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# Syntactic and cognitive issues in investigating gendered coreference

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**Abstract** This paper presents a framework for how the multifaceted nature of “gender” (human and linguistic) interacts with grammatical operations such as coreference dependency formation. It frames the question through the lens of English, in which it focuses on how personal names and referents who identify as nonbinary can provide insight into the conceptual representations of gender. Additional data from a variety of modern languages supports a model of how gender might be cognitively represented such that the observed linguistic patterns are available. I propose a three-tiered model of gender that unites grammatical, cognitive, social, and biological aspects and describes how implications of this model might be tested in future work.

**Keywords:** gender; features; coreference; pronouns; personal names

# 1 Introduction

## 1.1 Preface

The inspiration for this paper comes from the observation that gender agreement can sometimes follow different criteria cross-linguistically, and more crucially, in different contexts within a language and between individuals. This is not a new observation; this paper elaborates on it by examining typological variation and contextual variation to propose a system for discussing different types of “gender” that are linguistically encoded and how they affect the form that agreement takes. The novel contribution is a framework for integrating general and linguistic cognition as related to gender, broadly construed. This framework will allow theoretical and experimental work in this area to more clearly identify and navigate issues relating to human gender as both a categorical and gradient phenomenon.

To begin, I lay out my proposed terminology for discussing gender in a principled way. This sets the stage for examining data from English, which does not overtly mark gender agreement outside of third person singular pronouns, and comparing it to observations from a variety of other languages that have richer gender inflection systems. I also examine how some lexical innovations which encode nonbinary gender fit into the wider picture of coreference.

Finally, these observations provide the foundation for a proposal which places languages (or, potentially individual speakers of those languages) along a gradient of permissiveness in gender agreement and relates this to how different types of gender, including nonbinary identities, are conceptualized and learned. The intention of this structure is to organize formal, empirical, and philosophical evidence to support the claim that gender is represented and accessed at different levels and to different degrees during the process of coreference resolution.

## 1.2 Gender as a complex phenomenon

The term *gender* is fraught in part because definitions given in the linguistics literature can vary dramatically across subfields or even specific works and are sometimes left as tacit assumptions, even within contexts like coreference resolution. This paper aims to clarify what kinds of gender might be relevant for real-time processing of syntactic agreement and coreference between a pronoun and a referring expression, noting proper names and genders outside of the ‘masculine-feminine’ (or ‘male-female’) binary. It develops the hypothesis that the type of gender involved in coreference checking in English, and possibly other languages, is primarily a domain-general categorical representation of the referent which a formal syntactic or semantic feature can draw upon during agreement and checking oper-

37 ations. That is, the mechanism for categorization of gender which is used to check  
38 gender congruency between a pronoun and the expression with which it corefers re-  
39 lies fundamentally on a general cognitive mechanism for classifying and checking  
40 congruency of gender rather than relying on a mechanism specific to linguistic pro-  
41 cessing, in line with the ‘mental model’ framework (e.g. Garnham & Oakhill 1990;  
42 Garrod & Terras 2000). Finally, I suggest some lines of research into individual  
43 variation that would be able to inform the questions brought up herein.

44 I will explicitly and precisely define several types of gender in order to provide  
45 consistent and unambiguous terminology to the study of coreference and pronouns.  
46 These definitions of “gender” include grammatical gender, conceptual gender, gen-  
47 der identity, gender expression, and biosocial gender. I iteratively develop a cri-  
48 terion for checking gender congruency (whether or not two lexical items ‘match’  
49 in gender), then suggest a gradient way in which languages might employ the fi-  
50 nal formulation of the criterion to result in the typological variation observed. I  
51 also describe a three-tiered schema for formalizing the process of gender checking  
52 during coreference resolution. While English is the primary focus of this paper,  
53 I will demonstrate that motivation for these three categories can be found cross-  
54 linguistically. I draw on biological, social, cognitive, and grammatical evidence  
55 for how gender is conceptualized and used in human interaction in order to argue  
56 that coreference resolution (in English) relies primarily on a non-syntactic prop-  
57 erty, conceptual gender, for determining whether or not a pronoun and coreferring  
58 expression match or mismatch, which is domain-general in origin.

59 The relative difference in acceptability between sentences (1-a) and (1-b) (in-  
60 dicated by a #) illustrates that English coreference is influenced by discourse-level  
61 information and world knowledge. In order to develop a felicitous context for (1-a),  
62 one almost must assume the speaker is communicating their disapproval of the re-  
63 ferent through misgendering. That is, although the referent’s gender remains am-  
64 biguous without further context, a salient interpretation would be that the speaker is  
65 intentionally discussing the referent using gendered words (either pronouns or def-  
66 initional nouns) that are incongruent with the gender identity (defined in Section 2)  
67 and wishes of the referent.<sup>1</sup> In contrast, (1-b) provides a context that immediately  
68 allows for a felicitous and not necessarily transphobic interpretation since the gen-  
69 der of the costume-wearer and the gender of the pronoun may ‘mismatch’ without  
70 qualifying as misgendering the referent, as the costume is intended to mask their  
71 gender identity.

72 (1) a. # At the farmhouse, the cowgirl<sub>i</sub> left his<sub>i</sub> lasso in the kitchen.

<sup>1</sup> ‘Misgendering’, or referring to someone in a way that invalidates and devalues their identity, is known to cause mental, emotional and social distress, negatively impacting health and well-being, particularly in adolescents (K. Johnson et al. 2019; McLemore 2015).

73           b.     At the Halloween party, the cowgirl<sub>i</sub> left his<sub>i</sub> lasso in the kitchen.

74     The difference in apparent acceptability between these two sentences indicates that  
75     the property of gender relevant for coreference is, at the very least, more com-  
76     plex than a formal syntactic feature. This observation by itself is not novel (e.g.  
77     Collins & Postal 2012; Duffy & Keir 2004; Frazier et al. 2015; Garnham, Oakhill  
78     & Reynolds 2002; Gygax et al. 2008; Hess, Foss & Carroll 1995; Joseph 1979;  
79     Nieuwland & Van Berkum 2006; Pyykkönen, Hyönä & van Gompel 2010). Thus  
80     this paper develops a formal treatment of how certain “types” of gender can match  
81     or mismatch during coreference dependency resolution and what this means for the  
82     linguistic encoding of gender identity across languages.

83     One possible model to explain how gender is conceived and applied to linguistic  
84     referents is described in the following sections. It represents a self-consistent, com-  
85     prehensive model that can be tested empirically. Furthermore, it provides a starting  
86     point for interdisciplinary research into the many linguistic facets of gender. In  
87     particular, I anticipate this approach will benefit linguistic work which examines  
88     phenomena where an individual’s gender identity and/or gender expression is rel-  
89     evant, as well as work which makes use of biosocial gender, including phenotype  
90     and hormonal profiles. I especially hope to encourage linguists who make use of  
91     psycholinguistic properties of gendered pronouns in their research to be aware of  
92     the issues surrounding the various ways in which gender broadly construed and  
93     cognition may interface.

## 94     2     Defining gender

95     In order to precisely distinguish different types of gender, the following section  
96     briefly defines the types of gender relevant to this proposal. These types have been  
97     derived from syntactic, semantic, typological, sociological, anthropological, and  
98     neuro-biological work on gender. They are not intended to be all-encompassing;  
99     rather they are a terminological starting point for a coherent and precise discussion  
100     across fields and subfields in which the word *gender* may be used for multiple dis-  
101     tinct concepts. The following definitions are elaborated upon in this section.

102

103     **Grammatical gender:** The formal syntactic and/or semantic feature that is morpho-  
104     syntactically defined. (e.g., Comrie 1999; Kratzer 2009; Ritter 1993; Schriefers  
105     & Jescheniak 1999; Harley & Ritter 2002)

106     **Conceptual gender:** The gender that is expressed, inferred, and used by a perceiver  
107     to classify a referent (typically human, but can be extended to anthropo-  
108     morphized non-humans). (e.g., McConnell-Ginet 2015; Ansara & Hegarty

109 2013; Newman 1992; Gygax et al. 2008; Irmen & Kurovskaja 2010; Ar-  
110 mann & Bühlhoff 2012; Bussey & Bandura 1999)

111 **Biosocial gender:** The gender of a person based on phenotype, socialization, cul-  
112 tural norms, gender expression, and gender identity. These attributes may  
113 conspire to influence conceptual gender and gender expression, but this is  
114 an ongoing debate in the field. (e.g., Ansara & Hegarty 2013; Eckert 2014;  
115 Waxman 2010; Taylor & J. A. Hall 1982)

116 **Gender role:** A set of norms conventionalized by society which are asso-  
117 ciated with clothing or appearance, behavior, preferences, and social  
118 expectations. (e.g., Gabriel et al. 2008; Brutt-Griffler & Kim 2018)

119 **Gender expression:** The way a person appears and behaves, as relating  
120 to cultural norms for distinct gender roles. This type of gender can  
121 feed into others' perception, thus into conceptual gender as well. (e.g.,  
122 Garnham, Oakhill & Reynolds 2002; Rubin & Greene 1991)

123 **Gender identity:** The mental state of a person regarding that individual's  
124 association with conceptual gender, gender role, gender expression,  
125 and biosocial gender. When grammatical gender referring to a per-  
126 son and the gender identity of that person mismatch, this is likely to be  
127 considered 'misgendering'. (e.g., Ansara & Hegarty 2013; K. Johnson  
128 et al. 2019; Zimman 2017)

## 129 **2.1 Grammatical gender**

130 *Grammatical gender* comprises formal morphosyntactic features. They are the  
131 properties of words that allows the formal grammatical process of agreement to  
132 be carried out. This includes agreement of grammatical gender categories such  
133 as *masculine, feminine, neuter, common*, etc.<sup>2</sup> These features are properties of  
134 the morphemes themselves, and may be independent from the real-world biosocial  
135 genders associated with the referents. However, Corbett (1991) notes that there is a  
136 tendency for languages to correlate grammatical gender with the gender of the refer-  
137 ent, particularly if human. Moreover, Comrie (2005) adds that there is a tendency  
138 for personification of animals and inanimate objects in languages with grammat-  
139 ical gender to correlate with the grammatical gender of the noun phrase. This is  
140 further supported experimentally by Konishi (1993), who suggests that perception  
141 of inanimate referents are semantically influenced by grammatical gender cross-  
142 linguistically. Finally, it may be noted that languages that use different noun classes  
143 for subdividing humans almost always divide along a male-female category line

<sup>2</sup> Grammatical gender may include other noun classes as well, although a detailed discussion of noun classes is beyond the scope of this paper.

