

Chapter 1

A triad study of noun similarity judgments in Lubukusu: the role of abstract grammatical gender

Zuzanna Fuchs

University of Southern California

Travis Major

University of Southern California

Justine Sikuku

Moi University

This study explores the mental associations that speakers of Lubukusu (Bantu: JE.31C) make within and across noun classes in computing noun similarities and/or differences. We investigate whether semantic properties, morphological form, and/or abstract gender inform judgments of noun similarity. 29 native Lubukusu speakers were presented with sets of three nouns and asked to select the noun least like the others; there were 66 such triads. Results suggest speakers were sensitive to semantics and morphology, prioritizing semantics. If speakers decompose noun-class prefixes into singular/plural and an abstract gender feature, we do not find evidence that they prioritize this abstract feature in this task.

1 Introduction

Bantu noun classes constitute a system of grammatical noun categorization that groups nouns into anywhere from 12 to 21 noun classes (Nurse & Philippson 2003). Membership in these categories is seemingly determined by some combination of semantically salient properties of the referent (human, animal, location

etc.), number features (singular, plural), and/or arbitrary/abstract features (i.e. grammatical gender) (Corbett 1991; Carstens 1991; Selvik 2001) and determines agreement marking on other elements in the clause, such as adjectives, demonstratives, relative pronouns, verbs, and more (Maho 1999). Thus, knowing the noun class of any given noun in the language – easily accessing it in the mental lexicon and rapidly integrating this information into the realization of agreement morphology possibly several times in a sentence – is critical for fluent communication in a Bantu language. Still, while this rich noun class systems has been a topic of interest in the morphosyntactic literature for the insight it can give into noun structure and agreement, psycholinguistic work in this area remains scarce. Of particular relevance to the present study is the open question of how noun class information is stored in the mental lexicon and accessed in real time by speakers of Bantu languages.

In the present paper, we present a preliminary step in addressing this question: an investigation of how nominal features – semantic category, overt morphology (noun class prefix), and abstract grammatical gender – inform explicit judgments of noun categorization in Lubukusu (JE.31c) using a triad study. Previous work in this domain on Gikūyū (Burton & Kirk 1976) and Kinyarwanda (Lawyer et al. 2024) has used a similar method and found that semantic category and overt morphological similarity guide speakers’ noun similarity judgments. We build on this work not only by investigating a language in which this has not been studied, but also by leveraging paired singular vs plural noun classes to disentangle the role overt noun class morphology from abstract gender in noun similarity judgments. While triad studies have certain limitations – as we discuss in Section 5.2 – the present study is a valuable first step toward our long-term goal of understanding the mental representation of noun classes in Lubukusu. We use this as an opportunity to probe what triad studies can contribute to experimental work on noun classes in Bantu languages, and we discuss future steps in Section 5.

2 Background

2.1 Noun classes

Bantu languages spoken in most parts of Eastern, Central and Southern Africa have a rich system of noun classes. Reconstructions of the proto-Bantu noun class system propose 24 classes (Meinhof 1932; Meeussen 1967; Welmers 1973; Maho 1999), though none of the present day Bantu languages manifest all 24

reconstructed classes. The number of noun classes in modern Bantu languages varies significantly, with the majority having between 12 and 21 classes (Nurse & Philippson 2003). There are a few languages with a reduced system: Kako (A93), for example, has only 3 classes (Guthrie 1971). Each noun class reconstructed for proto-Bantu is associated with a prefix that occurs on nouns in that noun class.

Table 1: Noun classes reconstructed for Proto-Bantu with typical meanings for nouns in the semantic core of each noun class

Noun Class	Noun Class Prefix	Typical Meaning
1	mú	humans
1a	∅	Kinship terms, proper names, personified animals
2	βá	Plural to 1 and 1a, honorifics
3	mu	Trees, plants, inanimates
4	mi	Plural to 3
5	li	Miscellaneous, paired things
6	ma	Liquids, masses, collectives, plural of 5,9, 11, 14, 15
7	ki	Inanimates, manner/style, diminutives, augmentatives
8	βi	Plural to 7
9	N	Animals, inanimate objects
10	li-ni	Plural to 9, 11
11	lu	Long, thin things, abstract concepts
12	ka	diminutives
13	tu	Plural to 12
14	βu	Abstract concepts, mass nouns, plural to 12
15	ku	infinitives
16	pa	Locatives - remote or explicit
17	ku	Locatives - remote/general
18	mu	Locatives - inside
19	pi	diminutive
20	yu	Augmentatives/diminutives
21	yi	Augmentatives/perjoratives
22	ya	Plural to 20
23	i	Locatives - unspecified

