



Contents lists available at ScienceDirect

## Language Sciences

journal homepage: [www.elsevier.com/locate/langsci](http://www.elsevier.com/locate/langsci)

# The masculine form in grammatically gendered languages and its multiple interpretations: a challenge for our cognitive system



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## ARTICLE INFO

### Article history:

Received 9 August 2019

Received in revised form 31 August 2020

Accepted 17 September 2020

### Keywords:

Language comprehension

Gender stereotypes

Word meaning

Inferences

Grammatically masculine form

Role noun

Gender representation

Thinking-for-speaking

## ABSTRACT

We analyze the semantic ambiguity of the grammatically masculine form in languages where this form has more than one meaning (e.g., French, German, English to some extent) when used to refer to human beings. We discuss this ambiguity in terms of inference processing, meaning activation, and the link between language and the way we perceive reality. Importantly, we attempt to identify and explain the cognitive mechanisms at the very heart of gender biases when readers (and speakers) construct mental representations of gender through language. We ground our argument in memory-based approaches to reading, the meaning activation selection model and the thinking-for-speaking hypothesis. This paper provides a cognitive perspective to understanding why, in grammatical gender languages, gender representations are male biased.

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## 1. Introduction

Comprehending a text in terms of both its explicit and implicit meanings depends on the information we can extract and keep in memory. A common assumption is that we extract part of the information through *inferencing* (i.e., deducing implicit information) to build a coherent mental representation of a text (e.g., van Dijk and Kintsch, 1983; van den Broek et al., 1999). Coherence is necessary for comprehension to occur and readers are hence assumed to focus on elements that enable it, both at a local (e.g., between adjacent text constituents) and a global level (e.g., general theme). In this paper, we argue that some elements may still be processed and included in readers' mental representation even though they may not serve such a coherence purpose and might even unnecessarily constrain readers' understanding of the text. More specifically, we discuss the case of text referents' *gender* derived from role nouns. For the purpose of the present paper, we define role nouns as nouns that designate certain functions or positions as in *surgeon* (i.e., a person whose role is to conduct surgery), but that do not have gender as part of their core meaning, such as *queen* or *king*. As such, we are especially interested in gender as a spontaneous inference that is rarely needed for coherence. For example, in the sentence *The surgeons passed their exams*, readers do not need to process the surgeons' gender, as it is not needed to establish a coherent representation of the sentence. However,

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recent research has shown that this is still the case: readers process the gender of protagonists and include it as part of their mental representation of the text.

In what follows, we first discuss gender inference in light of its rather spontaneous nature, mainly focusing on processes involved when comprehending text in general, or more specifically, individual sentences. We particularly focus on behavioral studies – and not ERP studies – given that our goal is to illustrate how readers make sense of textual information for coherence maintenance, not so much identifying the specific time course of the processes at stake. We then demonstrate that this inference, depending on the language tested, offers an interesting illustration of *semantic ambiguity*. We particularly focus on languages – most Indo-European languages (for exceptions, see [Corbett, 1991](#)) – that have a grammatically masculine form entailing more than one meaning. Importantly, we discuss the way our cognitive system is drawn towards biased representations by showcasing current and classical theoretical models on inferencing and semantic ambiguity. By doing so, we gradually move from processes involved at a sentence level to those involved at a word level. Finally, we discuss how these different processes more globally influence our perception of reality. We frame our arguments in Slobin's *thinking-for-speaking* hypothesis ([Slobin, 1996, 2003](#)), which perfectly illustrates the link between language and thought.

## 2. Text comprehension and inferences

Text or discourse comprehension involves a wide range of cognitive processes, mostly oriented towards understanding the content of what is being presented. Beyond simply understanding, there are, quite obviously, other processes that serve a wide range of purposes, from interpreting intent of a depicted protagonist to memorizing textual information. Although one can engage in these processes in a conscious manner – as when students read a textbook for exam preparation –, our cognitive system deals with text comprehension in rather discrete ways.

