

The influence of grammatical gender and suffix transparency in processing Italian written nouns

Maria De Martino, Giulia Bracco,
Francesca Postiglione and Alessandro Laudanna
University of Salerno, Italy

In some languages the grammatical gender of nouns can be probabilistically detected using formal cues; for instance, in Italian, the majority of feminine nouns end in ‘-a’ (e.g., *casa*, ‘home’) and the majority of masculine nouns end in ‘-o’ (e.g., *albero*, ‘tree’). It has been hypothesized that the match/mismatch between the formal information of the suffix and the abstract grammatical information on gender affects lexical processing of nouns. An alternative account is that a default option available for gender poses constraints to mechanisms of lexical access for words exhibiting gender markers in the surface form.

In the present study, nouns with highly predictive gender suffix (regular), nouns whose gender cannot be recovered from surface form (opaque) and nouns with misleading gender suffix (irregular) were compared in two reading aloud and two lexical decision experiments. Results confirmed that regular nouns are processed better than irregular nouns. No difference was detected between masculine and feminine opaque nouns.

The results allow the conclusion that a formal gender feature (the gender orthographic regularity) is more likely to affect lexical processing of bare nouns than the activation of a gender default option.

Grammatical gender and lexical processing

Grammatical gender of words is a morpho-syntactic feature occurring in many human languages and the issue of its activation and selection during written or spoken language processing has been a matter of empirical and theoretical debate in Psycholinguistics.

Across languages, gender conveys different kinds of properties: (i) semantic properties, when it distinguishes between nouns referring to entities having a biological

gender (in Italian, *fratello*, masculine, ‘brother’ vs. *sorella*, feminine, ‘sister’); (ii) syntactic properties, when it works as a nominal classification feature and drives agreement operations between nouns and modifiers (e.g., determiner and noun, noun and adjective); (iii) morphological properties, when the gender markers displayed in the surface form allow the computation of the inflectional realizations of nouns.

Generally speaking, since grammatical-gender systems are language-specific, there is a great variability in the available evidence on whether and how grammatical gender affects processing of bare nouns, noun phrases, or sentences. In this research we focus on the formal systems of gender marking, namely the possibility that, at least in some languages (e.g., Romance languages), lexical entries for nouns are specified for an intrinsic gender feature by means of morphological markers.

In gender-marked languages, gender can entail strong correlations with the formal features of nouns. For instance, in Italian, according to a recent type-based count (Postiglione, De Martino, Bracco & Laudanna, 2014), the majority of nouns showing the mapping ‘-a/-e’ between the singular and the plural form are feminine (99.9%), while the majority of nouns showing the mapping ‘-o/-i’ between the singular and the plural form are masculine (99.97%). Analogously, in Spanish, almost all nouns ending in ‘-o’ are masculine, while the nouns ending in ‘-a’ are feminine (Harris, 1991). Across languages, these consistent associations allow to set apart nouns where formal cues are highly predictive of the noun gender (*sedia*, Italian feminine, ‘chair’) from nouns where gender cannot be recovered from the surface form (*fonte*, Italian feminine, ‘source’). The available empirical data showed that the lexical system is sensitive to the presence of gender-related formal cues: nouns with formal cues that are usually associated with a definite gender tend to be processed more efficiently. This pattern can be observed across languages and in a variety of conditions: in the acquisition of grammatical gender of nouns (Caselli, Leonard, Volterra & Campagnoli, 1993; Matthews, 2010; Pérez-Pereira, 1991), during recognition and production of nouns presented as targets when gender information is pre-activated in modifiers presented as primes (Bates, Devescovi, Hernandez & Pizzamiglio, 1996), in linguistic tasks requiring explicit recovery of gender information (Gollan & Frost, 2001; Guillelmon & Grosjean, 2001; Taft & Meunier, 1998), in the retrieval of gender information during language comprehension (Hernandez, Kotz, Hofmann, Valentin, Dapretto & Bookheimer, 2004; Gollan & Frost, 2001; Padovani & Cacciari, 2003), and in gender assignment in second language learners (Bordag, Opitz & Pechmann, 2006; Bordag & Pechmann, 2007; Chini, 1995). Taken together, the results of the above-mentioned investigations might be explained by a model of gender retrieval that predicts lexical system to access gender information by means of two routes (Gollan & Frost, 2001):

1. the lexical route allows retrieval of gender through an abstract gender node where grammatical information is arbitrarily associated with a noun and stored in the lexicon independently of gender-correlated formal aspects (e.g., the masculine gender associated with the Italian word *albero*, masculine, 'tree');
2. the non-lexical route allows retrieval of gender information by exploiting its correlation with formal cues as phonological/orthographic information (e.g., the nominal ending '-o' of Italian masculine nouns).

