Biological Sex Context Influences Grammatical Gender Categorization of Objects

Armina Janyan (ajanyan@cogs.nbu.bg)
Department of Cognitive Science and Psychology, New Bulgarian University
21 Montevideo St., 1618 Sofia, Bulgaria

Yoana Vergilova (yoana_vergilova@yahoo.com)
Department of Cognitive Science and Psychology, New Bulgarian University
21 Montevideo St., 1618 Sofia, Bulgaria

Abstract

We have conducted three behavioral experiments testing the hypothesis of non-arbitrariness of grammatical gender assignment. A grammatical gender-biological sex association was tested with the use of the Implicit Association Test. Pictorial stimuli of artifacts and of humans of both sexes were used for gender and sex online categorization. Overall, the results suggested that the task of explicit sex and grammatical gender categorization can reveal the sex-gender association. The results suggest that grammatical gender may not be completely arbitrary.

Keywords: grammatical gender; biological sex; gender arbitrariness; RT.

Introduction

Grammatical gender can be a pervasive construct that can be linked with a number of other linguistic categories such as phonological and morphological markers as well as with semantic origin (including biological sex). Traditionally, however, grammatical gender is assumed to have arbitrary assignment, that is, to have little if any, links with the semantics of the word. This account has been challenged recently with a great deal of research that suggests a link between the conceptual properties of objects and their grammatical gender. In line with the linguistic relativity hypothesis, this link would suggest an influence of grammatical gender knowledge on cognition. Studies have shown that speakers have knowledge of gender assignment regularities (e.g. Schwichtenberg & Schiller, 2004); that speakers connect biological sex with grammatical gender of artifacts; and, as a consequence, grammatical gender can influence the semantic/conceptual representation of artifacts (e.g. Boroditsky, Schmidt & Phillips, 2003). These and similar studies have used off-line methodology like category membership decision, attribute property listing, similarity rating, gender assignment (e.g. Andonova, Gosheva, Janyan & Schaffai, 2007), assignment of male or female voice to an object (e.g. Sera, Berge, & del Castillo-Pintado, 1994), semantic substitution errors (e.g. Vigliocco, Vinson, Paganelli, & Dworzynski, 2005). On-line reaction time (RT) studies focus mainly on psycholinguistic processing peculiarities and grammatical information representation viewing grammatical gender as lexico-syntactic 'stored' property of words (see Schriefers & Jescheniak, 1999 for a review in language production).

The aim of the current study is to test online the hypothesis that grammatical gender of nouns is associated with biological sex and is not entirely arbitrary. For that we have used the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998). It is a task used mainly in social psychology to uncover implicit attitudes, stereotypes and schemas. It uses reaction time (RT) with the implication that the more robust an association is, the faster the subjects' reactions are. In other words, when the two concepts are associated or similar (e.g., pleasant-flower), participants respond faster compared to when the concepts are not associated or are dissimilar (pleasant-insect). Usually, the participants have to distinguish between three or four categories (e.g., one or two attribute and one or two target categories) of stimuli, by pressing two corresponding buttons. In our case target categories represent grammatical gender (feminine and masculine), and attribute categories – biological sex. We pose the hypothesis that grammatical gender might be associated with biological sex. In this case if our target category (e.g., feminine grammatical gender) is paired with a corresponding (congruent) attribute category (e.g., female) then participants would respond faster comparing to the not corresponding (incongruent) pair (feminine grammatical gender and male).

In this paper we use the term "gender" in short for grammatical gender and oppose it to the term "sex", by which we mean biological sex. In other words, for linguistic purposes in this study "sex" refers to people (male and female sex) and "gender" refers to grammatical gender of the names of inanimate objects (artifacts).

