentences. The first sentence mentioned a group of people either (1) coming out of a place, (2) waiting somewhere, (3) going into a place, (4) being somewhere, (5) walking, or (6) going across a place. For each content type, there were six different versions: for example, for walking, walking through the station, and walking across the street. The role names were randomly assigned to the contents. The second sentences differed first, and most importantly, in their mention of women or men. Each participant saw eighteen continuations about women, six following sentences with a female stereotyped role name, six following sentences with a neutral stereotyped role name and six following sentences with a male stereotyped role name, and eighteen about men. Furthermore, there were three types of continuation content, one based on different emotions (angry, sad, happy, and joyful), one based on different weather conditions (sunny, put some sun cream on, cloudy, and need an umbrella) and one based on different actions (go, have a break, leave, and rest). In all experimental conditions the intended response was “yes” (the second sentence is a sensible continuation of the first). To ensure that the participants read the passages, 36 filler texts, requiring “no” answers were constructed. These filler pairs were similar to the experimental ones (but using different role names), but included a clear semantic or pragmatic incongruity, leading to a “no” answer. An (English) example of such a pair is (4a and 4b):

(4a) The professors were taking a break in the sun.

(4b) Due to the bad weather the majority of the women had an umbrella.

**Adding pronouns.** Each original first sentence from Gygax et al. (2008) was extended by adding a pronoun together with some extra (gender neutral) information. Therefore, all first displays in this experiment introduced a role name at the beginning and later contained a plural pronoun (they, ils or sie), as in the example:

(a) The neighbours came out of the cafeteria. They went away.

(b) Because of the cloudy weather one of the women [men] had an umbrella.

(a) Les voisins sortirent de la cafeteria. Ils partirent.

(b) A cause du temps nuageux un[e] des femmes [hommes] avait un parapluie.

(a) Die Nachbarn kamen aus der Cafeteria heraus. Sie gingen weg.

(b) Wegen des bewölkten Wetters, hatte eine[r] der Frauen [Männer] einen Regenschirm.

### **Control task for a possible alternative interpretation of the passages**

The determiners in the second sentences were meant to be inclusive (i.e., “some of the women” means that there could be men in this group as well). However, they could be interpreted as exclusive, hence biasing responses. For example, when reading the German passage below, there are two reasons why the second sentence (b) might be judged as not a sensible continuation of the first one:

(a) Die Statistiker passierten die Strasse.

[The statisticians were walking into the street.]

(b) Wegen der Hitze trank eine der Frauen Wasser.

[Because of the heat, one of the women was drinking water.]

As Statistiker is stereotypically male, participants could think that it is not possible that a woman is a statistician. However, participants may also think that “one of the women” means that there are only women in the group (i.e., they might take “one of” to induce an exclusive interpretation of the composition of the group). In this case, there is a grammatical mismatch between the word “Statistiker” (masculine grammatical gender) and (the correct way of referring to) a group composed only of women, which should have been “die Statistikerinnen” (the female statisticians). What a participant takes to be a grammatical mismatch might be interpreted as a stereotype mismatch.

To investigate whether people make this second interpretation, we introduced a further short task. This task was administered directly after the main experiment and contained twelve passages: six experimental and six fillers. All passages were similar to those in the main experiment. A first display (comprised of two short sentences) was followed by a second one, and the participants' task was to judge if the sentence in the second display was a sensible continuation of the first. The first display (a) mentioned that some people were doing something, and among them there was one woman or one man. A second sentence (b) referred to some men or women (the opposite of the first sentence) whose number is given by one the six determiners (in this case, “some”).

(a) The people came out of the room. One woman was wearing a raincoat.

(b) Because of the bad weather one of the men had an umbrella.

The expected answer was “yes” in all experimental passages. But if the participants

thought that “one of the men” meant that there were only men in the group of people, they would give a negative answer. To make sure participants attended to the task, six filler passages with the correct answer “no” were added. There were two types of filler passages (see examples below). Some stated in the first sentence that they were people of only one sex (c), and then the other sex was mentioned in the second sentence (d). Other filler passages were semantically or pragmatically incongruent (e, f).

(c) The group of men went into the building. One man looked at the mailboxes.

(d) After so little time, a few of the women seemed to want to go on.

(e) The people were at the airport. One man seemed happy.

(f) One could see that several of the women were swimming.