The model accounts for the advantage of transparent and regular nouns because their gender can be reliably recovered by both the lexical and the non-lexical route while, on the contrary, only lexical route succeeds in providing the correct gender information for opaque and irregular nouns. However, if the two-route hypothesis offers a convincing explanation of how transparency and regularity of phonological/orthographic information of gender affects explicit retrieval of noun gender, it does not clarify whether and how specific gender features (i.e., transparency) contribute to single noun processing. Actually, this latter issue has been investigated in a number of papers (Colé, Pynte & Andriamamonjy, 2003; De Martino, Bracco & Laudanna, 2011; Grosjean, Dommergues, Cornu, Guillelmon & Besson, 1994; Paolieri, Lotto, Leoncini, Cubelli & Job, 2011; Spinelli, Meunier & Seigneuric, 2006) but the overall picture of the data is still rather inconclusive because of the variability of the exploited experimental conditions and of the investigated language gender systems.

An intriguing hypothesis is that lexical processing of single nouns could be affected by gender features as expressed in the orthographic-phonological form of a word (the Independent Network model (Caramazza, 1997; Caramazza & Miozzo, 1997) is compatible with such a prediction) or also that the constraints imposed by language-specific gender morphology could determine effects of gender in single word processing (Double-Selection model, Cubelli, Lotto, Paolieri, Girelli, & Job, 2005). For instance, we may hypothesize that for languages like Italian (where word stems do not correspond to words, but necessarily occur in combination with morphological affixes encoding word's lexical properties), the reliability of gender affixes affects lexical processing since it may facilitate or hamper the lexical access to the whole set of lexical features associated to the representation of the word form.

Remarkable suggestions about the role of formal gender regularities in lexical access for single nouns come from a study on Italian (De Martino et al., 2011) where the problem was addressed by comparing two groups of nouns: regular (feminine nouns ending in '-a', *piscina*, 'swimming pool') and irregular (masculine nouns ending in '-a', *problema*, 'problem'). Participants were asked to make

a lexical decision, to read aloud or to inflect the nouns. The results revealed that the formal gender irregularity of the masculine nouns ending in ‘-a’ gave rise to a disadvantage in lexical processing of these nouns when compared with fully transparent nouns (feminine nouns ending in ‘-a’). The authors concluded that the lexical system is sensitive to formal cues in processing single words and argued that their results provide evidence against models of lexical access that predict gender effects only when agreement operations must be computed. They explained the asymmetry in lexical processing of nouns exhibiting different degrees of transparency of the gender suffix by hypothesizing that lexical access to nouns irregularly inflected for gender is slowed down by the presence of a mismatch between the orthographic-phonological information as displayed in the suffix of the nouns and the abstract gender information assigned to Italian nouns. This line of reasoning, although quite clear, is likely to be vitiated by a confound due to the direct comparison between nouns belonging to different genders (masculine vs. feminine): in principle, the observed differences might be produced by differences between the gender options available in Italian and not, or not only, by the mismatch between sublexical/formal and abstract lexical gender features of the tested Italian nouns. Actually, different latencies between masculine and feminine nouns are predicted by Masculine Default Accounts (MDAs), a set of linguistic hypotheses based on the existence of asymmetries in representation and processing between the masculine and the feminine options for grammatical gender. The basic idea is that a principle of economy of representation drives the exclusion of redundant information in the lexicon; as a consequence, when two or more options are available for grammatical categories (masculine vs. feminine vs. neuter for grammatical gender, verbs finiteness vs. non-finiteness, 1st vs. 2nd vs. 3rd for person, and so on) one option emerges as the default. In the framework of theories of morphology (e.g., Halle & Marantz, 1994; Carstairs-McCarthy, 1998; Harley and Ritter, 2002) default options are supposed to be based on an underspecification of features: for instance, in languages like Italian, masculine is represented by the absence of a gender feature, in contrast to feminine. The choice of default in a given language is constrained according to principles of its morphological and syntactic features and markedness is identified on the basis of a number of empirical observations: default (or unmarked) options appear earlier during language evolution, are acquired faster by speakers and L2 learners and require a minimum effort (White, Valenzuela, Kozłowska-Macgregor & Leung, 2004; Franceschina, 2001; Harris, 1991; Tsimpli & Hulk, 2013). In terms of lexical processing, default options are meant to be automatically applied to all items of a particular lexical category unless this application is blocked by contradictory information in the word’s lexical representation (e.g., Pinker, 1998). As far as grammatical gender is concerned, evidence of masculine

acting as the default are available for Spanish: the plural masculine Spanish word *hermanos* (brothers/siblings) can include both male and female siblings, otherwise *hermanas* (sisters/siblings) only refers to female siblings. Masculine agreement also applies in Spanish in syntactic contexts where triggers for agreement are absent; for instance, when words without a grammatical gender (like prepositions) are used in sentences like this: “*Tienes demasiados “paras” en este párrafo*” (You have too many (MASC) “paras” in this paragraph). In such a case, the word “para” does not have a gender because it is a preposition and the masculine gender is used in order to recover an inflection for the quantifier (Harris, 1991; McCarthy, 2008). Analogous observations are reported for Italian (Di Domenico, 1997). As a consequence of the linguistic pervasive distribution of the above described examples, speakers tend to represent masculine as the unmarked and underspecified gender. This poses constraints to mechanisms of lexical access in terms of an advantage for masculine nouns: it has been demonstrated that Spanish L2 intermediate and advanced level learners use the masculine gender extensively to perform agreement both in recognition and production tasks when they know the gender of words and even when they do not (McCarthy, 2008).

