



Double vowels, double fairness? Assessing the viability of diphthongs as novel strategies for gender fairness in Italian

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ABSTRACT

Proposals for gender-fair language in Italian include Alternative grammatical Gender Encoding Devices (AGEDs) such as the schwa (ə) or asterisk, potentially also accommodating non-binary identities. These solutions, though, often pose challenges for oral communication, accessibility, and social acceptance, as they may be perceived as external to the Italian language system. We examined the possibility of employing diphthongs—integral components of standard Italian phonology—as more internalized AGEDs by testing whether replacing typical masculine or feminine word endings (-o/-i (M), -a/-e (F)) with various diphthongs (e.g., *ai*, *eu*) could produce forms interpreted by native speakers as more gender-neutral. We conducted a within-subject experiment, where Italian participants ($N = 424$) were asked to rate words ending in diphthongs (1) along a five-point scale from feminine to masculine and (2) as singular, plural or unclear for number. Results revealed a significant Diphthong \times Number Judgement interaction, with certain diphthongs interpreted as more gender-neutral than others. Specifically, diphthongs that excluded or combined the sounds typically associated with masculine and feminine grammatical genders were rated as more neutral. These findings suggest that select diphthongs could serve as AGEDs, potentially offering an accessible, linguistically coherent pathway toward more inclusive and gender-fair Italian language practices.

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1. Introduction

Proposals for gender-fair language have long been at the center of linguistic and social debates. Traditionally, two gender-fair strategies have been proposed: *feminization* and *neutralization*. Feminization strategies seek to enhance the linguistic visibility of women by using feminine terms. Neutralization strategies, on the other hand, aim to avoid gender marking altogether, employing gender-neutral nouns and constructions. Substituting the English noun “chairman” with “chairman and chairwoman” or the generic pronoun “he” with “he or she” are instances of feminization; the corresponding examples of neutralization are the use of “chairperson” and “they”. A further, more recent, type of strategy mainly aims at

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accommodating non-binary identities by introducing new linguistic resources in the language, such as the neopronoun “ze” in English. González Vázquez et al. (2024) label this family of strategies *innovative*.

Each strategy has its own pros and cons, which change depending on the target language (cf. European Parliament 2018). In this work, we are concerned with Italian and how gender-fair strategies are applied in this linguistic context. We will focus especially on innovative strategies, which in Italian take the form of substituting gendered suffixes with Alternative grammatical Gender Encoding Devices (AGEDs) such as the schwa (ə) or the asterisk (*). Given the intrinsic limitations of such AGEDs, we tested new potential candidate AGEDs. In particular, we tested diphthongs as they lack the limiting features of current innovative proposals for Italian (i.e., letters and symbols).

1.1. State of the art

Over the past decades, in Italy, much of the focus among linguists has been directed toward strategies of *feminization*, particularly concerning the issue of reducing linguistic sexism and giving more visibility to women in language (Sabatini, 1986, 1987). The feminization of language in Italy is rooted in broader feminist linguistics debates that gained prominence in the 1970s, first in the United States and later in Europe (Luraghi and Olita, 2006: 33). These debates emphasized the role of language in reflecting and perpetuating gender discrimination, highlighting the importance of addressing linguistic inequalities to combat social discrimination. This reformist approach includes both structural and discourse-level changes to ensure women’s visibility and combat stereotypes (Cameron, 1995). Specifically concerning feminization strategies, the Italian feminist linguist and activist Alma Sabatini produced pivotal works such as *Recommendations for non-sexist use of the Italian language* (1986) and *Sexism in the Italian language* (1987). These publications analyzed the linguistic representation of women and proposed guidelines for non-sexist language. In particular, they suggest the use of feminine forms of role nouns and the avoidance of *masculine generics*, where the use of masculine grammatical gender intends to represent both men and women. Key feminization strategies in Italian aim to address structural asymmetries (also referred to as *dissymmetries* by Robustelli, 2012; Sabatini, 1987) in the representation of women and men, through morphological and syntactic changes. These proposed structural adjustments are designed to suit the Italian linguistic system, a sex-based grammatical gender language (Corbett, 1991) that features only two available values: the masculine and the feminine. In Italian, grammatical gender is obligatorily encoded in all nouns that govern syntactic agreement, also called *agreement controllers*, as well as in their dependent elements like articles, adjectives, and the past participles of verbs. Concerning morphological feminization, Sabatini (1986) suggested the use of feminine forms of role nouns obtained through the derivational process of *gender motion* (Thornton, 2004), from masculine nouns (e.g., *avvocato* - > *avvocata* ‘lawyer(M) - > lawyer(F)’)¹. Looking at syntactic strategies, feminization is also applied in specific syntactic constructions such as *mixed-gender coordinated conjuncts* (Giusti, 2022; Motschenbacher, 2014), where both masculine and feminine forms are included (e.g., *i ballerini e le ballerine* ‘the.M dancers(M) and the.F dancers(F)’ instead of using masculine generics).

Despite such efforts, feminist linguistic reform in Italy remains contentious, with debates over its practical and ideological implications continuing today (Thornton, 2023). Alongside the still heated debate on female visibility in language use, a new debate has gained attention on grammatical gender neutralization (Galeandro, 2021). The strategies of *neutralization* of grammatical gender are exemplified, in usages long accepted by Italian grammar, through the use of epicene or collective nouns where grammatical gender is independent of the human referents’ gender identity (e.g., *gli spettatori* ‘the.M spectators(M)’ vs. *le persone spettatrici* ‘the spectating people’ or *il pubblico* ‘the audience’), as well as lexical and syntactic reformulations (see Comandini, 2021: 49). These strategies blur the *referential gender* values, namely “the extralinguistic gender of a referent to which a linguistic expression relates in a concrete utterance” (Doleschal, 2015: 340), once again serving as an alternative to the use of masculine generics.

More recently, moreover, some language policy proposals have explored the possibility of replacing the encoding of masculine or feminine grammatical gender with letters (e.g., *x*, *u*, *y*) or symbols (e.g., *, @, ə). As observed by González Vázquez et al. (2024), such *innovative* strategies can either convey a grammatical gender value distinct from the binary, providing proper visibility and representation to non-binary people, or be used to neutralize referential gender, akin to the neutralization strategies discussed above. Such theoretical possibility gets actually reflected in use: recent studies (Comandini, 2021; Safina, 2023; Safina, 2026; Thornton, 2022) examining speakers’ written usage have found that the motivation behind employing such symbols fluctuates between neutralization, aimed at obscuring referential gender information about individuals mentioned in a sentence, and the explicit specification of non-binary gender. Considering such fluctuation, the present work will refer to those letters and symbols as *Alternative grammatical Gender Encoding Devices* (AGEDs), independently from their actual referential gender value.

These different usages have distinct implications, as highlighted in the philosophical debate by Dembroff and Wodak (2018). The authors discuss the case of English personal pronouns and distinguish between the *moderate* and *radical claims*. According to the *moderate claim*, a non-binary pronoun (e.g., “they”) can coexist alongside the binary ones (i.e., “he” and “she”). The *radical claim*, instead, calls for the complete elimination of gendered pronouns and the adoption of a single, gender-neutral pronoun for everyone, regardless of their gender. Implementing the *moderate claim* in Italian amounts to

¹ Along the present paper, grammatical gender values will be glossed as follows: M for masculine, F for feminine, N for neuter, and A meaning *alternative* grammatical gender. The value A will be further explained introducing the issue of *Alternative grammatical Gender Encoding Devices* (AGEDs).

introducing an AGED conveying a non-binary gender value. According to the *radical claim*, such an AGED should convey a gender-neutral value instead. Dembroff and Wodak (2018) defend the *radical claim* and argue that the *moderate claim* yields an egalitarian scenario where men and women would have a dedicated pronoun while the different non-binary identities would all be referred to with the same non-binary pronoun, lumping them together. Furthermore, such a system would force people to *disclose* their gender identity (Dembroff and Wodak, 2018: 392–402), resulting in negative and emotional, psychological, and social repercussions for non-binary people, which remain marginalized within the actual social environment (Knutson et al., 2019). Dembroff and Wodak's position is not unanimously accepted in the debate (see, e.g., Hernandez and Crowley 2024). Discussing which option is better to adopt for Italian is beyond the scope of the present work. Using the label AGEDs for all the uses of these strategies, regardless of the gender value conveyed, has the further advantage of allowing one to remain neutral on this issue.

The use of AGEDs has been analyzed in terms of its linguistic advantages and limitations (Comandini, 2021; Safina, 2023; Safina, 2026; Facchini, 2024). On the one hand, some symbols (e.g., @, _ *) are unpronounceable and, thus, cannot be used as such in oral communication. But even pronounceable AGEDs, such as the *u* and the schwa (ə), face specific challenges: there is also apprehension that adopting ə or *u* as an AGED might lead to a phonetic convergence with some central and southern Italian dialects, where such sounds are pervasive². Furthermore, /ə/ does not exist in the phonological inventory of standard Italian, and its appearance in stressed syllables, as in the proposed singular neopronoun /əi 'singular] they', is typologically uncommon. In terms of morphology, syntax, and textual coherence, AGEDs face significant challenges. The International Phonetic Alphabet symbol for the mid-central vowel [ə] (schwa) (Boschetto, 2020; Gheno, 2020, 2021) has especially been subjected to scrutiny for its linguistic limitations (Giusti, 2022; Thornton, 2022) as well as its social objectives (Gheno, 2022a, 2022b; Maturi, 2020a, 2020b; Sulis and Gheno, 2022)³. According to those studies, such use has yet to achieve significant linguistic stability. This instability is reflected in various morphosyntactic inconsistencies, which arise not only due to the relatively recent introduction of those symbols but also because they challenge the deeply gendered structure of the Italian language.