Typically, when reading a text, we construct mental representations of the conveyed information (e.g., [van den Broek et al., 1999](#); [Graesser et al., 1994](#)). Although their content has been widely discussed, it is generally assumed that mental representations entail three separate levels. At the surface level, the exact words and the syntax are represented for a short period, at the textbase level, explicit text propositions and elements needed for text cohesion are included, and at the final level, known as the situation or mental model, the global state that is conveyed by the words and the sentences in the text is represented ([Kintsch, 1988](#); [van Dijk and Kintsch, 1983](#); [Zwaan et al., 1995](#)). The present paper focuses on this final level, which incorporates elements that pertain to the characters, settings, and actions mentioned in the text (e.g., [Garnham and Oakhill, 1996](#)), and that often drives readers to read between the lines ([Marmolejo-Ramos et al., 2009](#)). As such, readers' mental models include elements that are explicitly derived from the text, as well as elements that are implicit. The process by which implicit elements are deduced and generated is called *inference making* (e.g., [Johnson-Laird, 1983](#); [Kintsch, 1988](#); [van Dijk and Kintsch, 1983](#)), and this process has received a large amount of attention in the past 30 years (for a recent review, see [Cook & O'Brien, 2017](#), and [O'Brien et al., 2015](#)).

Readers can, and sometimes are required to, generate a large panel of inferences. For example, in the sentence *John passed his exams*, the emotional state of *John* is not explicit, yet, it is reasonable to assume that *John* may be consequently *happy*, or *proud*. Although there has been quite a debate on their exact nature ([Gygax and Gillioz, 2015](#)), it is now accepted that emotion inferences are readily included in readers' mental representations ([Gillioz and Gygax, 2017](#)). Similarly, in [Winter and Uleman \(1984\)](#), participants were presented with sentences such as *The reporter steps on his girlfriend's feet during the foxtrot*. The authors found that the trait *clumsy* was reliably activated in the absence of an explicit mentioning of the social trait. Emotion or trait inferences are not the focus of this paper, however, they conveniently illustrate an issue of coherence that has been central in theories on text comprehension, namely, whether or not inferences are generated only if they are required to properly understand the text. Put differently, the question pertains to whether all inferences serve a purpose, especially in terms of coherence. In the case of emotion and trait inferences, for example, one could argue that they refer to the characters' state of mind, thus enabling readers to anticipate the future actions and goals of the depicted protagonists ([Miall, 1989](#)). In the case of gender inferences, their function might be less obvious.

Classically, two opposing views have led the debate as to the functions of inferences and as to the spontaneity by which they are generated. On the one hand, generating inferences are considered to arise by a search-after-meaning principle (inspired by [Bartlett, 1932](#)) in which the cognitive system actively attempts to satisfy *why* questions in a goal-oriented fashion (e.g., *why are certain aspects mentioned?*). This view, known as the *constructionist approach* ([Graesser et al., 1994](#)), assumes that a large amount of inferences is routinely drawn during reading at both a local (e.g., to understand that *his* in *John passed his exams* refers to *John*) and global (e.g., to understand the overall plot of a story) level ([Graesser et al., 1994](#)). This process is particularly important as inferences serve coherence purposes and meet readers' comprehension goals. On the other hand, some have argued that readers only generate two types of inferences: those that maintain local coherence, and those that are *quickly and easily available* ([McKoon and Ratcliff, 1992](#); [Kintsch, 1988](#); [Myers & O'Brien, 1998](#)). Originally coined as the *minimalist approach* ([McKoon and Ratcliff, 1992](#)) and further refined as the *memory-based approach*, this approach stresses a dumb and passive, yet unrestricted activation of inferences that are not necessarily relevant or linked to reading goals (e.g., [Gerrig and McKoon, 1998](#)). This means that inferences are activated without effort or control and may be superficial in establishing coherence. The two opposing approaches differ primarily on the notion of the readers' commitment to the text, with the constructionist accounts emphasizing the goal-driven approach to generating inferences, as opposed to memory-based accounts that stress the passive nature in which they occur ([Cook & O'Brien, 2017](#)).

Despite the unsettled dispute between these two opposing accounts, the general cognitive mechanism that enables readers to generate inferences has been well documented and is widely accepted. Readers activate previously acquired knowledge that is stored in long-term memory and combine it with information explicitly mentioned in the text to form their mental representations (e.g., Kintsch, 1988; Gernsbacher, 1997). The term *world knowledge* has often been used in the literature as describing the long-term memory of knowledge, which is acquired by the reader through their experiences and interactions with the real world. In the sentence, *The surgeon passed the exams*, the inference that the surgeon is *happy*, or *proud*, is directly derived from one's knowledge that when one succeeds in an exam, one likely feels some level of happiness. Although this principle may sound quite simple, it is, in fact, possible for the reader's world knowledge to *mismatch* the information depicted in the text, as in *The surgeon passed the exams and cried*, forcing the cognitive system to resolve the mismatching information (e.g., *The surgeon cried in happiness*).

