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What constrains grammatical gender effects on semantic judgements? Evidence from Portuguese

Sara Ramos^a; Debi Roberson^b

^a National University of Singapore, Singapore ^b Department of Psychology, University of Essex, Colchester, UK

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What constrains grammatical gender effects on semantic judgements? Evidence from Portuguese

Sara Ramos

National University of Singapore, Singapore

Debi Roberson

Department of Psychology, University of Essex, Colchester, UK

Four studies investigated whether grammatical gender biases the semantic judgements of Portuguese speakers, relative to speakers of English. Some research reports that grammatical gender has a pervasive influence on speakers' cognitive representations (e.g., Boroditsky, Schmidt, & Philips, 2003; Sera, Elieff, Forbes, Burch, & Rodriguez, 2002). Others argue that effects of grammar arise through linguistic processing (e.g., Vigliocco, Vinson, Paganelli, & Dworzynski, 2005) and are restricted to animate categories for which gender is a pertinent feature. The present results found effects of gender in Portuguese speakers' judgements of inanimate objects, but only when gender was task relevant and/or when the stimuli were words, rather than pictures. These findings support the view that gender effects on cognitive judgements arise as a function of linguistic processing and/or task demands, rather than directly influencing conceptual or semantic representations.

Keywords: Grammatical gender; Portuguese; Semantic judgements.

One of the most striking ways in which languages differ is in whether or not they assign grammatical gender to object names. In some languages, like Spanish and Portuguese, all nouns are either masculine or feminine. Others, such as Russian and German, include a third, neuter gender, and some remote languages have seven or eight (Corbett, 1991). Languages such as English lack any grammatical gender. Several recent investigations have

Correspondence should be addressed to Debi Roberson, Dept. of Psychology, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, UK. E-mail: robedd@essex.ac.uk

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asked whether the grammatical gender of the label (in languages that assign gender to object names) affects the conceptual and/or semantic representation of the object (Boroditsky, Schmidt, & Philips, 2003; Flaherty, 2001; Martinez & Shatz, 1996; Sera, Berge, & Castillo Pintado, 1994; Sera, Elieff, Forbes, Burch, & Rodriguez, 2002; Vigliocco, Lauer, Damian, & Levelt, 2002).

Sera et al. (1994) reported that Spanish speakers categorised pictures of objects as masculine or feminine according to the grammatical gender patterns of Spanish, whereas English speakers assigned gender randomly. To minimise obligatory grammatical gender access, they subsequently asked participants to assign a feminine or masculine voice to a proposed cartoon animation of the pictured objects. Eighty-five per cent of Spanish speakers' choices still reflected the object labels' grammatical gender, compared to 53% of English speakers' choices. Older Spanish children performed like Spanish adults, but English speakers' categorisation patterns did not differ from chance between kindergarten, second grade, fourth grade, and adults. Sera et al. argued that learning a grammatically gendered language restructures underlying mental representations, so that objects sharing grammatical gender come to be represented as more alike, even though they may otherwise be semantically unrelated. Sera et al. (2002) found gender effects on classification for French and Spanish children and adults, but not German speakers. They concluded that the distinction between masculine and feminine may be blurred for speakers whose grammatical system allows a neutral classification, as in the case of German, which has three grammatical gender categories (masculine, feminine, and neuter).

However, testing participants only in their native language cannot determine whether experience with a language affects language-independent thought. Boroditsky et al. (2003) therefore gave Spanish/English and German/English bilinguals a paired-associate learning task in English. Participants learned proper names for objects (e.g., apple–Patrick). Half the pairs were gender-congruent in the participants' native language, and half were not (e.g., Spanish: congruent: apple (F)–Patricia; incongruent: apple–Patrick). Both Spanish and German speakers remembered more gender-congruent than gender-incongruent pairs. Since both groups were tested in English, grammatical gender was argued to shape their underlying conceptual representations, rather than affecting only online language processing. Spanish and German speakers also rated (in English) the similarity between pictures of objects and of males or females. Differences in similarity ratings correlated with experience in a given language. Spanish-German bilinguals with more Spanish experience rated similarity like native Spanish speakers. Bilinguals with more German experience rated similarity like native German speakers. Unlike Sera et al. (2002), these experiments found effects of gender for both Spanish and German speakers. However,

with proper names in paired-associate learning and pictures of people in the similarity ratings task, bilingual participants might have strategically accessed grammatical gender in their native language to perform these tasks.