In the light of these observations, there is a possibility that the pattern of results reported by De Martino et al. (2011) might be coherent with default-based predictions: the default option (the masculine) is automatically activated when processing nouns; thus, in order to achieve lexical access for masculine nouns irregularly inflected for gender (*problema*), the lexical system must solve an interference arising from the activation of the abstract unmarked gender (masculine) and the formal marked gender ending (the vowel “-a”, which in Italian is present in a small percentage of masculine nouns (1.3% in Postiglione et al.’s count (2014))). The conflict between an unmarked abstract gender information and a marked gender-suffix could explain the longer latencies and the lower accuracy for masculine irregular nouns.

The aim of the present study was to test the predictions of the MDAs.

In the following sections we will give a brief description of the grammatical gender in Italian, then we will describe a series of four experiments: the first two experiments are designed to enlarge the empirical evidence provided by De Martino et al. (2011) about an asymmetry in processing between nouns with reliable vs. tricky gender affixes; the latter two experiments are specifically designed to challenge the issue of how a hypothetical masculine default drives lexical access in Italian.

Grammatical gender in Italian

In Italian, nouns are classified into two genders: masculine and feminine; such a distinction is semantically motivated for a restricted group of animate nouns, whereas nouns referring to males are generally masculine (for example, *marito*, masculine, singular, ‘husband’) and nouns referring to females are generally feminine (*moglie*, feminine, ‘wife’). Inanimate nouns are almost totally arbitrarily associated with a gender (*poltrona*, feminine, ‘armchair’, vs. *divano*, masculine, ‘sofa’), even though some regularities do exist: for instance, most nouns denoting trees are masculine (*ulivo*, masculine, ‘olive tree’), whereas the majority of nouns denoting fruits are feminine (*oliva*, feminine, ‘olive’, Dardano & Trifone, 1985; Serianni, 1988).

As far as formal features of gender are concerned, almost all Italian nouns end in a vowel which is the morphological suffix marking simultaneously gender and number information. Different vowels can be more or less strongly related to the masculine and feminine genders. Transparent (or regular, hereafter the two terms will be used interchangeably) nouns take inflectional endings which are highly predictive of noun gender (masculine forms ending in ‘-o’ (e.g., *alber-o*, (masculine, singular, ‘tree’; and feminine forms ending in ‘-a’ (e.g., *cas-a*, (feminine, singular) ‘house’)). On the contrary, for opaque nouns, although being unambiguous for gender, both feminine and masculine nouns take the final vowel ‘-e’; thus, gender cannot be recovered from surface form (e.g., *pont-e* (masculine, singular) ‘bridge’; *font-e* (feminine, singular) ‘source’).

A small but relevant group of Italian nouns are irregularly inflected for gender: some masculine nouns (about 1.3% of masculine nouns (Postiglione et al., 2014)) take the suffix that is normally used for feminine nouns: *problem-a* (masculine, singular), problem, and a few feminine nouns (0.2% (Postiglione et al., 2014)) end with the final vowel usually associated with masculine gender and have only one form both for the singular and the plural, e.g., *radi-o*, (feminine, singular, ‘radio’). Other nouns ending in ‘-a’ are ambiguous for gender in the singular form e.g., *regist-a*, (feminine/masculine, singular) ‘director’, and have the regular inflection on the plural form e.g., *regist-i* (masculine, plural) ‘directors’ (men), *regist-e*, ‘directors’ (women).

Experiment 1

The following two experiments are designed in order to replicate the results of De Martino et al. (2011) with different sets of stimuli and participants. A reading aloud (Experiment 1) and a lexical decision task (Experiment 2) are used, where masculine and feminine nouns with the same ending vowel (-a) are compared.

Consistently with De Martino et al. results (2011), a disadvantage for nouns showing a gender suffix irregularity (masculine) was expected.

Method

Participants

Thirty-nine students from the University of Salerno (23 females), all native speakers of Italian, took part in the experiment; their age ranged from 20 to 30 years (average: 25 years). They all had normal or corrected-to-normal vision and served for a single session lasting about 15 minutes.

Stimuli

Forty Italian nouns were selected. Twenty were feminine singular nouns with a regular gender suffix (*arena*, ‘arena’) and 20 were masculine singular nouns with an irregular gender suffix (*aroma*, ‘flavor’). The type of gender suffix (regular vs. irregular) was the independent variable. The nouns in the two groups had the same initial phonemes and the stress on the penultimate syllable (the most common locus of lexical stress in Italian). The two sets of experimental stimuli were matched for the following psycholinguistic variables: length (calculated in number of letters, phonemes and syllables), singular and plural form frequency, imageability, neighborhood size (mean n-count) and neighborhood frequency (mean frequency of neighbors). The values for these parameters are reported in Table 1. The frequencies were extracted from a corpus of about 4.000.000 occurrences (Bertinetto, Burani, Laudanna, Marconi, Ratti, Rolando & Thornton, 2005) and imageability was calculated by asking 20 participants to judge the imageability of the 40 words selected as stimuli, by means of a 7-points Likert scale.