It should be noted that Bulgarian has three gender categories: masculine, feminine, and neuter. Generally, nouns, adjectives, pronouns and some verb forms ending in consonant are considered masculine (unmarked form); those ending in -a/-ia – feminine; and those ending in -e/-o/-i/-u – neuter (marked forms). Because of the nature of the task and our main aim (a test of the gender-sex association), only masculine and feminine gender categories were studied.

In order to avoid explicit linguistic gender markers, pictures of objects/artifacts and of humans of both sexes were used as stimulus material. The first experiment sought to test if a simple object categorization (without explicit activation of gender information) in biological sex context would reveal the gender-sex implicit association.

Experiment 1: Object Categorization

Method

Participants 24 right-handed native Bulgarian speakers (8 males) participated in the experiment (mean age=23.5, SD=2.2 years) voluntarily or for course credit.

Stimuli and Design Stimuli for a 2 (Gender: Feminine vs. Masculine) x 2 (Sex-Gender Congruency: Congruent vs. Incongruent) design were selected from the pictures in an on-line object naming task with 520 pictorial stimuli in Bulgarian (a cross-linguistic study, 50 participants per language (Szekely et al., 2004). For more details on participants, procedures, and pictorial stimuli in the picture naming norming study, see Szekely et al. (2004) and / or visit the on-line data base at http://www.crl.ucsd.edu/~aszekely/ipnp/. Overall, 20 target inanimate object pictures were selected: 10 object names in feminine gender and 10 object names – in masculine (see Table 1 for stimuli examples). The object pictures had high name agreement percentages to ensure specific target name activation and its unique gender. 8 attribute pictures that depict humans (4 females and 4 males) were selected for the sex categorization part to insure the biological sex context.

Table 1: Target (first row) and attribute (second row) stimuli examples with their respective gender or sex.

	балон [balon], masculine		лъжица, [lazhitsa], feminine
	мъж [mazh] male		жена [zhena] female

The pictures and words characteristics were matched on the most important psycholinguistic characteristics derived from the data base (see Table 2). Picture naming RTs (from the norming study) were also included to ensure that pictures in the two conditions were recognized and named equally fast. T-tests showed all the differences between characteristics across grammatical gender condition to be highly insignificant (t_s<1, p_s>.3).

Table 2: Means and standard deviations (in parentheses) of characteristics of picture and its name for each grammatical gender condition[1].

	Feminine	Masculine
Naming RT, ms	934 (142)	974 (176)
Name agreement[2]	92 (4)	93 (8)
Image agreement[3]	5.8 (0.4)	5.7 (0.4)
Imageability	6.1 (0.3)	6.1 (0.2)
Concreteness	6.0 (0.4)	6.1 (0.4)
Objective frequency	0.7 (0.4)	0.6 (0.3)
Subjective frequency	4.6 (0.4)	4.4 (0.6)
Animacy	1.8 (0.3)	1.8 (0.2)
Object familiarity	6.1 (0.2)	6.1 (0.2)
AoA	5.2 (0.4)	5.2 (0.5)
Length in letters	5.2 (0.9)	5.2 (0.4)

Note. Concreteness, imageability, object familiarity, subjective frequency, animacy and image agreement represent a 7-point subjective rating (7 – the most concrete, imageable etc.); Age of word acquisition (AoA) 7-point rating scale represents 7 as the earliest acquired items (under 2 years of age) and 1 – the latest acquired items (over 13 years old); length in letters refers to word length measured in number of letters. Objective word frequency data were derived from a 72-million data base (Simov et al., 2004). These were converted into frequency score per million and then 10-base logarithm of the score was taken with one added to the score per million to avoid the undefined Lg(0).