144 independently of how many other noun classes are present or what other types of  
 145 nouns are included in those two classes. Subdivision of humans across noun classes  
 146 is a crucial point here, as noun classes that use animacy as a distinction will group  
 147 humans in the animate category, independent of human gender. I am not aware of  
 148 any language that encodes more than two human genders grammatically.<sup>3</sup> Even  
 149 languages of people whose culture encodes more than two human genders do not  
 150 seem to encode those genders grammatically, as illustrated in Section 3.3.

151 In (2), the Dagestani language Tsez places animals in a noun class that is dis-  
 152 tinct from ones that include humans, and Comrie (2005) reports that grammatical  
 153 gender does not change to reflect the gender roles of personified animals. This  
 154 contrasts with languages like English, in which personification or anthropomor-  
 155 phization can result in the use of gendered third person pronouns to refer to non-  
 156 human animals and inanimate objects that would otherwise be referred to with *it*,  
 157 the inanimate/non-human pronoun. I argue that the variation in use of grammati-  
 158 cal gender points to a deeper, more complex system of gender categorization both  
 159 grammatically and conceptually. That is, grammatical gender is in principle in-  
 160 dependent from other types of gender but the way it is deployed and the way it  
 161 influences non-grammatical interpretation suggests it is not entirely decoupled.

162 The extracts in (2) come from a story in which a rooster (definitionally male)  
 163 and a hen (definitionally female) are married, but the rooster has another romantic  
 164 partner (a frog, no specified gender explicitly or grammatically) thus causing strife  
 165 in the rooster and hen's relationship (Comrie 2005). Although all animals fall into  
 166 the third noun class (III) in Tsez, the words for rooster (*mamalay*) and hen (*onoču*)  
 167 still have defined conceptual or semantic genders despite this not being reflected in  
 168 the grammatical features. That is, the grammatical gender of the frog, the hen, and  
 169 the rooster are all obligatorily noun class III, with agreement marked on the verb,  
 170 which is not used for humans of any gender.

171 (2) Tsez:

172 a. b - oħix - no            loħr - ā    eħi - n            wit'-wiš ħin  
           III - appear - PAST+CVB frog - ERG say - PAST+UNW wit'wish QUOT  
 173 'The frog appeared and said "witwish".'

<sup>3</sup> Kirby Conrod, *p.c.*, suggests that examination of how honorifics are encoded, conceptualized, and learned may provide insight into how gender categories adapt and change over time. Although this is outside the purview of this paper, I suspect that this line of research could potentially be very fruitful. However, it is important to note that honorific systems are much more variable cross-linguistically and also seem to be more susceptible to change over time than gender systems. Still, this comparison warrants further investigation.

- 174           b.   onoč - ā    b - egir - xo                   zew - č'ey                   mamalay  
                   hen - ERG III - send - PRES+CVB be - NEG+PAST+UNW rooster  
 175           neł - de    - r    - tow   b - ik'i    mi yaq<sup>s</sup>uł - no λin  
                   it- APUD - LAT - EMPH III - go.IMP you today- and QUOT  
 176           'The hen wouldn't let the rooster in, saying, "Go to her<sup>4</sup> again today".'

177           In (2), the gender roles of the three characters are inferred through cultural  
 178 norms, e.g. marriage, and expectations, e.g. housework and romantic liaisons,  
 179 rather than solely through grammatical gender such as noun class morphology. In  
 180 the case of *toħro* (*frog*) there is no lexical distinction between the males or fe-  
 181 males of the species. Thus, the interpretation that the frog is a female interloper in  
 182 the birds' marriage is not linguistically encoded. Comrie (2005) reports that Tsez  
 183 speakers uniformly interpret the frog to be female and not male, although it would  
 184 not be ungrammatical for the frog to be male. Thus, the interpretation of the frog as  
 185 female must come from the cultural expectations of the speakers rather than from  
 186 their language.

187           Compare *rooster* and *hen* in English and Tsez to languages like German (mas-  
 188 culine *Hahn* and feminine *Henne*, respectively) and Russian (masculine *petux* and  
 189 feminine *kurica*, respectively), in which the grammatical gender of the words and  
 190 the real-world sex of the animals is congruent. In Russian, the word for *frog*  
 191 (*ljaguška*) happens to be grammatically feminine, thus congruent with the anthro-  
 192 pomorphic gender role of the frog character. However, in German the word for *frog*  
 193 (*Frosch*) is grammatically masculine. Comrie (2005) reports that this makes it dif-  
 194 ficult, potentially bordering on ungrammatical, to use *Frosch* in translation, since  
 195 the grammatical gender is incongruent with the anthropomorphic gender role of the  
 196 frog character. According to him, the way to translate this story without indicating  
 197 a homosexual relationship between the rooster and the frog would be to change the  
 198 species of the interloping character to a feminine word like *toad* (*Kröte*). This sug-  
 199 gests that the grammatical gender of a word and the gender role of the character are  
 200 conceptually connected, even though this need not be the case (Konishi 1993; Irmen  
 201 & Kurovskaja 2010). On the other hand, what might be called grammatical gender  
 202 in English, which is restricted almost entirely to third person pronouns, appears to  
 203 be fully coupled to conceptual gender since the pronoun used would determine how  
 204 the character's gender role is interpreted. This leads us to the question: what role  
 205 does grammatical gender play in English, if any?

206           It is unclear whether or not grammatical gender plays a role in English syntactic  
 207 operations or psycholinguistic processes. It has been argued that English has com-  
 208 pletely lost grammatical gender, based on historical changes and loss of productive

<sup>4</sup> Here, *her* refers to the frog because in translation to English, *it* would be ambiguous and unnatural.

209 gender morphology (Baron 1971). Certainly, there is no overt gender agreement  
 210 between nouns, adjectives and articles. However, Bjorkman’s recent treatment of  
 211 gender agreement between names and pronouns makes a case for a limited gram-  
 212 matical gender system in English, in which sentences like (3) display a contrast in  
 213 acceptability (Bjorkman 2017).

- 214 (3) a. That surgeon<sub>i</sub> operated on three of their<sub>i</sub> patients today.  
 215 b. ?\* Jonathan<sub>i</sub> operated on three of their<sub>i</sub> patients today.

216 Bjorkman observes that sentences like (3-a) are more acceptable than (3-b), even  
 217 when the surgeon is known to all parties, and suggests this is due to names having  
 218 grammatical gender (i.e., a  $\phi$ -feature) in English, which must then agree with the  
 219 pronoun, at least for some speakers. A reviewer points out that (3-b)’s acceptabil-  
 220 ity is contextually dependent, as Johnathan’s gender identity and the interlocutors’  
 221 knowledge of this will affect the acceptability of the sentence. For instance, how-  
 222 ever, consider people like anti-bullying activist Jeffrey Marsh who is nonbinary and  
 223 whose pronouns are *they/them*, but whose forename is strongly biased as mascu-  
 224 line. In this case, it is unlikely that speakers will have a lexical entry for *Jeffrey* that  
 225 doesn’t have a masculine  $\phi$ -feature, but this does not change that Jeffrey Marsh’s  
 226 pronouns are *they/them* and using other pronouns would be misgendering. Speakers  
 227 would then need to have explicitly acquired the knowledge of which pronouns are  
 228 appropriate in order to avoid misgendering a person whose gender identity is not  
 229 immediately inferred from culturally specific cues in gender expression and gender  
 230 role.

231 Whether or not English makes use of grammatical gender to determine gender  
 232 congruency between coreferring elements, an argument for  $\phi$ -features on names  
 233 must account for how gender (conceptual and/or grammatical) is associated with  
 234 their referents, since gender bias of names is wildly variable and mutable, more  
 235 akin to cultural shifts than language change (Van Fleet & Atwater 1997; Barry &  
 236 Harper 1982; 1993; 2014; Lieberman, Dumais & Baumann 2000; Hahn & Bentley  
 237 2003). Thus, for grammatical gender to play a role in English, it would need to be  
 238 the case that names and a limited number of nouns have  $\phi$ -features for gender, but  
 239 that agreement with a coreferring pronoun is optional in cases where the antecedent  
 240 does not have a  $\phi$ -feature for gender. To this end, I will set aside the status of  
 241 grammatical gender in English for the time being and return to it in Section 4.1.3.