The absence of a neuter grammatical gender in standard Italian limits the system's adaptation to the need of expressing a referential gender value different from binary ones, and Italian's stable orthography and morphology resist changes, except for pronouns, which are more susceptible to innovation (Andorno, 2006). AGEDs can also lead to a loss of number information since the same symbols have been used both in singular and plural nouns, creating difficulties in identifying referents in complex anaphoric chains of agreement since it is difficult to distinguish singular and plural references.

Beyond linguistic hurdles, extralinguistic factors further complicate AGEDs adoption. Handwritten texts may struggle to accommodate italics or capital letters in AGEDs such as the schwa. Moreover, AGEDs, being unconventional grammatical gender encoding, might complicate understanding, processing, and reproduction of language. For these reasons, they risk creating linguistic barriers for several groups of people. In particular, it has been argued that individuals with dyslexia or dysgraphia may find such symbols challenging to read or write (De Santis, 2022). Vocal synthesizers also fail to interpret these symbols, posing accessibility issues for blind or visually impaired users (Iacopini, 2021; De Santis, 2022). Moreover, AGEDs can similarly create barriers for elderly people that face a physiological decline in linguistic ability (Messer 2015). Given the linguistic complications due to them, De Santis (2022) further hypothesized that AGEDs can constitute a challenge for anyone "not fully mastering the code" (our translation), including Italian learners or L2-Italian speakers with migrant background, and those with limited education. This claim, however, has not been tested empirically. To date, these are theoretical hypotheses, but we still lack experimental studies showing that AGEDs actually pose difficulties for individuals with dyslexia or dysgraphia, elderly people, or anyone not fully mastering the code.

To address some of the limitations surrounding the use of symbols, particularly the schwa, this study aims to test the likelihood of Italian diphthongs to operate as AGEDs⁴. This approach involves replacing the word endings encoding masculine and feminine grammatical gender with a diphthong (e.g., *maestro/maestra* -> *maestreu* 'teacher(M)/(F) -> (A)'). Except for *ai* (Reubens, 2021; González Vázquez et al., 2024), diphthongs have not been proposed as AGEDs.⁵ However, we believe that their use could provide a language policy solution that leverages elements already functional within the linguistic system. Indeed,

² The ending vowel *u* is particularly present and frequently corresponding to the masculine grammatical gender value in the extreme southern varieties (Salento, Calabria, Sicily) and Sardinia. In addition, the ending of masculine nouns in *-u* is also found in the varieties of Campania, especially in Neapolitan, but also in central-southern Marche and Liguria (Rohlf, 2021).

³ For a comprehensive discussion, see Giusti (2022) on phonetic and phonological aspects, Thornton (2022) on typological and morphosyntactic challenges, and Gheno (2022a, 2022b) and De Santis (2022) on textual and extratextual limitations, especially in the context of education.

⁴ Diphthongs are single-syllable vowel sequences where one of the two sounds serves as the syllabic peak, while the other is pronounced very rapidly, typically with an approximant articulation (Mioni, 1986) sometimes called semivowel, semiconsonant, or glide (Ladefoged and Johnson, 2014). For the scope of this paper, we adopt the terminology of Bertinetto and Loporcaro (2005), referring to opening diphthongs (also called raising diphthongs) when the glide (*i* or *u*) precedes the syllabic peak (*ia, ie, io, iu, ua, ue, ui, uo*), and closing diphthongs (also called falling diphthongs) when the glide follows the syllabic peak (*ai, au, ei, eu, oi, ou*). We wish to include a disclaimer regarding the use of the term *diphthong* in this paper. Although we selected vowel sequences that function as diphthongs in Italian, our focus is on instances in word-final position, which we refer to as AGEDs. In this specific context, the term diphthong may be less accurate. Indeed, Italian diphthongs in which both vowels are unstressed never occur in word-final position, with the exception of a few non-integrated English loanwords where the phenomenon might be attested (e.g., *survey*). In native Italian words, diphthongs can only appear at the end of a word when at least one of the two constituent vowels bears stress (e.g., *sei* 'six'). Therefore, although what we propose represents a phonologically atypical pattern within the Italian system, we deliberately choose to refer to these AGEDs forms as diphthongs in order to emphasize that, in the audio stimuli described below, the AGED sequences were indeed produced as diphthongs—that is, with a single-syllable vowel sequences.

unlike the AGEDs proposed so far (e.g., *, ə or u), diphthongs are both pronounceable and part of the phonological repertoire of standard Italian, with their pronunciation already familiar to the entire Italian-speaking community. Thus, this strategy aligns with communicative needs while remaining linguistically internal and, at least graphically, accessible. Furthermore, diphthongs used as AGEDs have never been discussed in public discourse, either in media or academic contexts. Thus, testing them increases the likelihood that participants, in providing their interpretation of the grammatical gender value of diphthongs, were not biased by either a positive or negative ideology associated with the topic of gender-fair language. It further makes it more likely that participants did not guess what we were testing and what the AGED intended function was.

The numerous limitations outlined above underscore the importance of continuing to test the effectiveness of existing solutions while also exploring new approaches to avoid both linguistic sexism and binarism. Crucially, the hypothesis motivating the feminist linguistic reforms discussed above, that sexist language contributes to gender discrimination, has recently gained empirical support (see Gygax et al., 2021, for a review). In gendered languages such as French (Gygax and Gabriel, 2008; Gygax et al., 2012; Sato et al., 2013; Richy and Burnett, 2021; Tibblin et al., 2023a, 2023b; Xiao et al., 2022) and German (Braun et al., 1998, 2005; Irmen and Roßberg, 2004; Sato et al., 2016; Stahlberg et al., 2001), numerous experiments have demonstrated how mental representations elicited by reading text were biased by grammatically masculine forms. When describing groups of referents of mixed or unknown gender, the use of masculine generics often results in a *male bias*, interpreting the group as solely composed of men. In contrast, gender-fair strategies mitigate this bias. These cognitive findings are particularly relevant in workplace communication contexts involving role nouns, both in written and spoken forms, such as job advertisements and interviews. Notably, research has shown that masculine forms, even when intended as generic, can heighten feelings of exclusion, ostracism, and sexism in the workplace, especially among women (Stout and Dasgupta, 2011). Furthermore, they have been found to reduce the interest in participating in entrepreneurial programs, compared to when they are advertised in pair forms (Hentschel et al., 2018), and to negatively affect recruiters' evaluation of women candidates for managerial positions (Horvath and Sczesny, 2016).

Currently, no experimental studies examine the effectiveness of Italian AGEDs in increasing the visibility of non-binary individuals within groups of mixed-gender referents. Similarly, no research investigates the specific interpretation of the grammatical gender value conveyed by such symbols. This study aims to explore, in an initial capacity, the grammatical gender value that Italian diphthongs might convey when used as AGEDs. If some Italian diphthongs are interpreted by participants as gender-neutral, neither masculine nor feminine, they could be proposed as a language policy that does not create the same barriers as AGEDs that don't already belong to the Italian system. Hence, gender-neutrally interpreted diphthongs could be adopted for the development of best practices by public and private organizations seeking to adopt gender-fair language. Such a proposal would enable these entities to fully achieve their inclusivity goals, while avoiding outcomes that inadvertently result in exclusionary, ageist, or ableist practices.

1.2. The present study

Over the past decades the need for inclusive and gender-fair language has increased exponentially. In Italian, while some alternatives, such as symbols and letters, have been proposed in the past, their usage in oral communication or reading is one of the most problematic limitations that raises issues over the actual usability of these AGEDs. Thus, an alternative is to look for AGEDs whose pronunciation is familiar to the Italian-speaking community. For this reason, with the current research project we aimed at finding useable, easy-to-read, and easy-to-pronounce AGEDs taken from the repertoire of standard Italian. In other words, the innovative point of this study is to assess the viability of replacing typical ending vowels in Italian masculine/feminine nouns (-o/-i (M), -a/-e (F)) with diphthongs (ai, au, ei, eu, ia, ie, io, iu, oi, ou, ua, ue, ui, uo) by testing to what extent these newly coined forms are easily interpreted as gender-neutral. This is based on the understanding that the link between sound and grammatical gender is only partially motivated. According to Doleschal (2006), grammatical gender originates from basic semantic categories such as 'male' and 'female' but becomes abstract and polysemous through grammaticalization. As a result, gender assignment often reflects generalized associations rather than direct reference to referential gender. Following Corbett (1991), gender information is stored categorically, supported by semantic and formal cues, rather than individually for each noun. A key factor motivating this form of categorical storage is the frequency with which particular endings correlate with gender values. Specifically, the majority of nouns ending in -o belong to the first inflectional class and are masculine, while those ending in -a typically belong to the second class and are feminine (D'Achille and Thornton, 2003). Moreover, 99% of singular nouns ending in -o are masculine, while 87% of those ending in -a are feminine (Thornton, 2022, p. 19, see also Sgroi, 2008, p. 109). Consequently, in Italian, the final vowels -o/-i are typically associated with the masculine while -a/-e are typically associated with the feminine grammatical gender (Thornton, 2022).

The idea is to identify which phonemes of *standard Italian* could function as AGEDs in Italian. Across a single study, we considered whether participants interpreted a new coinage as more or less feminine/masculine, or gender-neutral.

The study will specifically test a core hypothesis (H1) articulated in two parts (H1.1 and H1.2):

H1 - Some Italian diphthongs are interpreted as more gender-neutral than others.