Procedure The experiment consisted of two phases: familiarization phase and experimental phase. During the familiarization phase participants were presented with the pictorial stimuli blocked by type (objects and humans). The pictures stayed on the screen for 3 sec. The experimental phase was divided into four pseudorandomized sessions to counterbalance congruency conditions and presentation side (left or right) within subjects (see Figures 1 and 2). In each session participants saw every object picture twice and every human picture 5 times. Sex categories (male and female) were written on the left and right upper corners of the screen, and object category (written 'object') appeared under one of them. Congruent condition was considered a case of two categories assigned to one corner and being congruent in sex and gender (e.g., male and object in one corner was a congruent condition if an object had a masculine gender name, and was an incongruent condition if an object had a feminine gender name. For an example see

[1] For an overview of how picture processing and psycholinguistic factors influence the processing see Johnson, Paivio & Clark (1996).
[2] Name agreement refers to the degree to which participants agree on the name of the picture measured by the percentage of people who produced a given name.
[3] Image agreement reflects the degree (subjectively rated) to which a mental image generated by participants in response to the name of the picture matches the picture.

Figure 2.). Participants' task was to categorize humans (male or female) and objects and press a corresponding button (left or right, depending on which corner a particular category was assigned). Each trial started with a fixation cross ("+") for 1000 ms followed by a picture in the center of the screen that stayed for 3 sec or until a subject's response. The inter-trial interval was set to 700 ms. Stimuli presentation order was unique for each subject and pseudorandomized so that no more than two consecutive trials appeared in the same condition. E-prime software (Schneider, Eschman, & Zuccolotto, 2002) controlled the stimulus presentation and the recording of RT and accuracy. Participants had to press the leftmost or rightmost button (in a row of five buttons) on a serial response box with a 1 ms time resolution. RT was measured from the onset of the picture. The experiment was run in a sound-proof booth and took about 20 minutes. Participants had short breaks between the four sessions.

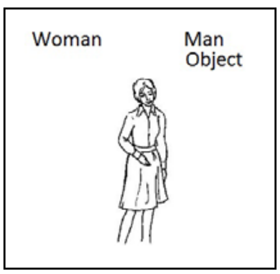

Figure 1. Example of a categorization set and an attribute stimulus from Experiment 1. In this case subjects had to respond with the left button, categorizing the stimulus as belonging to the female biological sex. Image not to scale.

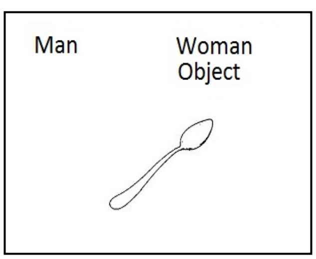

Figure 2. Example of a categorization set and a target stimulus from Experiment 1. In this case the subjects had to answer with the right button as *lazhitsa* (spoon) is an object. The portrayed condition is congruent, since *lazhitsa* (spoon) is of feminine gender in Bulgarian and the categorization for "object" is done with the same button as the categorization for "woman". The image is not to scale.

Results and Discussion

Prior to the analysis, erroneous responses (1.7%) and response times lying more than ±2 standard deviations from the RT mean per condition were excluded (4.3%). A repeated measures analysis of variance (ANOVA) was run on target object categorization RTs.

Here only the results of the by-subject analysis are presented, as the number of items was quite low (10 per condition) for the item analysis. By-item analyses were also conducted and were essentially the same. Table 3 presents subject means and standard deviations for each condition in ms.

A 2 (Gender: masculine vs. feminine) by 2 (Sex-Gender congruency: congruent vs. incongruent) repeated measures ANOVA on the mean RT revealed a main effect of gender ($F(1,23)=21.90$, $p<.001$, $\eta_p^2=.49$) which showed that it took less time to categorize an object with a name in feminine gender (588 ms) than with a name in masculine (608 ms). No effect of congruency ($F(1,23)=0.07$, $p>.8$, $\eta_p^2=.003$) or interaction ($F(1,23)=1.63$, $p>.2$, $\eta_p^2=.07$) was observed. Additional analyses did not provide any explanation to the gender response bias.

Table 3: Mean response times (in ms) and standard deviations (in parentheses) for four experimental conditions, subject means.