## 242 2.2 Conceptual gender

243 *Conceptual gender* encompasses a large number of closely related terms currently  
 244 in use in the literature. This includes semantic gender (e.g. Asarina 2009), defini-



245 tional gender (Kreiner, Sturt & Garrod 2008) and notional gender (i.e. natural gen-  
 246 der, but see McConnell-Ginet (2015) for why the term ‘natural’ is inappropriate),  
 247 which are ways of associating lexical items with masculine or feminine properties,  
 248 but without necessarily attributing formal features to them.

249 This may be illustrated by the strong gender biases of many English occupa-  
 250 tional terms (e.g., Garnham, Oakhill & Reynolds 2002; Kennison & Trofe 2003;  
 251 Duffy & Keir 2004; Gygax et al. 2008; Kreiner, Sturt & Garrod 2008). These bi-  
 252 ases, although in principle mutable, seem to hold consistently and for large swathes  
 253 of the population. This bias underpins the confusion caused by the “riddle” cited in  
 254 Reynolds, Garnham & Oakhill (2006) (originally from Sanford (1985: 311)):

255 *A man and his son were away for a trip. They were driving along*  
 256 *the highway when they had a terrible accident. The man was killed*  
 257 *outright but the son was alive, although badly injured. The son was*  
 258 *rushed to the hospital and was to have an emergency operation. On*  
 259 *entering the operating theatre, the surgeon looked at the boy, and*  
 260 *said, “I cant do this operation. This boy is my son.” How can this*  
 261 *be?*

262 The difficulty of interpreting the surgeon as being either the son’s mother or  
 263 any other parental figure besides the previously mentioned father is reflected in the  
 264 enduring nature of this riddle. In either case, *surgeon* is demonstrated to have a  
 265 strong male bias despite there being no definitional requirement for surgeons to  
 266 be men. While gender is not overtly morphologically or grammatically marked in  
 267 English, there is still some sort of conceptual bias that can be difficult to override.

268 In Russian, conceptual gender and grammatical gender sometimes clash. Asa-  
 269 rina (2009; 2011) observes that *doctor* (*vrach*) is in the first noun class (I), which  
 270 typically includes human male nouns, among other things. However, when refer-  
 271 ring to a doctor who is a woman, there are a few strategies that may be employed  
 272 in different registers.<sup>5</sup> (See also King (2015) for another detailed account of mixed  
 273 agreement in Russian.) This is a particularly clear case of a clash between grammat-  
 274 ical and conceptual gender because there are two loci that agreement could target  
 275 and the different structural positions each target a different locus.

276 The explanation Asarina gives for how Russian can have mixed case agreement  
 277 is that there is a structural representation of the grammatical feature in the syntax  
 278 (as opposed to in the semantic representation). This means that an unpronounced  
 279 functional projection encodes something about conceptual gender. For example, in  
 280 Russian, there is a functional projection in sentences like (4), i.e. <*wmn*>, and the

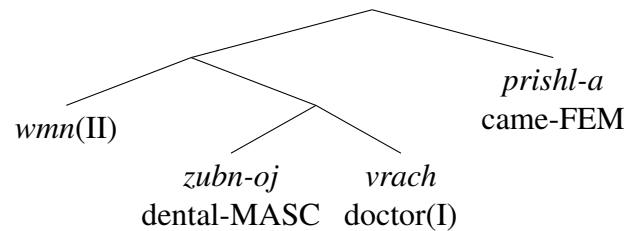
<sup>5</sup> While Asarina does not address how nonbinary conceptual gender could be encoded in Russian, this is an issue which is being explored by nonbinary users of Russian (Wilson 2018).

281 agreement is triggered by the closest class feature in the tree, i.e. noun class II. Thus  
 282 the adjective agrees with the grammatical gender of the noun (masculine/noun class  
 283 I, because ‘doctor’ is in the first/masculine noun class), but the verb agrees with the  
 284 conceptual gender of the noun phrase (feminine/noun class II, because the doctor is  
 285 a woman).

286 (4) Mixed agreement in Russian where *vrach* (*m*) refers to a woman and possi-  
 287 ble structural representation, adapted from Asarina (2009)

288 a. Zubnoj vrach prishla.  
 dental.MASC doctor(I) came.FEM  
 289 ‘The [female] dentist has come.’

290 b.



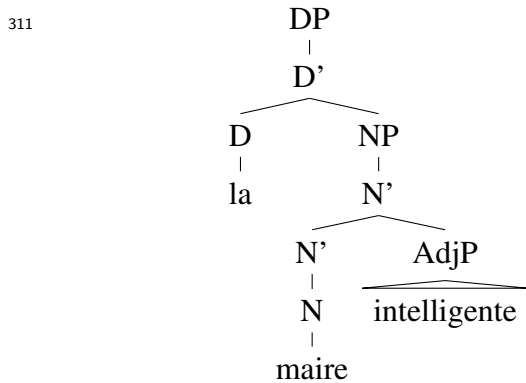
291 In this representation, it’s argued that ‘dental’ agrees with ‘doctor’ because  
 292 the masculine  $\phi$ -feature from *vrach* is the closest target of agreement in the tree,  
 293 whereas the verb agrees with the (unpronounced) functional head <*wmn*> as it is  
 294 the closer target of agreement. This requires the functional head be tied to the dis-  
 295 course context, thus is more flexible and potentially more defeasible than if such  
 296 a functional head were absent or unavailable in the language. In fact, this type of  
 297 functional head only seems to be available for human referents and not animals,  
 298 even when the animals are anthropomorphic (Comrie 2005). This suggests that  
 299 there is some super-level of categorization in Russian that distinguishes animals  
 300 and humans even in contexts where animals are filling human-like gender roles. I  
 301 will set aside the question of distinguishing animals and humans grammatically, but  
 302 I will also suggest that the categories could be cognitively structured in a manner  
 303 similar to gender.

304 On the other hand, this is not also the case in formal registers of European  
 305 French.<sup>6</sup> In (5), the form of the noun (masculine) does not change to match the  
 306 gender of the referent, although this is at least partly for orthographic reasons.

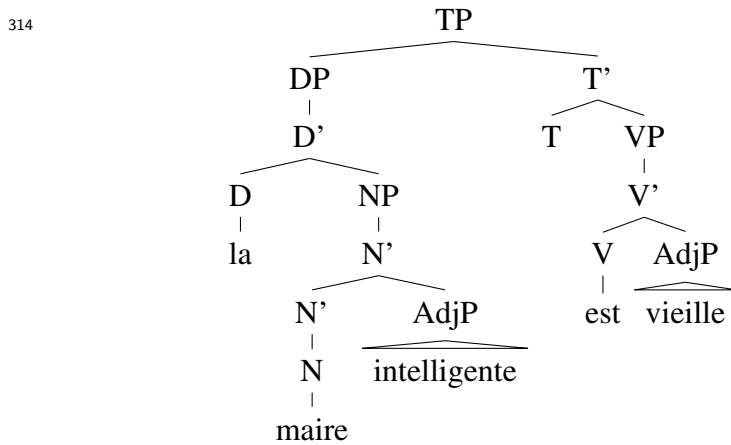
<sup>6</sup> Speakers of Canadian French report the best solution is to use the feminine word *mairesse*. This is purportedly unavailable in formal registers of European French, as it means *the wife of the mayor* rather than the mayor herself. This is also attested as an older definition in Québécois French (Office québécois de la langue française 2017).

307 (5) Mixed agreement in French where *mayor* (*m*) refers to a woman and possi-  
 308 ble structural representation

309 a. la maire intelligente  
 det.FEM mayor.MASC intelligent.FEM  
 310 ‘The intelligent mayor’



312 b. la maire intelligente est vieille  
 det.FEM mayor.MASC intelligent.FEM is old.FEM  
 313 ‘The intelligent (female) mayor is old.’



315 In formal European French the form of the noun does not change. All gender  
 316 agreement must match either the grammatical gender of the head noun or the con-  
 317 ceptual gender of the referent. Thus, any mixed agreement should only occur when  
 318 the conceptual gender of the referent mismatches the grammatical gender of the  
 319 head noun. In this case, the *<wmn>* features Asarina proposed would be located  
 320 above N but below any of its projections, which is *prima facie* counter-evidence for  
 321 a syntactic head that governs gender agreement in French.

322 Responses by Francophone colleagues to my informal queries indicate that  
 323 mixed agreement in formal French is marginal in some speakers, since there is often

324 an alternative form of the noun that would match the conceptual gender of the referent. Thus, further investigation into the nuances of mixed agreement in French is warranted. Further investigation into agreement with nonbinary conceptual gender will also become a viable line of research, as users of French (much like Russian) are in the early stages of developing gender-neutral or nonbinary grammatical solutions to conceptual gender (Shroy 2016).

330 Returning to sentence (1) for instance, *cowgirl* is definitionally female, but can be used for a male/masculine referent in certain circumstances. The feminine definition associated with *cowgirl* is thus defeasible, since gender agreement between *cowgirl* and *his* should be impossible if the property being checked is a morphosyntactically defined  $\phi$ -feature. This is not incompatible with English having formal gender features for some words, but I argue that it is strong evidence that what is primarily relevant for coreference resolution is not the morphosyntactic feature. This argument will be elaborated upon in Section 4.1, below.