Noun classes are not only distinguished by noun class prefixes that occur on nouns: in some languages, the prefixes co-occur with pre-prefixes and/or augments. Noun classes are also distinguished by a set of class-specific agreement markers that occur on verbs, adjectives, adverbs, and numerous modification words (Maho 1999). Noun classes in modern Bantu languages are numbered,

by convention, corresponding to noun classes reconstructed for proto-Bantu (cf. Table 1). Typically, Bantu languages have several pairs of noun classes that follow a singular/plural pattern, whereby nouns that occur in a particular noun class in the singular consistently occur in the corresponding noun class in the plural, ex. in Lubukusu the singular *kumukhono* ‘hand’ occurs in NC3 while the plural *kimikhono* ‘hands’ occurs in NC4, the singular ‘liliino’ *tooth* occurs in NC5 while the plural *kameeno* ‘teeth’ occurs in NC6, etc. (see Table 1 for illustration of this pattern reconstructed for proto-Bantu and Table 2 for this pattern in Lubukusu specifically). These pairings are considered to instantiate abstract gender categories, which by convention are labeled with capital letters, ex. nouns that occur in NC3 in the singular and NC4 in the plural are considered to belong to Gender B (Carstens 1991).

Some studies on Bantu noun classes have also focused on crosslinguistic variation based on a number of parameters (e.g. Bresnan & Moshi 1990; Beaudoin-Lietz et al. 2004; Marten et al. 2007; Guérois et al. 2017; Fuchs & van der Wal 2021), including the form of the augment, grammatical function of noun class markers, derivational function of noun class markers, form of the NC5 prefix, number of noun classes, and whether infinitives, diminutives, augmentatives, and locatives are marked by noun class prefixes. There has also been debate on the status of noun prefixes on nouns versus on adjectives and verbs: some research distinguishes the former as markers of deriflection class (Taraldsen et al. 2018) and the latter as markers of gender agreement (Güldemann & Fiedler 2019; Corbett 1991).

Each noun class reconstructed for proto-Bantu is also claimed to have a typical meaning associated with nouns that occur in that class – what is sometimes referred to as the semantic core (Corbett 1991). It is important to note that, perhaps with the exception of noun classes 1 and 2, there are generally many exceptions to generalizations about the semantic content of noun classes (e.g. Denny & Creider 1976). Maho (1999: pp. 51) presents the proto-Bantu noun classes, their prefixes, and their typical meanings, summarized in Table 1. The criteria for membership of nouns into the various noun classes or gender categories in proto-Bantu and in modern Bantu languages has been a subject of debate for some time (e.g. Richardson 1967; Contini-Morava 1997); possible explanations include, but are not limited to semantic, phonological, and/or arbitrary criteria (Corbett 1991; Selvik 2001), as will be discussed further in Section 2.3.

Whatever the nature of the debate, research on the structure of Bantu noun classes and the motivation for noun membership in abstract gender cate-

gories holds the key to a deeper understanding of gender systems in the world's languages, including a deeper understanding of the kind of information that must be learned, stored in the mental lexicon, and accessed regularly by speakers for successful communication.

2.2 Lubukusu

The Bantu language investigated in the present study is Lubukusu. Lubukusu is one of the seventeen or so languages grouped under the Luhya Macrolanguage. It is spoken by approximately 1.2 million speakers, according to the 2019 Kenyan census, located predominantly in Bungoma and TransNzoia counties in Kenya, with some speakers also scattered throughout Western Kenya in Vihiga, Kakamega, and Busia counties.

Lubukusu has 19 noun classes, summarized in Table 2. Noun classes 1-11 alternate between singular and plural. Nouns in Lubukusu are marked by both a pre-prefix (augment) and a prefix. Classes 16, 17, 18, and 23 mark location and are hence referred to as locatives. As discussed for other Bantu languages in the previous section, noun classes in Lubukusu are part of the larger agreement system, whereby nominal modifiers, pronominals, and verbs are all morphologically marked with a noun class feature matching the head noun (Demuth 2000). Also as in other Bantu languages, Lubukusu noun classes represent a less than perfect semantic categorization, as noun class membership seems to be determined by some combination of semantics, phonology, and arbitrary categorization.

