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Does learning a foreign language affect object categorization in native speakers of a language with grammatical gender? The case of Lithuanian speakers learning three languages with different types of gender systems (Italian, Russian and German).

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Abstract

Aims and Objectives/Purpose/Research Questions: We examined whether categorization of inanimate objects is influenced by learning a language with a different type of gender system. Previous research has examined speakers of languages without grammatical gender (English and Hungarian) who were learning a language with grammatical gender (Spanish and French). By contrast, we examined speakers of a language with grammatical gender (Lithuanian) learning a language with a structurally different gender system (Italian, Russian or German).

Design/Methodology/Approach: We compared four groups (Lithuanians speaking only English and Lithuanian, Lithuanians learning Italian, Lithuanians learning Russian, Lithuanians learning German) in the completion of a voice attribution task where subjects are asked to attribute either the voice of a man or a woman to inanimate objects.

Data and Analysis: We tested 128 subjects (32 for each group). The first group included Lithuanians who spoke only Lithuanian and English, and served as baseline for Lithuanians with a single grammatical gender system (Group B). The other three groups included Lithuanians that were proficient in either Italian (Group ITA), Russian (Group RUS) or German (Group GER). Data were analysed by means of mixed effects generalized linear models created using R *glmer*() function. We conducted a series of logistic regressions examining the following fixed effects: sex, age, distinction 'artefact vs. natural object', Lithuanian gender, proficiency in the relevant foreign language and the gender of each item in the relevant foreign language (i.e. either Italian, Russian or German).

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Findings/Conclusions: Our results suggest that the four groups behaved somewhat differently and that belonging to one group or the other was a significant predictor of a participant's choices. It seems, however, that gender in the respective foreign language did not affect a participant's choices. By and large, differences between the four groups did not mirror gender asymmetries between the four languages, yet learning a foreign language did appear to interfere with the standard pattern exhibited by baseline Lithuanians who had the highest frequency of attributions congruent with Lithuanian gender.

Originality: Recent studies showed that the effects of grammatical gender on categorization might not be limited to native language, but could apply also to a second language acquired later in life. Whereas previous research has examined subjects speaking an L1 without grammatical gender, we followed Kurinski and Sera's suggestion and tested native speakers of a gendered language learning an L2 with a structurally different gender system. More specifically, we compared native speakers of a language with two genders (Lithuanian) learning either a system with three genders (Russian), a system with three genders and gender-marking articles (German) or a system with two genders and gender-marking articles (Italian). Our goal was to understand whether language effects on cognition are influenced not only by specific properties of the L1 – as suggested by Kurinski et al., who noted a difference between English and Hungarian learners – but also by specific properties of the L2 gender system and by the typological gap between the L1 and the L2 gender system.

Significance/Implications: We asked whether we would find language-specific effects suggesting that learning a foreign language systematically 'pulls' standard categorization patterns towards the L2 gender system. Our findings do not support this idea. However, our results do suggest that learning a foreign language weakens the strength of the link between each item and its gender.

Keywords
Language and cognition, linguistic relativity, grammatical gender, cognitive restructuring, bilingual cognition

Introduction

Increasing evidence suggests a correlation between subjects' behaviour in laboratory settings and certain lexical or morphological features of their native language. Taken together, research done in recent years shows that certain linguistic categories can affect behaviour even in seemingly non-verbal tasks. Language effects have been found in tasks which tap into different cognitive processes, including categorization, discrimination, similarity judgment, memory encoding and retrieval.

It has been shown, for instance, that morphological features of common nouns can influence categorization preferences' manifestation in tasks which can be accomplished in the absence of language (e.g. Athanasopoulos & Boutonnet, 2016; Bassetti, 2007, 2014; Boroditsky & Schmidt, 2000; Boutonnet, Athanasopoulos, & Thierry, 2012; Flaherty, 2001; Imai & Gentner, 1997; Imai, Gentner & Uchida, 1994; Imai & Mazuka, 2003, 2007; Kurinski & Sera, 2011; Kurinski et al., 2016; Lucy, 1992, 1996, 1997; Lucy & Gaskins, 2001, 2003; Martinez & Shatz, 1996; Phillips & Boroditsky, 2003; Roberts & Gathercole, 2006; Sera, Berge, & Del Castillo Pintado, 1994; Sera et al., 2002).

Other studies have demonstrated that our native language can have an impact on our conception of time (Boroditsky, 2001), on the system of spatial coordinates that we use 'by default' (Levinson,

1997, 2001), as well as on motion event coding and recall (Athanasopoulos & Bylund, 2013b; Gennari, Sloman, Malt, & Fitchd, 2002; Slobin, 1996, 2003).

Some authors have also reported language effects at a pre-conceptual level of processing, affecting most notably visual perception (Boutonnet & Lupyan, 2015; Flecken, Athanasopoulos, Kuipers, & Thierry, 2015; Gilbert, Regier, Kay, & Ivry, 2008; Klemfuss, Prinzmetal, & Ivry, 2012; Lupyan, 2008, 2015; Lupyan & Clark, 2015; Lupyan & Spivey, 2008, 2010; Lupyan & Swingley, 2012; Lupyan & Thompson-Schill, 2012; Meteyard, Bahrami, & Vigliocco, 2007; Mitterer, Horschig, Musseler, & Majid, 2009) and colour discrimination (Athanasopoulos, 2009, 2011; Athanasopoulos, Dering, Wiggett, Kuipers, & Thierry, 2010; Athanasopoulos, Wiggett, Dering, Kuipers, & Thierry, 2009; Gilbert, Regier, Kay, & Ivry, 2006; Goldstein, Davidoff, & Roberson, 2009; Kay & Regier, 2006; Mo, Xu, Kay, & Tan, 2011; Regier & Kay, 2009; Roberson, Davidoff, Davies, & Shapiro, 2004; Winawer, Witthoft, Frank, Wu, & Boroditsky, 2007).

Language effects on cognition have been investigated mostly by means of cross-linguistic studies comparing native speakers of different languages in the same exact task. Using this approach, researchers have often found relative patterns which apparently reflect lexical and/or morphological asymmetries between the languages under investigation. Taken together, similar findings provide increasing empirical support for the long-debated 'linguistic relativity hypothesis' (for a review, see Lucy, 2016; Thierry, 2016).

Of particular interest are the relationships between grammatical gender and non-verbal categorization. In many languages, certain categories of words are assigned a formal gender-marking and belong in one of two – but usually three – mutually exclusive grammatical categories. Examples of languages with two genders are: Italian, Spanish and Lithuanian; examples of languages with three genders are: Russian, Ukrainian and German. Contrary to what happens in English, all nouns in these languages – including those referring to objects and entities which do not have a biological sex – are assigned to a specific morphological class that is marked for gender (e.g. masculine nouns as opposed to feminine nouns).

As noted by Sera et al. (1994), in the field of psycholinguistics it was traditionally assumed that gender marking is semantically arbitrary; in support of such a view, researchers usually noted that – for no apparent reason – different languages assign a different gender to the same object. Such apparent disagreement of gender assignments across languages was usually interpreted as conclusive evidence for an arbitrary alignment of semantic and grammatical gender (Sera et al., 1994). Grammatical gender was therefore considered as encapsulated from conceptual representations. However, as noted by Sera et al. (1994) and by Phillips and Boroditsky (2003), even if a set of universal semantic features cannot explain grammatical gender, this does not mean that grammatical gender lacks semantic force.