338 Furthermore, there is evidence from developmental psychology and language acquisition that young children acquire labels for gender categories before they are able to consistently sort people into those categories (Fagot & Leinbach 1993; Waxman 2010; Zosuls et al. 2009; Fausto-Sterling 2012; Bussey & Bandura 1999; O'Brien et al. 2000; Welch-Ross & Schmidt 1996). At this point in development, (at least) two gender categories are present but not enough input has been received to develop a consistent rubric for evaluating the massive variation present in the population. For instance, children may be able to use the proper pronouns for common and canonically gendered referents (e.g., “mommies” and “daddies”) but fail to generalize identification criteria to novel referents that deviate in one or more ways (e.g., men with long hair, women wearing collared shirts) (Fagot & Leinbach 1993; Taylor & J. A. Hall 1982; Ansara & Hegarty 2013; Armann & Bülthoff 2012). This may indicate that gender categories are developed and refined by repeated exposure to exemplars and top-down societal reinforcement. The acquisition of gender category labels could conceivably support the acquisition of the conceptual categories. I am unaware of any cross-linguistic differences in age of acquisition of gender categories, but should such differences exist, this would support my claim that linguistic labels feed into non-linguistic categorization behaviors.

### 356 **2.3 Biosocial gender**

357 *Biosocial gender* is, fundamentally, an individual’s gender as it is experienced internally. In addressing this type of gender, a few terminological clarifications are necessary. I will assert a distinction between sex and gender, which are widely conflated terms in linguistics and psychology (Ansara & Hegarty 2013; Cheshire 2002). Herein, *sex* refers to biological properties such as karyotype (XX, XY,

etc.) and phenotype (e.g., internal and external anatomy, circulating hormonal milieu). Even in biological terms, sex is not a binary property since the physical traits contributing to an organism's sex can vary along multiple dimensions (see Fausto-Sterling (2019) for a recent review). As an example of an edge case, people with Complete Androgen Insensitivity Syndrome (CAIS) may have XY chromosomes but a predominantly female phenotype (e.g., Hughes et al. 2012). However, *sex* is still often used as a shorthand for distinguishing the bimodal nature of the male-female spectrum (J. L. Johnson & Repta 2012; Lorber 1996).

This definition of sex overlaps with biosocial gender. More precisely, biosocial gender is the multidimensional property of an individual as determined by their biology and cultural norms of identity expression. What distinguishes biosocial gender from other types of gender is that, as an external observer, one's accuracy of categorization is impossible to assess without input from the individual's introspection and medical history. That is, biosocial gender may not be something that can be doubtlessly determined without detailed anthropological, introspective and potentially invasive medical analyses. This is because social pressures and societal norms can contribute to an individual representing themselves in a way that is inconsistent with the way they categorize themselves (Fausto-Sterling 2012; Ansara & Hegarty 2013; Zimman 2017). One clear illustration is the case of transgender people who are "in the closet" or otherwise representing themselves as the binary gender category to which they were assigned at birth, despite not identifying as this gender. Here, an individual's biosocial gender might be in direct conflict with the gender with which other people would categorize them, that is, the conceptual gender other people attribute to them.

Our current census data suggests that the majority of people have a gender identity that fall into a bimodal distribution of biosocial genders (0.4% of respondents in a UK survey reported thinking of themselves as a way other than 'male' or 'female'; Glen & Hurrell 2012). But many individuals do not categorize themselves with a discrete binary label, and it would do the science and the individuals a disservice to gloss over the often subtle and diverse variations in gender identity present in the population at large, even within male and female categories (J. L. Johnson & Repta 2012). Despite the potential complications in identifying the precise biosocial gender of an individual, it is still an important factor for phenomena involving social identity and certain physiology relevant to linguistic processes such as auditory brainstem responses (Liu et al. 2017). One's biosocial gender can affect mental, emotional, and social well-being outcomes, indexical properties of speech, and perception of in-group versus out-group (Zimman 2017; K. Johnson et al. 2019; Rubin & Greene 1991). Therefore, it is important to explicitly define biosocial gender as distinct to ensure it is not confounded during investigation of phenomena associated with either grammatical or conceptual genders.

### 3 Further evidence for distinguishing gender types

#### 3.1 Personal names as antecedents

Personal names comprise a large portion of antecedents used in empirical investigations and syntactic judgments of English coreference, presumably due to their intuitive gender-specificity, although this has been identified as an issue in stimulus design (Gabriel et al. 2008; Kasof 1993; Merritt & Kok 1995; Van Fleet & Atwater 1997; Lieberman, Dumais & Baumann 2000). However, English lacks overt morphological marking on names to unambiguously distinguish a correct assessment of the gender identity of the referent, where a ‘correct assessment’ would result in a conceptual gender that is congruent with the referent’s gender identity. A clear example of this problem is illustrated in (6-a), in which the two given pronouns can corefer with the name equally well in the absence of disambiguating context (such as whether the Taylor in question is Taylor Swift, a woman, or Taylor Lautner, a man. As for Taylor Mason, a nonbinary character played by the nonbinary actor Asia Kate Dillon, (6-b) is the appropriate construction (Dillon 2017), although the processing cost and intuitive acceptability of this linguistic structure, in terms of linguistic judgments, is currently a subject of investigation and may vary in reported ‘acceptability’ (Ackerman 2018; Conrod 2018; Konnelly & Cowper 2017; Prasad, Morris & Feinstein 2018).

- (6) a. On the red carpet, Taylor<sub>i</sub>’s fans screamed to get [his<sub>i</sub>/her<sub>i</sub>] attention.  
 b. On the red carpet, Taylor<sub>i</sub>’s fans screamed to get [their<sub>i</sub>] attention.

One possibility is that the name *Taylor* is stored in the lexicon as discrete entries (e.g., Taylor<sub><masc></sub>, Taylor<sub><fem></sub>). The possibility of the lexicon containing Taylor<sub><nonbinary></sub> is a logical possibility but cannot be discussed in much more detail at this point without introducing speculation because of the current dearth of empirical studies on nonbinary gender perception and its influence on lexical categories. If we consider the two binary grammatical genders, a comprehender may retrieve one of the two entries initially, but have to revise the selection if conflicting information is received at a later time during comprehension. The presence of different lexical entries for each string-identical name, each with a distinct valuation of a gender  $\phi$ -feature, makes testable predictions regarding the learning and application of new lexical entries. One can quickly learn a new name or a new use of a common name, but if extensive previous experience with a common name (e.g., Michael<sub><masc></sub>) influences the processing of a newly encountered and rare version of the name (Michael<sub><fem></sub>), this might be observable in behavioral or psychophysical measures. If this is the case, it would need to be determined how names most often used by nonbinary people are stored in the lexicon, and if these entries are

439 associated with a specifically nonbinary feature or another configuration of gram-  
440 matical gender. If names are stored generically with some gender label determined  
441 by stereotypicality or statistical probability, then by familiarizing a naïve partici-  
442 pant to an uncommon or novel pairing between a name and gender (e.g., a woman  
443 named Michael or a boy named Sue), there should still be a detectable processing  
444 cost to forming a coreference dependency between the pronoun and name. How-  
445 ever, if names instead receive gendered properties from domain-general or world  
446 knowledge, then retrieval of the uncommon entry should be facilitated more by the  
447 context and less processing cost should be observed (Pyykkönen, Hyönä & van  
448 Gompel 2010). See Cai et al. (2017) for examples of how long- and short-term  
449 learning can be tested.

450 Another possibility is that “unisex” or names which are not strongly associated  
451 with a particular gender category are morpho-syntactically underspecified for gen-  
452 der (e.g., Taylor<sub><0></sub>), and whatever gender assumptions are made about the referent  
453 are done so without reference to the lexicon or morphosyntactic features. However,  
454 it is not immediately clear what the implications of this configuration would be or  
455 how this could be tested. At the very least, it would be necessary to conduct ex-  
456 tensive evaluation of each individual participant’s experience with the target names  
457 and gender nonconformity and examine effects from the perspective individual dif-  
458 ferences (Lieberson, Dumais & Baumann 2000; Van Fleet & Atwater 1997; Barry  
459 & Harper 1982; 1993; 2014).

### 460 **3.2 English as a leader of change**

461 More than just a language of convenience, English has certain properties that allow  
462 dissociation of the three proposed types of gender. English marks gender (broadly  
463 construed) on its third person pronouns (*she*, *he*), but it does not have consistently  
464 overt or productive morphological agreement for gender. Numerous studies demon-  
465 strate strong gender biases of certain noun phrases (e.g., *surgeon*, *pilot*, *nurse*,  
466 *babysitter*), but these are defeasible which indicates the biases are tied to concep-  
467 tual gender rather than grammatical gender (Kennison & Trofe 2003; Duffy & Keir  
468 2004; Pyykkönen, Hyönä & van Gompel 2010; Garnham, Oakhill & Reynolds  
469 2002; Kreiner, Sturt & Garrod 2008). Furthermore, English has some remnants of  
470 gendered morphology (*actor/actress*, *aviator/aviatrix*) and definitionally gendered  
471 nouns (*mother*, *father*, *cowgirl*, *bellboy*). It is conceivable that the morphologically  
472 gender-marked words *do* have grammatical gender. At least those marked as *<fem>*  
473 are the most likely to have retained grammatical gender in English, as those are  
474 distinctly non-default and definitional. As for the definitionally gendered words, I  
475 have already demonstrated that it is possible to find contexts where the gender is

476 defeasible. This suggests that these words are not grammatically gendered, or at  
477 least the relevant type of gender is conceptual gender and not grammatical gender.