The properties of the Lubukusu noun class system make it an excellent language for an experimental investigation of noun classification in Bantu languages. One crucial desideratum for the experiment described in Section 4 is a set of unique NC prefixes. This is necessary to ensure that a noun's prefix(es) is/are associated with a single noun class and thus a single abstract gender. As mentioned in Section 2.1, in many Bantu languages, noun class systems have been reduced; this has introduced substantial homophony and syncretism among noun class prefixes that in turn introduces ambiguity regarding which gender is indicated by a given noun class prefix. Lubukusu has maintained a rich noun class system, combined with an equally rich set of pre-prefixes that also vary with the noun class of the noun. Since both the pre-prefix and prefix are part of the citation form of the noun (cf. Table 2), the outcome of this is that there are enough sets of unique prefixes to populate a well balanced experimental study. Before we introduce the present study, however, we will discuss previous experimental

Table 2: Noun classes in Lubukusu; example words are presented in modified orthography

Class	Gender	Number	Pre-prefix	Prefix	Example	Translation
1	A	SG	o-	mu-	omuundu	‘person’
2		PL	ba-	ba-	babaandu	‘people’
3	B	SG	ku-	mu-	kumukhono	‘hand’
4		PL	ki-	mi-	kimikhono	‘hands’
5	C	SG	li-	li-	liliino	‘tooth’
6		PL	ka-	ma-	kameeno	‘teeth’
7	D	SG	si-	si-	sisiindu	‘thing’
8		PL	bi-	bi-	bibiindu	‘things’
9	E	SG	e-	n-	enyungu	‘pot’
10		PL	chi-	n-	chinyungu	‘pots’
11			lu-	lu-	luluchi	‘river’
12			kha-	kha-	khakhaandu	‘small thing’
14			bu-	bu-	bubuukhi	‘honey’
15			khu-	khu-	khukhwasaka	‘to split’
16a			a-	-	anju	‘at/by the house’
16b			sya-	-	syaanju	‘toward the house’
17			khu-		khunju	‘on the house’
18			mu-	muunju-	omuundu	‘in the house’
20			ku-	ku-	kuliango	‘big door’
23			e-		ebung’oma	‘at Bungoma’

work on the productivity of various nominal features in noun categorization in Bantu languages.

2.3 Previous experimental work on noun categorization

Despite the richness of the noun class systems in Bantu languages, the mental representation of these systems remains under-explored. As discussed, scholars have noted the interconnectedness of semantics, overt morphology, and abstract grammatical gender in this categorization system (e.g. Corbett 1991; Selvik 2001), but the degree to which this is reflected in the synchronic mental lexicon of speakers of Bantu languages is still an open question. Some corpus-based studies in this vein have been conducted (Schryver & Nabirye 2010; Taljard & de Schryver 2016; Kanampiu et al. in press[b]) as well as a few experimental studies that we review below, but quantitative approaches to this topic remain scarce.

The fundamental observation that has driven quantitative research in this

domain is that in most Bantu languages noun classes may have a semantic core (Corbett 1991) – nouns that share salient semantic features such as being human, animals, or locations (e.g. Creider 1975; Burton & Kirk 1976; Selvik 2001; Katamba 2003) – but even in proto-Bantu (cf. Table 1) this categorization by semantics was far from clear-cut (see discussion in Selvik (2001)), with a great deal of arbitrariness in the system. This motivates questions regarding how speakers learn this categorization system and what (if any) nominal features or properties are productively used by speakers of modern Bantu languages for noun classification.

One approach to this question has been to observe speakers' choices in explicit noun classification tasks and to investigate what nominal features may guide these choices. Two notable studies in this vein have investigated the role of semantic features and noun class morphology in how speakers of a Bantu language categorize nouns: Burton & Kirk (1976) in a study on Gikūyū and Lawyer et al. (2024) in a study on Kinyarwanda. These studies used the triad method, which targets speakers' explicit judgments of noun similarity. In this kind of study, participants are shown three nouns at a time and each time asked to select the noun that they perceive to be the least like the others¹; participants are not timed. The assumption is that, if speakers are sensitive to a particular feature in making these judgments, then when two of the nouns in the triad share that feature and the third does not, participants will select that third noun at a rate higher than chance, i.e. more frequently than if they were selecting randomly. Indeed, Burton & Kirk (1976) and Lawyer et al. (2024) found this to be true both for semantic features and for overt morphology: participants on average preferred to select a noun that did not match the other two in some kind of salient semantic property, and participants on average also preferred to select a noun that had a different noun class marker than the other two in the triad. Moreover, Lawyer et al. (2024) found that the strength of these preferences among Kinyarwanda speakers showed a substantial amount of individual variation, and was at least partly determined by whether the speaker was also familiar with Kiswahili, with more proficient Kinyarwanda-Kiswahili bilingual speakers being more likely to use overt morphology to guide their judgments. The authors suggest that the effect of proficiency in Kiswahili may be due to the fact that speakers proficient in Kinyarwanda and Kiswahili must maintain and resolve two noun classification systems in their mental lexicon during the experimental task. Both Burton & Kirk (1976) and Lawyer et al. (2024) also tested the relative preference for semantic vs