H1.1 - The diphthongs *ei* and *ie* are interpreted, for the plural, as less gendered than all the diphthongs containing *i* but not *e*. This is because *i* and *e* constitute the plural encoding devices of, respectively, the first and second inflectional class of Italian nouns. Crucially, these classes typically include, albeit with exceptions (e.g., *mano*/-i hand(F)/-s(F)), masculine

(e.g., *libro/-i* book(M)/-s(M); class I) and feminine (e.g., *finestra/-e* window(F)/-s(F); class II) nouns, respectively (D'Achille and Thornton, 2003). Hence, since grammatically plural nouns end in *-i* with high frequency, and feminine ones in *-e*, participants might interpret as more gender-neutral those diphthongs that merge these two sounds, such as *ei* and *ie*.

H1.2 - By the same token, we expect that the presence of the vowels *o/a* in a diphthong would trigger more masculine and feminine judgments since they constitute the singular encoding devices of, respectively, the first and second inflectional class of Italian nouns (D'Achille and Thornton, 2003). Hence, we expect that diphthongs such as *eu*, *ue*, *ei*, *ie*, *iu*, and *ui* are interpreted, for the singular, as less gendered than those containing vowels *o* or *a*.

2. Methodology

2.1. Stimuli

The stimuli consisted of eight Italian lexical roots referring to humans, which were selected avoiding those of stereotypically gendered nouns in Italian (Misersky et al., 2014) to minimize the activation of gender-stereotypical inferences in the interpretation of the stimuli. They were selected from the category of non-independent symmetric nouns (Thornton, 2022: 20), which, unlike epicene, common gender, and independent or heteronymic nouns, display distinct masculine and feminine word endings in Italian (e.g., *maestro/maestra* teacher(M)/teacher(F)). Non-independent non-symmetric nouns were also excluded, as their masculine and feminine forms differ not only in their final vowel but also in longer suffixes (e.g., *professore/professoressa* professor(M)/professor(F)). An additional selection criterion for the roots was that all stimuli would consist of three syllables. The selected roots are indicated here with an asterisk at the end of the word: *adult** 'adult', *alunn** 'schoolchild', *anzian** 'elder', *bambin** 'child', *cognat** 'sibling-in-law', *cugin** 'cousin', *ragazz** 'kid', *vicin** 'neighbor'. Each root was modified 15 times: once by attaching one of the most typical ending vowels in masculine/feminine nouns (*-o/-i*(M), *-a/-e*(F)), and 14 times by attaching each of the diphthongs that are object of the present study (*ai*, *au*, *ei*, *eu*, *ia*, *ie*, *io*, *iu*, *oi*, *ou*, *ua*, *ue*, *ui*, *uo*). Stimuli with typical ending vowels were included to serve as attention checks.

All 120 stimuli were audio recorded by a 30-year-old female native Italian speaker, who was instructed to pronounce each word while maintaining consistent intonation. Given that the stimuli were not self-identifying utterances, we have no reason to believe that the speaker's gender identity would affect the interpretation of the stimuli. Indeed, speakers of any gender identity utter words of any grammatical gender. Nonetheless, as a precaution, the recordings were acoustically analyzed using SFS/WASP software (Version 1.80) to measure pitch through median fundamental frequency (F0Median) values, and pitch was adjusted to 170 Hz using Audacity software to bring it within the gender-neutral range, which is generally reported to fall between 145 and 175 Hz (Davies et al., 2015: 122). Silence duration was also edited using Audacity to standardize total duration at 3383 ms across all items. This manipulation was performed by also ensuring that in all items the end of the word (i.e., the moment when the diphthong is heard) occurred 1000 ms before the end of the recording. The moment when the diphthong is heard was aligned across all stimuli to allow for consistent reaction time calculations. Finally, all recordings were normalized to ensure uniform intensity levels across stimuli. All the stimuli are available at the OSF public link: <https://osf.io/eh65z/>.

2.2. Participants

We decided to reach a total of 520 participants given the exploratory nature of the study. Participants were enrolled through Prolific Academic and received a fee of 3£ upon completion for a median time of 25 min. Rejection of participants and outlier detection were computed in three different ways. Firstly, participants taking longer than 45 min to complete the study ($N = 12$) were discarded. Secondly, participants with accuracy $< 75\%$ to the attention check trials were discarded ($N = 84$). Trials with response times higher than the mean + 2SDs were removed from the dataset (0.0007 % of total trials). After cleaning data included $N = 424$ participants (206 male, 208 female, 10 non-binary, Mean Age = 33.10, Age range = 20–72). Due to a programming error, 64 out of the whole sample of 424 participants did not perform 1 out of 8 attention check trials. The study was performed in accordance with relevant guidelines and regulations and all methods were approved by the University of Milan's Human Research Ethics Committee (135/23). All participants gave their consent at the beginning of the experiment. In this work, we report all measures, manipulations, and exclusion criteria.

2.3. Procedure

The experiment started with participants agreeing to the informed consent. Afterwards, in a within-subject design, they were presented with a total of 120 auditory words stimuli. Specifically, 8 different words were presented in combination with the chosen 14 diphthongs (*ai*, *au*, *ei*, *eu*, *ia*, *ie*, *io*, *iu*, *oi*, *ou*, *ua*, *ue*, *ui*, *uo*). Participants were asked to listen carefully to each word and answer two different questions for each of them. They were first asked to identify the words' gender on a 5-point Likert scale where 1 represented the feminine end while 5 was the masculine one and 3 the most gender-neutral point (*né femminile né maschile*, "neither feminine nor masculine"). Then, we asked them to indicate if the word was singular (1), unclear (*non saprei*, "don't know") (2) or plural (3). Participants completed the experiment with some final questions. Thus, before being redirected to the compensation part, participants were asked to indicate in open-ended questions if one or more words were clearer than the others and if they had some further comments. After completing the experimental task,

participants were then asked to answer some demographic questions (age, gender identity, educational level, first language – including any other languages or Italian dialects they were fluent or familiar with – level of feminism, political orientation, familiarity with the debate on inclusive language, and attitude towards it). This information was collected only afterwards, so as not to interfere with the experiment. All the raw data is available at the OSF public link: <https://osf.io/eh65z/>.

3. Data analysis

After cleaning the data, a gender neutrality index was computed by rescaling 1–5 Likert scores (1 = Feminine, 5 = Masculine) obtained from the gender interpretation questions into a 0–1 value by assigning the maximum neutrality value of 1 to Likert scores of 3, 0.5 to Likert scores of 2 and 4 and 0 to Likert scores of 1 and 5. In this way, we obtained a new variable indicating the interpreted gender neutrality irrespectively from the direction (Feminine/Masculine leaning). Data was fit to a linear mixed effects model by using lmerTest R package (Kuznetsova et al., 2017) in which the gender neutrality index was the dependent variable, while the word endings (levels = *a, e, i, o, ai, au, ei, eu, ia, ie, io, iu, oi, ou, ua, ue, ui, uo*) and number judgment (levels = “singular”, “plural”, “don’t know”) were included as a categorical predictors. Participants’ IDs and roots were included as random intercepts. This model had the lowest AIC score when compared to simpler models only including either one of the fixed effects or both fixed effects (Diphthong, Number Judgement) and no interaction between the two. To evaluate all the fixed effects and interactions, F-tests (type II with Satterwhite approximation) were run on each of the models via the ‘Anova’ function of the package car in R (Fox and Weisberg, 2019). Post-hoc comparisons were implemented via the emmeans R package (Lenth et al., 2018) on the estimated marginal means (EMMs) of each model and bonferroni-corrected. Estimated marginal means (EMMs) correspond to model-based estimates of the mean response for each level of a factor/covariate adjusted for all the other variables included in the model while Standard Errors (SE) reflect the precision of the EMMs accounting for both the residual variability and the variance components associated with the random effects of the model.

4. Results

The mixed model fitted on the neutrality index had conditional $R^2 = 0.407$ and a marginal $R^2 = 0.191$. The analysis of the gender neutrality index showed a significant Diphthong x Number Judgement interaction, $F(34, 50349) = 69.13, p < 0.001$. Post-hoc tests performed comparing diphthongs with each other for each Number Judgement level showed that the most gender-neutral plural-interpreted diphthongs were *ei* (EMM = 0.53, SE = 0.01), *ia* (EMM = 0.53, SE = 0.02) and *ai* (EMM = 0.51, SE = 0.01) and they did not differ between each other. The most gender-neutral singular-interpreted diphthongs were *eu* (EMM = 0.48, SE = 0.02) and *ue* (EMM = 0.43, SE = 0.02) as they were judged as significantly more neutral with respect to all the others but they did not differ between each other. The most gender-neutral diphthongs when number interpretation was unclear (“don’t know”) were *ei* (EMM = 0.73, SE = 0.02), *ue* (EMM = 0.69, SE = 0.02), and *ie* (EMM = 0.69, SE = 0.03), which did not differ between each other. In other words, results showed that *ei, ia* and *ai* were judged as the most gender-neutral when they were interpreted as plural while *eu* and *ue* were judged as the most gender-neutral when they were interpreted as singular. Instead when participants interpretation was unclear with respect to number, *ei, ue* and *ie* were judged as the most gender-neutral. The EMMs and SEs for all diphthongs are indicated in Table 1. All the significance levels and the estimated differences are reported in Tables 2–4. See Fig. 1 for a graphical representation of each diphthong and Figs. 2–4 for graphical representations of the significant comparisons.