Table 1. Mean values for the relevant parameters controlled in Experiment 1

Variable	Irregular gender	Regular gender
Number of letters	7	7
Number of syllables	3	3
Number of phonemes	6	7
Token frequency – singular forms	42 (per million)	38 (per million)
Token frequency – plural forms	12 (per million)	23 (per million)
Lemma frequency	54 (per million)	60 (per million)
Imageability	4.5	4.5
Mean N-count	2	3
Neighborhood frequency (mean)	9 (per million)	15 (per million)

The two lists of stimuli were matched for the presence of letters and letter clusters violating the consistency in grapheme to phoneme correspondence in Italian.

One-hundred and one singular nouns were added as fillers. Sixty fillers were masculine nouns: 8 were opaque nouns ending in ‘-e’ (*girasole*, ‘sunflower’) and 52 were regular nouns ending in ‘-o’ (*dado*, ‘nut’); 41 fillers were feminine nouns: 28 were opaque words ending in ‘-e’ (*stazione*, ‘station’), 5 were irregular nouns ending in ‘-o’ (*mano*, ‘hand’) and 8 were invariant nouns ending in ‘-i’ (*eclissi*, ‘eclipse’) or in ‘-e’ (*serie*, ‘series’), that is, nouns that do not change when inflected into the plural. This arrangement of experimental materials was chosen in order to prevent putative effect of list composition on response latencies since it replicates in a laboratory setting the probability that an Italian speaker has to come across:

- either a masculine or a feminine noun;
- either a word ending in -a, or in -o, or in -e, or in -i.

The whole list of experimental stimuli and fillers was subdivided in three blocks each composed of 47 nouns. Three randomizations of the experimental materials for each block were assembled and a further randomization was created for the order of presentation of the blocks. Three experimental sessions were formed, so that each block was shown in each of the three possible positions. An equal number of participants completed each session.

Equipment

The stimuli appeared on a video display unit controlled by a personal computer. A microphone connected to a voice key monitored reading responses and the experiment was controlled using the E-Prime software (Version 1.1).

Procedure

A reading aloud task was employed as the experimental paradigm. In a practice session the participants were familiarized with the experimental procedure. When they reached 90% of valid responses in the practice session, the experiment started. The stimuli appeared in lower-case letters in the center of the computer screen, preceded by a fixation point (300 ms) and by a blank (300 ms). They remained on the computer screen for a maximum of 800 ms. After the voice key was triggered, the word disappeared from the screen and an exclamation mark appeared in the center of the screen, signaling that the reaction time was measured. If the participants did not produce any answer within 800 ms, the feedback *Fuori tempo* (‘Out of time’) appeared on the screen. The stimuli pronounced incorrectly were scored as errors as well as the responses given after the time limit. An experimenter was seated behind the participants and scored the responses for errors. Observations

where the voice key was triggered by non-speech sounds preceding the pronunciation of the noun and where speech onset latencies were shorter than 200 ms were discarded from the analyses. A pause of 1 second was provided between stimuli.

The reaction times and the errors constituted the dependent variables.

Results

Two-tailed *t*-tests comparing the irregular masculine and the regular feminine conditions were performed on the mean reading latencies and on error rate by participants (*t*₁) and by item (*t*₂). On reading latencies the effect of the variable 'Type of gender suffix' was significant: *t*₁ (38) = 2.79, *p* < .01; *t*₂ (19) = 2.06, *p* = .05. Irregular masculine nouns were responded to slower than regular feminine nouns. On error data the effect did not reach the statistical significance. The mean values for reaction times and the percentages of errors in the two groups of stimuli are reported in Table 2.

Table 2. Experiment 1. Mean values for reaction times and percentage of errors

	Irregular gender	Regular gender
Reaction times	465 ms	452 ms
Percentage of errors	5.3	3.5

Experiment 2

Method

Participants

Thirty students of the University of Salerno (16 females), all native speakers of Italian, took part in the experiment. Their age ranged from 18 to 31 years (average: 24 years). They all had normal or corrected-to-normal vision and served for a single session lasting about 20 minutes.

Stimuli

Twenty masculine singular nouns with an irregular suffix (*poema*, 'poem') and 20 feminine singular nouns with a regular suffix (*pioggia*, 'rain') were selected. The two sets of experimental stimuli were matched for the same psycholinguistic variables as in Experiment 1. The mean values for these parameters are reported in Table 3.