478 Finally, in cultural terms, English has been at the international forefront of in-  
479 formal, community-based development of nonbinary language and so-called “neo-  
480 pronouns” (e.g., Spivak pronouns introduced by Spivak (1990: xv), gender vari-  
481 ant neologisms described in Centauri (2013); Hord (2016); Bradley et al. (2019),  
482 a.o.). The combination of linguistic innovation, on-going sociological research, and  
483 prominence of media exposure makes the English language uniquely situated (in the  
484 present moment) to development and linguistic change regarding gender categories  
485 inclusive of nonbinary gender(s) and gender neutrality (Page 2013; Brutt-Griffler &  
486 Kim 2018).

### 487 **3.3 Other gender paradigms**

488 Many cultures around the world have established and traditional nonbinary, queer,  
489 and third-gender categories. Navajo people called *nádleehí* are traditionally charac-  
490 terized as participating in gendered behaviors of the “opposite sex” (Epple 1998).  
491 However, the Western concepts of being ‘transgender’, ‘queer’, or ‘homosexual’  
492 do not quite capture the Navajo cultural concept. To this end, the terms ‘alternate  
493 gender’ and ‘two spirit’ have been used to describe *nádleehí*. While these cultural  
494 concepts seem to provide potential for investigating concepts of gender categories  
495 and language, the Navajo language does not mark grammatical gender on human  
496 pronouns. Furthermore, the strategy for speaking about *nádleehí* in English is to  
497 use standard binary pronouns in a similar manner to how binary tran smen and  
498 trans women use English pronouns, and “not neuter pronouns or pronouns specific  
499 to *nádleehí*” (Epple 1998: 279).

500 This seems to be very similar to how Māori culture and language encodes gen-  
501 der outside of the binary (Murray 2003). The terms *whakawāhine* and *whakatāne*  
502 are “terms which translate roughly to ‘becoming’ or ‘making’ woman or man, in-  
503 dicating a transcendent or permeable gendered identification” (Murray 2003: 240).  
504 However, as in Navajo, Māori grammatical gender does not distinguish conceptual  
505 gender on pronouns.

506 The *hijras* of India are similarly difficult to quantify in Western terms, consider-  
507 ing themselves to be “‘deficiently’ masculine and ‘incompletely’ feminine” (K. Hall  
508 & O’Donovan 1996: 229). Linguistically, they use the grammatical (and concep-  
509 tual) gender system of Hindi to express their relationship to their gender identities  
510 and their affiliation to the community with a mix of grammatical gender and fluid  
511 interaction with binary gender roles.

512 In Buginese, a language spoken on Sulawesi, Indonesia, by approximately five  
513 million people, there are distinct lexical items for each of the five recognized gen-



514 ders, but gender is not otherwise encoded grammatically (Graham 2004). The  
 515 five genders can roughly be translated into Western concepts as feminine woman  
 516 (*makkunrai*), masculine man (*oroani*), feminine man (*calabai'*), masculine woman  
 517 (*calalai'*), and nonbinary (*bissu*).<sup>7</sup> Importantly, people who identify as *calalai'*  
 518 and *calabai'* do not wish to conform to feminine or masculine standards for the  
 519 *makkunrai* or *oroani*, respectively, but rather have their own standards for gender  
 520 expression. Furthermore, people who identify as *bissu* are considered to have both  
 521 masculine and feminine elements in their souls and thus serve spiritual roles in the  
 522 community (Graham 2004). Much like in Navajo and Māori languages, Buginese  
 523 does not distinguish pronouns for these five conceptual gender categories.

524 Generally, pronouns are more likely to mark animacy as a  $\phi$ -feature in these  
 525 example languages. When a language does mark grammatical gender, nonbinary  
 526 gender categories can be indicated through shifting use of standard binary gender  
 527 agreement (e.g., K. Hall & O'Donovan 1996). Investigation of gender perception,  
 528 category acquisition, and development in other cultural paradigms will bring crucial  
 529 supplementary information to our understanding of how different types of gender  
 530 are mentally represented and how they influence each other during linguistic and  
 531 non-linguistic cognitive behaviors.

## 532 4 Gender in coreference resolution

533 Coreference resolution is said to compare the grammatical features of the pronomi-  
 534 nal element and its candidate antecedent in cases where the parser checks for coref-  
 535 erence (Garnham, Oakhill & Reynolds 2002; Garnham & Oakhill 1990). Thus,  
 536 there must be criteria for what counts as 'matching' or 'mismatching' in order for  
 537 a coreference dependency to be resolved or rejected. In a case such as (1), restated  
 538 below in (7), where coreference is resolvable but is not *a priori* congruent, one  
 539 might expect the apparent mismatch in gender between *cowgirl* and *his* to create a  
 540 processing slowdown in contexts that do not include clues or information about the  
 541 referents ahead of time.

- 542 (7) a. # At the farmhouse, the cowgirl<sub>i</sub> left his<sub>i</sub> lasso in the kitchen.  
 543 b. At the Halloween party, the cowgirl<sub>i</sub> left his<sub>i</sub> lasso in the kitchen.

544 In (7-a), without knowledge of the context, the conceptual gender of *the cowgirl*  
 545 and *his* mismatch until a suitable alternative context is imagined. In (7-b), the con-  
 546 text of a Halloween party (in which gender roles, expression, and possibly even

<sup>7</sup> I have taken the liberty of adapting these rough translations away from including terminology such as "female-bodied man" or "masculine female" as these terms can carry negative connotations in English and are more likely to describe gender expressions rather than gender identities.

547 conceptual categories are expected to be challenged) easily provides the alternative  
 548 context. The difference, therefore, between (7-a) and (7-b) in terms of acceptability  
 549 comes from the readers' ability to find a suitable situation in which the concep-  
 550 tual genders match. However, the underlying mechanism for such a prediction is  
 551 not transparently derivable from syntax-first models of real-time coreference reso-  
 552 lution without incorporation of discourse-level knowledge. In what follows, I will  
 553 set out and incrementally refine a criterion used to evaluate gender congruency in  
 554 coreference resolution. A strict criterion for matching might look something like  
 555 this, loosely adapted from definitions of agreement by, e.g., Lasnik & Uriagereka  
 556 (1988); Carnie (2007); Payne & Huddleston (2002):

557 **Strict matching criterion:** Matching gender requires the formal grammatical fea-  
 558 ture ( $\phi$ -feature) of the pronoun to be identical to the candidate antecedent.  
 559 If the features are not identical, the coreference dependency is rejected.

560 This strict version of a matching criterion can be rejected immediately because it  
 561 is insufficient to account for some common, well-described types of coreference.  
 562 Looking briefly at (7-b), *cowgirl* must either have no  $\phi$ -feature for gender or the  
 563  $\phi$ -feature is <fem>, both of which necessarily mismatch with *him*<sub><masc></sub>. Another  
 564 example of how the strict matching criterion fails is when the antecedent is not ex-  
 565 plicitly or overtly present in the syntax, e.g., the 'statue rule' (Jackendoff 1992) and  
 566 "impostors" which are superficially 3<sup>rd</sup> person but conceptually 2<sup>nd</sup> or 1<sup>st</sup> (Collins  
 567 & Postal 2012), thus the  $\phi$ -features do not directly match:

- 568 (8) a. Regarding a customer (Jackendoff 1992):  
 569 [The ham sandwich in the corner]<sub>i</sub> needs his<sub>i</sub> bill.  
 570 b. Spoken to a king (Collins & Postal 2012):  
 571 [Your majesty]<sub>i</sub> must protect yourself<sub>i</sub>/himself<sub>i</sub>/\*herself<sub>i</sub>/\*themselves<sub>i</sub>.

572 Even still, in these cases of apparent feature mismatch, some formal level of rep-  
 573 resentation could contain formal features that can be checked during coreference  
 574 resolution, i.e. what Collins & Postal (2012) term a 'source'. These formal features  
 575 could be located in either (or both) the semantic and syntactic representations, but  
 576 the strict definition can only account for the apparent gender mismatch in (7) if we  
 577 posit that a masculine  $\phi$ -feature is attributed to *cowgirl* only after it is identified  
 578 as the candidate antecedent of *his*. In order to account for more data, a slightly  
 579 less strict criterion might be formulated as such, adapted for coreference processing  
 580 from Collins & Postal (2012: 182):<sup>8</sup>

<sup>8</sup> I have taken liberties in adapting this condition in order to present it in a relatively theory-agnostic manner.

581 **Less strict matching criterion:** The act of resolving a coreference dependency re-  
 582 quires an identity relation between the  $\phi$ -features of a pronoun and either  
 583 (a)  $\phi$ -features of the antecedent, or (b)  $\phi$ -features of the antecedent as de-  
 584 termined by the semantic properties of the notional ‘source’. If the features  
 585 are not identical, the coreference is rejected.