Before analyzing the data from the main experiment, we examined whether all determiners were interpreted as inclusive. We decided that for a determiner to be considered as inclusive, it should produce more than 50% of positive answers in the control task. On this basis, as shown in Table 2, all determiners in all languages were interpreted inclusively (Min = 59%, Max = 94%). Although all analyses for the main experiment were run including all responses, we also re-ran the analyses considering, for each participant, only those determiners that were considered by them as inclusive in the control task (i.e. above 50% for each participant). In addition, we ran analyses in which the determiners were included as an additional variable. We only present the first set of analyses (all responses, and without determiners as a variable), as the results of the second and third did not differ from those of the first.

### **Procedure for Main Experiment**

The participants were tested individually in a small quiet room. Their task was to read each passage, presented in two parts, and to decide whether the second part was a "sensible" continuation of the first one. In French and German, we used the terms "une continuation possible" and "eine mögliche Fortsetzung", which we judged to be semantically closest to the English "sensible". The participants in all languages were asked to make a quick decision, based on their first impression and not on prolonged reflection. A prompt (i.e., **\*\*Ready?\***, **\*\*Prêt?\***, **\*\*Bereit?\***) appeared on the screen before each passage. The participants pressed the "yes" button to make the first display appear, and then pressed the "yes" button again to make the second display (target sentence) appear. They then had to make a prompt decision by pressing either the "yes" button (i.e., I think it's a sensible continuation) or the "no" button (i.e., I don't think it's a sensible continuation). Participants were asked to keep the index finger of their dominant hand on the "yes" button and the index finger of their non-dominant hand on the "no" button.

## Results

We predicted that in English there would be a stereotype match-mismatch effect (Stereotype x Continuation interaction), which would be the same in the current experiment as in Gygax et al. (2008). In French and German, we predicted a main effect of Continuation (male continuations more easily processed) with a possible modulation in each language (Experiment x Continuation interaction). These effects do not map neatly onto interaction effects in an overall analysis with Language as a factor and, indeed, none of the relevant higher order interactions with Language were significant in such analyses. However, because we made specific predictions for each language, we present separate analyses for the three languages that specifically test the predictions we made. The sample sizes in Gygax et al. (2008) are directly comparable to those in the present study and were 35, 36, and 36 for English, French, and German, respectively.

## Proportion of positive judgments

The mean proportions of positive judgments in each of the three languages are shown in Table 3, along with the means from Gygax et al. (2008). In order to compare the results of this experiment and those of Gygax et al., we conducted both by-participants (F1) and by-items analyses (F2) (Clark, 1973). In the former (F1), mixed design ANOVAs were conducted with Stereotype (Male vs. Female vs. Neutral) and Continuation (Men vs. Women) as within-participant variables and Experiment (Gygax et al. vs. This Experiment) as a between-participant variable. In the latter (F2), mixed design ANOVAs were conducted with Experiment (Gygax et al. vs. This Experiment) and Continuation (Men vs. Women) as within-item variables (i.e., the same role names were presented in each experiment, and each role name was followed by male and female continuations) and Stereotype (Male vs. Female vs. Neutral) as a between-item variable.

**English data.** The analysis revealed a main effect of Experiment when considering items as random factor,  $F_1(1, 69) = 1.51, ns$ ;  $F_2(1, 33) = 14.55, p < .01$ : there were fewer positive answers in this experiment (73%) than in Gygax et al. (78%). Most importantly, there was no main effect of Continuation,  $F_1(1, 69) < 1$ ;  $F_2(1, 33) < 1$ , nor of Stereotype,  $F_1(2, 138) < 1$ ;  $F_2(2, 33) < 1$ , but as expected, there was a Stereotype by Continuation effect  $F_1(2, 138) = 31.28, p < .001$ ;  $F_2(2, 33) = 28.78, p < .001$ , and no Stereotype by Continuation by Experiment effect,  $F_1(2, 138) < 1$ ;  $F_2(2, 33) < 1$ . There were more positive judgments for continuations that matched the stereotype than for those that did not; for neutral role names both continuations were accepted equally. The results found in this experiment replicated those found in Gygax et al. (2008), suggesting that in English, the mental representation of gender when reading role names is solely based on the stereotypicality of those role names.