	Congruent	Incongruent
Feminine	600 (88)	576 (103)
Masculine	596 (110)	622 (100)

Overall, it can be concluded that the experiment did not reveal any grammatical gender association with biological sex. It could be assumed that an explicit gender categorization along with sex categorization might be more sensitive to the association. The next experiment was a control experiment that tested if there was any response bias in categorizing objects by their grammatical gender, to which the gender effect from the first experiment could be partially assigned.

Experiment 2: Grammatical Gender Categorization

Method

Participants 24 right-handed native Bulgarian speakers (4 males) participated in the experiment (mean age=25, SD=3.8 years) voluntarily or for course credit. Two of them participated in Experiment 1.

Stimuli and Design Stimuli were the same as in Experiment 1. Only the gender of the inanimate objects was of interest. That is, a one-factorial design with two levels (masculine and feminine gender) was applied.

Procedure The procedure was the same as in Experiment 1. The difference was in the task: participants were asked to categorize the inanimate objects by gender or to categorize pictures of men and women as human and press a corresponding button (see Figure 3). Gender categories (feminine and masculine) were assigned to the left or to the right upper corners of the screen, and the human category appeared under one of them. During this experiment the biological sex category was not explicitly mentioned on the screen and thus was of no interest. The appearance of categories was counterbalanced within subjects as in Experiment 1. Example of a categorization set and a stimulus is shown on Figure 3.

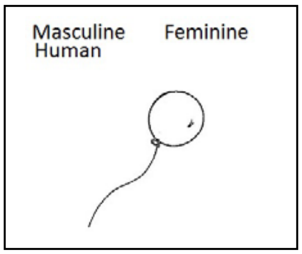

Figure 3. Example of a categorization set and a target stimulus from Experiment 2. In this case subjects had to respond with the left button, as *balon* (balloon) is of masculine gender in Bulgarian. Image not to scale.

Results and Discussion

Erroneous responses (0.4%) and RTs lying more than ±2 standard deviations from the mean per condition were excluded from the analysis (4.8%).

A one-way repeated measures ANOVA on subject means showed that there was no difference in assigning grammatical gender to objects (F(1,23)=1.20, p>.2, η_p^2=.05). Objects with names that bore feminine gender were processed equally fast as objects that bore masculine gender (887 and 898 ms, respectively).

The next experiment was conducted to test the prediction that a more explicit gender-sex categorization task would reveal an association between sex and gender. To increase the activation of the concept of biological sex, a male and a female face were used instead of printed words.

Experiments 3: Grammatical Gender and Biological Sex Categorization

Method

Participants 24 right-handed native Bulgarian speakers (10 males) participated in the experiment (mean age=24.8, SD=4.9 years) voluntarily or for course credit. None of them participated in previous experiments.

Stimuli and Design Stimuli were the same as in Experiment 1 and 2. The design was a 2 (Gender: Feminine vs. Masculine) x 2 (Sex-Gender Congruency: congruent vs. incongruent).

To avoid visual similarity in printed words (e.g., female-feminine gender [zhena-zhenski rod]) and to increase conceptual activation, two averaged faces of a male and a female (see Figures 4 and 5) were obtained from an open online faces database (http://faceresearch.org) and used as sex categories. The Gender category was presented with printed words (feminine and masculine). Thus, congruent condition was considered a case of two associated categories assigned to the same corner (e.g., male face and masculine gender in the same corner was a congruent condition, and female face and masculine gender in the same corner – an incongruent condition). Examples are shown in Figures 4 and 5.

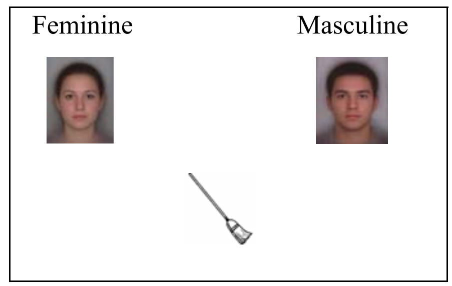

Figure 4. An example of a congruent categorization set. In this case, subjects had to respond with the left button, as the name of the object *metla* (broom) is of feminine gender in Bulgarian. Images are not to scale.