Table 3. Mean values for the relevant parameters controlled in Experiment 2

Variable	Irregular gender	Regular gender
Number of letters	7.1	6.7
Number of syllables	3	2.8
Number of phonemes	6.7	6.2
Token frequency – singular forms	53 (per million)	54 (per million)
Token frequency – plural forms	24 (per million)	28 (per million)
Lemma frequency	76 (per million)	82 (per million)
Imageability	4.5	4.7
Mean N-count	2	3
Neighborhood frequency (mean)	27 (per million)	15 (per million)

Two-hundred and eighty filler items were added. One-hundred and twenty were real words and 160 were pseudo-words. Real words were nouns belonging to different inflectional classes; in order to avoid effects of list composition, their distribution matched the distribution of final vowels and grammatical gender in Italian: 59 words ended in ‘-o’: 54 were masculine (*dado*, ‘nut’), while 5 were feminine (e.g. *mano*, ‘hand’); 9 feminine nouns belonged to the grammatical category of invariant nouns, that is, nouns that do not change when inflected into the plural: 2 ended in ‘-e’ (*serie*, ‘series’), and 7 ended in ‘-i’ (*eclissi*, ‘eclipse’); 42 nouns ended in ‘-e’: 11 were masculine (*girasole*, ‘sunflower’) and 31 were feminine (e.g. *stazione*, ‘station’); 5 words were feminine nouns ending in ‘-a’ (*parcella*, ‘fee’); 5 words were masculine nouns ending in -a (*pianeta*, ‘planet’).

Pseudo-words were created starting from existing Italian nouns, selected within the same range of frequency and length of irregular, regular, and opaque nouns and by changing one or two letters for one third in the initial part, one third in the central part and one third in the final part. Furthermore, we matched final vowels across no-response and yes-response stimuli, in order to avoid the possibility that some final vowels could be more likely associated to “yes-responses”.

The whole list of experimental stimuli and fillers was subdivided in 5 blocks each composed of 60 nouns. Five randomizations were created for the order of presentation of the blocks so that each block was shown in each of the five possible positions. The experimental session included all the experimental materials: each participant saw the whole set of experimental stimuli. The E-Prime software provided a randomized sequence of the experimental materials within each block.

Equipment

The stimuli appeared on a video display unit controlled by a personal computer connected to a response box. The experiment was controlled using the E-Prime software (Version 1.1).

Procedure

A lexical decision task was used. The participants were asked to take the decision whether the letter strings displayed on the screen were existing words or not. In a practice session they were instructed to answer by pressing the button provided for their dominant hand if the letter string corresponded to a word and by pressing the button provided for their not dominant hand if the letter string on the screen did not correspond to a word. When they reached 70% of valid responses the experiment started. The stimuli appeared in lower-case letters in the center of the computer screen, preceded by a fixation point (300 ms) and by a blank (50 ms). Stimuli remained on the computer screen for a maximum of 1 sec. If the participants did not produce any answer within that time, the feedback *Fuori tempo* ('Out of time') appeared on the screen. A pause of 1 second was provided between stimuli. Responses given after the deadline were scored as errors. The reaction times corresponded to the time in milliseconds between the presentation of the visual stimulus and the participant's response. The reaction times and the errors constituted the dependent variables.

Results

Data from one participant and one item (*asceta*, 'ascetic') were excluded from the analyses because they fell more than 2 standard deviations above the mean.

A series of two-tailed *t*-tests comparing the irregular masculine and the regular feminine conditions were performed on the mean reading latencies and on the average error rate by participants (*t*₁) and by items (*t*₂). Irregular masculine nouns were responded to slower than regular feminine nouns. On reaction times, the effect of the variable 'Type of gender suffix' was significant: *t*₁ (28) = 3.32, *p* = .002; *t*₂ (37) = 2.65, *p* = .01. Furthermore, they gave rise to a higher number of errors. On error data the effect reached the statistical significance in the analysis performed by participants (*t*₁ (28) = 2.4, *p* = .02) but not in the analysis by items (*t*₂ (37) = 1.5, *p* = .13). The mean values for reaction times and the percentages of errors in the two groups of stimuli are reported in Table 4.

Table 4. Experiment 2. Mean values for reaction times and percentage of errors

	Irregular gender	Regular gender
Reaction times	540 ms	522 ms
Percentage of errors	10	6

Interim discussion

The reported experiments replicate both the experimental design and the results described in De Martino et al. (2011) with different sets of stimuli and participants. Consistently with that study, a significant effect of the gender suffix regularity is reported: reading aloud and lexical decision latencies were slower for nouns with irregular gender suffix when compared with nouns regularly inflected for gender. These findings provide further evidence which is compatible with a mechanism of lexical processing where the mismatch between formal/sublexical and abstract/lexical grammatical gender information makes lexical access less efficient. However, as already outlined, the MDAs propose to ascribe the disadvantage for irregular masculine nouns ending in “-a” to the existence of a masculine default gender. The idea is that during lexical access the unmarked gender, i.e. masculine, is early available and thus activated whenever it is not blocked by any source of contrasting information. Hence, when a masculine noun irregularly inflected for gender is accessed, masculine default gender could be active and then subject to interference from the distributionally biased formal gender ending associated with feminine Italian nouns, i.e. the vowel “-a”. Such a conflict might explain the longer latencies and the worse accuracy for masculine irregular nouns. On the other hand, such a mechanism of default seems difficult to hold because it does not explain the lack of disadvantage in feminine nouns with a regular gender ending. The rationale for such a conclusion is the following: the presence of the formal cue “-a” would pre-activate the lexical gender “feminine”. As a consequence, the access to masculine nouns ending in -a is slowed because a conflict arises between formal information (a = feminine) and the automatically activated (default) information (masculine). Access to feminine nouns should also be delayed for the same reason: a conflict between formal information (a = feminine) and the automatically activated (default) information (masculine). In other words, in Experiments 1 and 2 (and in De Martino et al., 2011) similar interference effects should be observed both for feminine and masculine stimuli, and this is not the case. A further specification of default-based mechanisms could be that the action of default is modulated by the distributional asymmetry of the gender formal cues used in the reported experiments: since the gender suffix “-a” is strongly biased in favor of feminine in Italian, the masculine default is quickly blocked to weaker interference for feminine nouns. If it is the case, the experimental design adopted in De Martino et al. (2011) and replicated in Experiments 1 and 2 in this paper is inadequate to reject MDAs explanation of the data since it does not provide the critical comparison across the available levels of the studied variables: the grammatical gender (masculine vs. feminine) and the gender regularity (regular vs. irregular).