That interpretation is consistent with the view that syntactic information (including grammatical gender) is represented separately from semantic information (e.g., Bowers, Vigliocco, Stadthagen-Gonzalez, & Vinson, 1999). However, to date no studies have analysed how task instructions and presentation modality constrain gender effects. More recently, Vigliocco, Vinson, Paganelli, and Dworzynski (2005; see also Kousta, Vinson, & Vigliocco, 2008) proposed that semantic effects of grammatical gender are restricted to animate categories, for which sex is a semantically relevant property. Italian speakers judged animal names of the same gender as more similar in meaning than English speakers, but showed no difference in judgements for artefact names. They also made more same-gender semantic errors (compared to English speakers' baseline) in speeded naming, suggesting that semantic similarity increases between words of the same gender. This effect was also restricted to animal names. Vigliocco et al. (2005, p. 506) proposed that, rather than directly affecting representations, gender effects were "mediated by an association between gender of nouns and male- or female-like aspects of meaning".

Nevertheless, the proposal that grammatical gender only influences the semantic representations of animate entities cannot account for the effects observed for inanimate items (Boroditsky et al., 2003; Sera et al., 1994, 2002). Those effects might have arisen because the tasks referred (directly or indirectly) to grammatical gender categories, prompting strategic use of these categories in the task. Alternatively, participants may have covertly named the items, thereby accessing grammatical gender information, which produced gender effects on semantic tasks.

The present studies manipulated task instructions (overt vs. covert reference to grammatical gender) and level of mandatory linguistic access (pictorial vs. verbal modality) to investigate gender effects. We compared Portuguese and English speakers on categorisation and semantic similarity tasks using only inanimate items. Portuguese has only two grammatical genders, masculine and feminine, that are highly correlated with natural gender, which may, in turn, lead to overgeneralisation of male and female features to inanimate objects (Sera et al., 2002).

Experiment 1 investigated the effects of Portuguese grammatical gender on adults' categorisation of objects when reference to gender was overt in the instructions. Experiments 2 and 3 investigated the impact of gender on similarity judgements when overt reference was removed, as well as the effects of materials (pictorial vs. verbal). If grammatical gender restructures mental representations during language development (Boroditsky et al., 2003; Sera et al., 1994), Portuguese speakers should show a gender bias in all

tasks, compared to English speakers. However, if grammatical gender does not influence representations of inanimate entities, the performance of English and Portuguese speakers should not differ at all. Finally, if accessing the grammatical gender of a noun indirectly activates male or female aspects of meaning, Portuguese speakers might show a gender effect only on overt tasks in which linguistic access is mandatory.

EXPERIMENT 1

Experiment 1 investigated whether Portuguese speakers would show the gender effects observed for Spanish and French speakers (Sera et al., 1994, 2002). Given the regularity of Portuguese grammatical gender, a task containing clear reference to gender should trigger strong gender effects in semantic categorisation tasks by Portuguese speakers. Following Vigliocco et al. (2005), we take English speakers' performance as a baseline for comparison to exclude any bias by both populations to categorise natural kinds as feminine and artefacts as masculine (e.g., Sera et al., 1994). We investigate Portuguese adherence to grammatical gender over and above any such bias.

Method

Participants. Fifty native Portuguese speakers (36 women, 14 men, age $M = 20.31$, $SD = 4.45$) from a Lisbon university and 50 native English speakers (39 women, 11 men, age $M = 18.18$, $SD = 3.71$) from the University of Essex volunteered for this experiment.

Materials. Eighty pictures of common objects, and eight control items with natural gender (man, woman, boy, girl, nurse, knight, king, and queen) were taken from the International Picture Naming Project Database (IPNP; Szekely et al., 2004). Appendix 1 lists the items. Forty were of feminine Portuguese grammatical gender and 40 were of masculine gender. Control items had obvious gender and so should have been assigned in the same way by both English and Portuguese participants.

Stimuli were presented in booklets with six items per page, in random order. Participants circled the letters "M" or "F" below each picture, to indicate a male or a female voice. Pretest naming by 27 Portuguese speakers confirmed the grammatical gender of the nouns used.