Recent empirical findings suggest that grammatical gender could be paramount for conceptual representations. Taken together, evidence gathered so far shows that grammatical gender interferes with the categorization of inanimate objects (Athanasopoulos & Boutonnet, 2016; Bassetti, 2007, 2014; Bender, Beller, & Klauer, 2016; Boroditsky & Schmidt, 2000; Boutonnet et al., 2012; Flaherty, 2001; Imai et al., 2013; Kurinski et al., 2016; Kurinski & Sera, 2011; Martinez & Shatz, 1996; Phillips & Boroditsky, 2003; Sato, Gygax, & Gabriel, 2013; Sedlmeier, Tipandjan, & Jänchen, 2016; Seigneuric, Zagar, Meunier, & Spinelli, 2007; Sera et al., 1994, 2002; Vigliocco, Vinson, Paganelli, & Dworzynski, 2005). Grammatical gender effects on categorization have been found in children between the ages of five and nine, as well as in adults (Flaherty, 2001; Martinez & Shatz, 1996; Nicoladis & Foursha-Stevenson, 2011; Seigneuric et al., 2007; Sera et al., 2002).

To investigate this issue, researchers have used a variety of experimental paradigms including: voice-attribution tasks (Bassetti, 2007; Kurinski et al., 2016; Kurinski & Sera, 2011; Sera et al., 1994, 2002), sorting tasks (Martinez & Shatz, 1996), common-noun/proper-noun associations

(Phillips & Boroditsky, 2003), semantic ratings and adjective associations (Flaherty, 2001), as well as tasks based on inference (Imai et al., 2013).

Using these tasks, researchers frequently found significant cross-linguistic differences between subjects speaking languages with different gender systems; while comparing language groups, researchers observed relative patterns which were apparently congruent with asymmetries between the gender systems of the languages under investigation (Athanasopoulos & Boutonnet, 2016; Bassetti, 2007, 2014; Bender et al., 2016; Boroditsky & Schmidt, 2000; Boutonnet et al., 2012; Flaherty, 2001; Imai et al., 2013; Kurinski et al., 2016; Kurinski & Sera, 2011; Martinez & Shatz, 1996; Phillips & Boroditsky, 2003; Sato et al., 2013; Sedlmeier et al., 2016; Seigneuric et al., 2007; Sera et al., 1994, 2002; Vigliocco et al., 2005).

For instance, Sera et al. (1994; Experiment 2) found that, when asked to attribute to common objects the voice of a man or the voice of a woman, Spanish speakers tended to classify according to Spanish grammatical gender. This experiment gave rise to countless replications with different combinations of languages, all of which confirmed that speakers of languages with a grammatical gender tend to categorize objects according to their grammatical gender. Similar results were obtained by Martinez and Shatz (1996) in a sorting task, by Flaherty (2001) in a proper-noun association task, by Phillips and Boroditsky (2003) in a picture similarity task, and by Boroditsky, Schmidt, & Phillips, (2003) in different types of noun and adjective association tasks (for a more in-depth literature review, see Kurinski & Sera, 2011). More recently, Imai et al. (2013) compared the performance of German and Japanese speakers in a task involving inferences about sex-specific biological properties and found that German speakers generalized the grammar–semantics mapping even when the sex of the target was explicitly indicated.

The fact that grammatical gender effects have been consistently found in different types of tasks confirms that grammatical gender can interfere with different types of cognitive processes. While the extent of language effects appears to vary according to the task being employed and the languages under investigation (Sera et al., 2002), an increasing body of research confirms substantial effects even when alternative explanations are statistically controlled for (Sedlmeier et al., 2016).

Grammatical gender effects on cognition are also supported by recent neurological evidence. Boutonnet et al. (2012), for instance, compared event-related brain potentials (ERPs) of Spanish–English bilinguals and native speakers of English performing a semantic categorization task on triptychs. Subjects were asked to press a button if the third picture of a triptych belonged to the same semantic category as the first two, and another button if it belonged to a different category. In half of the trials, the gender of the Spanish noun denoting the third picture was the same as that of the first two; in the remaining trials, it had the opposite gender. As the authors explain, ERPs revealed not only the semantic priming effect in both groups, but also a negative modulation by gender inconsistency only in Spanish–English bilinguals. According to the authors, this suggests that gender features (whether semantic or not) are part and parcel of the pattern of activations in the brain when retrieving conceptual information about the objects for which categorization will be performed. Conceptual retrieval and categorization, thus, appear to be unconsciously affected by grammatical gender, even when such information is task-irrelevant (Boutonnet et al., 2012). As the authors explain, gender information appears to be accessed implicitly – almost automatically – and prior to syntactic and phonological information (Boutonnet et al., 2012).

Similar results suggest that – contrary to a reductive view of grammatical gender as an encapsulated and exclusively grammatical phenomenon – grammatical gender carries a meaning to native speakers and could be paramount in conceptual representation (Flaherty, 2001). To explain grammatical gender effects on cognition, it has been suggested that objects may come to be associated with gender for the simple reason that grammatical gender is associated with nouns and nouns

are associated with objects. Over time, this could bring about an implicit association between gender and objects (Kurinski & Sera, 2011).

Recent evidence also suggests that the effects of grammatical gender on categorization might not be limited to native language, but could also apply to a second or language acquired later in life (Athanasopoulos & Boutonnet, 2016; Kurinski et al., 2016; Kurinski & Sera, 2011).

Kurinski and Sera (2011), for example, examined how the acquisition of a grammatical gender from Spanish influenced the categorization of native speakers of English. To do so, the authors conducted a longitudinal study in which a group of English students without any prior knowledge of Spanish participated in a Spanish course for absolute beginners and were tested repeatedly (four times throughout one academic year) in two tasks. The first task examined their acquisition of grammatical gender, while the other examined their categorization of inanimate objects. After 10 weeks of Spanish instruction, the authors started to observe changes in participants' grammatical gender acquisition and categorization patterns. According to the authors, similar results indicate that learning a second language as an adult can change the way one categorizes objects. At the same time, the authors point out that the effect of Spanish grammatical gender was limited compared to that observed in native Spanish speakers. Moreover, this effect did not increase with learners' proficiency which suggests that adults learning Spanish reach a plateau beyond which changes in categorization do not occur. As noted by the authors, a possible limitation of this study is that performance could be affected by repeated testing as well as contextual influences.

These findings were later replicated by Kurinski et al. (2016), who examined the effects of grammatical gender on categorization in native speakers of Hungarian, a language that – like other Finno-Ugric languages and contrary to English – uses gender-neutral pronouns. In English, a distinction is made between 'he' and 'she' and it is technically possible to refer to certain objects as either 'he' or 'she' (Flaherty, 2001; Nicoladis & Foursha-Stevenson, 2011). In Finno-Ugric languages there is no such distinction and therefore it could be said that Hungarian lacks grammatical gender in a more 'extreme' way than English and can thus represent a better baseline for gender-free languages.