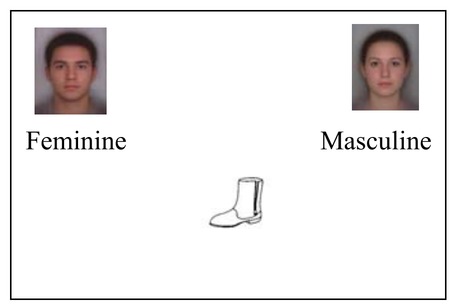

Figure 5. An example of an incongruent categorization set. In this case, subjects had to respond with the right button, as the name of the object *botush* (boot) is of masculine gender in Bulgarian. Images are not to scale.

Procedure The procedure was the same as in the previous experiments. The difference was in the categorization frame and the task: here participants were explicitly asked to categorize objects by their grammatical gender and humans by their biological sex and to press a corresponding button (see Figures 4 and 5). The conditions and spatial appearance of categories were counterbalanced within subjects.

Results and Discussion

Prior to the analyses erroneous responses (4.7%) and response times lying more than ±2 standard deviations from the RT mean per condition were removed (4.9%).

Table 4 presents subject means and standard deviations for each condition in ms.

Table 4: Mean response times (in ms) and standard deviations (in parentheses) for four experimental conditions, subject means.

	congruent	incongruent
Feminine	818 (120)	1138 (144)
Masculine	877 (153)	1120 (159)

A 2x2 repeated measures ANOVA on subject means obtained significant effect of congruency ($F(1,23)=127.72$, $p<.001$, $\eta_p^2=.85$) and a significant interaction ($F(1,23)=26.73$, $p<.001$, $\eta_p^2=.54$). Main effect of grammatical gender did not reach the significance level ($F(1,23)=3.19$, $p<.09$, $\eta_p^2=.12$) (cf. Table 4).

Main effect of congruency unambiguously showed that in gender-sex congruent condition gender was categorized faster (848 ms) than in the incongruent condition (1129 ms)[4]. The interaction suggested that while incongruent condition was not sensitive to the grammatical gender, congruent condition forced objects with names of feminine gender to be categorized faster ($p<.001$) than objects with names of masculine gender (cf. Table 4). This result cannot be attributed to a grammatical gender bias since the control Experiment 2 showed that there was no difference in gender assignment without explicit biological sex context. Additional analyses did not provide a definite explanation of the effect. The nature of the effect may lie in the perceived strength of the faces in terms of their sex. The case may be that the female face that was used as a category marker was more feminine than the male face was masculine. This assumption can be tested with a subjective rating task.

Another possibility could lie in the linguistic markedness and the gender's cognitive salience. Although masculine gender is the unmarked category in Bulgarian, markedness of feminine gender is more reliable in its predictive power. There is a fairly substantial amount of nouns in Bulgarian that do not bear a marker (end with a consonant), but are of feminine gender (e.g., *misal* (thought), *kost* (bone), *esen* (autumn) etc.) and can thus be confusing to categorise (they might be masculine or feminine). Whereas if a noun is marked with a feminine ending (-a/-ia) it will fall in the female gender category with very few exceptions. Of course, adult Bulgarian native speakers are not explicitly aware of this ambiguity of the unmarked nouns in their language and do not make mistakes in categorisation.

[4] Interestingly, when attribute pictures (biological sex stimuli) were analyzed, main effect of congruency in sex categorization was weaker ($F(1,23)=54.78$, $p<.001$, $\eta_p^2=.70$) than the same effect in grammatical gender categorization (140 vs. 281 ms). This may mean that the association link gender-sex is stronger than sex-gender, a hypothesis that needs further exploration.