Procedure. Following a similar procedure to that of Sera et al. (1994), participants were told that film-makers were making a new cartoon film in which everyday objects came to life, and wanted to assess whether the characters should have a man's or a woman's voice. Participants were

instructed to classify each item rapidly by circling “M” for a masculine voice, or “F” for a feminine voice.

Results and discussion

All participants assigned appropriate gender to control items. Table 1 shows mean proportions of “same-gender” (Portuguese grammatical gender) voice assignments by English and Portuguese speakers to the experimental items.

The proportion of same-gender assignments was analysed in a 2 (language: Portuguese vs. English) \times 2 (gender: masculine vs. feminine) ANOVA with repeated measures over the second factor. This revealed a significant effect of language both by participant, $F(1, 98) = 91.45$, $MSE = 0.02$, $p < .05$, $\eta_p^2 = .48$, and by item, $F(1, 78) = 126.08$, $MSE = 0.09$, $p < .01$, $\eta_p^2 = .62$, with Portuguese speakers making significantly more “same-gender” assignments. The effect of gender was also significant, $F(1, 98) = 8.31$, $MSE = 0.02$, $p < .05$, $\eta_p^2 = .08$; $F(1, 78) < 1$, as was the Language \times Gender interaction, $F(1, 98) = 11.97$, $MSE = 0.01$, $p < .05$, $\eta_p^2 = .11$; $F(1, 78) = 11.18$, $MSE = 0.01$, $p < .01$, $\eta_p^2 = .13$. Simple main effect analyses showed that English speakers made more “same-gender” voice assignments to masculine than to feminine items, $F(1, 98) = 20.12$, $MSE = 0.01$, $p < .05$; $F(1, 156) = 4.16$, $MSE = 0.05$, $p < .05$, but Portuguese speakers’ “same-gender” assignments did not differ between masculine and feminine items, $F(1, 98) < 1$; $F(1, 156) < 1$.

Although Portuguese speakers were clearly influenced by Portuguese gender markings, there was a significant correlation between voice assignments in the two language groups, $r(80) = .81$, $p < .01$. Both English and Portuguese speakers may have a semantic bias to categorise natural kinds as feminine and artefacts as masculine (Sera et al., 1994, 2002), but of interest here is the extent to which Portuguese speakers are influenced by the grammatical gender assignments of their language, over-and-above any more universal semantic bias. The results of the present experiment support the findings of Sera et al. (1994, 2002) for Spanish and English speakers.

TABLE 1
Mean proportion of “same gender” (Portuguese) (standard deviations in parentheses) voice assignments in the voice assignment questionnaire by language, and Portuguese grammatical gender

Portuguese grammatical gender	Language	
	Portuguese ($N = 50$)	English ($N = 50$)
M	0.69 (0.15)	0.56 (0.10)
F	0.70 (0.14)	0.46 (0.11)

Portuguese participants' 'same-gender' choices were significantly above chance for all items and Portuguese participants made significantly more "same-gender" assignments than English speakers.

Indeed, if English speakers consistently assigned female voices to natural items and male voices to artefacts, this tendency might mask much larger differences between the two language groups because both groups would assign masculine gender to artefacts that carry masculine gender in Portuguese, or natural items carrying feminine grammatical gender. Sera et al. (2002) suggested that grammatical gender assignments in Spanish captured a universal conceptual tendency that would also predict English speakers' classifications. The present findings, however, like those of Boroditsky et al. (2003) for Spanish-German bilinguals, suggest that there are genuine influences of grammatical gender in addition to any such universal bias.

Like Spanish and French speakers, Portuguese speakers are strongly influenced by grammatical gender when assigning gendered voices to objects. This could result either from the influence of grammatical gender on conceptual representations, or because participants strategically use grammatical gender as a basis for voice selection. If grammatical gender is incorporated into conceptual representations, its effects should be observed across a wide range of tasks, using both pictorial and verbal materials, and should be minimally influenced by manipulations to task instructions.

Experiment 2 assessed whether Portuguese speakers' similarity judgments would also be influenced by grammatical gender.

