

# Gender and Sex: The Experiential Basis of Grammar

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## Abstract

There have been contradictory reports of sex differences in language processing. A novel approach is adopted here which explores the experiential basis of such differences. Two studies examine the auditory processing of grammatical gender in Bulgarian in a gender decision (gender monitoring) task and a cued shadowing (word repetition) task. Reaction times in both experiments reveal significant two-way interactions between the grammatical gender of words (masculine vs. feminine) and the sex of the voice (male vs. female). The sex of participants in the gender decision task also interacted with word gender in terms of decision accuracy. Women were relatively more accurate on their “own reference” word gender (feminine) and less accurate on masculine gender words. A two-way interaction between word gender and participant sex on response latencies in the cued shadowing task supports the view that these effects are not strategic but have a highly automatic nature instead. Findings are interpreted in terms of individual differences in the experience of grammatical gender in such gender-marking languages.

**Keywords:** grammatical gender, participant sex/gender, individual differences.

## Introduction

Over the past decades a number of studies have claimed to reveal sex differences in language performance, language ability and underlying brain cortical areas and hormonal levels. For example, Shaywitz, Shaywitz, Pugh, Constable, Skudlarski, Fulbright, et al. (1995) have suggested differences in language lateralization, Weiss, Kemmler, Deisenhammer, Fleischhacker, & Delazer (2003) in verbal fluency tasks, Kramer, Kaplan, Delis, O'Donnell, & Prifitera (1997) in verbal learning, etc., and theoretical accounts of such differences may attempt to explain them in terms of evolutionary origins and advantages and/or hormone level variation. Although sex differences may disappear in later childhood, large-scale studies have found robust evidence for the effects of gender on early language development, including vocabulary comprehension and production using the MacArthur Bates Communicative Development Inventories (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994). On the other hand, in a critical review of the research presented in numerous studies, Wallentin (2009) concludes that there is not much clear and uncontroversial evidence for sex differences in language

processing with the exception of the early language development advantage for girls and that although certain language-related deficits exhibit clear sex differences, such as stuttering, dyslexia, and autism whose occurrence is much higher in males, a causal link and a good theory of why and how such differences may arise are still lacking.

In this paper, an entirely different aspect of human experience with language is explored, which may lead to sex differences in language processing, more specifically grammar. Even if grammatical categories are learned and used by all typically developing speakers of a language, both men and women, the specific individual experiences with these categories may differ. The use of grammatical gender is a case in point here. Individuals vary on the dimension of sex and in at least some languages this individual characteristic is important in selecting the appropriate grammatical gender form used in reference to that individual. In the relatively poor morphology of the English language, this variation is observed in very few forms such as the personal pronouns in the 3<sup>rd</sup> person, Singular (*he* vs. *she*), in the richer morphology of the German language it is found in noun phrases referring to both animate and inanimate entities encoded in pronouns and articles (*der*, *die*, *das*), and in Slavic languages even further on word categories such as adjectives, verb forms, numerals, etc. Grammatical gender may furthermore be not as arbitrary as it is habitually seen. In a study of gender processing and lexical access in Bulgarian, Andonova, D'Amico, Devescovi, & Bates (2004) discovered a significant contribution of semantic gender to processing in Bulgarian in contrast with previous findings for Italian. Particularly interesting, however, was another finding of this research, namely, an interaction between sex of the subject and noun gender, reflecting a bias toward one's own grammatical gender “counterpart” (especially for females) in Bulgarian. Triggered by this novel finding, a reanalysis of data from a prior study in Italian showed a similar interaction. How could such differences emerge? In contrast with biological and/or cultural explanations, we offer here an experiential account.