Table 1

Estimated Marginal Means (EMMs) along with Standard Errors (SEs) of Gender Neutrality Index estimated by the mixed model for each diphthong and each number judgement. The last column shows the EMMs averaged across number judgement.

| Singular | | | Plural | | | Unclear | | | Averaged | | |
|-----------|-------|-------|-----------|-------|-------|-----------|-------|-------|-----------|-------|-------|
| | EMM | SE | | EMM | SE | | EMM | SE | | EMM | SE |
| <i>eu</i> | 0.475 | 0.017 | <i>ei</i> | 0.533 | 0.011 | <i>ei</i> | 0.731 | 0.023 | <i>ei</i> | 0.55 | 0.02 |
| <i>ue</i> | 0.433 | 0.022 | <i>ia</i> | 0.533 | 0.018 | <i>ue</i> | 0.698 | 0.018 | <i>ie</i> | 0.489 | 0.02 |
| <i>ei</i> | 0.384 | 0.05 | <i>ai</i> | 0.511 | 0.014 | <i>ie</i> | 0.682 | 0.025 | <i>eu</i> | 0.482 | 0.012 |
| <i>ie</i> | 0.347 | 0.047 | <i>au</i> | 0.478 | 0.047 | <i>eu</i> | 0.671 | 0.016 | <i>ue</i> | 0.466 | 0.013 |
| <i>iu</i> | 0.297 | 0.015 | <i>ie</i> | 0.437 | 0.011 | <i>ia</i> | 0.62 | 0.014 | <i>ai</i> | 0.463 | 0.011 |
| <i>ui</i> | 0.294 | 0.031 | <i>ua</i> | 0.413 | 0.048 | <i>ai</i> | 0.607 | 0.013 | <i>ia</i> | 0.461 | 0.012 |
| <i>ai</i> | 0.272 | 0.012 | <i>iu</i> | 0.353 | 0.011 | <i>ua</i> | 0.604 | 0.024 | <i>au</i> | 0.435 | 0.02 |
| <i>ua</i> | 0.268 | 0.011 | <i>uo</i> | 0.34 | 0.046 | <i>e</i> | 0.604 | 0.057 | <i>ua</i> | 0.429 | 0.02 |
| <i>au</i> | 0.261 | 0.011 | <i>io</i> | 0.307 | 0.018 | <i>au</i> | 0.566 | 0.024 | <i>iu</i> | 0.381 | 0.011 |
| <i>ia</i> | 0.229 | 0.011 | <i>eu</i> | 0.3 | 0.011 | <i>uo</i> | 0.554 | 0.032 | <i>ui</i> | 0.363 | 0.015 |
| <i>oi</i> | 0.225 | 0.014 | <i>ui</i> | 0.3 | 0.011 | <i>ou</i> | 0.547 | 0.027 | <i>uo</i> | 0.346 | 0.021 |
| <i>io</i> | 0.17 | 0.011 | <i>oi</i> | 0.293 | 0.012 | <i>iu</i> | 0.495 | 0.015 | <i>ou</i> | 0.313 | 0.021 |
| <i>e</i> | 0.162 | 0.056 | <i>ue</i> | 0.268 | 0.011 | <i>ui</i> | 0.494 | 0.021 | <i>e</i> | 0.259 | 0.028 |
| <i>uo</i> | 0.143 | 0.011 | <i>ou</i> | 0.252 | 0.049 | <i>a</i> | 0.378 | 0.086 | <i>oi</i> | 0.246 | 0.011 |
| <i>ou</i> | 0.14 | 0.011 | <i>i</i> | 0.157 | 0.014 | <i>o</i> | 0.348 | 0.082 | <i>io</i> | 0.237 | 0.012 |
| <i>i</i> | 0.111 | 0.102 | <i>a</i> | 0.108 | 0.11 | <i>i</i> | 0.313 | 0.09 | <i>i</i> | 0.194 | 0.046 |
| <i>a</i> | 0.01 | 0.014 | <i>o</i> | 0.036 | 0.269 | <i>io</i> | 0.234 | 0.014 | <i>a</i> | 0.165 | 0.047 |
| | | | <i>e</i> | 0.012 | 0.014 | <i>oi</i> | 0.22 | 0.013 | <i>o</i> | 0.129 | 0.094 |

Table 2

Post-hoc comparison between all diphthongs when judged as singular. The comparisons were performed by subtracting the diphthong in the columns from the one in the rows. Asterisks indicated the level of significance (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

| | a | ai | au | e | ei | eu | i | ia | ie | io | iu | o | oi | ou | ua | ue | ui | uo |
|----|---|-----------|-----------|-------|-----------|-----------|------|-----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| a | | -0.26 *** | -0.25 *** | -0.15 | -0.37 *** | -0.47 *** | -0.1 | -0.22 *** | -0.34 *** | -0.16 *** | -0.29 *** | 0.01 | -0.22 *** | -0.13 *** | -0.26 *** | -0.42 *** | -0.28 *** | -0.13 *** |
| ai | | | 0.01 | 0.11 | -0.11 | -0.2 *** | 0.16 | 0.04 *** | -0.08 | 0.1 *** | -0.03 | 0.27 *** | 0.05 ** | 0.13 *** | 0 | -0.16 *** | -0.02 | 0.13 *** |
| au | | | | 0.1 | -0.12 | -0.21 *** | 0.15 | 0.03 ** | -0.09 | 0.09 *** | -0.04 | 0.26 *** | 0.04 | 0.12 *** | -0.01 | -0.17 *** | -0.03 | 0.12 *** |
| e | | | | | -0.22 | -0.31 *** | 0.5 | -0.07 | -0.18 | -0.01 | -0.13 | 0.16 | -0.06 | 0.02 | -0.11 | -0.27 *** | -0.13 | 0.02 |
| ei | | | | | | -0.09 | 0.27 | 0.16 | 0.04 | 0.21 ** | 0.09 | 0.38 *** | 0.16 | 0.24 *** | 0.12 | -0.05 | 0.09 | 0.24 *** |
| eu | | | | | | | 0.36 | 0.25 *** | 0.13 | 0.31 *** | 0.18 *** | 0.47 *** | 0.25 *** | 0.33 *** | 0.21 *** | 0.04 | 0.18 *** | 0.33 *** |
| i | | | | | | | | -0.12 | -0.24 | -0.06 | -0.19 | 0.11 | -0.11 | -0.03 | -0.16 | -0.32 | -0.18 | -0.03 |
| ia | | | | | | | | | -0.12 | 0.06 *** | -0.07 *** | 0.23 *** | 0 | 0.09 *** | -0.04 *** | -0.2 *** | -0.07 | 0.09 *** |
| ie | | | | | | | | | | 0.18 * | 0.05 | 0.34 *** | 0.12 | 0.21 ** | 0.08 | -0.09 | 0.05 | 0.2 ** |
| io | | | | | | | | | | | -0.13 *** | 0.17 *** | -0.05 *** | 0.03 ** | -0.1 *** | -0.26 *** | -0.12 ** | 0.03 * |
| iu | | | | | | | | | | | | 0.29 *** | 0.07 *** | 0.16 *** | 0.03 | -0.14 *** | 0 | 0.15 *** |
| o | | | | | | | | | | | | | -0.22 *** | -0.14 *** | -0.27 *** | -0.43 *** | -0.29 *** | -0.14 *** |
| oi | | | | | | | | | | | | | | 0.08 *** | -0.04 ** | -0.21 *** | -0.07 | 0.08 *** |
| ou | | | | | | | | | | | | | | | -0.13 *** | -0.29 *** | -0.15 *** | 0 |
| ua | | | | | | | | | | | | | | | | -0.16 *** | -0.03 | 0.13 *** |
| ue | | | | | | | | | | | | | | | | | 0.14 * | 0.29 *** |
| ui | | | | | | | | | | | | | | | | | | 0.15 *** |
| uo | | | | | | | | | | | | | | | | | | 0.15 *** |

Table 4

Post-hoc comparison between all diphthongs when number interpretation was unclear (“don’t know”). The comparisons were performed by subtracting the diphthong in the columns from the one in the rows. Asterisks indicated the level of significance (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

| | a | ai | au | e | ei | eu | i | ia | ie | io | iu | o | oi | ou | ua | ue | ui | uo |
|----|---|-------|-------|-------|-----------|----------|----------|----------|---------|----------|-----------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| a | | -0.23 | -0.19 | -0.23 | -0.35 ** | -0.29 | 0.07 | -0.24 | -0.3 | 0.14 | -0.12 | 0.03 | 0.16 | -0.17 | -0.23 | -0.32 * | -0.12 | -0.18 |
| ai | | | 0.4 | 0 | -0.12 *** | -0.06 ** | 0.29 | -0.01 | -0.07 | 0.37 *** | 0.11 *** | 0.26 | 0.39 *** | 0.06 | 0 | -0.09 *** | 0.11 *** | 0.05 |
| au | | | | -0.04 | -0.16 *** | -0.11 ** | 0.25 | -0.05 | -0.12 * | 0.33 *** | 0.07 | 0.22 | 0.35 *** | 0.02 | -0.04 | -0.13 *** | 0.07 | 0.01 |
| e | | | | | -0.13 | -0.07 | 0.29 | -0.02 | -0.08 | 0.37 *** | 0.11 | 0.26 | 0.38 *** | 0.06 | 0 | -0.09 | 0.11 | 0.05 |
| ei | | | | | | 0.06 | 0.42 *** | 0.11 *** | 0.05 | 0.5 *** | 0.24 *** | 0.38 *** | 0.51 *** | 0.18 *** | 0.13 ** | 0.03 | 0.24 *** | 0.18 *** |
| eu | | | | | | | 0.36 * | 0.05 | -0.01 | 0.44 *** | 0.18 *** | 0.32 * | 0.45 *** | 0.12 ** | 0.07 | -0.03 | 0.18 *** | 0.12 * |
| i | | | | | | | | -0.31 | -0.37 * | 0.08 | -0.18 | -0.04 | 0.09 | -0.23 | -0.29 | -0.39 ** | -0.18 | -0.24 |
| ia | | | | | | | | | -0.06 | 0.39 *** | 0.13 *** | 0.27 | 0.4 *** | 0.07 | 0.02 | -0.08 ** | 0.13 *** | 0.07 |
| ie | | | | | | | | | | 0.45 *** | 0.19 *** | 0.33 * | 0.46 *** | 0.13 * | 0.08 | -0.02 | 0.19 *** | 0.13 |
| io | | | | | | | | | | | -0.26 *** | -0.11 | 0.01 | -0.31 *** | -0.37 *** | -0.46 *** | -0.26 *** | -0.32 *** |
| iu | | | | | | | | | | | | 0.15 | 0.27 *** | -0.05 | -0.11 ** | -0.2 *** | 0 | -0.06 |
| o | | | | | | | | | | | | | 0.13 | -0.2 | -0.26 | -0.35 ** | -0.15 | -0.21 |
| oi | | | | | | | | | | | | | | -0.33 *** | -0.38 *** | -0.48 *** | -0.27 *** | -0.33 *** |
| ou | | | | | | | | | | | | | | | -0.06 | -0.15 *** | 0.05 | -0.01 |
| ua | | | | | | | | | | | | | | | | -0.09 | 0.11 * | 0.05 |
| ue | | | | | | | | | | | | | | | | | 0.2 *** | 0.14 ** |
| ui | | | | | | | | | | | | | | | | | | |
| uo | | | | | | | | | | | | | | | | | | |