EXPERIMENT 2

If the gender of nouns leads speakers to attribute gender features to inanimate objects, Portuguese speakers should show increased similarity ratings for pairs of object nouns taking the same gender, compared to English speakers. Speakers of Portuguese and English rated the similarity in meaning between pairs of words from the same semantic category. We manipulated language (Portuguese vs. English) and grammatical gender (same-[f], [f] or [m], [m] vs. different-[f], [m]). As English has no grammatical gender, taking English speakers' ratings of semantic relatedness as baseline values controls for variations in visual or semantic similarity across the object pairs (Vigliocco et al., 2005). Increased similarity ratings by Portuguese speakers for same-gender pairs would reflect a higher number of shared semantic features between those concepts in Portuguese. However, if gender effects in the previous experiment were due to overt task demands, rather than reflecting the impact of gender acquisition on conceptual representations, Portuguese speakers should not give increased similarity ratings to objects with same-gender nouns.

Method

Participants. Forty-two native Portuguese speakers from the Escola Superior de Educação de Leiria (age $M = 20.24$, $SD = 3.98$), and 42 native English speakers from the University of Essex (age $M = 17.51$, $SD = 4.55$) participated in this experiment. None had participated in Experiment 1.

Materials. One hundred and six pairs of object nouns were used. Both members of each pair belonged to the same semantic category (body parts, clothing, food, fruits, household items, musical instruments, plants, or vehicles). Pilot testing with 20 English speakers established a set of items that were consistently rated across participants and matched for semantic relatedness between the two gender alternatives—same and different. Thirty-five pairs were objects nouns of the same grammatical gender, and 71 were of different grammatical gender. A full list is provided in Appendix 2.

Procedure. Participants were tested using a booklet with instructions, seven examples, and the experimental word pairs. Each pair had a 5-point rating scale beside it. Participants were asked to evaluate the similarity in meaning of each pair of words (Ford, personal communication, January 27, 2005) and instructed to rate each pair without lengthy consideration.

Results and discussion

Mean differences in semantic relatedness ratings between English and Portuguese speakers were calculated for same- and different-gender pairs (Figure 1).

Following Vigliocco et al. (2005), ratings given by Portuguese speakers were compared to the baseline English ratings. Higher ratings reflect higher similarity. A 2 (language: Portuguese vs. English) \times 2 (Portuguese grammatical gender: same vs. different) ANOVA with repeated measures over the second factor revealed no significant main effect of language, $F(1, 82) < 1$, $\eta_p^2 = .00$, significant in the analysis by items, $F(1, 104) = 4.52$, $MSE = 1.97$, $p < .05$, $\eta_p^2 = .04$, but a significant effect of gender, $F(1, 82) = 5.63$, $MSE = 0.01$, $p < .05$, $\eta_p^2 = .06$, not significant in the analysis by items, $F(1, 104) < 1$, $\eta^2 = .00$, and a significant Language \times Gender interaction, $F(1, 82) = 29.57$, $MSE = 0.01$, $p < .01$, $\eta_p^2 = .27$; $F(1, 104) = 6.60$, $MSE = 0.04$, $p < .05$, $\eta_p^2 = .06$, in both analyses. Simple main effects analyses showed that for pairs with different gender, Portuguese speakers' similarity ratings were significantly lower than those given by English speakers, but only in the analysis by items, $M_{Portuguese} = 2.63$ $SD = 0.29$, $M_{English} = 2.76$, $SD = 1.04$, $F(1, 82) = 1.91$, $p = .17$; $F(1, 104) = 16.69$, $p < .01$. In contrast, the analysis by participants

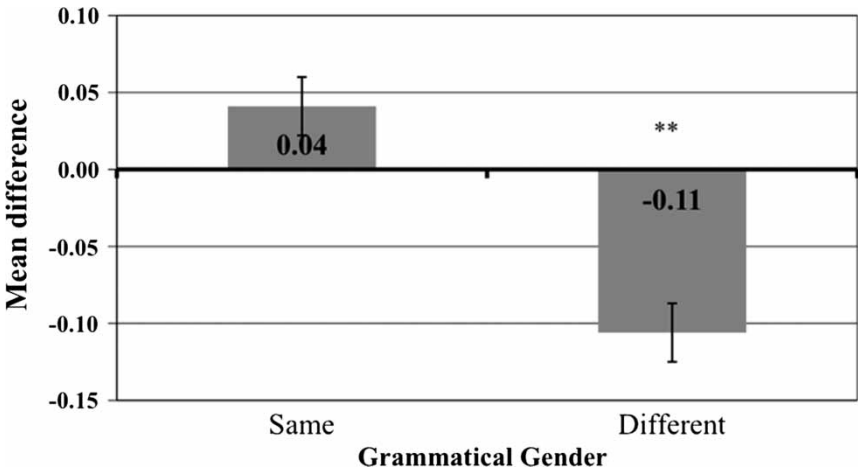


Figure 1. Mean relatedness difference (error bars represent the standard errors of the mean) between baseline (English) and Portuguese. **Significant at the .01 level.

