

**Federico Soriano**  
fedeg.soriano@gmail.com  
Buenos Aires University, Buenos Aires, Argentina

**Julieta Fumagalli**  
fumagallijulieta@gmail.com

**Diego Shalom**  
diegoshalom@gmail.com  
National Scientific and Technical Research Council (CONICET)  
Buenos Aires, Argentina

**Julia Carden**  
juliacarden@gmail.com  
Buenos Aires University, Buenos Aires, Argentina

**Geraldine Borovinsky**  
gborovinsky@ineco.org.ar

**Facundo Manes**  
fmanes@ineco.org.ar

**Macarena Martínez-Cuitiño**  
mariamacarenamartinez@gmail.com  
Institute of Cognitive Neurology (INECO), Buenos Aires, Argentina

## **SEX DIFFERENCES IN A SEMANTIC FLUENCY TASK?**

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**Abstract.** It is a well-documented empirical fact that men and women perform differently in language tasks involving various semantic categories. The sex-by-category effect has been reported in several languages and through different tasks. The results of these studies agree that some semantic categories are preferentially male while others are preferentially female, but which categories are associated with one gender or the other varies across studies. In our study, we tested a group of undergraduate native Spanish speakers from Argentina on a written semantic fluency task. Participants were tested on ten semantic categories, five from the Living Things domain (LT) and five from the Non-Living Things domain (NLT). While women retrieved more items than men across categories, differential output was only significant in five categories: *animals*, *vegetables* (LT), *furniture* and *utensils* (NLT) for females and *tools* (NLT) for males.

**Keywords:** *semantic categories, semantic fluency, gender, semantic domains, living things, non-living things.*

**Соріано Федеріко, Фумагаллі Джульєтта, Шалом Дієго, Карден Джулія, Боровінські Джеральдін, Манес Факундо, Мартінез-Квітіньйо Макарена. Чи існують гендерні відмінності в тесті на семантичну біжучість?**

**Анотація.** Згідно з емпіричними даними багатьох досліджень чоловіки й жінки неоднаково виконують мовні завдання на основі різних семантичних категорій. Гендерний ефект у виборі категорії під час виконання різноманітних завдань на матеріалі декількох мов вже досить вивчений. Результати цих досліджень засвідчили, що деякі семантичні категорії видаються «чоловічими», а інші – «жіночими». Проте питання, з якою статтю

асоціюється певна категорія, залишається й досі відкритим, позаяк не має переконливих емпіричних даних. Автори цього дослідження провели експеримент із групою аргентинських студентів – носіїв іспанської мови, в якому вони мали в письмовій формі виконати завдання на семантичну біжучість. Учасникам було запропоновано по п'ять семантичних категорій з розряду істот та неістот. Хоча респонденти жіночої статі й надали більшу кількість слів з різних категорій, значущі відмінності зафіксовано лише в п'яти категоріях. Для жінок – це категорії *тварин*, *овочів* (назви істот), *меблів* й *домашнього начиння* (назви неістот), а для чоловіків – категорія *інструментів* (назви неістот).

**Ключові слова:** *семантичні категорії, семантична біжучість, гендер, семантичний простір, назви істот, назви неістот.*

**Сориано Федерико, Фумагалли Джульетта, Шалом Диего, Карден Джулія, Боровински Джеральдин, Манес Факундо, Мартинез-Куитиньє Макарена.** **Существуют ли гендерные отличия в тесте на семантическую беглость?**

**Аннотация.** Согласно эмпирическим данным многих исследований мужчины и женщины неодинаково выполняют речевые задания на основе различных семантических категорий. Гендерный эффект в выборе категории при выполнении различных задач на материале нескольких языков уже достаточно изучен. Результаты этих исследований показали, что некоторые семантические категории – «мужские», а другие – «женские». Однако вопрос, с каким полом ассоциируется определенная категория, остается до сих пор открытым, поскольку не имеет убедительных эмпирических данных. Авторы настоящего исследования провели эксперимент с группой аргентинских студентов – носителей испанского языка, в котором те должны были в письменной форме выполнить задание на семантическую беглость. Участникам было предложено по пять семантических категорий из разряда одушевленных и неодушевленных предметов. Хотя респонденты женского пола и предоставили большее количество слов из разных категорий, значимые различия зафиксированы только в пяти категориях. Для женщин – это категории *животных*, *овощей* (одушевленные предметы), *мебели* и *домашней утвари* (неодушевленные предметы), а для мужчин – категория *инструментов* (неодушевленные предметы).