**French data.** The analysis revealed no main effect of Experiment,  $F_1(1, 67) < 1$ ;  $F_2(1, 33) = 1.33, ns$ , but a main effect of Continuation,  $F_1(1, 67) = 79.84, p < .001$ ;  $F_2(1, 33)$

= 48.78,  $p < .001$ , supporting an overall male bias. There was no Experiment by Continuation effect,  $F_1(1, 67) < 1$ ;  $F_2(1, 33) < 1$ . The presence of a masculine pronoun in addition to the role name in the grammatical masculine form in the priming sentences did not increase the male bias found earlier, though our prediction was only that the bias should at least be maintained. Thus, for French, the results from the current study and those from our previous study were very similar. There was also a Stereotype by Continuation effect when considering participants as a random factor  $F_1(2, 134) = 5.84$ ,  $p < .05$ ;  $F_2(2, 33) = 1.89$ , *ns*: the difference between male and female continuations was slightly bigger in the Male stereotype condition (27%) than in the Female stereotype condition (16%) and the Neutral stereotype condition (14%).

**German data.** The analysis revealed a main effect of Experiment,  $F_1(1, 70) = 7.30$ ,  $p < .05$ ;  $F_2(1, 33) = 27.86$ ,  $p < .001$ : there were more positive answers in this experiment (66%) than in Gygax et al. (54%). There was a strong main effect of Continuation,  $F_1(1, 70) = 74.09$ ,  $p < .001$ ;  $F_2(1, 33) = 143.04$ ,  $p < .001$ : there were more positive answers to men continuations than to women continuations. Most crucially, this main effect was qualified by an Experiment by Continuation interaction effect, but only when considering items as a random factor,  $F_1(1, 70) = 2.50$ , *ns*;  $F_2(1, 33) = 8.88$ ,  $p < .01$ , revealing an attenuated male bias in this experiment compared to Gygax et al. (i.e., a difference in positive judgments between men vs. women continuations: This experiment: 20%; Gygax et al.: 29%)<sup>2</sup>. As we expected, the presence of a pronoun morphologically identical to the feminine singular seems to have facilitated positive answers to continuation sentences about women, at least when considering items as random factor.

There was also a main effect of Stereotype,  $F_1(2, 140) = 4.82$ ,  $p < .05$ ;  $F_2(2, 33) = 3.62$ ,  $p < .05$ , showing more positive answers to the neutral role names (65%) than to the male (57%) and female (57%) stereotyped role names (LSD with  $p < .05$ ), as well as a Stereotype

by Continuation effect  $F_1(2, 140) = 4.24, p < .05$ ;  $F_2(1, 33) = 5.96, p < .01$ . Post-hoc analyses (LSD) showed that the difference in positive judgments between men and women continuations was higher for the male stereotyped role names (34%) than for the female (18%) and neutral (21%) stereotyped role names ( $p < .05$ ). On a descriptive level, when comparing the two experiments (see Figure 1, solid lines), the attenuation of the masculine bias seemed more pronounced in the female (decrease of 15%) and neutral stereotyped conditions (decrease of 11%) than in the male stereotyped condition (decrease of 1%).

### Judgment Times

Only response times for positive judgments were analyzed. The proportion of positive responses was quite low in some conditions, which led to an imbalanced data set. To accommodate this problem the data were analyzed by fitting linear mixed-effects models (SPSS 18.0), including both participants and items as random factors (Brysbaert, 2007). As in Gygax et al., judgment times that were 2.5 SD or more above each participant's mean were replaced by the 2.5 SD cut-off (1% of French, 2% of German, and 2% of English times were affected). All means for judgment times in both this experiment and in Gygax et al. are shown in Table 4. Separate models were estimated for each language. Experimental factors (Stereotype, Continuation, Experiment and their interactions) were treated as fixed effects; participants and role names were treated as random effects. Participants were nested under Experiment and Role names were nested under Stereotype. By means of  $\chi^2$ -difference tests we explored the change in model fit when further adding random slopes. In the sections below we report just those random effects that improved the fit of the model. In no case did adding these effects significantly change the conclusions from the fixed part of the model.

**English data.** Adding the Stereotype by Participant interaction as a random effect (i.e. participants differ in their susceptibility to the stereotype information) significantly improved the fit of the model ( $\Delta\chi^2 = 63, \Delta df = 1, p < .001$ ). The largest but only marginally significant

effect was the Stereotype by Continuation effect,  $F(2, 1742.8) = 2.8, p = .06$ ; all other  $ps > .20$ . On a descriptive level the Stereotype by Continuation pattern supports the findings from the proportion judgments: The difference in positive judgment times between men and women continuations was higher for male stereotyped role names (-277 ms) and for female stereotyped role names (+129 ms) than for neutral role names (-75 ms). Thus, for English, the results of this study and our previous one were very similar.