revealed that Portuguese speakers assigned significantly lower ratings to noun pairs of different gender than of the same gender, $M = 2.63$, $SD = 0.29$ vs. $M = 2.67$, $SD = 0.31$, $F(1, 82) = 4.70$, $p < .01$; $F(1, 104) < 1$, whereas English speakers showed the opposite pattern, assigning higher ratings to different gender pairs, $M = 2.76$, $SD = 0.54$, compared to same-gender pairs, $M = 2.66$, $SD = 0.55$, $F(1, 82) = 30.50$, $p < .01$; $F(1, 104) < 1$. Despite these differences, correlations between ratings across the two languages were high and reliable for both same-gender, $r(35) = .96$, $p < .01$, and different-gender, $r(71) = .97$, $p < .01$, noun pairs, indicating that speakers of English and Portuguese perceive the overall semantic relationship for these items to be similar. However, Portuguese speakers appeared to access grammatical gender information and this reduced their judgements of similarity for items taking different genders.

The dissociation between gender effects for items of same and different gender suggests that grammatical gender is not incorporated into semantic/conceptual representations, but is rather accessed during linguistic processing. Recent studies of grammatical gender access during language production suggest that gender-congruent information does not influence ongoing processing, whereas gender-incongruent information can lead to competition that affects naming latencies (Costa, Alario, & Sebastian-Gallés, 2007; but see Cubelli, Lotto, Paolieri, Girelli, & Job, 2005). Linguistic processing was mandatory in Experiment 2, since the items were presented as words. The results thus seem more compatible with gender effects arising from linguistic processing than with a model in which grammatical gender affects conceptual representations, because such a model would not predict the

asymmetry found here between congruent (same-gender) and incongruent (different-gender) pairs. The effects found in Experiment 2 might have reflected the obligatory linguistic access involved in rating the similarity of words. Experiment 3 therefore extended the investigation to ascertain whether comparable effects would occur with pictorial stimuli in a “better-likeness” judgements task.

EXPERIMENT 3

This experiment employed a “better-likeness” task to investigate whether similarity judgements are influenced by grammatical gender when the semantic similarity between a target and both same and different gender alternatives is matched. The task contained no overt reference to gender and, by using picture stimuli in Experiment 3a and words in Experiment 3b, compared responses when linguistic processing was mandatory (word matching) and when it was not (picture matching).

Method

Participants. Fifty native Portuguese-speaking undergraduates (age $M = 24.54$, $SD = 5.00$) and 50 native English-speaking undergraduates from the University of Essex (age $M = 20.79$, $SD = 7.12$) participated. All participants were either given course credits or paid for their participation and had not participated in previous experiments. Twenty-four in each group participated in Experiment 3a and 26 in Experiment 3b.

Apparatus and materials. Stimuli were presented on an Apple Macintosh computer running SuperLab Pro 1.75 software (Cedrus Corporation, San Pedro, CA). Responses were made by keyboard. Stimuli were 75 pictures of objects (Experiment 3a) or their noun labels (Experiment 3b) selected from the IPNP database (Szekely et al., 2004) (see Appendix 2).

Since English ratings are not biased by gender, the relatedness ratings that had been given by English speakers in Experiment 2 were used to construct triads where the semantic relationship between the target and the two alternatives was equated as closely as possible. In each trial, one alternative was of the same Portuguese grammatical gender as the target, and the other was of different gender. Mean semantic relatedness for same- and different-gender pairs of items was equivalent (same-gender pairs = 2.66, different-gender pairs = 2.76), $t(104) = 0.58$, $\eta_p^2 = .00$. Similarity matching was confirmed by subtracting mean ratings by English speakers to same-gender pairs from mean ratings to different-gender pairs. The resulting mean difference was 0.02 (not significantly different from 0), $t(73) = 0.35$, $\eta_p^2 = .00$.