In sum, making inferences is fundamental to text comprehension, and readers generate inferences by combining text information with available world knowledge. However, contradictions between text and world knowledge may lead to comprehension obstacles as will be further discussed in the context of gender inferences in the following section.

### 3. Gender inferences and world knowledge

In the sentence *The surgeon passed the exams*, it seems rather unlikely that one would need to know whether the *surgeon* refers to a woman or a man, at least not to understand the sentence (i.e., local coherence). In fact, this sentence is effortlessly understandable without knowing the gender of the referent, at least until an anaphor is encountered as in *The surgeon passed the exams and she seemed happy*. At the same time, however, the gender of the *surgeon* is a piece of information that could be readily available, as it belongs to a strongly shared belief, or stereotype<sup>1</sup>. Several studies have specifically addressed this issue of stereotypes and gender inferences during text comprehension (e.g., Garnham et al., 2002; Lassonde, 2015; Kennison and Trofe, 2003; Kreiner et al., 2008; Pyykkönen et al., 2010; Reynolds et al., 2006).

In Reynolds et al. (2006), for example, participants were shown different variants of the following short story:

*A father and son are driving home one day, when they are involved in a serious accident. The father is killed out-right, but the son is driven to hospital, where he is about to undergo an emergency operation. However, the surgeon refuses to operate, saying: "I can't operate on him: he's my son." The question is, how can this be?* (from Sanford, 1985, p. 311, p. 311)

In their set of experiments, only a few participants were able to dismiss the male stereotype associated to the role noun *surgeon* (i.e., a surgeon can be a woman, thereby referring to the boy's mother in this context) and reach a coherent interpretation of the passage. However, the majority of the participants struggled to make sense of the critical sentence, *he's my son*, when this gender specifying information conflicted with their expectations activated by the word *surgeon*. The authors concluded that readers readily make gender inferences based on stereotypical information, and that they make them in a forward fashion. Thus, the spontaneous inference that the surgeon is or *should be* a man is made as soon as the role noun *surgeon* is encountered in the text. Similar conclusions were also drawn for shorter passages such as (Garnham et al., 2002):

- (1) The *soldier* drove to the playgroup after work
- (2) and picked up one of the children,
- (3) who said "Look what I did today *mummy!*"

In this case, participants struggled to make sense of sentences like (3) when the gender specification of the person was incongruent with the role noun stereotype in (1). These results concur with the notion emphasized by memory-based views that readers passively infer gender information although it may be irrelevant or even detrimental for comprehension. The constructionist approach, on the other hand, would predict an absence of comprehension difficulty when encountering the contradicting information (e.g., anaphor) since gender would not be thought to be inferred until the pronoun is encountered. In other words, a search for gender information would have been initiated only if the reader was required to disambiguate the gender in cases such as anaphora resolution.

The assumption of this passive activation, as elucidated in the memory-based approach, originates from Myers and O'Brien's (1998) *resonance model*. According to this model, concepts in active memory (e.g., information read in a text, such as a role noun) send signals to long-term memory, where general world knowledge is typically stored. These signals trigger associated information to resonate, with their level of activation depending on the correspondence of features existing between the text and the readers' world knowledge stored in memory. In terms of the passive activation of gender stereotypes, Lassonde's study (2015) elegantly illustrates this resonance mechanism through a series of experiments. In her study, participants read short stories about characters that were either engaged in gender stereotype-congruent or incongruent activities (Experiment 1 & 3: Jill/Will – cheerleading/wrestling). While the stereotype-incongruent activities initially prompted reading difficulties (e.g., Will being a cheerleader), they disappeared if information that substantiated the incongruent behaviour had been provided prior to reading the target sentence (e.g., *Will's parents thought that participating on*

<sup>1</sup> For a discussion on the difference between typicality and stereotypicality, see Garnham et al. (2015) and Gygax et al. (2016).