¹Note that the instructions in Burton & Kirk (1976) are more narrow, asking participants to select the noun with the most different meaning.

morphological cues by constructing triads in which both cues were available, and they found that speakers generally relied more on semantic cues, though again [Lawyer et al. \(2024\)](#) note some individual variation in this effect.

A recent series of studies on Kĩitharaka pursued the role of semantics and morphology in explicit noun classification from a different angle ([Kanampiu et al. in press\[b\],\[a\]](#)). First, the authors used corpus to determine how many nouns in each noun class were consistent with a given semantic rule (ex. all human nouns belong in Gender A) vs how many nouns constitute exceptions to this rule. Assuming the Tolerance Principle ([Yang 2016](#)), the authors predicted that a very limited number of semantic properties are likely to be productive in noun classification in Kĩitharaka, whereas a similar process revealed that many more rules based on noun class morphology are likely to be productive ([Kanampiu et al. in press\[b\]](#)). In a follow-up experimental study ([Kanampiu et al. in press\[a\]](#)), the authors tested the productivity of the identified semantic and morphological features in Kĩitharaka speakers' noun classification by presenting experimental participants with nonce Kĩitharaka words (or wugs) either without a noun class prefix but with some information about meaning (in the form of a picture) or with a prefix but without any information about meaning. Participants were asked to fill in agreement marking on a numeral to match the nonce noun. The authors found robust effects of the nonce words' noun class prefix in determining speakers' choice of agreement marking, but only a few salient semantic properties – human, fruit, augmentative, diminutive, and pejorative – reliably determined speakers' choice of agreement marking. The authors conclude that in a wug-style classification task, speakers rely more on noun class morphology in determining noun class than on semantic properties.

Though [Kanampiu et al. \(in press\[a\]\)](#) did not test speakers' responses when semantics and morphology were available cues concurrently, [Selvik \(2001\)](#) conducted a study on Setswana in which participants were presented with a nonce word (with a noun class prefix) and asked to select the most likely meaning from a pre-determined set, or were presented with a definition and asked to select the most likely word from a set of four nonce word with different noun class prefixes. The author found that speakers' judgments were in general consistent with the semantic core of the noun classes she tested.

3 Present study

While previous studies have investigated the role of salient nominal properties (semantic category, noun class morphology) on speakers' explicit noun classification, an open question remains regarding the role of abstract gender features. To our knowledge, the distinction between noun class and abstract gender has not previously been pursued in this research domain, though there is a rich formal morphosyntactic literature on this matter (e.g. Carstens 1991; Contini-Morava 1997; Katamba 2003; Spuy 2010; Déchaine et al. 2014; Gibson et al. 2017; Taraldsen et al. 2018; Güldemann & Fiedler 2019; Fuchs & van der Wal 2021), and more recently Zeller et al. (2022) investigated the role of abstract gender in an EEG study on real-time language processing of agreement in Zulu.

In the present paper, we build on prior work on explicit noun categorization in Bantu languages by not only investigating effects of semantics and morphology on noun similarity judgments in Lubukusu but also introducing an experimental manipulation into the triad study paradigm that allows us to test for effects of abstract grammatical gender independently from effects of noun class morphology. Namely, we leverage the fact that paired singular and plural nouns have the same abstract gender feature but occur with different noun class prefixes, i.e. different overt morphology. This allows us to ask each of the following questions:

- (1) a. Are Lubukusu speakers sensitive to semantic features in judging noun similarity?
- b. Are Lubukusu speakers sensitive to overt morphology in judging noun similarity?
- c. Are Lubukusu speakers sensitive to abstract gender features in judging noun similarity?