Even if still inconsistent with the MDA account, an alternative explanation for the obtained results might be conjectured: since we used the same number of items for both masculine and feminine nouns ending in -a, one could hypothesize that in Experiment 1 and 2 participants came across an atypical proportion of masculine gender-irregular nouns, with the consequence of making these words highly salient. Although counterintuitive, there is a remote possibility that an over-representation of irregular forms determined more interference by drawing participants' attention to these items. Nevertheless, it is worth noting here that our experimental materials were strictly controlled in order to replicate in a laboratory setting the likelihood that an Italian speaker encounters masculine vs. feminine nouns, words ending in -a, or in -o, or in -e, or in -i, specific gender-to ending association within masculine and feminine nouns and furthermore, in the lexical decision (Experiment 2), each final vowel had almost the identical probability to be associated with items to be rejected or accepted as existing words.

In Experiments 3 and 4 we designed different suitable experimental conditions in order to test the predictions of the MDAs.

Experiment 3

Our aim here was to test the effectiveness of a gender default option by exploiting a gender suffix which is not probabilistically associated with one of the two genders. By this token, in Experiments 3 and 4 we compared masculine and feminine nouns sharing the same '-e' (opaque) gender suffix in a reading aloud and a lexical decision task. Quantitative analyses on the distribution of the '-e' suffix (Postiglione et al., 2014) show similar ratios for masculine (45%, e.g., *ponte*, 'bridge') and feminine (43%, e.g., *nave* 'ship') nouns: the formal information does not allow the suffix to act as a cue for grammatical gender. If the prediction of the MDAs is correct, a general disadvantage is expected for feminine opaque nouns because the default masculine gender should be first activated and then blocked by the lexical-grammatical information of the noun which, in turns, activates the feminine gender. On the contrary, lexical access for masculine nouns should be straightforward, because the default gender should not be blocked by any contrasting lexical-grammatical information.

Method

Participants

Thirty-five students from the University of Salerno (24 Females), all native speakers of Italian, took part in the experiment. Their age ranged from 20 to 35 years (average: 25 years). They all had normal or corrected-to-normal vision. None of them took part in the other experiments. They served for a single session lasting about 15 minutes.

Stimuli

Thirty-six Italian nouns with an opaque gender (-e) were selected: 18 masculine singular nouns (*fiume*, ‘river’) and 18 feminine singular nouns (*tigre*, ‘tiger’). The gender information (feminine vs. masculine) was the independent variable. The two sets of experimental stimuli were matched for the same psycholinguistic variables as in the previous experiments. The mean values for these parameters are reported in Table 5. Finally, the two groups of stimuli had the same initial phonemes and the stress on the penultimate syllable (the most common locus of lexical stress in Italian) and were also matched for animacy: in each group 16 words had an inanimate referent and 2 had an animate referent.

Table 5. Mean values for the relevant parameters controlled in Experiment 3

Variable	Masculine	Feminine
Number of letters	6	6
Number of syllables	2.7	2.7
Numbers of phoneme	6	6
Token frequency – singular forms	35 (per million)	33 (per million)
Token frequency – plural forms	10 (per million)	9 (per million)
Lemma frequency	44 (per million)	42 (per million)
Imageability	4.8	4.4
Animate referent	16	16
Inanimate referent	2	2
Mean N-count	4	6
Neighborhood frequency (mean)	12 (per million)	11(per million)

Ninety-nine singular nouns were added as fillers. Fifty-four fillers were masculine regular nouns ending in ‘-o’ (*dado*, ‘nut’) and 45 fillers were feminine regular nouns ending in ‘-a’ (*casa*, ‘house’). The same constraints on list composition as in Experiment 1 were applied.

The whole list of experimental stimuli and fillers was subdivided in three blocks, each composed of 45 nouns. Three randomizations of the experimental materials

for each block were assembled and a further randomization was created for the order of presentation of the blocks. Three experimental sessions were formed, so that each block was shown in each of the three possible positions.

Procedure and equipment

They were the same as in Experiment 1.