the cheerleading team would improve his overall flexibility). Intuitively, the ease with which stereotypical information was overruled in Lassonde's results may seem rather peculiar, given that these mechanisms have been shown to be rather impermeable to conscious manipulation (e.g., Oakhill et al., 2005). However, Lassonde argued that the effect created by providing counter-stereotypical information is not one of suppressing stereotype activation, but rather of competing with stored stereotypical knowledge, as suggested by memory-based approaches to reading comprehension. In other words, by providing counter-stereotype information, the feature overlap between the information presented in the text and knowledge in long-term memory is diminished, allowing the stereotype activation to be overruled. Note that without reinstating the counter-stereotypical information in text, stereotypes are very likely to re-emerge, given the strength of their associations with the behaviors presented in the text.

The issues discussed so far are of course relevant to all languages that readily convey and activate stored stereotypical knowledge. However, apart from carrying stereotypical information, languages known as grammatical gender languages also carry specific rules that govern the relationship between noun gender and referent gender, thereby adding to the complexity of comprehension.

#### 4. Grammatical gender and gender representation

In French, as in many other grammatical gender languages, there are two grammatical forms: the feminine and the masculine forms. For inanimate entities, such as *table*, categorical membership is arbitrarily determined and must be learnt as part of the noun's lexical entry. However, grammatical gender is not arbitrarily allocated for animate beings, in that it usually specifies the gender of the person (and frequently animals) that is being referred to (e.g., *une<sub>feminine</sub> chirurgienne<sub>feminine</sub> et un<sub>masculin</sub> chirurgien<sub>masculin</sub>* [a female and male surgeon]).

While this grammatical rule is generally quite easy and straightforward<sup>2</sup>, its complexity becomes evident when the gender of the person referred to is not known or irrelevant, or when a group of people composed of women and men is referred to. In such cases, the masculine form is used as the default value. In fact, only one man among a group of women suffices for the masculine form to be employed. This means that the masculine form can be used specifically (i.e., masculine form = *exclusively* a man or men) and generically (i.e., masculine form = mixed gender, neutral or unknown composition), wherein readers are required to make a decision about its probable meaning.

Consequently – at a word level already – the masculine form poses an interesting challenge for our cognitive system, as it needs to be consistently disambiguated and as it occurs remarkably frequently (Schärer, 2008)<sup>3</sup>. Namely, at each occurrence for which context does not provide any cues as to the gender of one or several referents, as in *Le chirurgien<sub>masculine</sub> a réussi ses examens, ses amis<sub>masculine</sub> aussi*. [The surgeon<sub>masculine</sub> passed his exams, his friends<sub>masculine</sub> too], the system must decide whether the masculine form – both for the *surgeon* as well as for the *friends* – refers to only men (i.e., the specific meaning), to a person or group whose gender constellation is unknown or withheld, or to a mixed group. Specifically, in our example, readers need to disambiguate whether the *surgeon* is a woman or a man, and whether the *friends* consist exclusively of men or a composite of both women and men. In this regard, the masculine form presents an *ambiguous* referent for the system to decode (Irmen and Kurovskaja, 2010). Recent studies investigating the interpretation of the masculine form show that the probability of this ambiguity being resolved is in fact not distributed equally across its multiple interpretations but favors the specific interpretation (i.e., masculine form = *exclusively* a man or men).

Irmen and Kurovskaja (2010), for example, compared the processing of masculine and feminine grammatical forms in German. The authors were mostly interested in the non-ambiguous status of the feminine form (i.e., in the case of role nouns, the feminine grammatical form can only refer to a woman or women) compared to the ambiguous status of the masculine form (i.e., specific vs. generic meaning). In their study, they presented participants with sentences composed of a role noun and a kinship term (e.g., *Der Lehrer ist meine Schwester/Die Lehrerin ist mein Bruder* [The teacher<sub>masculine form</sub> is my sister/The teacher<sub>feminine form</sub> is my brother]) and asked them to judge the sentences in terms of correctness and customariness. The results showed two important findings: First, for both grammatically feminine and masculine role nouns, incongruity between grammatical gender and kinship gender was considered less correct and less common than congruity. Second, the effect of incongruity was less pronounced when role nouns in the masculine form were paired with a female kinship term than when role nouns in the feminine form were paired with a male kinship term, suggesting that the masculine form was perceived as less specific than the feminine form. In terms of ambiguity, these results suggest a stronger activation of the specific meaning for the feminine form, yet some level of dominance of the specific meaning of the masculine form too.