586 One reviewer noted that this less strict criterion might account for sentences like in  
 587 (9-a), where the source of *person*<sub><0></sub> could be *woman*<sub><fem></sub>. If so, it is fairly accept-  
 588 able due to the reduction in ambiguity from the antecedent to its source (Foraker &  
 589 McElree 2007). Compare this to (9-b), in which *woman*<sub><fem></sub> could have a source  
 590 of *person*<sub><0></sub>, creating a noticeable reduction in acceptability, presumably because  
 591 *woman* is a proper subset of *person* and thus increases ambiguity unnecessarily.<sup>9</sup>

- 592 (9) a. One person<sub>i</sub> said she<sub>i</sub> lost her<sub>i</sub> sunglasses.  
 593 b. ? One woman<sub>i</sub> said they<sub>i</sub> lost their<sub>i</sub> sunglasses.

594 Yet, this next formulation still might not quite cover the case of (7), where the con-  
 595 ceptual gender of the antecedent *cowgirl* is female but the coreference between  
 596 the masculine pronoun and the (female) antecedent is licit. That is, unless the  
 597 sources is “man<sub><masc></sub> [dressed as a cowgirl<sub><fem></sub>]”, the source could easily also  
 598 be “rancher<sub><0></sub>” or “party-goer<sub><0></sub>”, which cannot match as they do not have the  
 599 <masc> feature, which would form an identity relationship with *his*<sub><masc></sub>. Neither  
 600 does this less strict criterion fully explain (8), in which the antecedents might or  
 601 might not be interchangeable with sources that have matching gender  $\phi$ -features  
 602 (a: ✓ “The man<sub><masc></sub>”, ✗ “The customer<sub><0></sub>”; b: ✓ “The king<sub><masc></sub>”, ✗ “The  
 603 monarch<sub><0></sub>”). This might be accounted for in two ways. First, there might be a

<sup>9</sup> Another interesting point this reviewer notes is that coreference between pronouns seems to require much stricter feature matching than between a pronoun and a referring expression, at least in English, as illustrated in (i).

- (i) a. One person<sub>i</sub> said she<sub>i</sub> lost her<sub>i</sub> sunglasses.  
 b. One person<sub>i</sub> said they<sub>i</sub> lost their<sub>i</sub> sunglasses.  
 c. \*One person<sub>i</sub> said they<sub>i</sub> lost her<sub>i</sub> sunglasses.  
 d. \*One person<sub>i</sub> said she<sub>i</sub> lost their<sub>i</sub> sunglasses.

Since (i-a) and (i-b) are considered acceptable, we can infer that both *she* and *they* can corefer with *one person*. However, mixing *she* and *they* within one sentence and thus one set of coreferring elements causes a noticeable reduction in acceptability. This cannot be due to a mismatch in gender between each of the pronouns and *one person*, as (i-a) and (i-b) demonstrate these are individually acceptable. Therefore, it seems likely that it is coreference between the pronouns that is unacceptable. In this case, I propose that English (or at least the English that is informing these judgments) employs a **Strict matching strategy** as defined in (11) to evaluate coreference between pronouns, but not between a pronoun and a referring expression.

604 way to override the feature checking criteria through modeling the parser as hav-  
 605 ing earlier access to pragmatics and world knowledge (consistent with Sigurðsson  
 606 (2018)), or second, the feature checking process has a broader criterion of what can  
 607 count as matching. The latter could be formulated as such:

608 **Broad matching criterion:** Matching gender requires at least one level of the men-  
 609 tal representation of gender to be identical to the candidate antecedent in order  
 610 to match. A conceptual property might include a probabilistic representa-  
 611 tion of the semantic set of possible referents, but also would be susceptible  
 612 to environmental context, e.g., pragmatics, world knowledge, or discourse  
 613 context (Cai et al. 2017; Arnold et al. 2018).

614 This final formulation can account for (7) as it directly references the conceptual  
 615 gender of the referents. It can also account for some of the cross-linguistic variation  
 616 observed in the literature (e.g., Comrie 2005). While one of the stricter formulations  
 617 would be sufficient to account for data in some languages, the broad criterion allows  
 618 for language-specific variation in strategy for checking gender matching, which  
 619 can address language-internal variation and hypothetical change over time. This  
 620 makes it both powerful and testable, as it still requires a parameter setting or a  
 621 clearly defined discourse context and theory of gender categories. Languages with  
 622 very strong or strict matching criteria would then find it difficult to have pragmatic  
 623 context override the formal gender features of the pronoun (e.g., anaphor, cataphor)  
 624 which triggered the coreference dependency.

625 However, all of this assumes that languages that have formal gender features  
 626 on pronominal elements also have formal features that can be checked on the can-  
 627 didate antecedents. What then, would happen if the candidate antecedent didn't  
 628 have a  $\phi$ -feature in any instantiation? Would this cause a processing slowdown  
 629 because the initial checking operation would automatically fail? If so, we should  
 630 expect to see processing slowdowns for coreference dependencies which connect  
 631 gender-unbiased or undefined antecedents and gender-specific pronouns as com-  
 632 pared to coreference dependencies which connect gender-specific antecedents to  
 633 gender-specific pronouns (cf. Foertsch & Gernsbacher 1997).

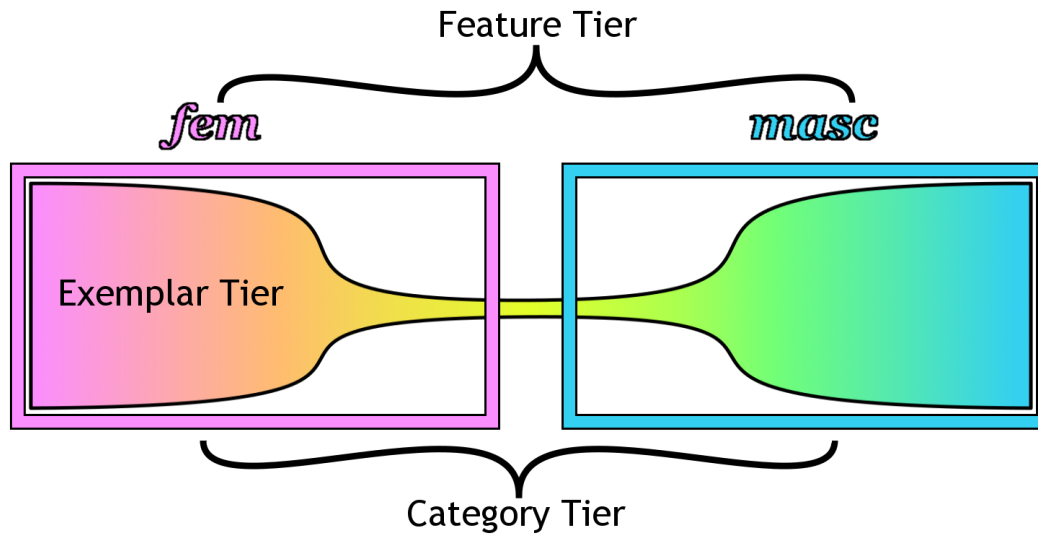
634 With this 'broad' matching criterion, I have shifted the formal problem of ty-  
 635 pographical variation from the process of checking for gender congruency to the type  
 636 of gender that is checked. This is addressed by the three-tier model illustrated in  
 637 Figure 1, which provides a formal structure that languages and individuals can use  
 638 to determine gender congruency all using the same standardized criterion.

#### 639 **4.1 Checking for congruency**

640 If formal morphosyntactic gender features are present in a language like English,  
641 but cannot be used to model how the parser checks for congruency in coreference  
642 dependency formation, what purpose do they serve? I will not argue for or against  
643 English having formal grammatical features for gender, but rather that such fea-  
644 tures are irrelevant during coreference dependency formation. Instead, English and  
645 languages with similar gender systems rely on conceptual gender for evaluating  
646 gender congruency in real time. In order to describe how such a system operates,  
647 a three-tiered scheme of linguistically and cognitively encoding gender is posited  
648 below.

649 The three tiers comprise an Exemplar Tier, a Category Tier, and a Feature Tier  
650 (Figure 1). These tiers are not meant to represent actual processing mechanisms or  
651 structures in the mind. Rather, they are abstract categories of processes or represen-  
652 tations that can be used to map behaviors and empirical observations to theoretical  
653 properties of grammars and other mental mechanisms and modules. Thus, each tier  
654 is designed to be as theory-agnostic as possible to provide the most utility across  
655 the various popular frameworks.

656 The first tier, the Exemplar Tier, is represented by a strongly bimodal contin-  
657 uum indicative of how biosocial gender and conceptual gender can vary within a  
658 population. Although only color and height vary in this diagram, one may imagine  
659 that this tier has many more dimensions that could align with variation in gender  
660 role, gender expression, and overt biosocial properties. The second tier, the Cate-  
661 gory Tier, comprises two discrete, non-overlapping spaces overlaid on the Exemplar  
662 Tier. These categorically distinct spaces represent the binary genders as might be  
663 conceptualized by someone from a society that reinforces a strictly binary gender  
664 schema. However, even so, one might not be able to categorize all individuals into  
665 one of these spaces, so the gap between the categories allows for ambiguous, non-  
666 conforming, and ‘other’ instances to exist outside the binary. If the Exemplar Tier  
667 is, indeed, multidimensional beyond what can be represented on paper, I request  
668 that the reader accept that these two categories are not as simple as the rectangles  
669 depicted, and their apparent shapes simply due to the limitations of the medium.  
670 For instance, if one dimension encodes hair length as a gendered property of ap-  
671 pearance, then a man who otherwise fits all other stereotypically masculine traits  
672 but has long hair would align predominantly but not completely with the Category  
673 Tier’s binary (masculine) category. Finally, the third tier is the Feature Tier which,  
674 unlike the previous two, comprises labels associated with spaces rather than spaces  
675 themselves. In this illustration, the labels are the grammatical features <fem> and  
676 <masc>, corresponding to a language that has two noun classes. A language with  
677 more noun classes (or fewer) would have a different configuration for the labels.