**French data.** Adding the Stereotype by Participant interaction as a random effect (i.e. participants differ in their susceptibility to the stereotype information) significantly improved the fit of the model ( $\Delta\chi^2 = 15, \Delta df = 1, p < .001$ ). The analysis revealed a main effect of Experiment,  $F(1, 65) = 5.4, p = .02$ , showing that there were faster positive responses in this experiment (3049 ms) than in Gygax et al. (3657 ms), as well as a main effect of Continuation  $F(1, 1554.2) = 8.0, p < .01$ , positive responses being faster for sentences containing men (3263 ms) than sentences containing women (3444 ms). As in the analysis of the proportion of positive responses, there was no Experiment by Continuation effect,  $F(1, 1561.9) = 1.1, p = .34$  (all other  $Fs < 1$ ). The bias reported by Gygax et al. (2008) was maintained, but not enhanced. The only difference between the two studies was the faster mean reaction time in this study compared with the previous one.

**German data.** Adding the Stereotype by Continuation by Participant interaction as a random effect (i.e. participants differ in their susceptibility to the stereotype-continuation match/mismatch) significantly improved the fit of the model ( $\Delta\chi^2 = 35; \Delta df = 1, p < .001$ ). The analysis revealed a main effect of Continuation,  $F(1, 229.4) = 15.6, p < .001$ , positive responses being faster for sentences containing men (2882 ms) than sentences containing women (3123 ms). There was also a main effect of Experiment,  $F(1, 69.27) = 5.4, p = .02$ , showing that there were faster positive responses in this experiment (2790 ms) than in Gygax et al. (3205 ms). Most crucially, as expected and supporting the analysis of the proportion of

positive responses, there was an Experiment by Continuation effect,  $F(1, 753.2) = 5.7, p = .02$ , suggesting an attenuated male bias in this experiment compared to Gygax et al. The difference in positive judgment times between men and women continuations was higher in Gygax et al. (451 ms) than in this experiment (120 ms). The presence of a pronoun identical to the feminine singular seems to have facilitated positive response time to target sentences containing women. All other  $F_s < 1$ .

### Discussion

The objective of this research was to examine the influence, if any, of the different grammatical systems in French and German on the grammatical bias in gender interpretation found in Gygax et al. (2008). The central idea was to add referential pronouns (they / ils / sie) that carried different grammatical gender cues in the languages under scrutiny. Our study then investigated whether the use in French of the pronoun “ils” would maintain or reinforce the masculine bias and the use of “sie” in German would attenuate it. In English, we did not expect any changes, as the pronoun “they” is not gender-marked. An alternative possibility was that the basic grammatical information on the pronouns is used by the anaphor resolution process, but that the more subtle aspects of the morphological marking (i.e., the relation between the form actually used and other forms in the language) should not affect the already-established representation of the pronoun's referent.

In line with our expectations, in English the proportions of positive judgments and the positive judgment times revealed that the gender representation was biased by stereotyped information (or lack of it, in the case of the neutral items, so that “they” maps readily onto the representation of, say, “singers” and both “men” and “women” in the second sentence are seen as equally consistent with that representation) as in Gygax et al. (2008). Also in line with our expectations in German, the potentially feminine form of the plural pronoun (sie) significantly weakened the overall male bias reported by Gygax et al. (2008) for both the

proportion of positive judgments and the judgment times, and for all three type of role nouns, including, importantly, neutral ones. This finding is in line with Rothermund's (1998) results and thus provides the first corroboration of his post hoc explanation of those results: The German plural pronoun "sie", which is morphologically identical with the feminine singular pronoun, has female associations, which work against the male associations evoked by the masculine role names. In French, the addition of pronouns had no effect, though because those cues provided the same information as the masculine-as-generic, we could not definitively predict an enhancement effect as opposed to maintenance of the strength of bias in the gender representation. By adding further grammatical cues, we succeeded in attenuating (in German) but not in further amplifying (in French) the masculine bias brought about by employing the masculine (supposedly generic) forms of the role names. In short, combining grammatical cues that match in their gender-marking (as in French, i.e., a masculine noun and a masculine pronoun) does not seem to have an additive effect, whilst combining grammatical cues that do not match (as in German, i.e., a masculine noun and a plural pronoun morphologically identical to a feminine singular one) seems to distract readers from forming a specifically male gender representation. More generally, the question of whether the gender-based part of the representation of a person, introduced by a referential noun phrase, comprising (possibly morphologically gender-marked) determiner and role name, can be modulated by gender information in a later pronoun, can be answered in the positive, at least in the German case. As noted in the Introduction, this result, while compatible with the overall mental models framework, and its strictures about the nature of representations of content, shows that other influences are at work in the language processing system. More specifically, the relation between the German plural "sie" and the German feminine singular "sie" is independent of what is referred to by a particular use of the German plural "sie" (all women, all men, or a mix of men and women). This result indicates another case, like that of