<sup>2</sup> Note that some studies have documented the asymmetrical processing and learning of grammatical gender forms (see Beatty-Martínez and Dussias, 2019 for a discussion on findings based on linguistic, psycholinguistic, and neurolinguistic evidence). Typically, in Romance languages, feminine nouns have been shown to be more slowly acquired and processed (e.g., Antón-Méndez, Nicol and Garrett, 2002), because they can be considered as marked, whereas the masculine form – the default value – as unmarked. Although we would argue that this is not central when addressing nouns that explicitly refer to women or men, it is important to keep in mind that masculine and feminine grammatical forms (i.e., lexeme) – when referring to both animate as well as inanimate beings – are not necessarily processed and acquired equally easily. When referring to humans, at least, some studies indicate that feminine forms may be processed similarly easily to masculine form in younger children, in terms of comprehension and production (e.g., Flaherty, 2001).

<sup>3</sup> See also Sá-Leite et al. (2019) for a discussion on the prevalence of the activation of grammatical gender in L1 and L2 learners, even in the absence of agreement context (i.e., a context that actually forces readers to compute gender).

These findings are in line with other studies on the topic. For example, in Gygax and Gabriel (2008), French-speaking participants had to decide whether the person referred to by a kinship term (e.g., *un frère* [a brother], *une soeur* [a sister]) could be part of a group referred to by a role noun in the masculine form (e.g., *musiciens<sub>masculine</sub>* [musicians]). Although male kinship terms were more easily and faster mapped onto role nouns written in the masculine form than female kinship terms, the proportion of positive responses to *female kinship-masculine role noun* pairs was still above 50% (i.e., 59%, vs. 95% for male kinship terms). Note that when role nouns in the feminine form were added to the items, the proportion of positive responses to *female kinship term-masculine role noun* pairs dropped below 50% (i.e., 48%, vs. 95% for male kinship terms). Such a drop suggested that the generic meaning of the masculine form was even less accessible to participants when role nouns in the feminine form were also present. The authors suggested that the specific and exclusive meaning of the feminine form further facilitated the already dominant specific meaning of the masculine form.

These studies, among others, seem to indicate that the specific meaning dictates readers' interpretation of the masculine form, although never to the extent of completely erasing its generic one. The bigger question, then, is why the male-specific interpretation takes precedence over the generic one and what cognitive mechanisms underlie these processes. Lévy, Gygax, and Gabriel (2014) and Gygax et al. (2012) addressed these issues. Employing the same paradigm as Gygax and Gabriel (2008), Lévy et al. (2014) systematically varied the proportion of pairs including a female or a male kinship term. They showed that when there were more masculine role noun pairs with a female kinship term than there were with a male kinship term, the probability of responding positively to the former increased, and the response times to do so decreased (i.e., participants became faster), to the extent of resembling positive response times to male kinship - masculine role noun pairs. The authors claimed that increasing exposure to exemplars where the generic meaning is required – typically when a woman is presented as part of a group represented by a role noun in the masculine form – increased the likelihood of the generic meaning to be activated later in the experiment. In Gygax et al. (2012), rather than manipulating the exposure to female exemplars, the authors simply told participants halfway through the experiment to keep the generic meaning of the masculine form in mind when responding to the different kinship - masculine role noun pairs (Experiment 1). Prior to receiving instructions to explicitly attend to the generic meaning of the masculine form, participants struggled to map female kinship terms to role nouns written in the masculine form, although the proportion of positive responses to these pairs was, again, above 50% (i.e., 58%, vs. 95% for male kinship terms). After receiving the experimental instructions, however, the proportion of positive responses to female kinship - masculine role noun pairs drastically increased to 95% (vs. 98% for male kinship terms). These results suggested that the generic meaning of the masculine form could be activated, maybe even to the extent of becoming the dominant meaning. However, response times for positive responses gave a somehow different picture. Before the instructions, even when responding positively to female kinship - masculine role noun pairs, participants took longer to do so. After the instructions, this effect remained the same, suggesting that linking masculine forms to female referents persists to be more difficult than linking masculine forms to male referents, further supporting the prevalence of the specific meaning of the masculine form.