**Figure 1:** A schema depicting the three proposed tiers, overlaid.

#### 678 4.1.1 The Exemplar Tier

679 The Exemplar Tier consists of observations from individual's exposure to the vari-  
 680 ety of observable gender expression. This may include tokens of phenotypic vari-  
 681 ation, non-conformity of gender expression, and variation of cultural norms. Cru-  
 682 cially, most individuals will be primarily exposed to other individuals who have  
 683 unambiguous binary gender expression and thus will have distinctly bimodal input  
 684 represented in this tier (Fagot & Leinbach 1993; Glen & Hurrell 2012). Individu-  
 685 als who are members of or adjacent to non-conforming or nonbinary communities  
 686 may have a different distribution of input, especially if exposure occurs during early  
 687 acquisition of gender categories.

688 It cannot be that this tier includes the perceiver's categorization of the gender  
 689 of the person which they interact with, because that requires a secondary (categor-  
 690 ical) behaviour that is crucially not a component of this tier. Instead, the tokens in  
 691 this tier might be conceptualized as matrices of perceived properties that are used  
 692 downstream to categorize the gender of the individual. For example, hair length and  
 693 style, face shape, pitch range of voice, clothing style, sociolinguistically marked  
 694 properties of speech, etc, could be dimensions of each token. These properties can  
 695 be used to categorize an individual's gender (Fagot & Leinbach 1993; Ansara &  
 696 Hegarty 2013; Armann & Bülthoff 2012; Bussey & Bandura 1999; Fausto-Sterling  
 697 2012; Zimman 2017), but are not inherently properties of biosocial genders. Fur-  
 698 thermore, few of these properties are purely linguistic, so the parser will not interact  
 699 with the information stored in this tier. It therefore represents a way of organizing

700 general perceptual input about individuals who a person encounters and interacts  
701 with throughout the lifespan.

#### 702 4.1.2 The Category Tier

703 The Category Tier consists of categories that are established through cognitive pro-  
704 cesses relying on bottom-up input from the Exemplar Tier and top-down informa-  
705 tion from semantics (e.g., gender schema; Bem 1981; Fagot & Leinbach 1993;  
706 Bussey & Bandura 1999; Zosuls et al. 2009; O'Brien et al. 2000). The categories  
707 of gender encoded in this tier may shift if the distribution of input to the Exemplar  
708 Tier changes. As an individual accumulates more exemplars over the lifespan, each  
709 new token will comprise a smaller proportion of the total input, thus will have less  
710 influence on the shape of the Category Tier.<sup>10</sup> The way someone sorts individuals  
711 into gender categories should take into account a subset of the dimensions cata-  
712 logued in the Exemplar Tier. Whichever way an individual categorizes people into  
713 genders and whatever information is used to make those determinations, the Cat-  
714 egory Tier holds coarse-grained information about the parameters of each gender  
715 category. The structure and robustness of this tier relies on the assumption that gen-  
716 der is most frequently perceived categorically (Fagot & Leinbach 1993; Armann &  
717 Bülthoff 2012).

718 For example, this could manifest as recognition of variance in feminine gen-  
719 der expression and what it means to “self-identify” as having a particular gender  
720 (e.g., Zimman 2017). However, humans are still readily able to categorize people  
721 based on indices canonically associated with binary gender expressions into cate-  
722 gories (leaving aside the accuracy or relevance of these categories) (Waxman 2010;  
723 Bussey & Bandura 1999). This suggests that the categorical perception of gen-  
724 der is complex and culturally specific. The details of this perceptual categorization  
725 process are beyond the scope of this paper. What remains relevant is that the bound-  
726 aries of these categories may slightly differ between individuals within a culture or  
727 society. Thus the boundaries may differ more between individuals belonging to  
728 different cultures or societies.

729 These categories are not strictly linguistic, but contribute to assessments of  
730 whether linguistic meanings are consistent or felicitous when concerning the gender  
731 of referents. For instance, when discussing a known person (who is, say, catego-  
732 rized by both interlocutors as *female*), it may be relevant for the comprehension

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<sup>10</sup> A reviewer points out that it not be the total cumulative number of tokens that shapes the Category Tier, but rather more marked, recent or salient tokens might be more heavily weighted in terms of their influence. This seems quite plausible and could potentially be investigated through experimental means, but I will leave this to future works.

733 mechanism to refer to the category when assessing the plausibility of statements  
 734 (Prasad, Morris & Feinstein 2018; Kreiner, Sturt & Garrod 2008).

735 (10) Did that student<sub>i</sub> email you her<sub>i</sub> follow-up questions yet?

736 Imagine that the person who uttered (10) was a guest lecturer and doesn't know  
 737 the referenced student personally. The guest lecturer told the student to email the  
 738 regular lecturer with any questions and those questions would be forwarded on.  
 739 Then, when the guest lecturer approaches the regular lecturer to ask about the status  
 740 of the awaited email, the gender of the student is assumed based on visual and  
 741 perhaps auditory cues. In this type of situation, the gender of the student may also be  
 742 important for communicative efficiency if it potentially disambiguates the referent  
 743 (Newman 1992; Foraker & McElree 2007). However, in English, specifying the  
 744 student's perceived (i.e., conceptual) gender is always optional, and the choice to  
 745 include or omit it can be influenced by various social and pragmatic reasons.

746 The interaction of the Exemplar Tier and the Category Tier may generate and  
 747 assign probabilities of genderedness to gender-biased (or equi-biased) lexical items,  
 748 including names. In being exposed to instances of *surgeons* or *Michaels*, the tokens  
 749 that have *surgeon* or the name *Michael* as a property fall predominantly into the  
 750 male category. If this is the mechanism for generating gender stereotyping, then the  
 751 stereotype would be accessed in one of several ways (that all have the same conse-  
 752 quence): An aggregate of all *surgeon/Michael* tokens is assessed as a probability;  
 753 an individual token of *surgeon* or *Michael* is evaluated for gender category (thus  
 754 drawn at random from all tokens of *surgeon/Michael*); or the evaluation of gender  
 755 is assessed at an earlier time and is a property that is rarely updated in the lexicon,  
 756 independent of the content and structure of the Exemplar and Category tiers. Cru-  
 757 cially, whatever the process for determining gender bias associated with a lexical  
 758 item, its meaning, or gender plausibility, this information is stored separately from  
 759 the grammatical information stored in the Feature Tier.

760 Speculatively, if an individual were to have a substantial proportion of their life-  
 761 time experiences involving nonbinary people, we could assume that the distribution  
 762 of their personal Exemplar Tier would not be so bimodal as depicted in Figure 1.  
 763 This might make the shapes of the Category Tier more complex, or possibly cre-  
 764 ate discontinuous categories, categories with fuzzy boundaries and other categories  
 765 besides those designating the masculine and feminine modes of the Exemplar Tier.

### 766 4.1.3 The Feature Tier

767 The Feature Tier consists of discrete  $\phi$ -features or labels which may include *<fem-*  
 768 *inine>* and *<masculine>*, among others. These labels can be mapped one-to-one  
 769 onto the conceptual categories in the Category Tier, but need not be. During coref-



770 erence resolution, whether or not the Feature Tier is used to determine gender con-  
771 gruency is graded from languages that rigidly rely on the Feature Tier for corefer-  
772 ence evaluation to languages without grammatical gender that do not map separate  
773 (grammatical) labels onto human gender categories (see [Corbett \(2015\)](#) for exam-  
774 ples).

775 This tier differs from the Category tier in that the  $\phi$ -features are strictly linguis-  
776 tic and are formally encoded in the grammar of a language. That is, where the Cat-  
777 egory Tier concerns categorization of people and animate gendered referents based  
778 on social/cultural norms, the Feature Tier does not categorize anything: it consists  
779 of linguistic labels that are used in purely grammatical operations like agreement.  
780 These labels do not need to correspond to human gender (e.g. Bantu noun class sys-  
781 tems, etc.), and can apply to inanimate lexical items. Furthermore, they do not apply  
782 to the *referents* of the relevant lexical items, but to the lexical items (antecedents)  
783 themselves. For instance, languages that have strict gender agreement will ignore  
784 the conceptual gender of the referents (Category Tier) in using grammatical gender  
785 to satisfy agreement relations (Feature Tier). This is elaborated on in Section 4.2.