The study in 2016 used the same design as Kurinski and Sera (2011), the only difference being that this time subjects were Hungarian native speakers. Similar to Kurinski and Sera (2011), the authors began observing changes in categorization after 10 weeks of instruction. According to the authors, similar results provided additional evidence that human cognition can be influenced by learning a language in adulthood. The authors also point out that Hungarian learners were more successful at acquiring Spanish grammatical gender than the English speakers studied in Kurinski and Sera (2011) and that language effects occurred earlier and were much stronger than those from that previous work. Comparing their findings with those of Kurinski and Sera (2011), the authors conclude that the magnitude of language effects on cognition may depend on the specific properties of one's native language (Hungarian as opposed to English).

Overview of the present study

Our experiment is a partial replication of Kurinski and Sera (2011) and Kurinski et al. (2016). As we mentioned, these studies focused on English and Hungarian learners, i.e. on native speakers of languages *without* a grammatical gender. Following Kurinski and Sera's (2011) suggestion, we decided to test native speakers of languages *with* a grammatical gender. Needless to say, this scenario is quite different from the previous one and at least three outcomes are possible. It could be that, contrary to what happens in the case of speakers of languages without a grammatical gender, categorization is not affected at all. This would suggest that L1 categories are so entrenched in the brain of native speakers that they are completely insensitive to the introduction of L2 categories.

Another possibility is that categorization is affected and through examining the interplay between L1 and L2 gender one clearly sees that learning the L2 somewhat 'pulls' the standard L1 pattern towards the L2 gender system (regardless of the strength of this interference, i.e. whether the L2 pattern entirely supplants the L1 pattern or weakly counterbalances it). Lastly, categorization could be affected in ways that are not necessarily congruent with the L2 gender system.

Any outcome could help shed light not only on the influence of grammatical gender on categorization, but also on the psychological processes involved in learning the L1 and the L2 as well as on cognitive processing and restructuring in bilinguals.

In our experiment, we tested Lithuanian native speakers and compared the performance of a baseline group (monolingual Lithuanian speakers) with those of advanced learners of Italian, Russian or German. The reason we chose these particular languages is that we wanted to examine languages with different *types* of gender systems: in Lithuanian, there are two genders and no articles; in Italian, there are two genders and articles; in Russian, there are three genders and no articles; and in German, there are three genders and articles. This will allow us to explore the possibility that the outcome could be influenced not only by specific properties of the L1 – as suggested by Kurinski et al. (2016), who noted a difference between English and Hungarian learners – but also by specific properties of the L2 gender system, as well as the typological gap between the L1 and the L2 gender system. Since this possibility has not been fully explored, we believe the results of our experiment could help shed light on this issue.

It might turn out, for instance, that learning an L2 affects object categorization only if the L2 gender system has the same number of gender categories as the L1 (say, Italian vs. Lithuanian). However, the opposite could be true, with categorization being affected only if the L2 gender system has a different number of gender categories than the L1 (say, Russian or German vs. Lithuanian). In addition to structural similarities/differences between the L1 and the L2, a role could be played by the specific properties of languages with three genders (Bassetti, 2007; Sera et al., 2002). Sera et al. (2002), for instance, found that classification by German speakers did not systematically vary according to grammatical gender as it did in the case of Spanish and French speakers. According to the authors, this could suggest that only a grammatical gender system with two gender categories can lead to the overgeneralization of female and male traits for inanimate objects. In this respect, Bassetti (2007) noted that in German there are different forms for each case and, consequently, a higher number of forms might have a weaker influence on classification behaviour. Therefore, it could be that – regardless of whether the L1 has two or three genders – an L2 with three genders is less likely to affect categorization. Another possibility is that only an L2 with gender-marking articles can influence categorization because – as suggested by Imai et al. (2013) – language effects could be more specifically related to articles. In their experiment, Imai et al. (2013) noted that language effects occurred only when nouns were accompanied by gender-marking articles; based on these findings, the authors suggested that German speakers project sex-specific biological properties onto gender-marking articles but not onto conceptual representations of animals as such.

Method

Participants

We tested four groups (group $n = 32$, total $n = 128$) of Lithuanian native speakers. Since previous studies have concluded that the gender of the participant does not affect similar tasks (e.g. Sera et al., 1994), we did not test an equal number of males and females. Each group consisted of 32 Lithuanian students (mean age: 23.10; sd: 0.47; range: 22–25) enrolled at different programmes at Vytautas Magnus University of Kaunas (VDU) and Vilnius University (VU). Careful screening

was carried out so as to exclude bilinguals (save for Lithuanians speaking English, see below) and subjects with a native language other than Lithuanian. In order to avoid any categorization bias arising from the language of instruction, all four groups were instructed in English. Based on post-test interactions and participants' responses for control items, we deemed the English proficiency across groups to be comparable.

The first group of subjects (hereinafter 'Group B', where B stands for 'baseline') included only Lithuanians who did not speak any foreign languages aside from English. Given that English lacks grammatical gender, we used Group B as baseline for subjects with a single grammatical gender system.

The second group of subjects (hereinafter 'Group ITA') included only Lithuanians who spoke Lithuanian, English and Italian. Subjects belonging to this group were students enrolled in the fourth year (in Lithuania, undergraduate courses last four years) of the Italian philology programme (VDU).

The third group of subjects (hereinafter 'Group RUS') included only Lithuanians who spoke Lithuanian, English and Russian. Subjects belonging to this group were students enrolled in the fourth year of the Russian philology programme (VU).

The fourth group of subjects (hereinafter 'Group GER') included only Lithuanians who spoke Lithuanian, English and German. Subjects belonging to this group were students enrolled in the fourth year of the German philology programme (VDU).

It is worth noting that at the time of the experiment participants belonging to Group ITA, RUS and GER had already studied their respective foreign language (Italian, Russian or German) for three consecutive years full-time, had passed all relevant exams, and should be regarded by all means as intermediate–to–advanced speakers with their competence falling anywhere between the levels B2 and C1 of the European Union framework. Moreover, it should be noted that in both semesters students had an average of five language classes per week. Considering the above, we did not deem it necessary to further test their language competence and accepted their status of intermediate–to–advanced speakers of Italian, Russian or German. At the same time, careful screening was carried out to ensure that subjects were proficient only in one foreign language in addition to English (we checked, for instance, that subjects included in Group ITA did not speak any Russian). This was accomplished by means of participants' self-reports. While information on proficiency *levels* provided in self-reports is oftentimes far from reliable, we used this information only as a second-level control to exclude people who knew other languages, regardless of their proficiency.

Materials

We used a series of 31 black and white drawings (Appendix 1 contains a sample of drawings used as stimuli). While trying to include the same objects as Sera et al. (1994), careful consideration was given to the inclusion of a combination of items with opposite grammatical genders in Lithuanian, Italian, Russian and German. As in Sera et al. (1994), there were eight control pictures and 23 test pictures. Control pictures depicted humans with obvious biological genders (king, knight, mechanic, boy, woman, girl, ballerina, bride) were added to ensure that subjects understood the instructions. Test pictures represented objects without a biological gender.