Results

Data from two participants were excluded from the analyses because they fell more than 2 standard deviations above the mean. A series of two-tailed *t*-tests analyses were performed by participants (*t*₁) and by items (*t*₂) in order to compare the feminine and masculine conditions. The analyses did not reveal any significant effect neither in *t*₁ (reading latencies: $t(33) = 1.21$; $p = .23$; errors: $t(33) = 1.4$; $p = .17$) nor in *t*₂ (reaction times: $t(18) = 1.01$; $p < .33$; errors $t(18) = 1.72$; $p < .10$). Both masculine and feminine opaque nouns elicited similar average reaction times and percentages of errors. The mean value of reaction times and the percentages of errors are reported in Table 6.

Table 6. Experiment 3. Mean values for reaction times and percentage of errors

Variable	Masculine	Feminine
Reaction times	446 ms	451 ms
Percentage of errors	3.7	5.6

Experiment 4

Method

Participants

Twenty-eight students from the University of Salerno (13 Females), all native speakers of Italian, took part in the experiment. Their age ranged from 20 to 35 years (average: 23 years). They all had normal or corrected-to-normal vision. None of them took part in the other experiments. They served for a single session lasting about 20 minutes.

Stimuli

Forty Italian nouns with an opaque gender ('-e') were selected: 20 masculine singular nouns (*fiume*, 'river') and 20 feminine singular nouns (*neve*, 'snow'). The gender information (masculine vs. feminine) was the independent variable. The 2 sets of experimental stimuli were matched for the same psycholinguistic variables as in the previous experiments.

The mean values for these parameters are reported in Table 7.

Table 7. Mean values for the relevant parameters controlled in Experiment 4

Variable	Masculine	Feminine
Number of letters	5.7	5.7
Number of syllables	2.5	2.5
Token frequency – singular forms	30 (per million)	28 (per million)
Token frequency – plural forms	13 (per million)	14 (per million)
Lemma frequency	43 (per million)	42 (per million)
Imageability	4.7	4.6
Mean N-count	6	8
Neighborhood frequency (mean)	15 (per million)	21 (per million)

Two-hundred and eighty singular nouns were added as fillers. One-hundred and twenty fillers were real words and 160 were pseudo-words. Real words were nouns belonging to different inflectional classes; the same constraints on list composition as in Experiment 2 were applied. Within the masculine nouns, 49 were regular nouns ending in '-o' (*muro*, 'wall'), 8 were irregular nouns ending in '-a' (*aroma*, 'flavor'), 4 were opaque nouns ending in '-e' (*pastore*, 'shepherd'). Within the feminine group, 41 words were regular nouns ending in '-a' (*candela*, 'candle'), 4 were irregular nouns ending in '-o' (*mano*, 'hand'), 5 were opaque nouns ending in '-e' (*stazione*, 'station') and 9 were invariable nouns ending in '-e' (*serie*, 'series') and '-i' (*eclissi*, 'eclipse').

Pseudo-words were created following the same constraints as in Experiment 2.

The whole list of experimental stimuli and fillers was subdivided in 4 blocks each composed of 80 nouns. Four randomizations of the experimental materials for each block were assembled and a further randomization was created for the order of presentation of the blocks. Four experimental sessions were formed, so that each block was shown in each of the four possible positions. An equal number of participants completed each session.

Procedure and equipment

They were the same as in Experiment 2.

Results

Data from one item (*razione*, ‘ration’) and from three participants were excluded from the analyses because they fell more than 2 standard deviations above the mean.

A series of two-tailed *t*-tests analyses was performed by participants (*t*₁) and by items (*t*₂) in order to compare the feminine and masculine conditions. The analyses did not reveal any significant effect neither in *t*₁ (reaction times: $t(24) = 0.33$; $p = .75$; errors: $t(24) = 1.50$; $p = .15$.) nor in *t*₂ (reaction times: $t(37) = 0.01$; $p = .93$; errors $t(37) = 0.99$; $p < .30$). Both masculine and feminine opaque nouns elicited similar average reaction times and percentages of errors. The mean value of reaction times and the percentages of errors are reported in Table 8.

Table 8. Experiment 4. Mean values for reaction times and percentage of errors

Variable	Masculine	Feminine
Reaction times	542 ms	541 ms
Percentage	5	3

Interim discussion 2

The results of Experiments 3 and 4 do not fulfil the predictions of the MDAs: indeed, we fail in detecting any difference between masculine and feminine nouns sharing the same (while not ambiguous) gender suffix. This means that when a gender suffix which is compatible with both masculine and feminine grammatical genders, i.e. the ending vowel “-e”, lexical access is similarly accomplished by feminine and masculine nouns.

The overall pattern of findings does not disprove the hypothesis that the match/mismatch between the distributional regularity of the formal cues to gender and the lexical-grammatical information associated with nouns induces facilitation/interference in lexical processing of bare nouns. Furthermore, on the basis of the latter findings, the results of Experiments 1 and 2 cannot be explained by positing that the processing of underlying masculine gender itself causes slower naming and lexical decision latencies for irregular masculine nouns when compared to regular feminine nouns.