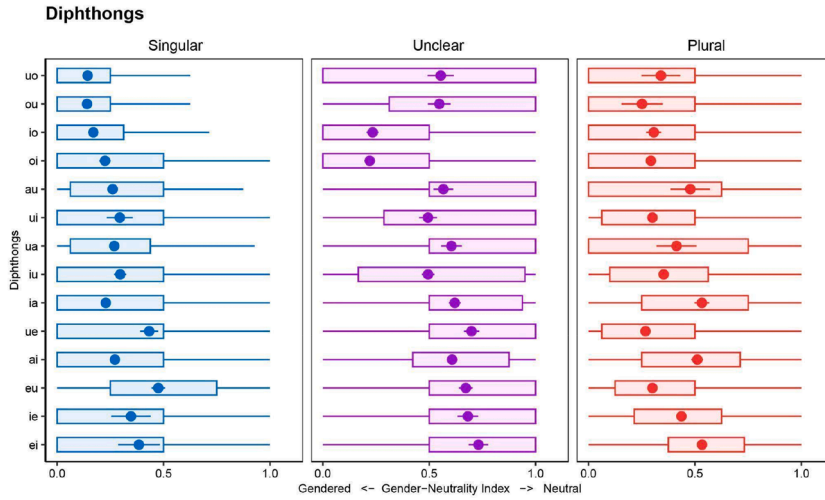


Fig. 1. Gender Neutrality Index for all diphthongs. The picture shows the distributions of the Gender Neutrality Index (x-axis) along with the Estimated Marginal Mean (EMMs) of the mixed model (points and SE bars) for each number judgement (singular in blue, unclear in violet and plural in red).

Diphthongs Contrasts - Singular

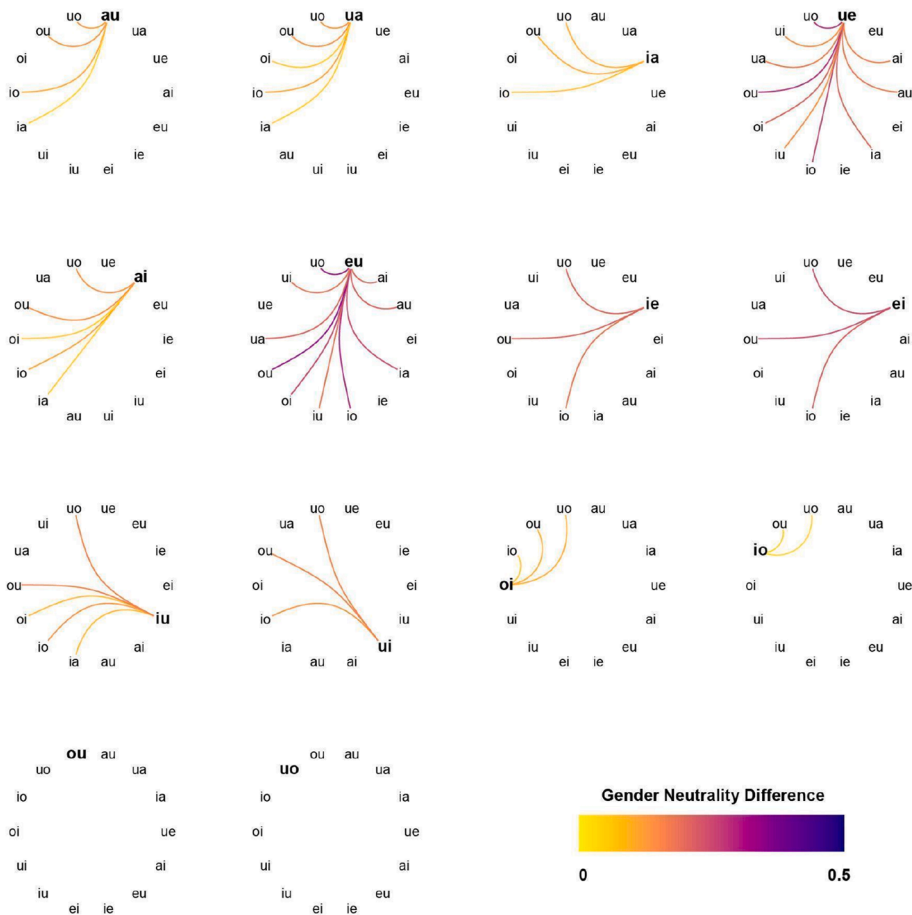


Fig. 2. Post-hoc contrasts on the Gender Neutrality Index between diphthongs when judged as singular. The figure depicts the post-hoc contrasts performed on the EMMs from the model between all diphthongs (the standard gender encodings “a”, “e”, “o”, “i” were excluded) when judged as singular. In each circular graph the arcs connecting the first term of the comparison (in bold) represent a significant difference ($p < 0.05$) between the first term and the connected diphthongs but only if the first term is more neutral. Arcs’ color represents the magnitude of the difference.

Diphthongs Contrasts - Plural

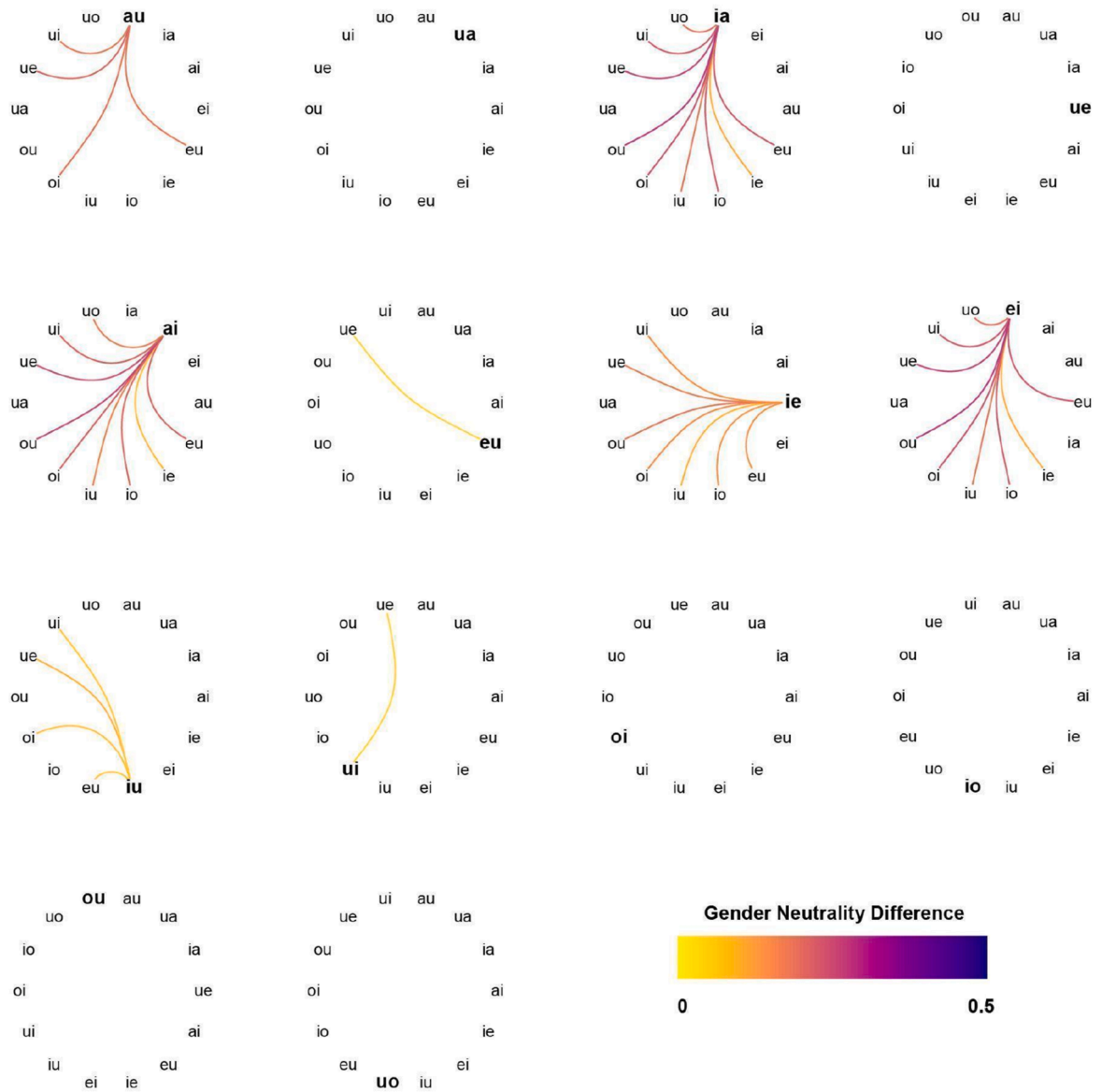


Fig. 3. Post-hoc contrasts on the Gender Neutrality Index between diphthongs when judged as plural. The figure depicts the post-hoc contrasts performed on the EMMs from the model between all diphthongs (the standard gender encodings “a”, “e”, “o”, “i” were excluded) when judged as plural. In each circular graph the arcs connecting the first term of the comparison (in bold) represent a significant difference ($p < 0.05$) between the first term and the connected diphthongs but only if the first term is more neutral. Arcs’ color represents the magnitude of the difference.