Additionally, given that both semantics and noun class morphology have been shown to guide speakers' similarity judgments in previous work (Burton & Kirk 1976; Lawyer et al. 2024), we follow this line of work in investigating whether one of these cues is preferred over the other by speakers of Lubukusu:

- (2) Do Lubukusu speakers rely more on semantic features or overt morphology in judging noun similarity when both features are available?

We implement the triad method for our research purposes. All experimental methods have advantages and disadvantages; the triad method certainly has

limitations, especially when investigating a language that is primarily oral (as discussed in detail in Section 5.2). Still, we take it to be a useful first step in our investigation for a few reasons. First, it has been used a number of times to explore how speakers of Bantu languages categorize nouns in an experimental setting (Burton & Kirk 1976; Lawyer et al. 2024), so using this method allows us both to directly compare with and build on prior work and to probe the types of nominal features that can effectively be investigated using this method. Specifically, we consider it a valuable contribution to determine whether this method can reliably detect evidence for abstract gender playing a role in explicit noun categorization. Second, this method is not resource-intensive and is deployable via the internet, allowing us to reach a broader group of participants. We discuss limitations and outline future directions for this work using more traditional psycholinguistic methods in Section 5.

4 Experimental method & results

4.1 Experimental design

Thirty-three nouns were selected for the purposes of the experiment. Nouns were selected to be comparable in length, and written forms were selected and verified by one of the co-authors, who is a native speaker of Lubukusu. These nouns belonged to Genders B (Class 3/4), D (Class 7/8), and E (Class 9/10) and belonged to three semantic categories (animals, body parts, and foods). The distribution of nouns across these genders and semantic categories is presented in Table 3; the counts represent singular nouns only, and nouns also appeared in the experiment in their plural form. Genders B, D, and E were selected because the corresponding sets of noun class prefixes and pre-prefixes are unique (cf. Table 2). The semantic categories were selected not based on the properties of the semantic core of any individual noun class (cf. Table 2) but rather based on which semantic categories allowed us to identify enough suitable nouns of that semantic type in each of the selected noun classes. Still, we note that there were not enough animal nouns from Gender B – that would also satisfy other desiderata, such as word length – to allow for counter-balancing throughout the experiment. Thus, a limitation of the present study may be that no animal nouns from Gender B were included in the stimuli.

A full list of the nouns used for this study, as well as all data and code used for analysis, can be found in an OSF repository created for this project and available at https://osf.io/cwdpe/?view_only=c30f14faea08445bbf8712f42cdd5b45.

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Table 3: Distribution of experimental nouns across semantic categories and noun classes

	Class 3/4	Class 7/8	Class 9/10
Animals	0	4	4
Body parts	5	4	4
Foods	4	4	4

Nouns were arranged into sixty-six triads distributed across the conditions presented in Table 4. In each triad (with the exception of those in the semantics vs morphology condition, discussed below), one noun was the target item and the other two were non-target items. The study was counter-balanced such that target items occurred in each singular noun class an equal number of times; each experimental noun occurred in the study as a target a similar number of times and as a non-target a similar number of times.

In control conditions, all three nouns in the triad shared a semantic category and morphological form (i.e. noun class prefix), it was therefore expected that neither semantic category nor morphology should provide a clear cue to the target item, so participants should select the target item roughly at chance (33% of the time, given three response options). The control condition therefore serves as a baseline for comparison for the other conditions.

Table 4: Experimental conditions and sample stimuli

	Target	Non-target 1	Non-target 2
control	eekhima ‘monkey, NC9’	eekhisi ‘deer, NC9’	eefukho ‘mole, NC9’
semantics	eendiimu ‘lime, NC9’	eefukho ‘mole, NC9’	eekhisi ‘deer, NC9’
morphology	kumurwe ‘head, NC3’	siifuusi ‘fist, NC7’	siikele ‘leg, NC7’
abstract gender	siianga ‘skull, NC7’	kumukhono ‘arm, NC3’	kimyaasi ‘shins, NC4’
semantics vs. morphology	eeng’juuku ‘nut, NC9’ kumwaasi ‘shin, NC3’	kumukaati ‘bread, NC3’	

In three of the test conditions – designed to address Research Question 1 – the two non-target nouns shared a property that the target noun did not share. Per the discussion in Section 2.3, if participants are sensitive to that property in making noun similarity judgments, they should select the target noun in these

triads at a rate higher than chance. In the semantics condition, all nouns shared morphological form, and the non-target nouns also shared a semantic category, to the exclusion of the target noun. In the morphology condition, the opposite was true: all nouns shared a semantic category, and the non-target nouns also shared a noun class prefix (and abstract gender feature), to the exclusion of the target noun. In the abstract gender condition, all nouns shared a semantic category, and the non-target nouns were of the same abstract gender, but crucially did not have the same morphological form, ex. one non-target noun was in NC3 and the other in NC4. An example triad for each condition is illustrated in Table 4.