Procedure

We followed the procedure for the voice attribution task originally developed by Sera et al. (1994) and later employed by Kurinski and Sera (2011) and Kurinski et al. (2016). Subjects were tested singularly with pictures presented on a 15.6" laptop screen. Subjects were told the

following instructions in English: 'We are thinking about making a new movie in which some everyday objects come to life. We are going to show you a series of pictures of these objects and want you to write down, on this sheet of paper, by each number, whether you think each pictured object should have a man's voice or a woman's voice. Okay, here is picture number one [the Experimenter would then show one picture to the subject], should this have a woman's voice or a man's voice in the movie?' (instructions were exactly the same as in Sera et al. 1994). Each stimulus was displayed for four seconds, after which the next stimulus was automatically displayed. As pictures were shown one by one, subjects wrote the corresponding answer on a numbered response sheet. Contrary to Sera et al. (1994), in this experiment we used only one experimental condition: when displaying the object, the Experimenter did not pronounce the corresponding noun.

Each participant entered the following information on the response sheet: age, sex, native language, all languages known (specifying if at beginners or advanced level).

Results

To analyse and plot our observations we used R-Studio (version 3.3.1), a statistical software based on the computing environment R. In Figures 1–3, you can find an overview of the relative frequency of attributions for each language group. Figure 1 shows the relative frequency of participants' choices on an item basis. In Figures 2 and 3, instead, items were clustered together according to their grammatical gender in the four languages (Figure 2 shows grammatical gender of each language in isolation, while Figure 3 considers grammatical gender with respect to the other languages).

On average, 81.38% of voice attributions made by Group B were congruent with Lithuanian grammatical gender, which supports the effects of grammatical gender on cognition. Note that by congruent we mean voice of a woman attributed to feminine nouns and voice of a man attributed to masculine and neuter nouns. Compared to Group B, Lithuanians speaking Italian, Russian or German made fewer attributions which were congruent with Lithuanian grammatical gender. This is true for both feminine and masculine nouns. Group GER, ITA and RUS attributed the voice of a woman less frequently to items with a feminine gender in Lithuanian. These groups also attributed the voice of a man less frequently to items with a masculine gender in Lithuanian (for statistics, see Figure 4, the significance of these effects is discussed below in more detail).

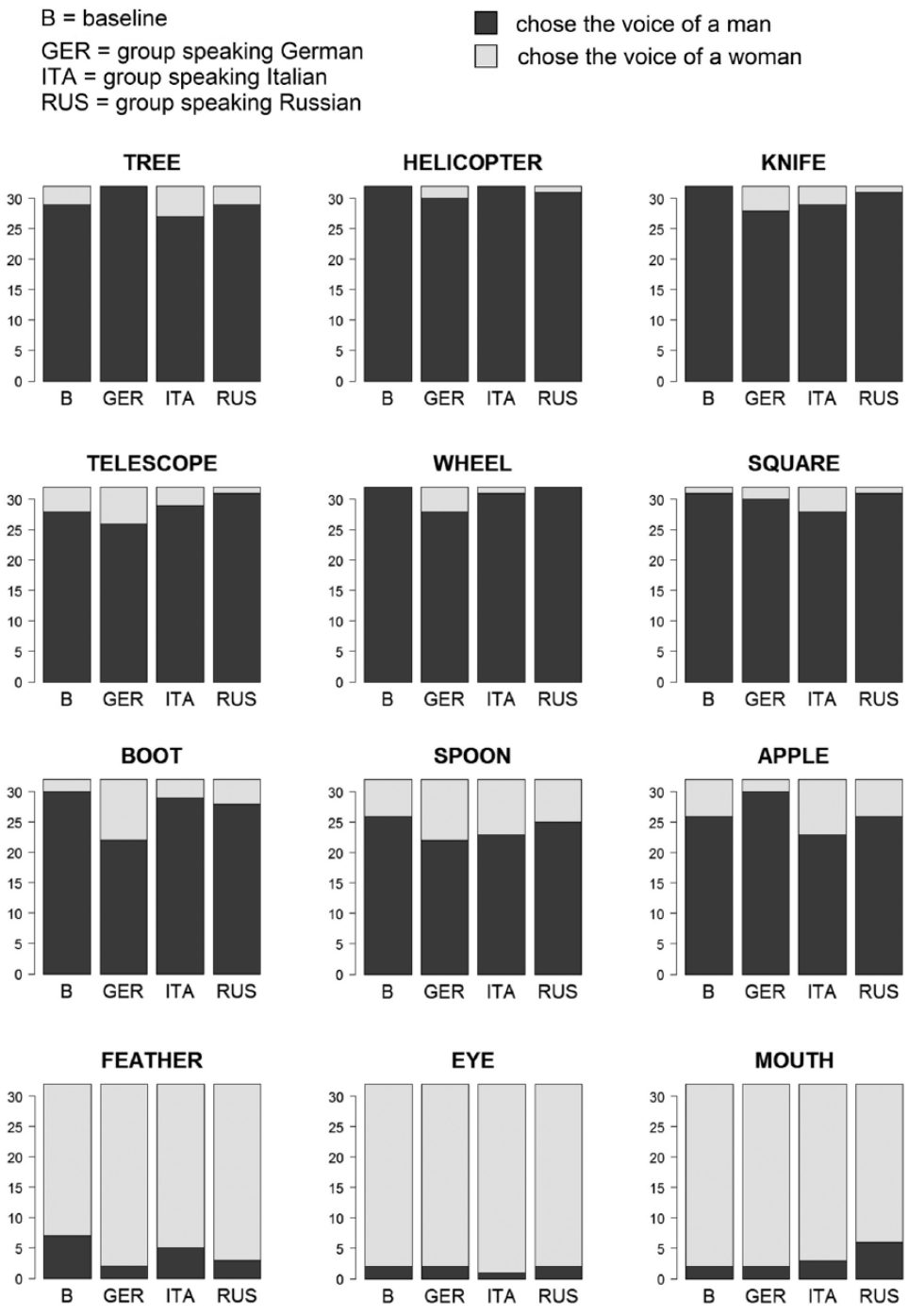
All three language groups (Group ITA, RUS, GER) made more attributions congruent with Lithuanian grammatical gender than with the gender in their respective foreign language. Figure 5 highlights this pattern.

We examined whether each language group had a higher frequency of attributions congruent with their respective foreign language (Italian for Group ITA, Russian for Group RUS and German for Group GER). This does not seem to be the case. Figure 6 shows this pattern.

For each bar plot of Figure 6, we have highlighted with a white column the group where we would expect the highest frequency of congruent attributions. As you can see, Group GER, ITA and RUS do not have the highest frequency of attributions congruent with their respective language. To further refine our analysis, we compared the relative pattern for items that are feminine both in Lithuanian and in the foreign language (Italian, Russian or German) with the pattern for items which are feminine in Lithuanian but not in the foreign language.

Figure 7 shows results of this comparison.