Diphthongs Contrasts - Unclear

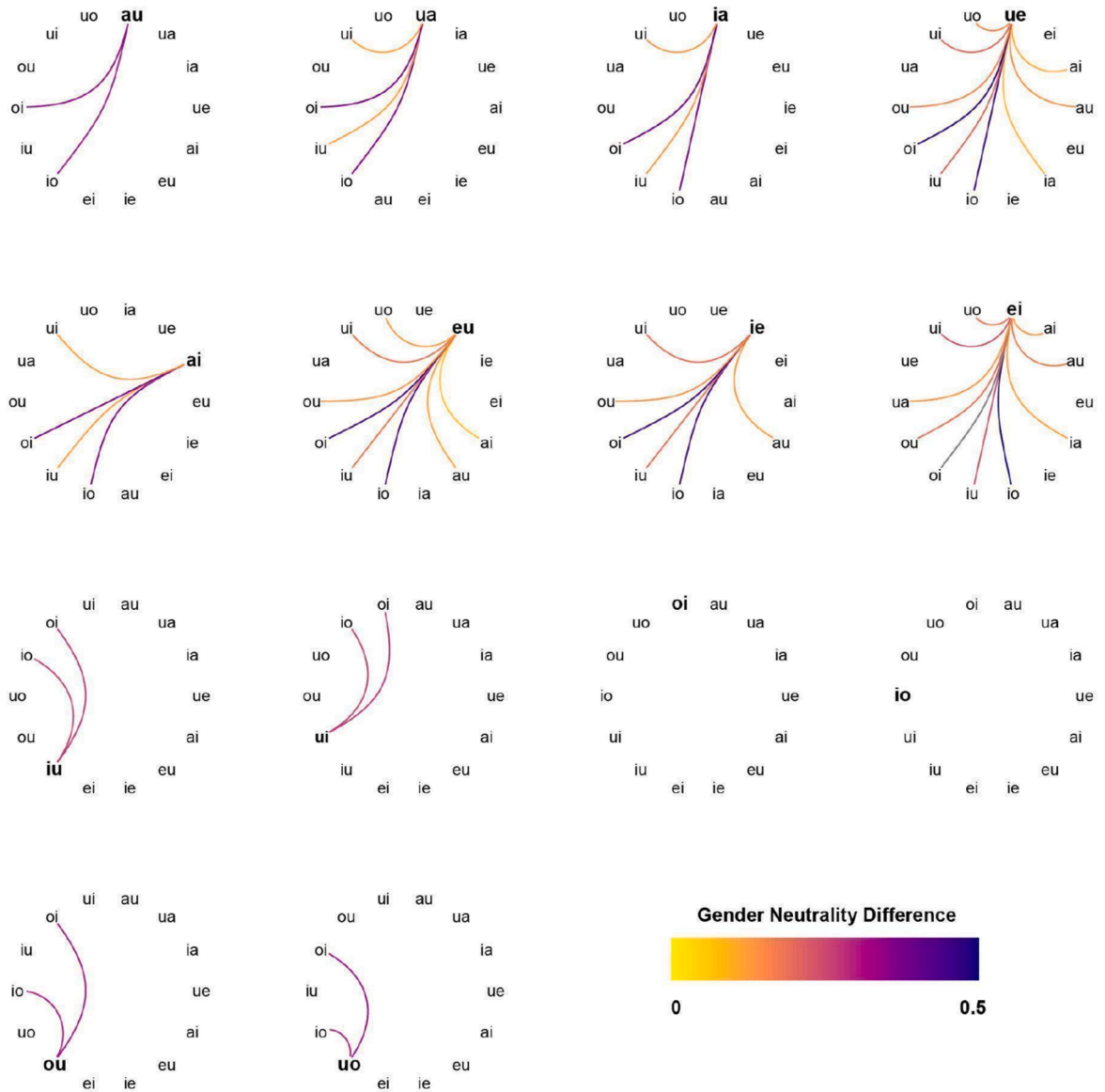


Fig. 4. Post-hoc contrasts on the Gender Neutrality Index between diphthongs when number interpretation was unclear (“don’t know”). The figure depicts the post-hoc contrasts performed on the EMMs from the model between all diphthongs (the standard gender encodings *a*, *e*, *o*, *i* were excluded) when number interpretation was unclear. In each circular graph the arcs connecting the first term of the comparison (in bold) represent a significant difference ($p < 0.05$) between the first term and the connected diphthongs but only if the first term is more neutral. Arcs’ color represents the magnitude of the difference.

A main effect of Number Judgement, $F(2, 50558) = 1286.42$, $p < 0.001$, showed that, irrespectively from the specific diphthong, diphthongs were judged as more gender-neutral when number interpretation was unclear compared to when they were judged as singular (Estimate = -0.29 , SE = 0.01 , $p > 0.001$) or plural (Estimate = -0.20 , SE = 0.02 , $p < 0.001$). Secondly, also when judged as plural, diphthongs were judged as more gender-neutral compared to when they were judged as singular (Estimate = 0.08 , SE = 0.02 , $p < 0.001$). The main effect of Diphthong, $F(17, 49977) = 416.06$, $p < 0.001$, was also analyzed. Post-hoc tests showed that, when averaged across number judgments, the diphthong interpreted as more gender-neutral with respect to all the others was *ei* (EMM = 0.55 , SE = 0.02). The EMMs and SEs for all diphthongs are indicated in Table 1 All the significance levels and the estimated differences are reported in Table 5. See Fig. 5 for a graphical representation of the significant comparisons.

Table 5
 Post-hoc comparison between all diphthongs averaged across number judgments. The comparisons were performed by subtracting the diphthong in the columns from the one in the rows. Asterisks indicated the level of significance (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

| | a | ai | au | e | ei | eu | i | ia | ie | io | iu | o | oi | ou | ua | ue | ui | uo |
|----|---|----------|-----------|----------|-----------|-----------|----------|-----------|-----------|----------|-----------|---------|----------|----------|-----------|-----------|-----------|-----------|
| a | | -0.3 *** | -0.27 *** | -0.09 | -0.38 *** | -0.32 *** | -0.03 | -0.3 *** | -0.32 *** | -0.07 | -0.22 *** | 0.04 | -0.08 | -0.15 | -0.26 *** | -0.3 *** | -0.2 ** | -0.18 * |
| ai | | | 0.03 | 0.2 *** | -0.09 *** | -0.02 | 0.27 *** | 0 | -0.03 | 0.23 *** | 0.08 *** | 0.33 | 0.22 *** | 0.15 *** | 0.03 | 0 | 0.1 *** | 0.12 *** |
| au | | | | 0.18 *** | -0.11 *** | -0.05 | 0.24 *** | -0.03 | -0.05 | 0.2 *** | 0.05 | 0.31 | 0.19 *** | 0.12 *** | 0.01 | -0.03 | 0.07 | 0.09 * |
| e | | | | | -0.29 *** | -0.22 *** | 0.07 | -0.2 *** | -0.23 *** | 0.02 | -0.12 *** | 0.13 | 0.01 | -0.05 | -0.17 *** | -0.21 *** | -0.1 | -0.09 |
| ei | | | | | | 0.07 | 0.36 *** | 0.09 *** | 0.06 | 0.31 *** | 0.17 *** | 0.42 ** | 0.3 *** | 0.24 *** | 0.12 *** | 0.08 ** | 0.19 *** | 0.2 *** |
| eu | | | | | | | 0.29 *** | 0.02 | -0.01 | 0.25 *** | 0.1 *** | 0.35 * | 0.24 *** | 0.17 *** | 0.05 | 0.02 | 0.12 *** | 0.14 *** |
| i | | | | | | | | -0.27 *** | -0.29 *** | -0.04 | -0.19 ** | 0.06 | -0.05 | -0.12 | -0.23 *** | -0.27 *** | -0.17 * | -0.15 |
| ia | | | | | | | | | -0.03 | 0.22 *** | 0.08 *** | 0.33 | 0.21 *** | 0.15 *** | 0.03 | -0.01 | 0.1 *** | 0.11 *** |
| ie | | | | | | | | | | 0.25 *** | 0.11 *** | 0.36 * | 0.24 *** | 0.18 *** | 0.06 | 0.02 | 0.13 *** | 0.14 *** |
| io | | | | | | | | | | | -0.14 *** | 0.11 | -0.01 | -0.08 * | -0.19 *** | -0.23 *** | -0.13 *** | -0.11 *** |
| iu | | | | | | | | | | | | 0.25 | 0.14 *** | 0.07 | -0.05 | -0.08 *** | 0.02 | 0.04 |
| o | | | | | | | | | | | | | -0.12 | -0.18 | -0.3 | -0.34 | -0.23 | -0.22 |
| oi | | | | | | | | | | | | | | -0.07 | -0.18 *** | -0.22 *** | -0.12 *** | -0.1 *** |
| ou | | | | | | | | | | | | | | | -0.12 *** | -0.15 *** | -0.05 | -0.03 |
| ua | | | | | | | | | | | | | | | | -0.04 | 0.07 | 0.08 |
| ue | | | | | | | | | | | | | | | | | 0.1 *** | 0.12 *** |
| ui | | | | | | | | | | | | | | | | | | 0.02 |
| uo | | | | | | | | | | | | | | | | | | |