In the final test condition, following [Burton & Kirk \(1976\)](#) and [Lawyer et al. \(2024\)](#) and as introduced in Research Question 2, the triads were designed to test whether participants rely more on semantics or morphology as a cue to noun similarity when both are available. In this case there were two target nouns and one non-target noun. The non-target noun shared a semantic category with one of the target nouns, and shared a noun class prefix with the other (cf. Table 4).

The study included two additional conditions that should be noted but were not included in analysis and not reported in Section 4.4. In a condition intended to be a second type of control condition (six triads), all three nouns shared a semantic category but each had a different noun class prefix and different gender category (ex. *kumukoongo* ‘back, NC3’; *siianga* ‘skull, NC7’; *een-duumbu* ‘calf, NC9’). Like in the other control condition (Table 4), we expected participants to select randomly given that neither semantics nor noun class morphology should have been a salient cue to noun similarity. However, preliminary analysis showed that participants selected the target noun in these triads at a rate numerically higher than chance (45%, SE=3.8%), so this condition was not ultimately suitable as a control. An additional exploratory condition (six triads) designed to test whether participants were more likely to attend to certain types of semantic features over others. In these trials, all nouns had the same noun class prefix. Like in the semantics vs morphology condition, there was one non-target item and two targets: the non-target noun shared one semantic property (ex. shape) with one of the targets and a different semantic property (ex. size, animacy) with the other target noun. Because the results from these triads are not related to the research questions addressed in the present paper, we do not report them here.

4.2 Procedure

The study was implemented in Qualtrics and deployed online. Participants received general instructions in English, then proceeded to view each trial one-by-one; each trial consisted of one triad. In each trial, the question *Which word is least like the others?* was written in English above the triad. The order of trials was randomized for each participant, and the order of the three nouns was randomized within each triad for each participant. Both randomizations allowed for controlling effects of ordering – within a triad and across the study. At the end of the study, participants were invited to optionally provide feedback regarding the study.

4.3 Participants

Fifty-one native speakers of Lubukusu participated in the study. Only participants who responded to all trials were included in analysis, leaving $n=29$ participants. Participants were recruited via word of mouth in Uasin Gishu County and Bungoma County in Kenya. The authors obtained a research permit from the Kenyan government for the legal and ethical conducting of studies involving human subjects in Kenya. Participants received financial compensation.

4.4 Analysis & results

Responses were processed and analyzed in R version 4.1.2 (R Core Team 2021). Each response was coded as 1 if a participant selected the target item; the response was coded as 0 if the participant selected either non-target noun. The proportion of trials in which participants selected the target item in each of the conditions – except the morphology vs semantics condition, discussed further below – is presented in Figure 1. Numerically, in the control conditions participants selected the target 32.2% of the time ($SE=3.5$). In the test conditions, participants selected the target 85.6% ($SE=2.7$) of the time in the semantics condition trials, 51.1% ($SE=3.8$) in the morphology condition trials, and 28.7% ($SE=3.4$) in the abstract gender condition trials.

Data were analyzed using a logistic regression model², predicting binary response by Condition. Condition was a categorical variable, simple-coded such that the control condition is set to be the reference level, and each contrast

²A mixed effects logistic regression model including random intercepts grouped by participant was fitted to the data but resulted in singular fit.