To better understand the role of each foreign language in participants' choices, we modelled our data with the *glmer*() function from R *lme4* package. Using this function, we created


B = baseline
GER = group speaking German
ITA = group speaking Italian
RUS = group speaking Russian
chose the voice of a man
chose the voice of a woman
TREE
HELICOPTER
KNIFE
TELESCOPE
WHEEL
SQUARE
BOOT
SPOON
APPLE
FEATHER
EYE
MOUTH
0
5
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25
30
B
GER
ITA
RUS

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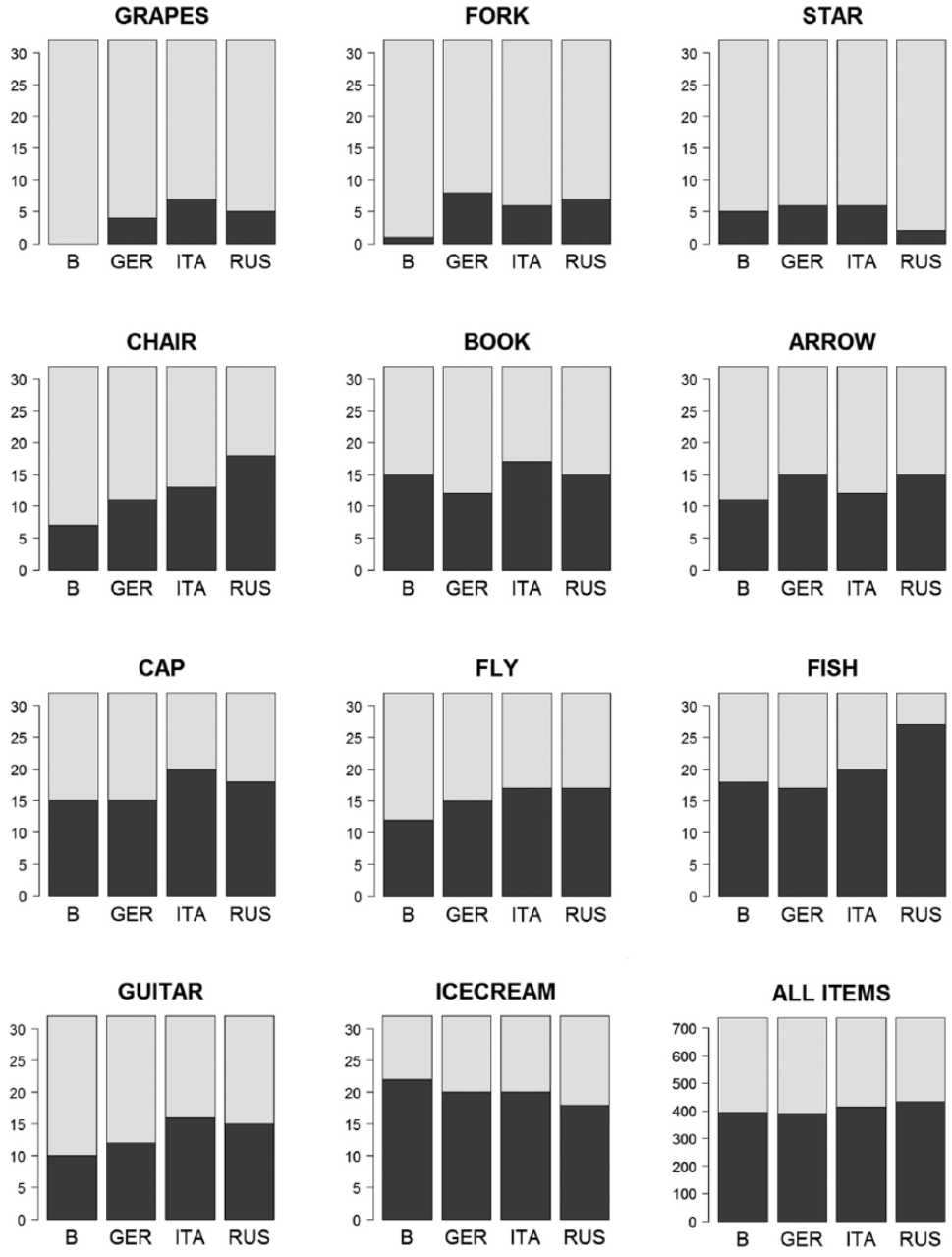

Figure 1. Relative frequency of voice attributions for each item.

a series of mixed effects generalized linear models based on different predictors of the participants' choices and conducted multiple logistic regressions on a binary variable indicating whether the voice of a woman (1) or the voice of a man (0) was chosen for the given item. As random effects, we had intercepts for both subjects and items. With our models, we analysed the relative contribution of the following regressors: sex; age; natural/artificial distinction;

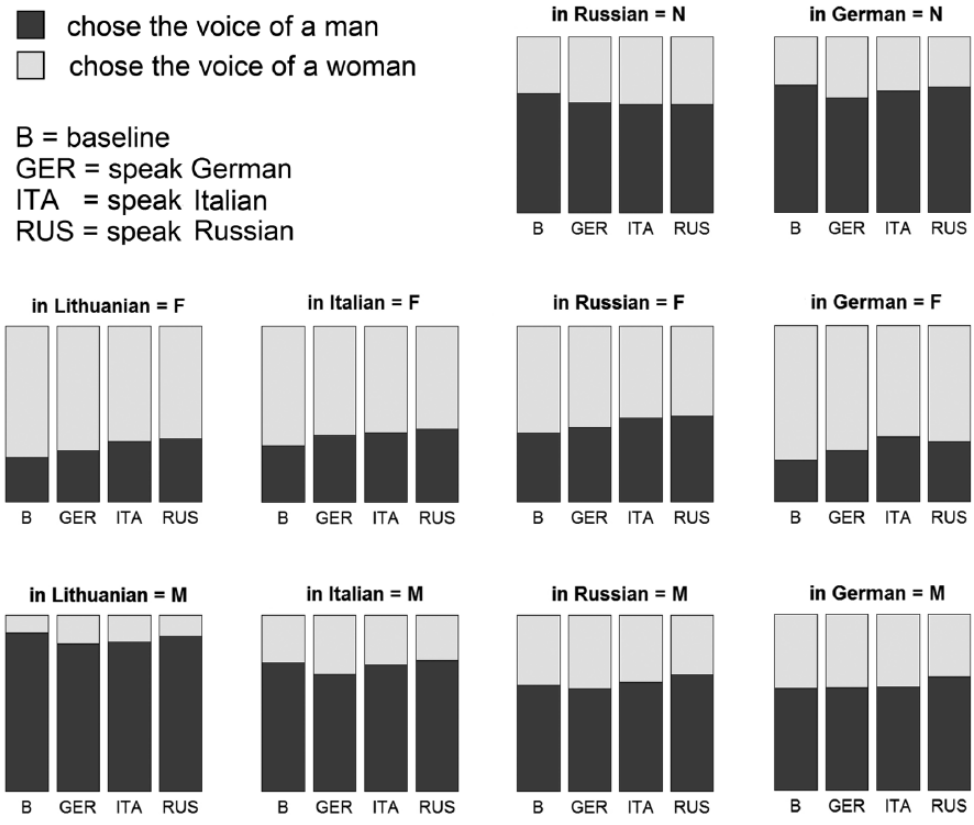

Figure 2. Relative frequency of voice attributions with respect to gender in each language.

grammatical gender of the item in Lithuanian; knowledge of Italian/Russia/German; and the item having a feminine gender in the relevant foreign language. The significance of each factor was assessed by means of a Likelihood Ratio Test (LFT) in which we compared a 'full' model (i.e. a model containing the effect being assessed and all relevant regressors) and an 'empty' model (i.e. a model containing the other regressors but not the effect in question). To do so, we used R *anova*() function, which gave us *P*-values indicating whether – as the other regressors remained constant – a specific factor was a significant predictor of participants' choices.