Both men and women produce gender-marked words (nouns, adjectives, verbs, etc.) in Bulgarian in large quantities on a daily basis, and so both sexes have a largely equivalent experience in terms of frequency of usage of the three genders. However, a woman's individual experience with gender-marked forms matching her own sex, i.e., Feminine gender words, would be different in some ways from the experience of a man with the same feminine gender forms, all else being equal. The difference is both in

the quantity and quality of the experience. Women speaking Slavic and Romance languages (for example) would produce a higher number of Feminine gender forms than men given that they use such forms in situations of self-reference, in which men would have to use Masculine gender forms, and vice versa. For example, a Bulgarian woman may express her feeling of fatigue by saying *уморена съм* (Eng., I am tired\_Fem), an Italian woman would say *sono stanca* (Eng., I am tired\_Fem) while in Italian, a man would have to admit *sono stanco* (Eng., I am tired\_Masc). The individual experience women and men have with gender-marking forms is not only different in quantity (frequency of usage) but also in the degree to which there is personal relevance to the individual (in self-reference). Thus, a lifetime of using gender marked forms in a sex-specific way would lead to the accumulation to differences in the sensitivity to such forms in the two sexes.

## Experiment 1

This first experiment had the following objectives. First, it aimed at testing for an interaction between participant sex and word gender in the gender decision task and extending previous somewhat limited findings with Bulgarian and Italian speakers performing a gender monitoring (decision) task on nouns in their native language (Andonova et al., 2004).

Second, every noun typically has only one gender, i.e., Masculine, Feminine or Neuter, for example, *стол* (Eng., chair) is a Masculine noun, *маса* (Eng., table) is a Feminine noun, and *куче* (Eng., dog) is a Neuter noun, that is, grammatical gender is invariant. However, adjectives and some verb forms in Bulgarian have all three gender forms, for example, *бавен*, *бавна*, *бавно* are the translation equivalents of the English word *slow* but in three different forms, one for each of the three genders (*slow\_Masc*, *slow\_Fem*, *slow\_Neut*). The second research objective was to test whether a participant sex by grammatical gender interaction would also emerge in the processing of adjectives and verb forms that can vary across gender categories. Note that in Bulgarian, there is typically a regular and transparent mapping between word form endings and the category of gender. This applies to nouns as well as the adjectives and verb forms included in the stimuli materials for this experiment.

The third objective was to examine the possibility of an interaction between grammatical gender and speaker sex in addition to participant sex. The motivation for this follows a somewhat similar rationale as that concerning the interaction of participant sex and grammatical gender and its possible explanation on the basis of the difference in the quantity and kind of experience the two sexes have with gender-marking word forms, as elaborated in the examples above. Speakers of gender-marking languages such as Slavic and Romance languages not only *produce* own-gender matching word forms more frequently but they also

*hear* such forms more frequently in verbal interactions, viz., in situations where their interlocutor refers to them, for example, asks them whether they are tired, etc. (Note though later – that it is confounded without situational context – speaker talking about 1<sup>st</sup> or 2<sup>nd</sup> person etc.) Therefore, one might expect to find such an interaction between speaker sex (the voice for the auditory stimuli) and the grammatical gender of the words. This possibility was tested by presenting stimuli in the auditory modality instead of in writing and recording stimuli in two voices – male and female – to be used as an experimental variable.

## Method

The design of the experiment included Participant Sex (men vs. women), Grammatical Gender of the word (Masculine vs. Feminine) and Voice Gender (male vs. female voice) as independent variables and mean percent errors and response latencies as the dependent variables.

**Participants** 40 participants (20 men and 20 women) took part in the experiment. They were university students within the 19-30 age range who were paid a modest amount for their participation. All were native speakers of Bulgarian.

**Stimuli and Procedure** The experimental stimuli consisted of 3 different gender forms each of 62 verbs and adjectives in Bulgarian presented in a different randomized order for each participant in the auditory modality by two speakers of Bulgarian, i.e., in two voices (a male and a female voice). Words of all three grammatical genders in Bulgarian were included in the list of stimuli in order to make the task more natural and the research objectives less obvious so that participants would not be tempted to follow a simple binary choice strategy. The analyses, however, focused on the two critical grammatical genders (Masculine and Feminine) in line with the research hypotheses.

Participants were tested individually in a sound proof booth and were asked to listen to stimuli one at a time and press one of three available buttons to indicate the grammatical gender of the word they have just heard (Masculine, Feminine, or Neuter). Accuracy and speed in completing the task were both emphasized in the experimental instruction.