The target items varied across trials so that a target in one trial would appear as an alternative in another trial, except when this manipulation resulted in two same-gender alternatives, in which case that triad was excluded. This resulted in a total of 74 trials. Experiment 3b used 67 of the noun labels for the objects pictured in Experiment 3a, resulting in a total of 62 trials. The matched semantic relatedness between the two alternatives within each triad was maintained across experiments (mean difference = 0.03), $t(61) = 0.64$, $\eta_p^2 = .01$.

Procedure. In both experiments participants chose, for each triad of objects, which of the two alternatives “goes best” with the target (the equivalent expression used in the Portuguese version was “combina melhor”). They were advised that there were no right or wrong answers, and to make a quick decision, based on their first impression.

Four practice trials were followed by the randomly ordered experimental trials. In each trial, a 500 ms fixation cross was followed by a target picture in the upper centre of the screen, with two alternatives in the right and left lower portion of the screen, so that the three objects formed the corners of an imaginary triangle.

Following a keypress response and a 1000 ms blank ISI, the next trial appeared. To control for naming variations by Portuguese speakers that might violate predicted grammatical gender pairings, Portuguese participants in Experiment 3a named all items at the end of the experiment.

Results and discussion

Experiment 3a (pictures). Triads with less than 75% name agreement for all items were excluded from the analysis. This resulted in the exclusion of 12 triads. Only triads where the alternative name given had a different gender from the expected one were excluded. All other alternative names were accepted. The trend shown by the two groups did not differ significantly whether these triads were included or not, $t(73) = -0.10$, $\eta_p^2 = .00$ vs. $t(61) = -1.18$, $\eta_p^2 = .02$. However, the effect is considerably smaller for the analysis that included these triads, suggesting that labelling and categorisation are strongly linked. Mean name agreement of the remaining set of 67 triads was 97.51 ($SD = 7.03$). Figure 2 shows the proportion of times that items of the same gender were chosen as most similar by Portuguese speakers compared to the baseline performance of English speakers.

An independent samples t -test revealed no significant difference between English and Portuguese speakers in the proportion of same-gender pairings for pictures, $t(46) = 1.08$, $p > .10$, $\eta_p^2 = .02$; $t(61) = 1.18$, $p > .10$, $\eta_p^2 = .02$, indicating no effect of gender on Portuguese speakers' choices. The correlation between the proportion of same gender choices made to each triad by

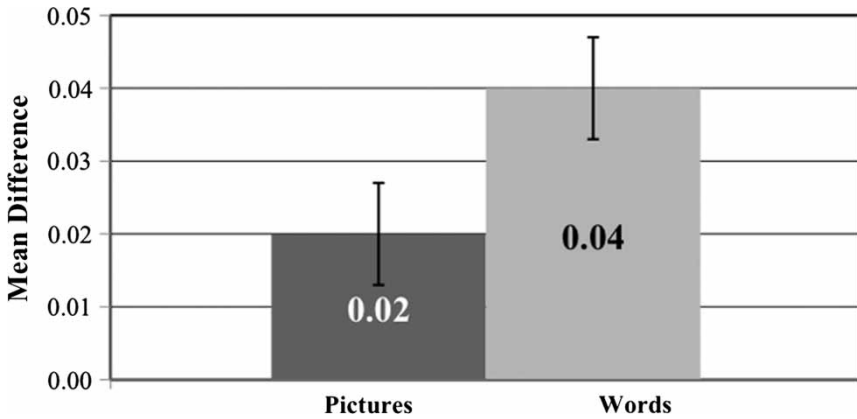


Figure 2. Mean difference in proportion of “same-gender” pairings made by Portuguese speakers compared to English speakers for the “better-likeness” task with pictures (Experiment 3a, $N=24$) and words (Experiment 3b, $N=26$) (error bars represent the standard error of the mean).

Portuguese and English speakers was high and reliable, $r(62) = .90$, $p < .01$, indicating that both groups were making similar judgements of semantic relatedness.

There were no reliable differences between Portuguese and English speakers’ better-likeness judgements for pictures. Speakers of both languages made comparable choices, revealing no apparent influence of grammatical gender on Portuguese speakers’ judgements of similarity with pictorial stimuli.

Experiment 3b (words). Figure 2 shows the difference in proportions of same gender choices between groups in this task.