As first raised by Lévy et al. (2014), the findings of these two studies can be well captured by the *activation-selection model* of ambiguity resolution (Gorfein, 2001; Gorfein et al., 2007). A primary assumption of this model is that a single word is represented by a set of weighted attributes that reflect the multiple features related to it (e.g., semantic representations, acoustic information, etc.). When considering a word in the masculine form, one could argue that it is *polysemic*<sup>4</sup>, and that the multiple features associated to its semantic representations may correspond to all its possible interpretations (or meanings). However, according to this model, not all attributes are necessarily activated when a word is encountered. In fact, their activations are dependent on the *context*, as well as the task at hand. In the absence of a particular context, the activation of an attribute depends on its current weight. The weight of an attribute can change over short and long periods of time, mainly as a function of its occurrences (i.e., how much one is exposed to it). Activating an attribute increases the likelihood of this attribute to be re-activated in subsequent processing. This is in line with Lévy et al. (2014) data, where the likelihood of the generic meaning to be activated increased as its weight was changed through the authors' manipulation of the proportion of occurrences (even without participants noticing the change in proportion). In contrast, Gygax et al. (2012) manipulation of simply *telling* participants to activate the generic meaning was insufficient to change its weight, as shown by their response time data. In other words, the specific meaning of the masculine form remained activated despite explicit instructions to consider the alternative meaning, instantiating the specific meaning's highly weighted attributes (i.e., its dominance).

Importantly, although we suggest through the *activation-selection model* that the selection of the specific meaning of the masculine form does occur at an early stage of processing, some word processing models such as *parallel distributed processing* models (PDP) (e.g., Plaut et al., 1996) do suggest that both (or all) meanings are activated, and that one meaning may be selected only at the decision stage of the comprehension process (or the task at hand). Support for the idea that both meanings are activated comes from studies showing processing advantage for ambiguous words in lexical based tasks (e.g., lexical decision task), yet processing disadvantage in semantic decision tasks (e.g., Hino et al., 2002; Pexman et al., 2004). When having to take a semantic decision (i.e., determine meaning), there is competition between meanings (i.e., a *one-to-*

<sup>4</sup> To be more accurate, we believe that the masculine form can be considered as a case of a *metonymous polysemy*, which refers to an ambiguous word consisting of several distinct, yet semantically related senses. For example, the word *church* not only refers to the physical building dedicated for Christian worship but can also metonymically refer to the institution or organization of Christian faith; meanings which differ yet are nonetheless related to each other. In the same vein, both the male-specific and generic interpretations are connected through their common inclusion of the male gender.

many mappings from orthographic to semantic; Hino et al., 2002), resulting in processing cost. In the absence of context, the frequency – or the familiarity – of the meanings, may become central in meaning determination (Haro and Ferré, 2018). As such, the specific meaning of the masculine form may override its generic meaning, as it is simply more frequent.

Although a detailed presentation of the exact mechanisms of word processing goes beyond the scope of this paper (see Haro and Ferré, 2018, for a discussion on meaning relatedness), it is important to note that most studies on the interpretation of the masculine form document the dominance of its specific interpretation, irrelevant of participants being exposed to other gender cues or not. As such, the specific interpretation of the masculine form can be considered as the more *salient* meaning. In the following section, we explore how this saliency may be established.

## 5. Meaning saliency

The saliency of the specific meaning of the masculine form may well be explained by the mechanisms involved in learning to interpret grammatical forms. In many languages, children are formally taught the specific meaning by approximately the age of six (i.e., the masculine form is used to refer to boys or men and the feminine form to girls or women) before the generic one (Gygax et al., 2009). One can argue that this sequence, which is invariant across languages, may play an important role in meaning saliency, or dominance.

In addition to this, the masculine in its singular form is arguably rarely intended in a generic way, thus increasing the weight of the specific meaning of the masculine form in the long run (even in the plural form). When looking at a male surgeon, for example, one would commonly say *Regarde le chirurgien* [Look at the male surgeon], increasing the association between the masculine form and male referents. Relatedly, in cases where the masculine singular form may be intended as generic, rarely is there a clarification that the masculine form was intended as such. In a sentence such as *Elle voulait discuter avec un chirurgien<sub>masculine</sub>* [She wanted to talk to a surgeon], it could well be the case that the generic meaning is intended (i.e., she just wants to talk to someone from the surgical staff, female or male), yet no linguistic cue signals this in the sentence.