Diphthongs Contrasts - Averaged across Number Judgements

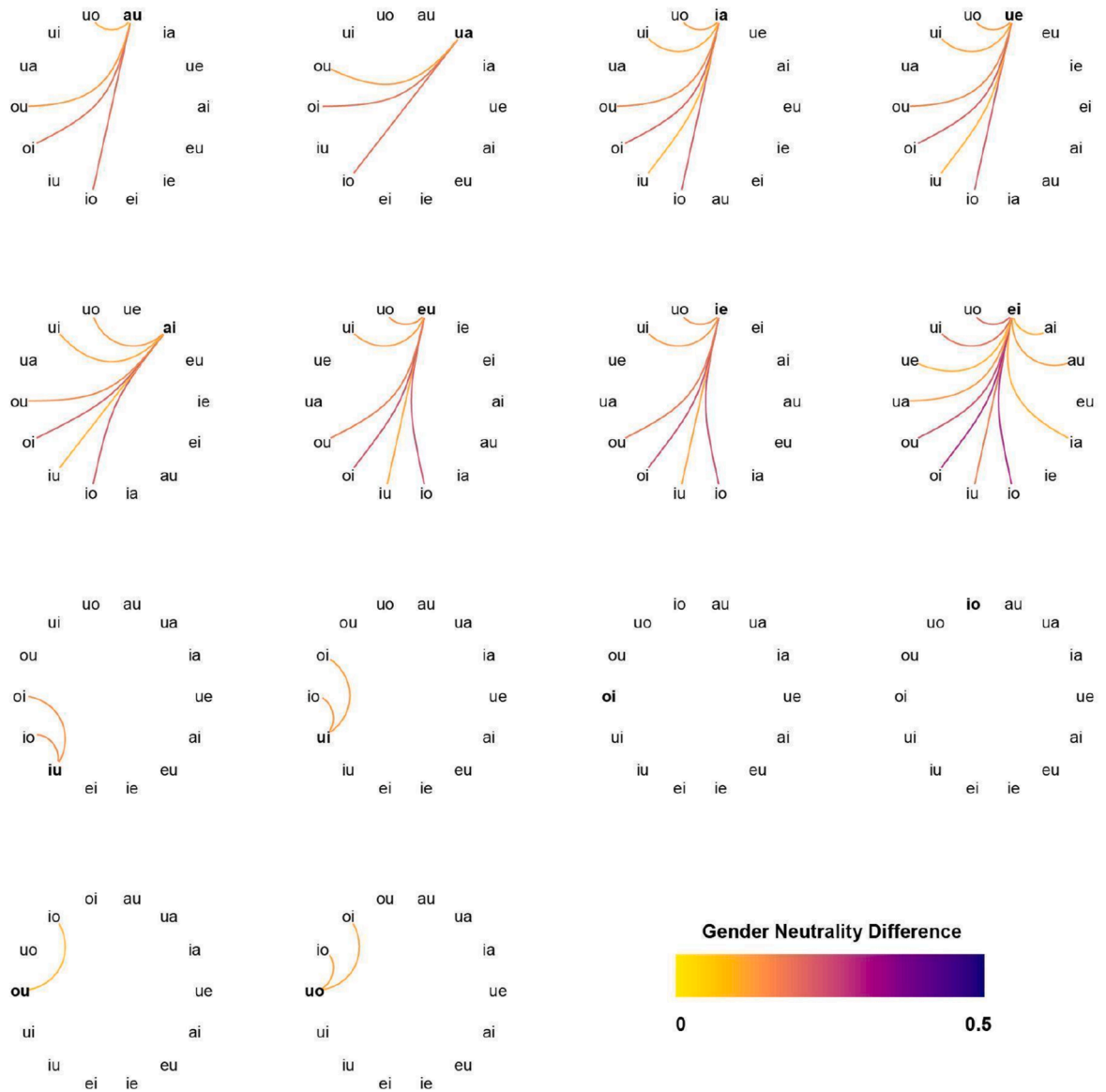


Fig. 5. Post-hoc contrasts on the Gender Neutrality Index between diphthongs averaged across number judgments. The figure depicts the post-hoc contrasts performed on the EMMs from the model between all diphthongs (the standard gender encodings *a*, *e*, *o*, *i* were excluded) when number interpretation was unclear (“don’t know”). In each circular graph the arcs connecting the first term of the comparison (in bold) represent a significant difference ($p < 0.05$) between the first term and the connected diphthongs but only if the first term is more neutral. Arcs’ color represents the magnitude of the difference.

Responses to open-ended questions at the end of the questionnaire regarding the presence of the *u* in diphthongs revealed two contrasting perspectives. On the one hand, some participants claimed to interpret *u* as masculine because of its grammatical gender value in certain Italian dialects. On the other hand, others viewed *u* as not carrying any grammatical gender value, probably because masculine and feminine nouns ending in *-u* are much rarer in standard Italian, and sometimes borrowed from other languages. These participants, thus, took *u* as either neutralizing the interpretation of the

whole AGED or failing to influence the interpretation contributed to by the other sound. Apart from considerations on the *u* and *u*_cluster dialects, a possible influence of other dialects was also hypothesized by a small number of participants when interpreting diphthongs such as *ie*, *io*, or *ai*⁶.

5. Discussion

Our hypotheses were, at least in part, confirmed by the results on the Diphthong × Number Judgement interaction. First, our hypotheses were formulated distinguishing diphthongs interpreted as plural versus singular, that is, we expected diphthongs and number interpretation to interact, as emerges from the analyses.

Second, post-hoc tests revealed *ei*, *ia*, and *ai* to be the most gender-neutral plural-interpreted diphthongs. We predicted (H1.1) *ei* to be one of the most gender-neutral plural diphthongs as it contains both sounds typically associated with feminine and masculine plural nouns (i.e., *e* and *i*, respectively). By the same token, we hypothesized that the diphthong *ie* would also be interpreted as more gender-neutral than others. However, this prediction is not matched by the results. Crucially, our hypotheses only focused on the sounds featured in the diphthongs. Component sounds alone, though, cannot explain the differences between diphthongs constituted by the same sounds which, however, emerged from the analyses: post-hoc tests revealed that *ei* was interpreted as more gender-neutral with respect to *ie*. Importantly, the difference between *ei* and *ie* cannot depend on which component is a full vowel or a glide: in both, the glide is *i*, as *e* is a full vowel which coincides with the syllabic peak in the presented stimuli. These results suggest that factors other than merely constituent sounds play a role, an aspect indicated as relevant also by participants in the open-ended comment section at the end of the questionnaire. Specifically, several participants declared taking into account not only the combination but also the position of sounds within the diphthong—whether final or penultimate. They assumed that these factors may play a significant role in determining diphthongs' gender interpretation. Despite what participants assumed, the main difference between *ei* and *ie* is not a matter of the order of the sounds within the diphthong. Rather, it lies in the fact that *ei* and *ie* are closing and opening diphthongs, respectively. In closing diphthongs, the transition moves from a stronger (more prominent for sonority and relative duration, and possibly even pitch) sound to a weaker one, while in opening diphthongs, it is the reverse (Mioni, 1986; Ladefoged and Johnson, 2014). Thus, the first sound acoustically and perceptually dominates in closing diphthongs, and the second dominates in opening ones. However, the relevance of the difference between opening and closing diphthongs in our study remains unclear. Some participants further declared a minor influence of *i* and *u* compared to the other vowels. In our stimuli, *i* and *u* are usually the weaker sounds not coinciding with the syllabic peak⁷. Their lower perceptual prominence compared to full vowels (e.g., *a*, *e*, and *o*) has probably motivated such observations.

Moreover, based on our hypothesis, we should not expect *ai* and *ia* to be among the most gender-neutral plural-interpreted diphthongs. An explanation of this result could be as follows. Diphthongs containing at least one of the sounds constituting the typical gendered plural endings (i.e., *e* for the feminine and *i* for the masculine) are interpreted as more plural than those containing neither. This could explain why diphthongs *ai*, *ei*, *eu*, *ia*, *ie*, *io*, *iu*, *oi*, *ue*, and *ui* are interpreted as more plural than *au*, *ou*, *ua*, and *uo*. Among these, some participants specifically reported associating the diphthong *ia* with the Latin neuter plural ending *-a*. Notably, a minor trend among participants was the observation that certain diphthongs might evoke cross-linguistic associations, with inflectional patterns in Latin and Greek grammar being the most frequently reported. Moreover, *eu* and *ue* could be interpreted as less plural because *e*, unlike *i*, can also encode the singular of the third inflectional class, whose singular and plural encodings are, respectively, *e* and *i*. Examples of nouns belonging to such a class are *fiume*/*-i* 'river(M).SG/*-s*(M).PL' and *chiave*/*-i* 'key(F).SG/*-s*(F).PL'. These considerations jointly explain why diphthongs containing *i* (i.e., *ai*, *ei*, *ia*, *ie*, *io*, *iu*, *oi*, and *ui*) are interpreted as more plural than those lacking it (i.e., *au*, *eu*, *ua*, *ue*, and *uo*).

Among the diphthongs containing *i*, *oi* and *io* could be interpreted as more masculine since, again, the final vowel *-o* appears with high frequency in masculine singular nouns. Hence, this explains why, among the plural-interpreted diphthongs, *iu*, *ui*, *ai*, *ei*, *ia*, and *ie* are interpreted as more gender-neutral than *oi* and *io*. Moreover, *iu* and *ui* could be perceived as more masculines because the ending sound *-u* is associated with masculine singular nouns in some dialects and regional varieties of Italian (i.e., Salento, Calabria, Sicily, Sardinia, and Campania, henceforth "*u*_cluster"). This leaves us with four diphthongs (i.e., *ai*, *ei*, *ia*, and *ie*), three of which actually are the most gender-neutral plural-interpreted ones.