But then again, a further description of the default could be provided. The hypothesis would be that the masculine default interacts both with the lexical information about the word (its proper gender) and the distributional properties of words in the lexicon (its gender markers). Under this construal, the default

mechanism would be effective only when a conflict originates between the two: thus, the empirical prediction is a delay for nouns with misleading gender cues (masculine nouns ending in “-a” and feminine nouns ending in “-o”)¹ but not for nouns with reliable or not ambiguous gender cues (masculine nouns ending in “-o” or “-e” and feminine nouns ending in “-a” or “-e”). If it was the case, default seems more likely to intervene at a later stage of processing of gender features, after lexical access has been accomplished and the distributional properties of gender affixes have been computed. Nevertheless, this seems a very unparsimonious model to account for the data because the default does not satisfy the expected characteristics of underspecification, immediacy and effortlessly efficiency.

General discussion

The data reported in this paper help in clarifying the role of the transparency of grammatical gender during lexical access for regular/transparent, opaque and irregular Italian nouns. Our aim was to demonstrate that the activation of gender information of a given word is triggered by the orthography of the word itself and, under particular circumstances, can affect lexical processing of that word even when the linguistic task does not require explicit retrieval of the gender information.

Actually, this position was taken by De Martino et al. (2011), in line with further evidence (Colè et al., 2003; De Martino & Laudanna, 2012; Paolieri et al., 2011), when interpreting the results of six experiments where they investigated lexical processing of gender-regular and gender-irregular nouns. It was observed (and here our data confirm) that nouns exhibiting a gender marking cue (e.g., the final affix ‘-a’) which is consistent with the distributionally dominant pattern for a given gender option (e.g., feminine) in a given language (e.g., Italian), are processed faster and better than nouns having the same final affix but which are not consistent with the dominant pattern of their gender (i.e., masculine). However, MDAs provide an alternative explanation for this pattern of data. Their starting assumption is that a default gender option is automatically activated during lexical access and since the masculine gender works as the default option in Italian, the observed delay of the masculine irregular nouns could be ascribed to the contrast between

1. A crucial test of the latter MDAs prediction might consist in contrasting masculine (regular) and feminine (irregular) nouns displaying a suffix which is orthographically biased in favor of masculine gender, that is, the ‘-o’ suffix (e.g. *mano*, ‘hand’, feminine, Vs. *libro*, ‘book’, masculine). Nevertheless, feminine irregular nouns are rare in Italian (0.02% of the nouns ending in “-o” (Postiglione et al., 2014)) and have unsystematic inflectional pattern. This makes it difficult to provide sufficient materials for well-matched experimental comparisons.

the default-driven and the formally-driven genders. The experimental conditions as designed in Experiments 3 and 4 in this paper were suitable to test whether a default gender option is effective when both masculine and feminine nouns share the same affix which is not distributionally biased in favor of one of the two genders. In this case, the distributional properties of nouns are not supposed to drive the activation of grammatical gender. The absence of any difference between masculine and feminine nouns does not support the hypothesis that a gender default option by itself determines the observed pattern of data.

Taken together, the findings reported in this paper show that the orthographic format of Italian nouns enhances the sensitivity of Italian speakers to the manipulation of different levels of lexical information, and shed some light about the processes underlying the activation of lexical information during noun processing. In particular, we explored how different kinds of gender information, namely the orthographic-phonological and grammatical-syntactic features of grammatical gender, contribute to representation and processing of words within the mental lexicon. Our overall pattern of result shows that sublexical information as available via a gender morpheme (the final vowel) allows the activation of distributionally-biased information about the noun gender. When the final vowel is mainly associated with a definite gender, as in the case of the correlation between the suffix ‘-a’ and the feminine gender in Italian, the regular feminine nouns can be more easily processed (Experiments 1 and 2), because such an information is consistent with the subsequently activated grammatically-based gender information about the noun. On the contrary, when the suffix is misleading about the real gender (e.g., the suffix ‘-a’ for Italian masculine nouns), a conflict arises between the distributionally-biased and the grammatically-based gender information; as a consequence, the conflict resolution slows down lexical processing of the noun. Third, when the gender suffix is not predictive of the noun gender, both masculine and feminine nouns seem to undergo the same lexical process.

This pattern of findings shows that distributionally-biased features of Italian nouns like the type-numerosity of the gender morphemes, that is, the cumulative number of words containing a particular morpheme, influences performance of speakers as well as the lexical organization of words within the lexicon.

The conclusion is that the orthographic format of words provides a direct access to different levels of lexical representation of gender information as stored in the lexicon and, more precisely, reveals that the connections between the sublexical information (the gender morpheme), the distributional information (the numerosity of the gender morpheme in a language and its association with a given gender) and the abstract information (the grammatical gender of the word) about gender affect lexical processing of words.

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Corresponding address

Maria De Martino
Laboratory of Experimental Psychology,
Department of Department of Political,
Social and Communication Sciences
University of Salerno, Italy
Via Giovanni Paolo II
132, 84084 – Fisciano (SA)
Italy
mdemartino@unisa.it