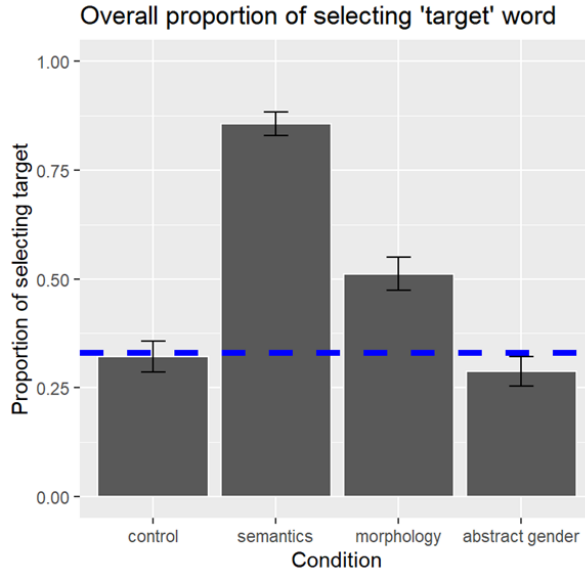


Figure 1: Proportion of responses selecting the target item in control vs test conditions

tests for the difference between the control condition and one of the test conditions. The model found a significant effect of semantics ($\hat{\beta}=0.53$, $SE=0.05$, $z=11.14$, $p<0.001$) and morphology ($\hat{\beta}=0.19$, $SE=0.05$, $z=3.95$, $p<0.001$) but no significant effect of abstract gender ($\hat{\beta}= -0.03$, $SE=0.05$, $z= -0.72$, $p=0.47$). This indicates that participants selected the target at a rate higher than in the control condition in the semantics condition and the morphology condition, but not in the abstract gender conditions. The full results of the model are summarized in Table 5.

Table 5: Regression table for logistic regression model predicting response by condition (Section 4.4)

effect	estimate	SE	t	p
Intercept	0.32	0.03	9.49	<0.001
Condition-semantics	0.53	0.05	11.14	<0.001
Condition-morphology	0.19	0.05	3.95	<0.001
Condition-abstract gender	-0.03	0.05	-0.72	0.47

Responses for the morphology vs semantics trials (cf. Table 4) were coded

differently. Responses were coded as morphology-based if a participant selected the target noun that did not share a noun class prefix with the other nouns and as semantics-based if a participant selected the noun that did not share a semantic category with the other two nouns. Responses in which the non-target noun was selected were coded as “neither”. As depicted in Figure 2, participants responded based on semantic similarity between two of the three nouns in 83.9% of these trials and based on morphological similarity in 9.2% of these trials.

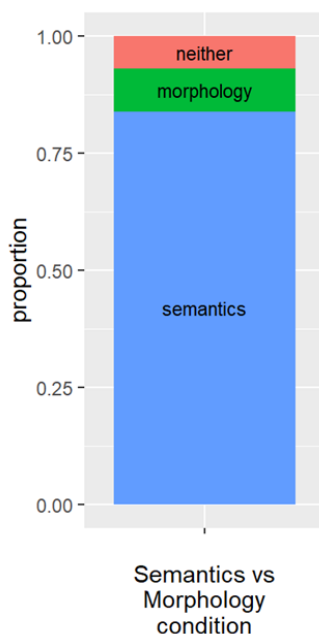


Figure 2: Proportion of responses in the Semantics vs Morphology condition based on semantic similarity (83.9%) between two of the three nouns, morphological similarity (9.2%), or neither

A Chi-Square Goodness of Fit test testing whether responses were equally distributed across the semantics and morphology response choices resulted in a statistically significant p-value ($\chi^2 = 488.24$, $df=2$, $p<0.001$). This indicates that participants were more likely to select a response based on the semantic properties of the nouns in the triad than based on the noun class prefixes, when both were available cues.

5 Discussion

5.1 Disentangling noun class and grammatical gender

In the present paper, we asked several questions regarding what properties of nouns in a language with a rich noun class system guide speakers' explicit judgments regarding noun similarity (Section 3). In a triad study on Lubukusu, we compared participants' rate of selecting a target item in control conditions in which they were expected to select randomly to several test conditions in which we manipulated the features of non-target items (to the exclusion of the target item) to be a shared semantic category, noun class prefix, or abstract gender category.

First, we asked whether Lubukusu speakers are sensitive to semantic features in judging noun class similarity. The findings in Section 4.4 suggest that in trials in which the non-target nouns belonged to the same semantic category, participants judged the target noun to be least like the others at a rate higher than in the control conditions. This suggests that semantic category does indeed guide participants' judgments of noun similarity, consistent with prior work using triad studies (Burton & Kirk 1976; Lawyer et al. 2024) and other methods (Selvik 2001; Kanampiu et al. in press[b],[a]).