We limited our analysis to test items (i.e. items without a clear biological gender). First of all, we checked whether the sex or age of the participant played a role in their choices. As expected, we did not find any effect of sex ($\chi^2(1) = 0.0759$, $p = 0.7829$) or age ($\chi^2(1) = 1.2907$, $p = 0.2559$). Then, we checked whether – as would be suggested by previous findings (e.g. Sera et al., 1994) – the participants' choices were affected by the conceptual distinction of 'artefact vs. natural object' (according to this distinction, artefacts tend to be perceived as more masculine, whereas natural objects tend to be perceived as more feminine). We found a significant effect (at <0.05) of the distinction 'artefact vs. natural object' ($\chi^2(1) = 5.548$, $p = 0.0185$), again confirming previous findings.

Keeping this factor in our model, we entered Lithuanian gender as a fixed effect and found a significant effect ($\chi^2(1) = 26.188$, $p = 3.09\times10^{-7}$). Similar results suggest that Lithuanian gender

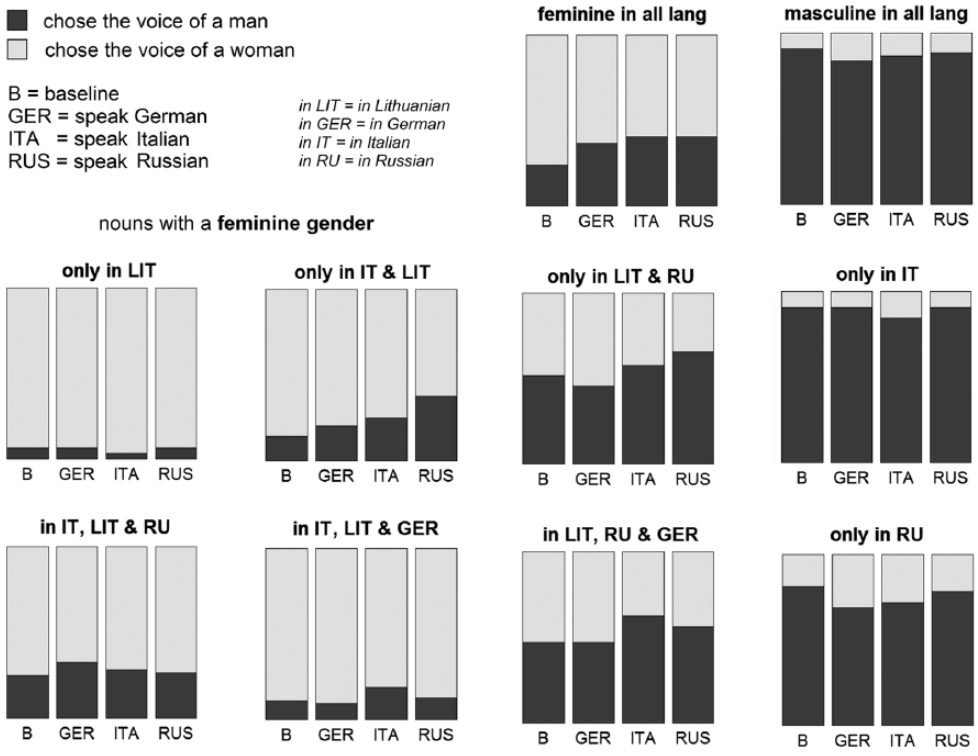

Figure 3. Relative frequency of voice attributions with respect to gender in the four languages.

was a very significant (at 0 level of significance) predictor of participants' choices. Keeping all these predictors in our model, we entered each group as a fixed effect and found a smaller yet significant (at <0.05) effect ($\chi^2(3) = 10.959$, $p = 0.01195$). This suggests that belonging to one of the different language groups (Group B, Group ITA, Group RUS, Group GER) had some kind of influence on the outcome of voice attributions.

To further refine our analysis, we checked whether knowing Italian, German or Russian had any impact on participants' choices. We did not find a significant effect from knowing Italian ($\chi^2(1) = 0.5985$, $p = 0.4392$), but we found a significant effect (at <0.05) from knowing German ($\chi^2(1) = 4.1925$, $p = 0.0406$) and a stronger effect (at <0.01) from knowing Russian ($\chi^2(1) = 7.6503$, $p = 0.005676$). According to our results, knowing Russian apparently reduced the likelihood of an item being attributed the voice of a woman, while knowing German increased this likelihood. Lastly, we checked whether having a feminine gender in the relevant foreign language (Italian for Group ITA, German for Group GER and Russian for Group RUS) affected participants' choices in a similar fashion to Lithuanian grammatical gender. Keeping all the other fixed effects constant, we did not find a significant effect of the item having a feminine gender in the foreign language ($\chi^2(1) = 1.5973$, $p = 0.2063$).

Discussion and conclusions

The goal of our experiment was to test whether the categorization of inanimate objects is influenced by learning a language with a different gender system. While previous research examined

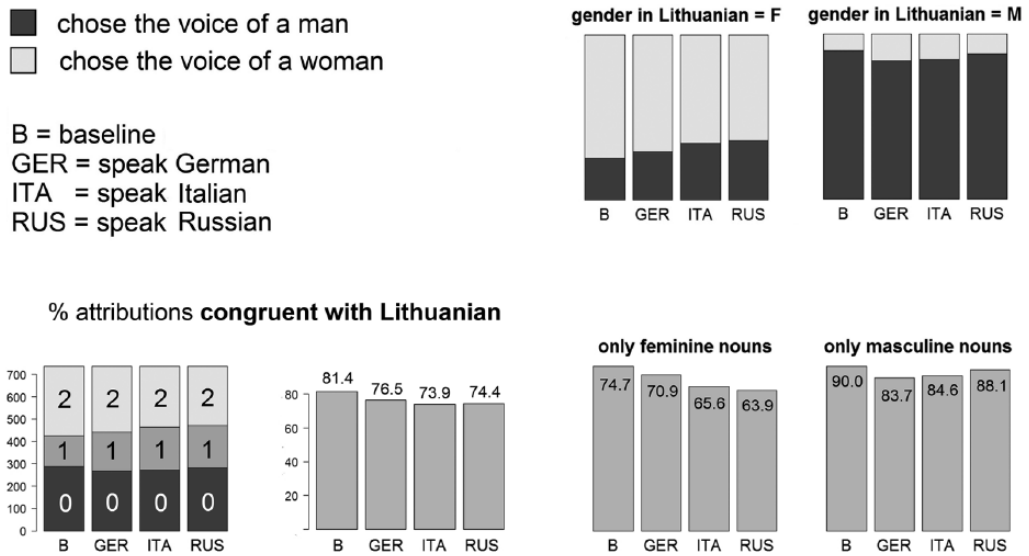

Figure 4. Voice attributions congruent with Lithuanian grammatical gender.