An independent samples t -test revealed no significant difference between English and Portuguese speakers in the proportion of same-gender pairings for words, $t1(50) = 1.72$, $p > .05$, $\eta_p^2 = .06$; $t2(61) = 1.67$, $p > .05$, $\eta_p^2 = .04$. However, this difference approached significance in one-tailed tests (both $t1$ and $t2$ $ps = .05$; for Experiment 3a, one-tailed tests $t1$ and $t2$ $ps > .10$). In addition, the observed effect size, albeit small, was twice as large as the effect size in Experiment 3a, suggesting that Portuguese speakers showed a weak influence of grammatical gender, categorising items whose nouns take the same gender as more similar than did English speakers.

The correlation between Portuguese and English speakers’ responses was lower than in the task with pictures, $r(62) = .76$, $p < .01$, but still high and reliable. So, Portuguese speakers might have been influenced by gender to a greater degree in the task with words than with pictures. This difference cannot be attributed to lower internal consistency in this condition, as Cronbach’s alpha values were lower for the task with pictures, and yet

Portuguese and English speakers' responses were more strongly correlated. A Fisher's Exact Test compared the number of participants who made a high or low proportion of same-gender pairings (≥ 0.65 / < 0.65 , respectively) across the two experiments. This cutoff value was chosen to distinguish the participants that were clearly influenced by gender in their responses, from those who might have been occasionally influenced by gender.

Portuguese speakers were marginally more influenced by gender with word than with picture stimuli, $p = .06$, one-tailed, but there was, as expected, no such pattern amongst English speakers, $p = .34$, one-tailed.

GENERAL DISCUSSION

The present results provide only limited support for grammatical gender effects on semantic judgements of inanimate items, and suggest that such effects depend on linguistic processing and/or explicit reference to gender information. Experiment 1 replicated and extended previous findings (Sera et al., 1994, 2002), and showed that Portuguese speakers were strongly influenced by gender when assigning male or female voices to inanimate objects. The influence of gender was significantly reduced, however, in the absence of an overt reference to gender (Experiments 2 and 3), especially with pictorial stimuli. Thus, grammatical gender effects on semantic judgements appear to vary along a continuum: strongest for tasks that involve both mandatory use of language (verbal modality) and overt reference to grammatical gender (e.g., Boroditsky et al., 2003; Sera et al., 1994); weaker for tasks where reference to gender categories is removed, but items are presented in the verbal modality (Experiment 2 and 3b); and virtually absent for tasks with pictorial materials that do not require language processing (Experiment 3a, see also Vigliocco et al., 2005). Removing overt references to gender significantly reduced the effects reported in previous studies (e.g., Sera et al., 1994, 2002, and in Experiment 1), but Portuguese speakers' response patterns still differed marginally from the English speakers' in judgements of words.

Previous findings of gender effects on judgements about animate entities (Kousta et al., 2008; Vigliocco et al., 2005) have been explained in terms of a biologically constrained "sex and gender" hypothesis that would predict effects of gender on semantic representations for animate items. Grammatical gender effects for inanimate objects may be more superficial, reflecting online linguistic access rather than an impact of gender on semantics. The current findings support such a model, which would explain why previous studies have produced conflicting results. Grammatical gender assignments for inanimate objects vary arbitrarily across languages, so a lack of attribution of male- or female-like properties at a conceptual level may be

unsurprising. Nevertheless, the grammatical gender of object labels may be taken into account when attention is drawn to it by task demands and/or presentation modality (verbal) (Boroditsky et al., 2003; Sera et al., 1994, 2002).

The composition of experimental pairs/triads in these experiments was based on the ratings of English speakers, since English does not assign grammatical gender. The differences in similarity judgements shown by Portuguese speakers, both with words and pictures, raise the question of whether semantic similarity judgements are an appropriate proxy for semantic representations in grammatically gendered languages, since these judgements may reflect lexical rather than conceptual similarity. Such effects may only occur relatively late during the development of meta-linguistic knowledge (e.g., Sera et al., 1994). However, whether access to gender information is made under voluntary control, or participants are aware of it, remains an open question (see Heim, Alter, & Friederici, 2005, for a discussion of this issue).

Longitudinal developmental research may be required to elucidate the relationship between meta-linguistic knowledge of gender categories and use of grammatical gender knowledge in categorisation tasks.