stereotype information, where information that is not necessary for comprehension and, indeed, may be detrimental to comprehension in certain cases, is nevertheless activated during comprehension.

In relation to the use of stereotype information in German and French, in German we found a stereotype by continuation effect for the proportions of positive judgments. While the masculine bias (more positive answers for men continuations than for women continuations) was of a similar strength for female stereotypical and neutral role names, it was stronger for male stereotyped role names. Although we expected dissimilarities between the German and French data due to the use of different grammatical cues, the pattern of results displayed in Figure 1 (and also Table 3) suggests a similar effect for the French sample (Figure 1, dotted lines) in the present experiment and the corresponding sample in Gygax et al. (2008). When analyzing the proportion of positive judgments from the French sample of the present experiment on its own, a significant Continuation by Stereotype effect,  $F_1(2, 66) = 4.87, p < .05$ ;  $F_2(2, 33) = 3.25, p < .06$ , emerged, corroborating the notion of a numerically similar trend to the German sample. Together, these results may indicate an influence of (male) stereotype information on gender representation both in German and (less pronounced) in French.

Because we presented whole sentences, and did not examine in detail times for reading the first part of the passages, our results do not bear directly on the time course of gender processing. Nevertheless, previous research suggests that, with the kinds of passages and procedure we used, processing and encoding of stereotype information and morphological information on nouns and pronouns is more or less immediate.

To conclude, we believe that this experiment has furthered our understanding of the interaction between grammatical cues and stereotypical information when constructing a representation of gender during reading. In non gender-marked languages, such as English,

readers based their representation on stereotype information. In gender-marked languages, when pronouns are added, subtle aspects of their morphology, such as the identity of the plural and the feminine singular form (sie) in German, modify the gender representation of the antecedents of those pronouns.

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### Footnotes

<sup>1</sup> As Gygax et al. (2008) and others have found no sex-of-respondent differences in this kind of reading/judgment task, and because we had access to many more female participants than males, we decided to not balance the sample.

<sup>2</sup> This result was confirmed in an ipsative analysis in which the number of positive answers given to men in each stereotype condition and for each participant was divided by the total number of positive answers for the specific stereotype condition, and similarly for the number of positive answers to women continuations. The resulting scores for men and women continuations always sum up to 1 for each person in each stereotype condition. A 2 (experiment) by 3 (stereotype) mixed-design ANOVA was run on the proportions of positive judgments for men continuations. In this ipsative data analysis main effects of Experiment and Stereotype mirror Experiment by Continuation and Stereotype by Continuation interactions in the main analysis. In this analysis the main effect of Experiment was significant ( $F(1, 69) = 4.77, p < .05$ ).

Table 1

*Role names chosen from Gabriel et al. (2008) along with the proportion of men evaluated by each language participant group.*