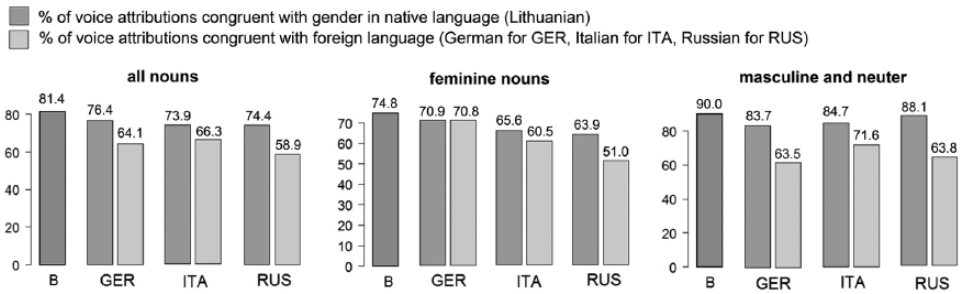

Figure 5. Voice attributions congruent with grammatical gender in native and foreign language.

native speakers of languages without grammatical gender (English and Hungarian) learning a language with grammatical gender (Spanish and French), we examined native speakers of a language with grammatical gender (Lithuanian) learning a language with a structurally different gender system (Italian, Russian and German).

To this end, we compared the performance of monolingual Lithuanians (Group B) with those of Lithuanians learning Italian (Group ITA), Russian (Group RUS) and German (Group GER). It is worth noting that subjects belonging to the last three groups were intermediate–to–advanced speakers of the language in question, which they had studied full-time for three consecutive years. Kurinski and Sera (2011) and Kurinski et al. (2016) focused on the emergence of the influence of grammatical gender during the early stages of language learning and examined this issue longitudinally in learners without any previous knowledge of Spanish. By contrast, we were more interested in any long-term influence that could be manifested by advanced learners.

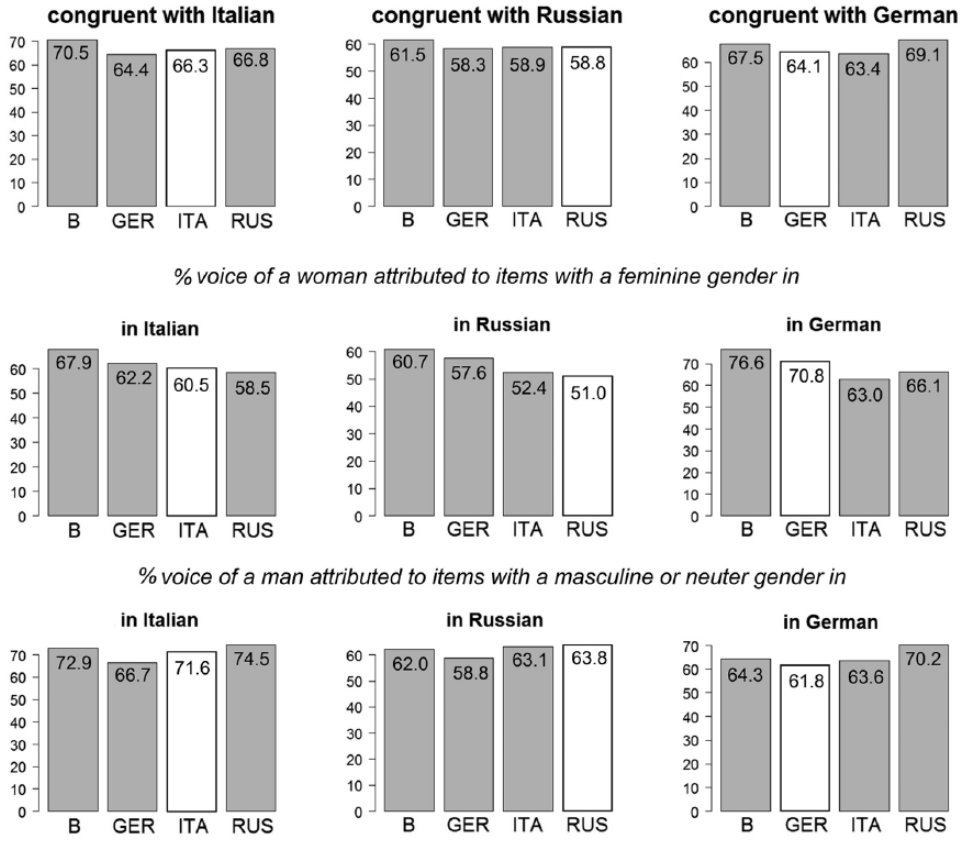

Figure 6. Cross-group comparison of the relative frequency of voice attributions congruent with each language.

Comparing the performance of our four groups, we found some interesting differences. Looking at the relative pattern for each item (see Figure 1), we noticed some minor differences in voice attributions (for some items, differences are more pronounced). Results of our logistic regression confirm that – all things being equal – the four groups behaved *somewhat differently* and that belonging to one group or another was a significant predictor of a participant's choices ($\chi^2(3) = 10.959$, $p = 0.01195$). While knowing Italian did not seem to affect participants' choices to any significant degree ($\chi^2(1) = 0.5985$, $p = 0.4392$), we found a significant effect from knowing German ($\chi^2(1) = 4.1925$, $p = 0.0406$) and a stronger effect from knowing Russian ($\chi^2(1) = 7.6503$, $p = 0.005676$). For some reason, knowing Russian also appeared to reduce the likelihood of an item being assigned the voice of a woman (regardless of its gender in Russian), while knowing German increased this likelihood (regardless of its gender in German).

It is difficult to tell why patterns were not consistent across language groups and any explanation provided here should be regarded as tentative at best. A possible explanation could lie in the typological gap between Lithuanian and each of the languages under examination. From a lexical and morphological perspective, Lithuanian shares more similarities with Russian than with Italian or German. Therefore, while the three language groups studied their respective language for the same amount of time, during this time Lithuanians studying Russian

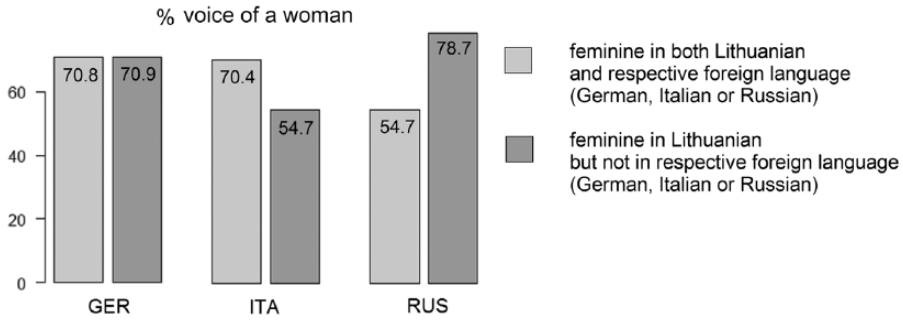

Figure 7. Voice attributions in case of converging and opposing gender.

could reach a much more advanced level than, say, Lithuanians studying Italian. This could explain – in principle – why we found a stronger effect from knowing Russian and no effect from knowing Italian, a language that has much fewer similarities with Lithuanian. In addition, it should be noted that – due to historical and geographical reasons – Lithuanians are frequently exposed to Russian input, which could contribute to faster progress by students learning Russian. In principle, one could also assume that a larger structural gap between the L2 and the L1 could keep the two gender systems more distinct and separate, making it more difficult for the L2 to permeate into the L1 system. However, if that were the case, we would expect weaker effects in Lithuanians learning German (which, in addition to articles, has a different number of gender categories) than Italian (which has the same number of gender categories), which is not what we found.