Presentation of stimuli and registration of participants' responses were controlled by Psyscope and a button box. Before the experiment began, participants did four to six practice trials to familiarize themselves with the task and procedure. In addition, since gender in Bulgarian is a three-member grammatical category, and in order to avoid bias, participants were assigned randomly to one of six spatial configurations of the three buttons in the gender-monitoring task, i.e., m-f-n, m-n-f, f-n-m, f-m-n, n-m-f, or n-f-m.

The 186 word forms were recorded by a female and a male speaker of Bulgarian in a neutral intonation with a falling tone. They were digitized using the Macintosh SoundEdit system, and were placed in a sound file within

the PsyScope experiment preparation package developed by Cohen, MacWhinney, Flatt, and Provost (1993) at Carnegie Mellon University. For each item, reaction times (RT) were measured from the offset of the stimulus word to the participant's response (the button press in the gender decision task).

## Results

All participants had a mean accuracy higher than 90% and a mean RT below 900 msec. RTs for trials on which participants made a decision error were dropped from further analysis. The following outlier procedure was used. The means (M) and standard deviations (SDs) for each participant were computed, and all RTs less than three SDs below the mean of the participant or greater than three SDs above the mean were considered outliers. This resulted in the rejection of 1.58% of all RT data. Here first the results of analyses run on participant means will be presented.

The data were analyzed in two 2 (Participant Sex: men vs. women) x 2 (Grammatical Gender of the word: masculine vs. feminine) x 2 (Voice: male vs. female) repeated measures ANOVAs on participant means of mean percent gender decision error and on mean response latencies measured from the end of presentation of the auditory stimuli with participant sex as a between-participants variable and word gender and voice as within-participant variables.

**Accuracy** In the analysis of the mean percent gender decision error, a main effect of words' grammatical gender was found,  $F(1, 38) = 6.77$ ,  $p = .013$ ,  $\eta_p^2 = .151$ . Participants overall ( $n = 40$ ) had a lower error rate in their gender decision when responding to Feminine gender words (Mean = 0.89%, SD = 9.38%) than Masculine gender words (Mean = 1.81%, SD = 13.34%). There were no main effects of participant sex or voice. There was, however, a statistically significant two-way interaction between participant sex and word gender,  $F(2, 38) = 6.20$ ,  $p = .017$ ,  $\eta_p^2 = .140$ . Whereas men's error rate did not differ on the two grammatical genders (M = 1.29% and M = 1.25% for masculine and feminine words, respectively), women produced more inaccurate gender responses on words of masculine grammatical gender than of feminine grammatical gender (M = 2.34% for masculine and M = 0.52% for feminine words). This interaction is illustrated in Figure 1. There were no further interactions.

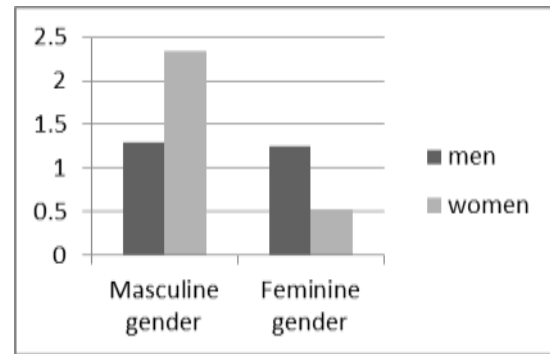


Figure 1: Mean percent error of male and female participants in the gender decision task for words of Masculine and Feminine gender.

**Response Times** In the analysis of the mean reaction times, a main effect of words' grammatical gender was found again,  $F(1, 38) = 23.31$ ,  $p < .001$ ,  $\eta_p^2 = .380$ . Participants overall responded slower to words of masculine grammatical gender (M = 576 ms, SD = 218 ms) than to words of feminine grammatical gender (M = 525 ms, SD = 194 ms). In addition, there was a main effect of participant sex,  $F(1, 38) = 6.26$ ,  $p = .017$ ,  $\eta_p^2 = .141$ . On average, women's decisions took longer (M = 582 ms, SD = 201 ms) than men's (M = 512 ms, SD = 208 ms). However, there was no participant sex by grammatical gender interaction on the mean reaction times.