These conditions make the specificity of the masculine form highly salient and provide grounds for readers to commit to a specific meaning once it is encountered. It could however be argued that the activation of the specific meaning of the masculine form might decay fairly quickly, consequently having rather small influences on readers' mental representation of gender, at least past a few seconds (which is the typical response times in the studies presented so far). In other words, and to refer back to memory-based views of reading, the specific meaning of the masculine form may well resonate (i.e., fast activation), but this does not necessarily mean that the information would be integrated and validated, as raised by Cook and O'Brien's RI-Val model (2017). This model, as an extension of the memory-based approach, argues that at the initial level, highly associated information – in our case the specific meaning – is activated through a passive process. This information is then integrated (integration stage) in active memory, depending on conceptual overlap between textual elements and information already in active memory. In the final stage, the information is then validated against other information in long-term memory (readers' knowledge). Consequently, one could wonder whether the specific meaning of the masculine form would survive the integration as well as the validation stages. It seems that it does. Off-line studies on grammatical gender (Braun et al., 1998; Stahlberg et al., 2001; Verweken et al., 2015) seem to indicate that the specific meaning of the masculine form is well integrated in readers' or listeners' mental representations in a durable fashion, and that these resulting representations influence different types of decisions. Therefore, the biasing effect of the masculine form and its specific meaning do not only emerge when psycholinguistic measures are taken within one or 2 seconds after the encounter of a role noun but are sustained in the mental model in a durable fashion.

In fact, it seems rather unlikely that the specific meaning of the masculine form would be invalidated, given that no other cues are given by the context. For the cognitive system, this would simply mean that the representation *masculine form = man or men* is a good-enough representation (as put forward by Ferreira et al., 2002). Note that even when the context does give conflicting cues, as when a role noun in the masculine form represents a stereotypically female job or activity – as in *les diététiciens<sub>masculine</sub>* [dieticians] – most studies show that the specific meaning of the masculine form is still activated and dominant (e.g., Gygax et al., 2008; Stahlberg et al., 2001).

In sum, it seems quite undeniable that the cognitive ambiguity underlying the masculine form is likely to be resolved towards thinking that there are more men involved when role nouns are used in the masculine form. Historically, it is important to note that in many languages, the masculine form has not always been officially associated to a generic meaning, nor has it been considered as the default value (for a history of the generic use of masculine forms see Viennot, 2014 for French, Irmen & Steiger, 2006 for German and Bodine, 1975 for English). As such, language reflects the social environment in which it evolves, or more specifically, our androcentric society. We would even like to argue that language, in turn, also contributes in building such a society, by cognitively compelling us to attend to these social cues, which is the focus of the next section.

## 6. Grammatical gender as attentional cues

When considering the influence of grammatical gender or in our case the specific meaning of the masculine form on readers' perception of reality, the relationship may well be contextualized within Whorf's framework of *linguistic relativity* (Whorf, 1956). This theory, which has sparked debate over the years, contends that language systems bias our conceptual categories by emphasizing certain characteristics of the world. As such, grammatical gender may orient our attention to

particular gender cues, which in turn inflict dynamic cognitive changes in the way we represent reality (Boutonnet et al., 2012; Sato and Athanasopoulos, 2018). Because the tasks used to study the issues of the masculine form have been limited to the explicit processing of language (see Lucy, 1997 for a discussion on methodological issues pertaining to linguistic relativity), this effect on the way we represent gender cannot truly be considered as an illustrative case of linguistic relativity. In the context of the interpretation of the masculine form, a more appropriate approach to consider may be that of Slobin's *thinking-for-speaking* hypothesis (Slobin, 1996, 2003).