We clustered test items according to their gender in the four languages and analysed the interplay between voice attributions, grammatical gender in Lithuanian and grammatical gender in each foreign language (Italian, Russian or German). On the one hand, we found a strong effect of Lithuanian gender ($\chi^2(1) = 26.188$, $p = 3.09\times10^{-7}$); on the other hand, results of our logistic regression suggests that an item being feminine in the foreign language spoken by each participant (either Italian, Russian or German) did not affect a participant's choices to any significant degree ($\chi^2(1) = 1.5973$, $p = 0.2063$).

When we plotted our observations against grammatical gender, we did not notice any sign of a general systematic correlation between voice attributions and grammatical gender in the foreign language. To be convinced of this, it is sufficient to look at Figures 2 and 3.

For example, if we consider items that are feminine only in Lithuanian and Russian (but not in Italian or German), we would expect a higher frequency of female voice attributions in Group B (monolingual Lithuanians) and Group RUS (Lithuanians learning Russian). However, that was not the case and it was Group GER that attributed the voice of a woman most frequently (see Figure 3) despite the fact that these items are *not* feminine in German. Similarly, if we consider items that are feminine only in Russian, we would expect a higher frequency of female voice attributions in Group RUS; however, Group GER and Group ITA attributed the voice of a woman more frequently, even if these items are not feminine in either German or Italian. It was only in some cases that we found a pattern which appears congruent with gender asymmetries between languages. For example, if we consider items that are feminine in Lithuanian, Russian and German, we can see that Groups B, GER and RUS chose the voice of a woman more frequently than Group ITA. Similarly, if we consider items that are feminine only in Italian, we can see that Group ITA chose the voice of a woman most frequently. If we

consider items that are masculine only in German, we can see that Group GER chose the voice of a man most frequently.

When looking at the general picture for test items, the differences between the four groups do not mirror gender asymmetries between the four languages; to put it differently, we did not find signs of a systematic and general correlation between voice attributions and gender in the foreign language. Figure 6 clearly shows that Groups ITA, RUS and GER do not have the highest frequency of attributions congruent with their respective foreign language. Here we can see, for instance, that the group with the highest frequency of attributions congruent with Russian gender is not – as one might expect – Group RUS, but Group B; while the highest frequency of attributions congruent with German gender has been recorded not by Group GER, but by Group RUS. In general, it seems that for test items Group RUS tended to choose the voice of a man more frequently, while Group GER tended to choose the voice of a woman more frequently – *regardless of grammatical gender*.

At the same time, Figure 7 shows that for items that are feminine in both their native (Lithuanian) and foreign language (Russian), Group RUS attributed the voice of a woman 54.7% of the time; whereas for items that are feminine in Lithuanian but not in Russian, this percentage – instead of decreasing as one would expect – *went up* to 78.8%.

Based on previous findings, we asked whether learning a foreign language could systematically 'pull' or 'counterbalance' standard categorization patterns (i.e. those exhibited by native speakers with only one gender system) in the direction of the L2 gender system. Our findings do not support this idea.

Yet, learning a foreign language does appear to interfere – even if only slightly – with the standard pattern exhibited by monolinguals. As we mentioned above, Lithuanian grammatical gender was a strong predictor of participants' choices and most voice attributions (73.91 to 81.38%) made by all four groups were congruent with Lithuanian grammatical gender. Interestingly, it was Group B that registered the highest frequency (81.38%) of congruent attributions, though the other three groups also had a similar frequency (see Figure 4). This appears to be true with respect to both the general pattern and to the pattern of feminine and masculine items considered separately (see Figure 4). Therefore, even if learning a foreign language did not 'pull' the standard pattern towards the L2 gender system, it was associated with a *slightly* lower frequency (for all three groups) of attributions congruent with the subjects' native language. This could tentatively suggest that learning a foreign language introduces an element of instability which ends up undermining the strength of the link between each item and its gender in the subjects' native language.

In the case of native speakers of languages that lack grammatical gender (such as English and Hungarian) learning a foreign language with grammatical gender (e.g. Spanish), the L2 grammatical gender strongly affected categorization preferences (Kurinski & Sera, 2011; Kurinski et al., 2016). In such a scenario, L2 categories do not face any competition and/or blocking effects because grammatical gender does not exist as such in the L1; therefore, it could be said that L2 might create new linguistic categories from scratch (Kurinski & Sera, 2011).

In our experiment, we examined native speakers of a language with grammatical gender (Lithuanian) learning different types of gender systems and found a much smaller effect. On the one hand, this is logical, because in our case one could assume that L2 categories would have to compete with L1 categories. On the other, L2 gender did not appear to systematically counterbalance the L1 gender system. Taken together, our findings suggest that learning an L2 with a different gender system does affect object categorization in native speakers of an L1 with grammatical gender. However, they also suggest that this effect could be better explained in terms of 'interference' rather than 'influence'; that is, while learning the L2 gender system does not supplant nor counterbalance the L1 gender system, it does seem to undermine the strength of the link between each item and its gender in the subjects' native language.

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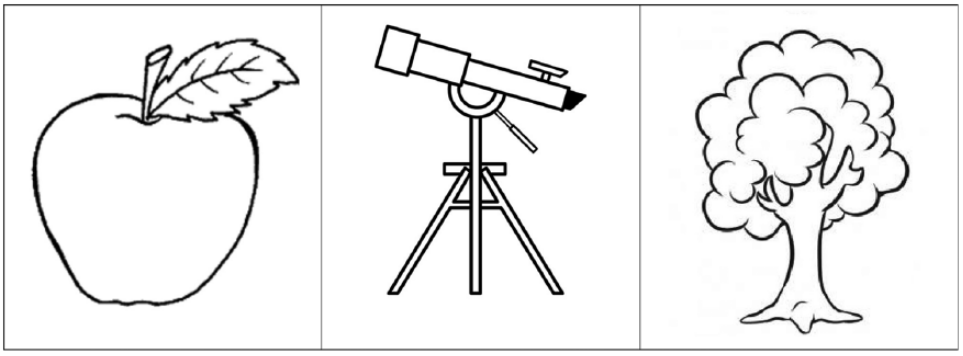

Appendix 1. Examples of drawings used as stimuli.