**Ключевые слова:** *семантические категории, семантическая беглость, гендер, семантическое пространство, одушевленные и неодушевленные предметы.*

## Introduction

Over the last few years, a vast amount of research in the field of cognitive science has focused on how the mind stores and processes semantic categories. Studies conducted with healthy as well as brain-injured patients have led to the development of some theoretical assumptions that lay the foundations for current and future research: (i) different semantic categories are stored and processed in different cortical regions; (ii) a sex-by-category interaction is observed in both healthy and brain-injured patients.

The first assertion is less controversial than the second (even though it is more difficult to test empirically), and studies have yielded conflicting results. However, most researchers agree that living things (LT) and nonliving things (NLT) seem to be processed by different cortical circuits. Some theories supporting the notion of sex differences in language processing have suggested the possibility that the sexes differ in terms of laterality, which would explain the differential performance of males and females in fluency and naming tasks (Halpern 2012). In a study using functional neuroimaging to compare and contrast hemispheric activation patterns in

males and females during an object naming task, Garn et al. (2009) came across two robust and barely-surprising results: activation was highly similar across genders. No significant differences or lateralized peaks of activation were observed for males versus females.

Many more research studies have been conducted to investigate the second theoretical assumption mentioned above, which is the focus of the current study. Several studies have shown that men and women show differential performance on various types of semantic tasks, with the most common being picture naming and semantic fluency (Halpern 2012), and most report a sex-by-category interaction (Barbarotto, Laiacona, Macchi & Capitani 2002; Capitani, Laiacona & Barbarotto 1999; Laws 1999, 2004; Laws, Evans, Hodges & McCarthy 1995). Although some categories are prominently female and others often appear to be male, these findings are not consistent across studies. While some authors suggest sex differences appear in general domains (i.e., women do better with living things and men with artificial objects), others argue that more subtle differences within categories must be accounted for. Specifically, *plants*, *fruits*, and *vegetables (included in LT)* and *furniture (included in NLT)* are usually defined as female categories and *tools* and *vehicles (both included in NLT)* are usually defined as male categories. The category of *animals* is controversial, with some authors attributing it to women and others to men (Laws 2004; Marra 2007; McKenna & Parry 1994). Capitani *et al.* (1999) conducted a fluency task with 266 healthy participants and reported no significant differences between male and female performance. Scotti *et al.* (2010) suggested that the category *animals* is heterogeneous and that males and females may perform better on sub-categories within the larger animal category. These authors collected familiarity ratings from males and females for different subtypes of animals and found that men seem to have better familiarity with *hunted/fished* animals only.

For a long time, there have been two opposing lines of thought aiming to explain the sex-by-category interaction: the first interpretation is based on the Domain Specific Hypothesis (DSH) (Caramazza & Shelton 1998) and assumes that the evolution of cortical development produced specialized and dissociated neural connections for different categories (these authors focused their work on *plants*, *animals* and *tools*) and that males and females have developed specialized brain circuits in those specific areas. The second hypothesis maintains that the acquisition of conceptual representations is experience-dependent and that concepts are represented in sensory and motor cortical circuits, which are learning-based cell assemblies. The social and cultural roles men and women have in each society would account for the difference in the performance on semantic tasks. Gainotti *et al.* (2012) asked elderly (60–80 years old) and young (undergraduate students aged 20–30) participants to perform a semantic familiarity task in two modalities: verbal and pictorial. The authors hypothesized that sex differences would occur among the elderly participants but not the younger ones, given how social roles have changed in modern society. Results supported their hypothesis, which suggests that differences in semantic performance between the sexes are experienced-based. It should be noted that some authors (Laws 1999) have questioned the validity of

familiarity tasks, given that several studies have found that women often assign a higher familiarity rating than men in all categories. We did not focus on that issue for the current paper but plan to address it in a future investigation.

In line with previous work, the aim of this study was to compare male versus female performance on a written semantic fluency task including ten categories from both domains (LT and NLT) and to assess whether differences found in English speakers would also be observed in native Spanish speakers from Argentina.

### Methods

*Subjects.* Sixty-four healthy undergraduate participants (32 women and 32 men) took part in this research. The mean age of men was 21 years ( $SD = 5.94$ ) and the mean age of women was 21 years ( $SD = 3.55$ ).

*Task.* Participants performed a semantic written fluency task in which they had to write as many items as possible from ten different semantic categories in one minute. Four categories are included in the LT domain (animals, fruits, vegetables and body parts) and six in the NLT domain (tools, utensils, furniture, vehicles, clothing and musical instruments).

Before statistical analyses, the databases for each category were revised and “cleaned” according to internal criteria. Superordinate categories (i.e., “birds”, “insects”, “citrus”, “vegetables”, “wind instruments”) were not accepted, and neither were subtypes (e.g., dog breeds such as Cocker or Siberian, or vegetable subtypes such as white vs. black potatoes). We also removed all synonyms from the database and when participants produced them, only the first was kept as a valid response.