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APPENDIX 1
Stimulus materials in Experiment 1

<i>English</i>	<i>Gender</i>	<i>Portuguese</i>	<i>English</i>	<i>Gender</i>	<i>Portuguese</i>
apple	F	maçã	log	M	tronco
ball	F	bola	match	M	fósforo
banana	F	banana	medal	F	medalha
bicycle	F	bicicleta	mirror	M	espelho
bone	M	osso	moon	F	lua
bowl	F	tigela	mountain	F	montanha
branch	M	ramo	mushroom	M	cogumelo
bread	M	pão	nest	M	ninho
broom	F	vassoura	onion	F	cebola
bucket	M	balde	orange	F	laranja
bus	M	autocarro	paintbrush	M	pincel
cactus	M	cacto	palm tree	F	palmeira
candle	F	vela	paper bag	M	saco
car	M	carro	peach	M	pêssego
carrot	F	cenoura	peanut	M	amendoim
chair	F	cadeira	pear	F	pêra
cheese	M	queijo	peas	F	ervilhas
cherry	F	cereja	pen	F	caneta
cloud	F	nuvem	pencil	M	lápis
comb	M	pente	pineapple	M	ananas
corn	M	milho	pinecone	F	pinha
crown	F	coroa	rainbow	M	arco-íris
cup	F	chávena	scarf	M	cachecol
egg	M	ovo	shovel	F	pá
feather	F	pena	skeleton	M	esqueleto
fire	M	fogo	sock	F	meia
flashlight	F	lanterna	sofa	M	sofá
fork	M	garfo	spider web	F	teia
frying pan	F	frigideira	spoon	F	colher
glass	M	copo	stool	M	banco
grapes	F	uvas	stove	M	forno
guitar	F	guitarra	strawberry	M	morango
hammer	M	martelo	sun	M	sol
jar	M	frasco	tomato	M	tomate
key	F	chave	toothbrush	F	escova-de-dentes
knife	F	faca	tree	F	árvore
leaf	F	folha	violin	M	violino
lemon	M	limão	volcano	M	vulcão
light bulb	F	lâmpada	walnut	F	noz
lightning	M	relâmpago	watermelon	F	melancia

APPENDIX 2
Stimulus materials in Experiment 2, 3a, and 3b

<i>English</i>	<i>Gender</i>	<i>Portuguese</i>	<i>English</i>	<i>Gender</i>	<i>Portuguese</i>
accordion	M	acordeão	jug	F	caneca
apple	F	maçã	jumper	F	camisola
arm	M	braço	key	F	chave
bag	M	saco	knife	F	faca
bicycle	F	bicicleta	leaf	F	folha
bowl	F	tigela	leg	F	perna
branch	M	ramo	lemon	M	limão
bread	M	pão	light bulb	F	lâmpada
broom	F	vassoura	log	M	tronco
bucket	M	balde	match	M	fósforo
bus	M	autocarro	mirror	M	espelho
butter	F	manteiga	nose	M	nariz
candle	F	vela	orange	F	laranja
car	M	carro	paintbrush	M	pincel
chain	F	corrente	pear	F	pêra
chair	F	cadeira	pen	F	caneta
cheese	M	queijo	pencil	M	lápiz
coat	M	casaco	pliers	M	alicate
comb	M	pente	rake	M	ancinho
cup	F	chávena	saucepan	M	tacho
dress	M	vestido	scarf	M	cachecol
dustpan	M	apanhador	screwdriver	F	chave-de-fendas
eye	M	olho	shirt	F	camisa
finger	M	dedo	shoe	M	sapato
flute	F	flauta	shoulder	M	ombro
flashlight	F	lanterna	shovel	F	pá
fork	M	garfo	skirt	F	saia
frying pan	F	frigideira	sock	F	meia
glass	M	copo	sofa	M	sofá
glove	F	luva	spoon	F	colher
guitar	F	guitarra	stool	M	banco
hammer	M	martelo	teapot	M	bule
hand	F	mão	teeth	M	dentes
hanger	M	cabide	toothbrush	F	escova-de-dentes
hat	M	chapéu	tree	F	árvore
hob	M	fogão	vase	F	jarra
hoe	F	enxada	violin	M	violino
jar	M	frasco			