The ambiguity and markedness effect might also serve as a partial explanation for the main effect of gender obtained in Experiment 1.

Conclusion

The main purpose of the study was to test the hypothesis of non-arbitrariness of gender assignment using an established in social psychology method for uncovering implicit associations (IAT). The results of the first experiment showed that just categorizing a picture of an artifact as an object even with the additional context of biological sex is not powerful enough to bring out the gender-sex association links. The second experiment inclined us to think that in the absence of sex context, there was no processing bias towards one or another gender in a gender categorization task. Finally, the third experiment strongly suggested that given the strong context of biological sex, a participant would be faster in a gender categorization task of sex unrelated artifacts if the artifacts were in a congruent sex-gender condition compared to an incongruent one. The results speak in favor of the non-arbitrariness of grammatical gender assignment.

The contribution of the present study was that it applied an online processing measure (IAT) to test the gender-sex association hypothesis. The study showed that the association can be captured online, during categorization processing, thus, possibly showing automatic processing of implicit associations.

References

Andonova, E., Gosheva, A., Janyan, A., & Schaffai, J.S. (2007). Second language gender system affects first language gender classification. In I.Kecskes & L. Albertazzi (Eds.), *Cognitive Aspects of Bilingualism*, Dordrecht, The Netherlands: Springer.

Boroditsky, L., Schmidt, L., & Phillips, W. (2003). Sex, syntax, and semantics. In Gentner & Goldin-Meadow (Eds.), Language in Mind: Advances in the Study of Language and Cognition. MIT Press: Cambridge, MA.

De Houwer, J. (2001). A structural and process analysis of the implicit association test. Journal of Experimental Social Psychology, 37, 443-451.

Greenwald, A.G., McGhee, D.E., & Schwartz, J.L.K. (1998). Measuring individual differences in implicit cognition: The implicit association test. Journal of Personality and Social Psychology, 74(6), 1464-1480.

Johnson, C.J., Paivio, A., & Clark, J.M. (1996). Cognitive components of picture naming. *Psychological Bulletin*, *120(1)*, 113-139.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). E-Prime user's guide. Pittsburgh: Psychology Software Tools Inc.

Schriefers, H., & Jescheniak, J.D. (1999). Representation and processing of grammatical gender in language production: A review. *Journal of Psycholinguistic Research, 28(6),* 575-600.

Schwichtenberg, B., & Schiller, N.O. (2004). Semantic gender assignment regularities in German. Brain and Language, 90, 326-337.

Sera, M., Berge, C., & del Castillo-Pintado, J. (1994). Grammatical and conceptual forces in the attribution of gender by English and Spanish speakers. *Cognitive Development, 9,* 261-292.

Simov, K., Osenova, P., Kolkovska, S., Balabanova, E., Doikoff, D. (2004). A language resources infrastructure for Bulgarian. *Proceedings of Language Resources and Evaluation Conference* (pp.1685-1688). Lisbon, Portugal http://www.bultreebank.org/papers/BulgarianLRI316.pdf.

Szekely, A., Jacobsen, T., D'Amico, S., Devescovi, A., Andonova, E., Herron, D., Lu, C-C., Pechmann, T., Pléh, C., Wicha, N., Federmeier, K., Gerdjikova, G., Gutierrez, G., Hung, D., Hsu, J., Iyer, G., Kohnert, K., Mehotcheva, T., Orozco-Figueroa, A., Tzeng, A., Tzeng, O., Arévalo, A., Vargha, A., Butler, A.C., Buffington, R., & Bates, E., (2004). A new on-line resource for psycholinguistic studies. *Journal of Memory and Language, 51,* 274-250.

Vigliocco, G., Vinson, D.P., Paganelli, F., & Dworzynski, K. (2005). Grammatical gender effects on cognition: Implications for language learning and language use. *Journal of Experimental Psychology: General, 134(4),* 501-520.