Finally, in the analysis of reaction times, a main effect of voice emerged,  $F(1, 38) = 125.33$ ,  $p < .001$ ,  $\eta_p^2 = .767$ . Participants' decisions took longer for stimuli pronounced by the male voice (M = 557 ms, SD = 205 ms) than by the female voice (M = 536 ms, SD = 209 ms). This gender difference is likely due to acoustic characteristics of the voices such as baseline pitch, for example. More importantly, however, there was a significant two-way interaction between the independent variables of grammatical gender and voice,  $F(1, 38) = 36.22$ ,  $p < .001$ ,  $\eta_p^2 = .488$ , such that responses to masculine gender words did not differ in latency with respect to the gender of the voice (M = 582 ms for male voice stimuli and M = 570 ms for female voice stimuli) but, on the other hand, participants responded slower to the male voice pronouncing feminine gender words (M = 556 ms) than to the female voice saying feminine gender words (M = 493 ms). This interaction is illustrated in Figure 2. There were no further interactions.

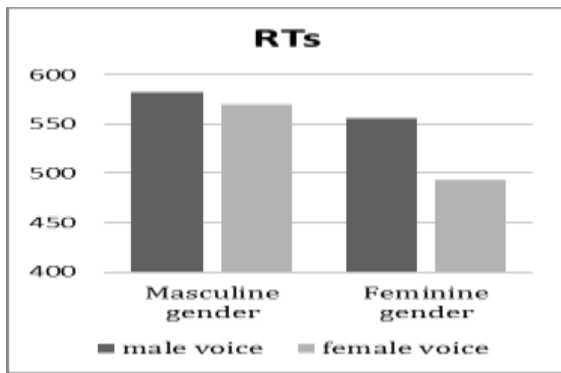


Figure 2: Mean response times in the gender decision task for words of Masculine and Feminine gender spoken by a male or a female voice. *Note:* RTs are measured from the offset of the auditory stimuli.

**Analyses on Item Means** A second set of analyses examined data patterns in item means. It yielded the same pattern of results as described above and will not be presented here in detail.

## Discussion

The data from Experiment 1 support the research hypothesis of an interaction between word gender and participant sex in the gender decision task. The results have shown that men and women respond in a different manner to the same stimuli in the Masculine and Feminine grammatical genders. The pattern of errors in this task is particularly revealing – whereas men’s gender decisions are equally accurate on both Masculine and Feminine gender words, women tend to make more errors on Masculine gender words than Feminine, a pattern that is in line with the expectation that after a lifetime of personal experience in a gender-marking language they have become sensitized to word forms that match their own gender in referential expressions. It remains to be studied further why the pattern is not mirrored clearly in the case of men and Masculine forms. One possibility is that their “own” referential gender overlaps with the unmarked, default member of the grammatical category while Feminine forms are also the marked member of the category and thus more salient generally but at this point it is hard to offer an explanation of sufficient specificity.

Secondly, a two-way interaction between word gender and voice/speaker sex on reaction times was also established. This is a novel and intriguing finding that deserves future investigation. Participants reached their gender decision faster when there was a match between the sex of the female voice and the grammatical gender of the words being heard. It appears that saliency of the feminine forms in combination with a matching ‘speaker perspective’ facilitated responses in this task.

## Experiment 2

The first experiment established the interaction of word gender decision times with speaker voice gender and the interaction of gender decision accuracy with the sex of participants. However, one might argue that these findings are task-specific. After all, participants were asked to reveal their linguistic competence by making a judgment on a clearly grammatical aspect of the stimuli. Although the participants in Experiment 1 performed the task with the kind of ease that shows them to be fully competent (low error rates) and highly efficient (low RTs) in making a gender decision, the question remains – would we find an interaction between word gender and each of the two extra-linguistic variables of participant sex and speaker voice sex in a different task, especially one that is even more automatic and requires no conscious effort in everyday experience? One such highly automatic experimental task is cued shadowing in which participants listen to and repeat words as fast as they can. This was the task used in Experiment 2.