The thinking-for-speaking hypothesis (1996, 2003) argues that as language acts as a medium to encode event conceptualizations, they inevitably compel language users to attend to properties of the world that are particularly accentuated by the language. Processing language thus activates linguistically-emphasized features, consequently tainting or biasing how we see the world. In this manner, grammatical gender drives language users to consistently attend to gender information, even when gender may be irrelevant to the given situation (see Gabriel and Gygax, 2016 for a discussion of the effect of this on identity). So for example, in the sentences *la chirurgienne<sub>feminine</sub> a réussi ses examens* or *le chirurgien<sub>masculine</sub> a réussi ses examens* (i.e., the only two options to describe *the surgeon passed the exams*), the grammatical gender of the role noun inevitably activates gender in both of the cases. Irrelevant of whether this is intended or not, the gender marking makes gender a salient feature in this sentence. In the latter case, and as discussed in this paper, the male-specific meaning of the masculine form drives people to perceive the surgeon as being a man, further constraining their mental representations towards male-dominant ones. Such a constraining effect is well substantiated by studies on the way grammatical gender is processed by bilinguals (e.g., Sato et al., 2013). In Sato et al. (2013), for example, French-English and English-French participants were presented with a series of sentence pairs such as (4) and (5) in English and (6) and (7) in French, and were asked, in each language, to respond whether the second sentence was a plausible continuation of the first one.

- (4) The *dieticians* came out of the room.
- (5) Because of the bad weather, one of the *women/men* was wearing a raincoat.
- (6) Les *diététiciens<sub>masculine</sub>* sortirent de la pièce.
- (7) A cause du temps nuageux, une des *femmes/un des hommes* portaient un manteau de pluie.

Results showed that when participants read in English, their responses were influenced by the stereotypicality of the role nouns (i.e., plausibility judgments were greater when the role noun in the first sentence matched the gender of the person in the second sentence), whereas when processing the sentence in French, the same participants were more likely to accept the sentence when the gender specification in the second sentence was male, confirming the male bias found in previous studies in French. This language switch effect, shifting from a stereotype bias to a male bias, was more pronounced in those participants more proficient in their second language, suggesting that second language fluency modulates gender activation.

Many studies on bilinguals (e.g., Boroditsky et al., 2003; Phillips and Boroditsky, 2003), as well as on monolinguals (e.g., Imai et al., 2014; Saalbach et al., 2012; Sera et al., 2002), similarly point to the impact of grammatical gender on mental representations. In other words, depending on the language at use, readers and speakers are pointed to the gender features associated with the grammatical category. When no grammatical markings are present, mental representations of gender are pushed towards stereotypical information, whereas when grammatical marks are present, these are dominant in driving readers' and speakers' mental representations.

## 7. Conclusion

When comprehending texts, readers are inclined to construct a coherent mental representation of the conveyed information. This mental representation entails explicit, as well as implicit elements that we generate through the process of inferencing. Although gender may not be crucial for comprehension purposes, we nevertheless encode gender when we are exposed to role nouns in sentences such as *The surgeons passed their exams*. To do so, we use the context, as well as information stored in long-term memory, also referred to as world knowledge, to encode the gender of the person(s) being referred to. In this paper, we have argued that world knowledge, in the form of stereotypical knowledge, is activated in a passive way when processing role nouns.

In grammatical gender languages, the structure of the language itself also provides inferential cues as to the gender of the person(s) referred to by the role nouns. In French, for example, the sentence *Les chirurgiennes<sub>feminine</sub> ont réussi leurs examens* [The female surgeons passed their exams], there is no ambiguity as to the fact that we are talking about female surgeons. However, when using the masculine form, as in *Les chirurgiens<sub>masculine</sub>, ont réussi leurs examens*, readers must disambiguate the masculine form, as it can refer to male surgeons on the one hand, but also to a group of people composed of both female and male surgeons. We have argued that this situation constitutes a difficult challenge for our cognitive system, and that it is most likely resolved by relying on meaning saliency, most likely based on meaning frequency and learning primacy. Consequently, the specific meaning of the masculine form (i.e., masculine form = *exclusively* a man or men) remains dominant. This dominance has also been very well documented when examining the English so-called generic *he* (e.g., see the review in the seminal book by Corbett, 1991, pp. 221–222), its strength gradually increasing from 6- to 8- year olds (first graders) to 18- to 22- year olds (college students) (Hyde, 1984). We have argued that although such dominance reflects our

androcentric society, it also contributes to further maintaining and reinforcing these biases by providing us with linguistic cues that heighten specific features of social reality.

In sum, using one single grammatical gender form to mark role nouns (i.e., the masculine form) for multiple possible meanings is highly problematic for our cognitive system. In turn, it is also problematic in the perceptual constraints it imposes on readers, which can have dramatic consequences in terms of social constructs.

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