One might wonder why if *oi* and *io* are interpreted as more masculine due to *o* being the typical ending vowel in masculine singular nouns, *ai* and *ia* are not interpreted as more feminine due to *a* being the typical ending vowel in feminine singular nouns. This might be due to the interaction between a 'typically feminine' vowel (i.e., *a*) and a 'typically masculine' one (i.e., *i*). In this case, the possible grammatical gender clues of the two components of the diphthong (*a* and *i*) may have balanced themselves out. Instead, both *o* and *i* gave a possible masculine grammatical gender clue, which added up yielding an overall stronger masculine interpretation of the diphthongs *oi* and *io*.

⁵ See supplementary materials for data concerning other languages or dialects.

⁶ Stimuli with *iu* are the only ones with *u* coinciding with the syllabic peak and not serving as a glide. Stimuli with *ui* are the only ones with *i* coinciding with the syllabic peak and not serving as a glide.

⁷ Sulis and Gheno, 2022 and Anelli (2022) also report the use of *ei* and *ie*, respectively. Notice, however that they have been proposed as combinations of typical feminine and masculine (and viceversa) plural endings.

Finally, post-hoc tests revealed *eu* and *ue* to be the most gender-neutral singular-interpreted diphthongs. This was partially in line with our hypothesis 1.2. According to H1.2, we expected *eu*, *ue*, *ei*, *ie*, *iu*, and *ui* to be the most gender-neutral singular-interpreted diphthongs because they do not include neither *o* nor *a*. Indeed, given that ending vowel *-o* typically appears in masculine singular nouns, we expected diphthongs containing it to be interpreted as more masculine than those lacking it. Our findings, though, further highlighted that *iu*, *ui*, *ei*, and *ie* were interpreted as more gendered than *eu* and *ue*. This can be explained as follows. Stimuli ending in *iu* could be interpreted as more masculine due to the influence of *u*-cluster dialects where it typically appears as masculine noun ending, as explained above, because *u* serves as a full vowel, rather than a glide, in this diphthong. A similar hypothesis could explain why stimuli ending in *ui* were interpreted as more masculine, given that *i* in this diphthong is a full vowel and that it is associated with the masculine gender. These considerations can jointly explain why *iu*, *ou*, *uo*, *oi*, and *io* were interpreted as more masculines than *au*, *ua*, *ai*, *ia*, *eu*, *ue*, *ui*, *ei*, and *ie*. Analogously, diphthongs containing *a* could have been interpreted as more feminine than those lacking it (i.e., *ei*, *eu*, *ie*, *io*, *iu*, *oi*, *ou*, *ue*, *ui*, and *uo*) because *a* typically appears as an ending vowel in feminine singular nouns. These observations jointly explain why *eu*, *ue*, *ei*, and *ie* might have been interpreted as less gendered than *ai*, *au*, *ia*, *io*, *iu*, *oi*, *ou*, *ua*, *ui*, and *uo*: they do not contain *o* or *a*, nor *u* or *i* occurring as a full vowel. Moreover, *ei* and *ie* might not be interpreted as singular because both their component sounds constitute the plural encoding devices of the first and second Italian inflectional classes. This leaves us with *eu* and *ue*, explaining why they have been interpreted as the most gender-neutral among the singular-interpreted diphthongs.

We also found that, when judged as plural, diphthongs were judged as more gender-neutral compared to when they were judged as singular. This could be due to the fact that, in Italian, the plural refers to mixed-gender groups more frequently than when the singular gets used generically and, thus, it could be applied to referents of any gender. This difference in frequency emerges, for instance, in [Frenda et al. \(2024\)](#). The authors analyzed a corpus of 2.187 sentences and a total of 223.367 words, and found 3.772 occurrences of plural masculines referring to mixed-gender groups compared to 597 of singular masculines used for either generic or unknown referents ([Frenda et al., 2024: 3](#)).

Furthermore, when number interpretation was unclear (“don’t know”), diphthongs were judged as more gender-neutral compared to when they were judged as singular or plural. That is, in these cases, participants judged words ending with diphthongs as undefined in both gender and number. This is unsurprising given that diphthongs are not standard devices for encoding either gender or number. Hence, words ending with diphthongs lack established linguistic clues for both categories and are judged as undefined, accordingly.

Last but not least, the main effect of Diphthong confirms our pre-registered Hypothesis 1: some Italian diphthongs are interpreted as more gender-neutral than others. In particular, the post-hoc test shows that the diphthong interpreted as the most gender-neutral is *ei*. This result is in line with our pre-registered hypotheses 1.1 and 1.2, given that diphthong *ei* features in both the hypothesis concerning diphthongs interpreted as plural (i.e., H1.1) and those interpreted as singular (i.e., H1.2): H1.1 predicts that diphthongs composed by both *e* and *i* are less gendered than those composed only by one of them, and H1.2 predicts diphthongs lacking *a* and *o* to be less gendered than those containing either of them. This, though, also applies to *ie*, which, however, was interpreted as significantly less gender-neutral than *ei*. As mentioned above, we are unclear as to the reasons for this difference between diphthongs constituted by the same sounds.

6. Conclusions

This study represents, to our knowledge, the first attempt to empirically test the efficacy of diphthongs used as Alternative grammatical Gender Encoding Devices (AGEDs) in Italian. Its relevance emerges from the structural constraints of Italian, which, on one the hand, relies on so-called “generic” or “overextended” masculine forms when referring to an unspecified person or a mixed-gender group; on the other hand, it lacks linguistic tools to address non-binary identities ([Comandini, 2021](#)). Extensive psycholinguistic research (e.g., [Gygax et al., 2021](#)) has shown that these masculine generics bias listeners’ interpretations toward male-only referents, ultimately excluding or obscuring both women and non-binary individuals. Moreover, unlike English—where a singular *they* can circumvent misgendering—Italian’s pervasive binary system in nouns, articles, and adjectives poses significant challenges for inclusivity ([Thornton, 2023](#)).

In contrast to existing, if niche, solutions—such as the schwa (ə), symbols (*, @), or specialized letters (*u*) that have seen limited public usage ([Gheno, 2020, 2021](#); [Giusti, 2022](#))—the present study tested a series of diphthongs that are part of standard Italian phonology and, except for the occasional use of *ai*, have not been proposed as inclusive language strategies. By repurposing diphthongs already familiar to Italian speakers, our aim was to minimize phonological disruptions and potentially increase both comprehensibility and social acceptance. Results suggest that certain diphthongs were interpreted as more gender-neutral than others (i.e., *ei*, *ia*, and *ai* for the plural; *eu* and *ue* for the singular), indicating that they may indeed serve as linguistically coherent devices to address the current lack of a gender-neutral category in Italian. While promising, these findings also highlight the need for additional research on dialectal variation, overall intelligibility, and how such novel endings might be understood across diverse age groups and educational levels ([De Santis, 2022](#); [Giusti, 2022](#)).

Further research is also required to examine the different types of nouns to which AGEDs can be applied. It would be valuable to test a range of symmetric nouns which, unlike those selected for the present study, exhibit strong gender-stereotypical connotations (e.g., *ingegnere* ‘engineer(M)’ vs. *infermiera* ‘nurse(F)’). Such an investigation would assess whether these strategies are perceived as gender-neutral even in the presence of pronounced biases, and the extent to

which AGEDs may mitigate or inhibit the activation of gender stereotypes. Still regarding symmetric nouns, future research should explore the effect of AGEDs on nouns where gender is encoded, among other information, through derivational suffixes (e.g., *sciatore* 'skier(M)' vs. *sciatrice* 'skier(F)'). Gheno (2021, p. 23) proposed to neutralize the forms in *-tore* (e.g., *sciatotorə*) which, indeed, appears more frequent in spontaneous Italian than the feminine-based *-trice* (Safina, 2026). Nevertheless, even if attested in informal, digital varieties of Italian, such forms were described as “masked masculines” from a morphological standpoint (Giusti, 2022, p. 15; Thornton, 2022, p. 40), and were therefore excluded from the present study to avoid potential bias. We leave to future research the task of assessing not only the perception of AGEDs across a broader class of symmetric nouns, including those in *-tore/-trice*, but also whether neutralized forms such as *sciatorei* are indeed perceived as masked masculines.

We are aware that our study per se is not enough to empirically demonstrate that certain diphthong-based AGEDs are genuinely gender-neutral in Italian; rather, it represents only a first step, and further research is needed. Future work should include measuring processing time, comparing diphthongs with “u” and *schwa* in terms of ease of articulation and pronunciation in word-final position, assessing potential performance improvement over time and with learning, and analyzing behavior in agreement chains. Finally, future work might investigate whether diphthong-based AGEDs can be smoothly integrated into institutional or public settings and whether they mitigate misgendering without introducing new forms of exclusion, thus contributing to best-practice guidelines for more inclusive and gender-fair language use.

CRediT authorship contribution statement

Martina Rosola: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Mara Floris:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Daniela Ruzzante:** Writing – review & editing, Writing – original draft, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Elena Sofia Safina:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Igor Facchini:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Giuseppe Di Dona:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation. **Giuliano Torrenzo:** Writing – review & editing, Writing – original draft, Resources, Methodology, Investigation, Conceptualization.

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Conflicts of interest

All the authors (Martina Rosola, Mara Floris, Daniela Ruzzante, Elena Sofia Safina, Igor Facchini, Giuseppe Di Dona, and Giuliano Torrenzo) declare that they have no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.langsci.2026.101812>.

Data availability

Double vowels, double fairness? Assessing the viability of diphthongs as novel strategies for gender fairness in Italian <https://osf.io/eh65z/>.

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