## Method

The design of the second experiment was exactly the same as the first experiment but this time the experimental task was cued shadowing. Participant sex (men vs. women) was a between-participant independent variable; voice (male vs. female) and word gender (Masculine vs. Feminine) were within-participant independent variables. No decision was required in this task and error rates were not of interest. The analyses were conducted on participant means and on item means of response times measured from voice onset registered by the Psyscope button box used as in Experiment 1.

**Participants** Another 40 participants (20 men and 20 women) took part in Experiment 2. They were university students within the 19-30 age range who were paid a modest amount for their participation. All were native speakers of Bulgarian.

**Stimuli and Procedure** The experimental stimuli consisted of two different gender forms each of 100 verbs and adjectives in Bulgarian presented in a different randomized order for each participant in the auditory modality by two speakers of Bulgarian, i.e., in two voices (a male and a female voice). As the cued shadowing task is a highly automatic and non-strategic one, there was no need to include neuter gender words to make the task more natural and the research objectives less obvious. Again, the analyses examined the two critical grammatical genders (Masculine and Feminine) in line with the research hypotheses.

Participants were tested individually in a sound proof booth and were asked to listen to stimuli one at a time and repeat each word. Accuracy and speed in completing the task were both emphasized in the experimental instruction.

Presentation of stimuli and registration of participants' responses were controlled by Psyscope and a button box. Before the experiment began, participants did four to six practice trials to familiarize themselves with the task and procedure.

The 200 word forms were recorded by a female and a male speaker of Bulgarian in a neutral intonation with a falling tone. They were digitized using the Macintosh SoundEdit system, and were placed in a sound file within the PsyScope experiment preparation package developed by Cohen, MacWhinney, Flatt, and Provost (1993) at Carnegie Mellon University. For each item, reaction times (RT) were measured from the offset of the stimulus word to the participant's response (voice onset as registered by the button box).

## Results

Hardly any errors were made by participants in this task except for fifty individual trials with false starts or where no response was registered by the button box. Data cleanup was accomplished in a two-step outlier procedure for the RTs of correct responses, following Balota, Yap, Cortese, Hutchison, Kessler, Loftis, et al. (2007). First, all negative response latencies, i.e., where voice onset preceded in time the end of the auditory stimulus, and all latencies longer than 1,500 msec were identified as outliers. Second, for the remaining RTs, the means and SDs were computed for each participant, and all RTs less than three SDs below the mean of the participant or greater than three SDs above the mean were considered outliers as well. This resulted in the rejection of 1.87% of all reaction time data.

Here the results of the statistical analyses of participant means will be presented. The pattern of results from the analyses of the item means was the same and would be redundant to describe.

The data were analyzed in a 2 (Participant Sex: men vs. women) x 2 (Grammatical Gender of the word: masculine vs. feminine) x 2 (Voice: male vs. female) repeated measures ANOVAs on participant means of response latencies measured from the end of presentation of the auditory stimuli with participant sex as a between-participants variable and word gender and voice as within-participant variables.

**Response Times** In the analysis of participants' mean reaction times, a main effect of words' grammatical gender was found again,  $F(1, 38) = 93.68$ ,  $p < .001$ ,  $\eta_p^2 = .711$ . Participants overall responded slower to words of masculine grammatical gender than to words of feminine grammatical gender. This result is consistent with the data pattern observed in the gender decision task. Since a decision was not involved in this task at all, however, the main effect of word gender in both experiments is likely due to the measurement of reaction times from the offset of the auditory stimuli.

There was no main effect of participant sex. In addition, a main effect of voice emerged,  $F(1, 38) = 214.78$ ,  $p < .001$ ,

$\eta_p^2 = .850$ . Participants' responses took longer for stimuli pronounced by the male voice than by the female voice. Again here, this gender difference is likely due to acoustic characteristics.