786 These tiers are three levels at which the parser could assess gender congruency  
787 during coreference resolution. Once a pronoun is linked to a candidate antecedent,  
788 the parser may access one of the tiers to check gender congruency ([Sturt 2003](#)).  
789 If the Feature Tier does not supply relevant formal features for both lexical items  
790 (e.g., if it supplies gender  $\phi$ -features for pronouns but not unisex names or gender-  
791 stereotyped nouns in English, cf. [Bjorkman \(2017\)](#)), it cannot compare like to like  
792 and an identity relationship will not be established. In this case, using the Category  
793 Tier as a holistic congruency assessment would be preferable because, presumably,  
794 any referring expression will be located in a category that can provide a property  
795 to be assessed against. Speculatively, if the Exemplar Tier were to have a third  
796 mode (e.g., a nonbinary human gender), this might affect the structure of the other  
797 tiers and provide organic support for the genesis of novel personal pronouns (e.g.,  
798 [Centauri 2013](#)). That is, the space depicted between the two categories is present  
799 to suggest that ambiguous or distinctly nonbinary tokens in the Exemplar Tier can  
800 be accommodated by this model. The presence or increased prominence of these  
801 sorts of tokens may lead the structure of the categories to adapt and develop a new  
802 categorical space, which may then provide a distinct space for a novel (grammatical  
803 gender) label to designate.

## 804 **4.2 Typological evidence**

805 Together, these tiers describe three levels of encoding of gender, broadly construed,  
806 that a language (or an individual) may draw upon in order to determine the gender  
807 congruency of a pronoun and candidate antecedent during real-time coreference res-

808 olution. In (11), I describe three possible configurations of languages based on the  
 809 broad criterion and the three tiers of mental representation of gender. These three  
 810 configurations are points within a hierarchy of how rigidly a language (or individ-  
 811 ual) adheres to matching the gender encoded on the Feature Tier to assess gender  
 812 congruency. While I list languages as examples of these points in the hierarchy, I  
 813 also suggest that individuals may vary within what an individual language permits.  
 814 That is, a speaker of French who finds any mixed agreement to be unacceptable  
 815 would be applying the description of a Strict feature rather than where I have cate-  
 816 gorized French on the whole (Mixed feature). Similarly, English speakers who find  
 817 singular *they* difficult to learn or use may be employing more of the ‘mixed’ match-  
 818 ing strategy than ‘absent’. Furthermore, English speakers who do use the ‘absent’  
 819 strategy may also vary in the shape and adaptability of their category tiers, thus  
 820 introducing intra-language variation in acceptability.

- 821 (11) **Strict matching strategy:** Languages with no exception to grammatical  
 822 gender agreement which access only the Feature Tier during corefer-  
 823 ence resolution. (e.g., Tsez, possibly German)  
 824 **Mixed matching strategy:** Languages with grammatical gender (to any  
 825 extent) will start with the Feature Tier, but draw on the Category Tier  
 826 in certain specific contexts, such as when the Feature Tier is incongru-  
 827 ent with referent’s conceptual gender. (e.g., Russian, possibly French)  
 828 **Absent matching strategy:** Languages without grammatical gender do  
 829 not have labels in the Feature Tier to be checked, so they must make  
 830 use of the Category Tier where gender plausibility and discourse con-  
 831 text is concerned. (e.g., Turkish, possibly English)

832 Tsez exemplifies a strict matching strategy, with (2) demonstrating a rigid grammat-  
 833 ical gender system for anthropomorphic animals and other noun phrases (Comrie  
 834 2005; Corbett 2015). Thus, no matter what the conceptual genders of the charac-  
 835 ters in the story are, the agreement is consistent with the morphosyntactic features  
 836 of the lexical items. This may also be the case for some speakers of French for  
 837 whom *maire* is necessarily <masc> and *mairresse* (mayor<fem>) is a viable alterna-  
 838 tive. While I am being careful to avoid a neo-Whorfian claim that language shapes  
 839 or limits our thought, I think it is reasonable to posit that the categories present  
 840 in one language and not in another could draw attention to different non-linguistic  
 841 properties of the members of those categories, thus creating subtle distinctions in  
 842 the boundaries and shape of the categories. In this way, we might explain how  
 843 grammatical gender can limit conceptual gender in practical translation without  
 844 necessarily claiming that German speakers think toads are necessarily feminine  
 845 (Konishi 1993; Irmen & Kurovskaja 2010). Languages with intermediate strategies

846 like French and Russian would then show some mixed properties wherein formal  
 847 features are checked during coreference resolution, but may be overridden given  
 848 contextually appropriate information (Asarina 2011; 2009). Moreover, languages  
 849 without grammatical gender would then rely entirely on the conceptual categoriza-  
 850 tion of the antecedent to evaluate coreference feasibility.

851 (12) Agreement patterns in Russian where *vrach* (*m*) refers to a woman (%=marked  
 852 in certain registers) (Asarina 2009)

- 853 a. Umnaja vrach prishla  
 smart.FEM doctor(I) came.FEM
- 854 b. %Umnyj vrach prishel  
 smart.MASC doctor(I) came.MASC
- 855 c. %Umnyj vrach prishla  
 smart.MASC doctor(I) came.FEM
- 856 d. \*Umnaja vrach prishel  
 smart.FEM doctor(I) came.MASC
- 857 ‘The smart [female] doctor has come.’

858 Where does English fit into this hierarchy? As it has been claimed that English  
 859 no longer has grammatical gender (except, possibly on pronouns) (Baron 1971),  
 860 it might be an absent feature language. However, Bjorkman (2017) suggests that  
 861 English does have limited use of grammatical gender agreement, particularly when  
 862 referring to named individuals. If so, we might expect such cases to elicit psy-  
 863 cholinguistic/cognitive behaviors that are similar to those observed in languages  
 864 that make use of the Feature Tier. However, testing this is made difficult by the lim-  
 865 ited circumstances in which English could have grammatical gender. The potential  
 866 environments for detecting grammatical gender in English overlap with environ-  
 867 ments where conceptual gender (as determined by the Category Tier) could be an  
 868 alternative source for checking during coreference resolution. That is, words that  
 869 could have formal gender features (as Bjorkman suggests, personal names) should  
 870 also typically receive a gender property from the cognitive gender of the referent,  
 871 encoded in the Category Tier.

## 872 5 Future directions and conclusions

873 There are myriad ways to test the hypotheses described in this paper. It is my hope  
 874 that readers will be inspired to use this as a starting point for investigating this rela-  
 875 tively new line of research into the links between cognition of gender (as a gradient,  
 876 nonbinary property) and how gender is encoded linguistically. If definitionally gen-  
 877 dered nouns or personal names have formal grammatical gender in English, then

878 there should be a failure in coreference resolution for the link between *cowgirl*<sub><fem></sub>  
 879 and *his*<sub><masc></sub> in (1)/(7), or *Johnathan*<sub><masc></sub> and *their*<sub><0></sub> in (3). At this stage of pro-  
 880 cessing, the parser may need to draw upon the Category Tier (rather than Feature  
 881 Tier, as it may have originally attempted). This could presumably cause a pro-  
 882 cessing slowdown or electrophysiological effect comparable to one that might be  
 883 observed for a plausibility mismatch.

884 Since the anaphor in (1)/(7) is also definitionally masculine/male, in conjunc-  
 885 tion with the pragmatic context (a Halloween party, in which costumes allow peo-  
 886 ple some flexibility in identity performance), the parser may reassign the gender of  
 887 the lexical item *cowgirl* in a process similar to that of impostor anaphora (Collins  
 888 & Postal 2012). This should be detectable in behavioral and psychophysiological  
 889 measures (e.g., Nieuwland & Van Berkum 2006; Kuperberg et al. 2003; Canal,  
 890 Garnham & Oakhill 2015). However, the tiered schema I propose predicts that in-  
 891 dividuals who have extensive exposure to third genders or gender nonconforming  
 892 communities will have differently shaped exemplar distributions, thus also differ-  
 893 ently shaped category tiers. If the category tier is shaped in such a way that the  
 894 boundaries between gender categories are overlapping or ‘fuzzy’, this may ease the  
 895 processing cost of reanalysis.

896 The three types of gender distinguished in this proposal comprise a model for  
 897 exposure to variance in gender expression, cognition, and linguistic encoding. The  
 898 model is designed to be broadly applicable and testable across interfaces of linguis-  
 899 tic, cognitive, psychological and sociological work. I describe some applications  
 900 of the model to psycholinguistic topics and suggest future directions for devel-  
 901 opment. Since forays into research on nonbinary gender are few and recent, the  
 902 three-tiered model is intended to lead to better informed hypotheses about individ-  
 903 ual variation related to gender, language processing, and experience. Moreover,  
 904 nonbinary people often suffer social stigma for their gender identities (McLemore  
 905 2015; K. Johnson et al. 2019). This puts empirical studies touching on nonbinary  
 906 issues in a position to set the standard for ethical and compassionate research on  
 907 and in conjunction with nonbinary people. This paper provides a set of terminology  
 908 and the beginnings of a framework from which formal, empirical, and experimen-  
 909 tal linguistic research on nonbinary issues can grow, while incorporating the varied  
 910 experiences of the people directly affected by it.

## 911 Abbreviations

912 <MASC> = masculine  $\phi$ -feature, <FEM> = feminine  $\phi$ -feature, <0> = no gender  
 913  $\phi$ -feature, I = declension class I, III = noun class III, APUD = location near, COND  
 914 = conditional, CVB = converb, ERG = ergative, IMP = imperative, INF = infinitive,

915 NEUT = neuter, NEG = negative, PAST = past, PRES = present, PREP = prepositional,  
916 QUOT = quotative, UNW = unwitnessed

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## 927 Competing interests

928 The author has no competing interests to declare.

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