*Data analysis.* To compare differences between semantic domains (LT and NLT) and genders, we performed a paired *t*-test. Next, we conducted a repeated measures ANOVA (2x10) to test for differences between sexes in each of the ten semantic categories evaluated. Finally, we conducted paired *t*-tests to detect which categories resulted in sex differences.

### Discussion and results

The first analysis revealed differences between men and women in LT ( $t_{(62)} = 3.34$ ;  $p = .001$ ), with women performing comparatively better, but no significant differences were observed in NLT ( $t_{(62)} = 1.01$ ;  $p = .315$ ). See **Table 1**.

*Table 1*

**Mean number of items produced and SD for males and females on the different semantic domains (LT vs. NLT)**

Domain	Male		Female	
	Mean	SD	Mean	SD
LT	52.72	9.70	60.44	8.72
NLT	62.22	12.72	65.41	12.45

The second statistical analysis revealed differences between categories within each gender ( $F_{(1,62)} = 4.30$ ;  $p < .05$ ; **Table 2**).

Table 2

**Mean number of items produced and SD for males and females on the different semantic categories**

Categories	Male		Female	
	Mean	SD	Mean	SD
Animals	15.06	3.68	18.00	3.39
Tools	9.13	3.00	7.50	2.27
Fruits	12.91	3.03	14.03	2.78
Musical Instruments	12.38	2.98	12.09	2.53
Vegetables	8.84	2.84	11.00	2.99
Furniture	7.69	2.44	9.00	2.74
Body parts	15.91	3.49	17.41	3.24
Utensils	8.78	2.47	10.38	2.86
Vehicles	11.19	2.38	11.88	2.98
Clothing	13.06	3.40	14.56	3.54

Finally, given the differences observed between domains and categories in the two statistical analyses reported above, we performed an additional paired *t*-test to find out which categories led to sex differences. Results showed that men performed better than women on *tools* only ( $p < .05$ ). Women, on the other hand, performed better than men on *animals* ( $p < .01$ ), *vegetables* ( $p < .01$ ), *furniture* ( $p < .05$ ) and *utensils* ( $p < .05$ ).

### Conclusions

The purpose of this study was to identify semantic differences between men and women in a written semantic fluency task assessing native Spanish speakers from Argentina. As reported by other authors (Capitani et al. 1999; Laws 1999, 2004; Marra 2007; McKenna & Parry 1994), there were statistically significant differences between LT and NLT. While women retrieved more items than men in both domains, the difference was only significant for LT.

We also observed sex differences in five out of ten categories tested. Within the category of LTs, women produced relatively more *animals* and *vegetables* than men. Within the NLT domain, men were better at retrieving *tools* and women were better at producing *furniture* and *utensils*.

Within the LT category, other studies (Capitani et al. 1999; Laws 2004) found that women perform better on *vegetables* and *fruits*. Our results only support the female advantage for retrieving *vegetables*. Our data also show a female advantage for producing *animals*. This is a controversial category: some studies show that women perform better with *animals*, since women tend to be better with LTs (Laws 2000), but other authors have found an advantage for men in this category (Marra 2007; McKenna & Parry 1994). Another complex category is body parts. Some

authors include this category in the LT domain. In the current study, we did not find any difference between sexes for body parts.

For the NLT domain, other studies have found that males perform better with *tools* (Barbarotto, Laiacona & Capitani 2008; Laws 2004) and females perform better with *furniture* (Marra 2007). Our results support these results and also show a female advantage for retrieving *utensils*.

Even though other studies with young adults did not find differences between the sexes (Gainotti, Ciaraffa, Silveri & Marra 2010; Moreno-Matínez 2008), in our study, there were sex differences among undergraduate students (mean age 21.11; SD= 4.86). The researchers who did not find differences between the sexes in younger adults support the experience-dependent hypothesis. Therefore, our results are at variance with this hypothesis and set the basis for future research testing the DSH (Caramazza & Shelton 1998).

Barbarotto *et al.* (2008) found sex differences across categories in healthy young children and adults using an oral naming task. Male children between 3 and 5 years old, as well as healthy male adults, performed better than their female counterparts on oral naming of *tools* and *vehicles*. There was also an adult female advantage for *fruits* and *vegetables*, which was not observed in children. These authors suggest that their findings support the DSH (Caramazza & Shelton 1998) and that the female advantage appears only after puberty as a result of hormonal changes. This leads us to think that the differences we found in our study could also be present in children. In the future, we will expand our sample to pre-school and primary school children as well as high school teenagers using a fluency task. If the differences we found also appear in children and adolescents, this will provide even stronger support for the DSH (Caramazza & Shelton 1998).

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