More importantly, however, there were two significant two-way interactions. One of them was an interaction between the independent variables of word gender and participant sex, revealing that women responded particularly fast to Feminine gender words,  $F(2, 38) = 5.51$ ,  $p = .024$ ,  $\eta_p^2 = .127$ . This interaction is illustrated in Figure 3.

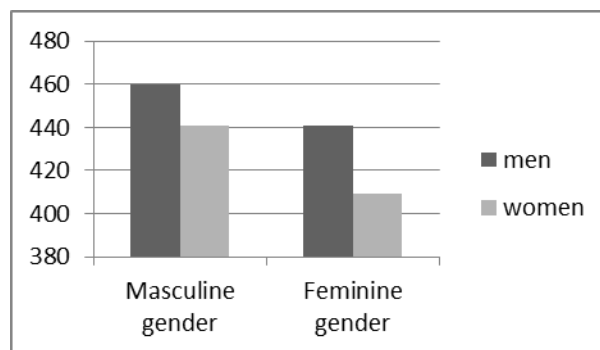


Figure 3: Mean response times by men and women in the cued shadowing task as a function of word gender. *Note:* RTs are measured from the offset of the auditory stimuli.

The second significant two-way interaction was between the independent variables of word gender and speaker voice,  $F(2, 38) = 59.33$ ,  $p < .001$ ,  $\eta_p^2 = .610$ . This interaction is illustrated in Figure 4. Participants responded to Feminine gender words particularly fast again when they were spoken by a female voice.

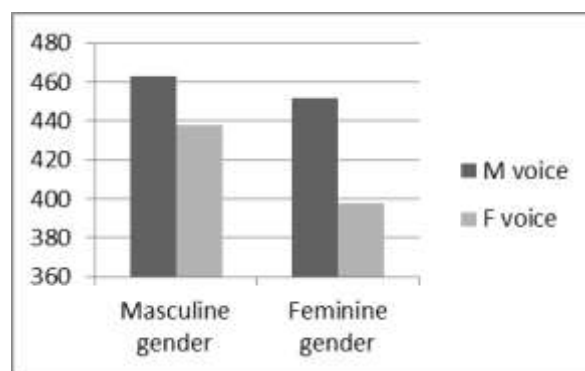


Figure 4: Mean response times in the cued shadowing task for words of Masculine and Feminine gender spoken by a male or a female voice. *Note:* RTs are measured from the offset of the auditory stimuli.

## Discussion

The results of experiment 2 mirror those of experiment 1 remarkably. Even though the two tasks were different in

their nature and task demands, participants' responses were strikingly similar in terms of speed of processing and the emergence of significant interactions between word gender as a grammatical feature and participant sex and speaker voice sex as extra-linguistic information sources.

## Conclusion

The studies reported here were guided by the research question whether the individual language experience of speakers may influence the way they process language online and offline, and how linguistic and extra-linguistic categories may interact as a result of this experience. In two studies with different language processing tasks and a total of 80 participants, the grammatical category of gender was found to interact with participant sex and with voice sex in the expected direction revealing the impact of individuals' usage of gender-marking forms throughout their lifetime on the speed and accuracy of gender decisions and on the efficiency of processing lexical items in a word repetition task.

It is worth pointing out here that these interaction effects were observed in the analyses of both participant means and item means and in both tasks, making them robust findings. The second task, word repetition, was particularly important in establishing the automatic, non-strategic nature of the effects, a finding that speaks in favor of extensive habitual use implicated in the emergence of these novel phenomena.

These findings have important implications of a methodological nature. Future studies of lexical processing in at least heavily gender-marking languages such as those from the Slavic and Romance language groups need to take into account the possibility of participant sex interactions with the grammatical category of gender, and implement the necessary control and counterbalancing mechanisms.

More importantly, however, the results from the two studies indicate the importance of studying individual differences in language processing and have further theoretical implications in line with the current growth of interest in embodiment and its experiential aspects and in alignment with our understanding of language and language usage being at least partially dependent on specific individual human experience instead of being an entirely arbitrary symbolic system without intrinsic or extrinsic motivation.

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