English	%	German	%	French	%
Male Stereotypes					
Spies	73	Spione	67	Espions	74
Golfers	73	Golfspieler	68	Golfeurs	73
Politicians	71	Politiker	69	Politiciens	72
Police officers	63	Polizisten	69	Policiers	70
Statisticians	70	Statistiker	72	Statisticiens	74
Bosses	62	Arbeitgeber	72	Patrons	74
Computer specialists	70	Informatiker	79	Informaticiens	67
Surgeons	62	Chirurgen	75	Chirurgiens	75
Technicians	72	Techniker	78	Techniciens	75
Engineers	78	Ingenieure	78	Ingénieurs	74
Physics students	56	Physikstudenten	81	Etudiants en physique	67
Pilots	70	Flieger	76	Aviateurs	74
Mean	68		74		72
Neutral Stereotypes					
Singers	53	Sänger	45	Chanteurs	48
Pedestrians	49	Spaziergänger	46	Promeneurs	52
Cinema goers	51	Kinobesucher	49	Spectateurs de cinéma	50
Concert goers	47	Konzert-Zuhörer	47	Auditeurs de concert	51
Schoolchildren	53	Schüler	48	Ecoliers	53
Spectators	55	Zuschauer	41	Spectateurs	51
Neighbours	50	Nachbarn	50	Voisins	50
Swimmers	50	Schwimmer	50	Nageurs	50
Tennis players	53	Tennisspieler	52	Joueurs de tennis	54
Authors	48	Autoren	52	Auteurs	54
Musicians	54	Musiker	50	Musiciens	59
Skiers	55	Skifahrer	53	Skieurs	55
Mean	52		49		52
Female Stereotypes					
Beauticians	29	Kosmetiker	11	Esthéticiens	18
Birth attendants	29	Geburtshelfer	11	Assistants maternels	18
Fortune tellers	32	Wahrsager	24	Diseurs de bonne aventure	28
Cashiers	39	Kassierer	27	Caissiers	24
Nurses	30	Krankenpfleger	24	Infirmiers	30
Hairdressers	48	Coiffeure	21	Coiffeurs	38
Psychology students	38	Psychologiestudenten	25	Etudiants en psychologie	33
Dieticians	39	Diätberater	27	Diététiciens	37
Dressmakers	43	Schneider/Näher	23	Couturiers	40
Dancers	32	Tänzer	33	Danseurs	29

Sales assistants	34	Verkäufer	33	Vendeurs	37
Social workers	29	Sozialarbeiter	41	Assistants sociaux	33
Mean	35		24		30

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Table 2

*Percentage of positive answers accompanying sentences containing the different determiners in all three languages.*

English	%	French	%	German	%
A few of the	94	Quelques	94	Einige	94
The majority of the	82	La majorité des	68	Die Mehrheit der	66
Most of the	61	La plupart des	61	Die meisten	59
One of the	91	Une/un des	94	Eine/einer der	91
Several of the	70	Plusieurs	65	Mehrere	63
Some of the	76	Une partie des	68	Ein Teil der	66
Mean	79		75		74

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Table 3

*Mean proportions of positive judgments (and standard deviations) in English, French and German as a function of stereotypes and continuations in this experiment and Gygax et al.*

Language	Stereotype	Continuation – contained the word « Men » or « Women »			
		This experiment		Gygax et al.	
		Men	Women	Men	Women
English	Female	.65 (.31)	.81 (.22)	.65 (.32)	.88 (.20)
	Male	.81 (.21)	.65 (.30)	.85 (.16)	.66 (.26)
	Neutral	.75 (.23)	.69 (.31)	.81 (.21)	.81 (.28)
French	Female	.76 (.29)	.62 (.29)	.77 (.28)	.59 (.32)
	Male	.83 (.20)	.54 (.30)	.83 (.23)	.58 (.29)
	Neutral	.76 (.25)	.66 (.25)	.73 (.34)	.56 (.34)
German	Female	.68 (.31)	.57 (.30)	.65 (.33)	.40 (.28)
	Male	.79 (.19)	.46 (.30)	.69 (.29)	.35 (.33)
	Neutral	.80 (.26)	.64 (.29)	.72 (.28)	.45 (.32)

Table 4

*Judgment times of positive answers (and standard deviations) in English, French and German as a function of stereotypes and continuations in this experiment and Gygax et al.*

Language	Stereotype	Continuation– contained the word « Men » or « Women »			
		This experiment		Gygax et al.	
		Men	Women	Men	Women
English	Female	2851 (1061)	2862 (1295)	2749 (1004)	2913 (1212)
	Male	2661 (1112)	2912 (857)	2810 (934)	2954 (1164)
	Neutral	2824 (1140)	2830 (902)	2885 (1476)	2912 (961)
French	Female	2923 (879)	3201 (1278)	3665 (1626)	3875 (1486)
	Male	2941 (824)	3137 (1667)	3523 (1380)	3866 (1791)
	Neutral	3137 (1804)	3125 (1131)	3701 (1101)	3873 (1355)
German	Female	2888 (923)	2850 (1188)	3088 (1336)	3512 (1657)
	Male	2663 (1086)	2851 (930)	3016 (1514)	3374 (1466)
	Neutral	2688 (1023)	2872 (1202)	3018 (1336)	3559 (1676)

Figure 1.

*Differences in proportions of positive judgments men vs. women continuations, as a function of languages and stereotypes in this experiment and Gygax et al.*