We also asked whether participants are guided by overt noun morphology in their noun similarity judgments. Results suggest that, in trials in which the non-target nouns shared a noun class prefix to the exclusion of the target noun, participants selected the target noun at a rate higher than in the control condition, which suggests that noun class morphology does indeed guide participants' judgments. This is also consistent with prior work (Burton & Kirk 1976; Selvik 2001; Kanampiu et al. in press[a]; Lawyer et al. 2024).

Unique to the present study is that we also tested for the effects of abstract gender category, leveraging singular/plural noun class pairings that allowed us to create triads in which the non-target nouns shared an abstract gender feature but not a noun class prefix, i.e. one noun was singular and the other was plural, but both belonged to the same abstract gender. We found, however, that in these conditions participants did not select the target noun – which did not belong to the same gender category as the non-targets – at a rate higher than in the control condition. Though null results should always be interpreted with caution, we take this to be evidence that participants' explicit noun similarity judgments were not informed by nouns' abstract grammatical gender.

In addition to testing the influence of each of the three features considered in this study individually, we also tested the relative weight of semantic category vs overt morphology – the two features that participants were found to be sensitive to in isolation – in determining participants’ response choices. We pitted these two features against each other in triads in which a non-target noun shared a semantic category with one of the targets and a noun class prefix with the other target noun. Results (cf. Figure 2) show that when presented with these triads, participants overwhelmingly based their judgments on shared semantic type, indicating that when semantics and noun class morphology are both available as cues to noun similarity, speakers rely more on the semantic category cue. This is again consistent with [Burton & Kirk \(1976\)](#) and [Lawyer et al. \(2024\)](#) (as discussed in Section 2.3, [Kanampiu et al. \(in press\[b\]\)](#) and [Kanampiu et al. \(in press\[a\]\)](#) only tested semantics and noun class morphology separately).

Taken together, the results demonstrate that in an offline task like the present triad study, native speakers of Lubukusu do not make use of abstract grammatical gender to calculate similarities between nouns; however, they are sensitive to other salient linguistic features, such as semantic category and noun class morphology, in making the same kinds of choices. Although these results do not provide evidence in favor of the hypothesis that speakers have representations of abstract grammatical gender that group noun class pairs in their mental lexicons, we do not interpret this as evidence against it either, given limitations to the present experimental method that we discuss below. We strictly conclude that speakers do not consciously make reference to abstract gender when looking for similarities between groups of nouns.

5.2 Limitations and going further

Selecting an experimental method often involves trade-offs. As discussed in Section 3, one of the advantages of using the triad method in the present study is the relative logistical ease and low cost of data collection. A triad study is deployable online and does not require specialized software. It can therefore be completed by any participant with access to a computer or smartphone. Additionally, given that this method has been used in prior work on Bantu noun classes ([Burton & Kirk 1976](#); [Lawyer et al. 2024](#)), using this experimental method allows us to directly compare to previous findings on related languages and to further test the types of effects that this method has the sensitivity to detect. Taken together with [Burton & Kirk \(1976\)](#) and [Lawyer et al. \(2024\)](#), our work demonstrates that triad studies can reliably detect effects of semantic category and noun class mor-

phology on participants' response patterns, which may be of interest to many scholars.

The method does, however, have its limitations. Chief among these is the fact that this method is based on written forms of words. This is a challenge when working with a language like Lubukusu, which does not have a standardized orthography. Speakers of Lubukusu do encounter the language in written form: many use a written form of Lubukusu using Latin characters when texting or on social media platforms. This written form of Lubukusu has developed some spelling norms, but there is still considerable variation in individual spelling choices. Indeed in our experiment we included space after the main task for participants to offer feedback, and a few participants noted that they did not recognize some of the words.

More broadly, the importance of aligning the modality of an experimental task with the modality in which speakers most typically encounter the language of testing has been particularly well articulated in the literature on heritage bilinguals, where it has been shown that heritage speakers perform very differently in written vs oral production tasks in their heritage language, to which most heritage speakers have very limited exposure in written form (Alarcón 2011; Montrul et al. 2014). While studies of real-time processing in other primarily oral Bantu languages have shown that this does not preclude successful experimental work that relies on written word recognition (Kgoro & Eisenbeiss 2015; Ciaccio et al. 2020), it remains an important consideration in experimental work on primarily oral languages.

These considerations fall under the larger umbrella of challenges encountered when investigating a language with limited resources for linguistic research. While there exists a Lubukusu lexicon (Marlo et al. n.d.), spellings in this resource and similar resources for other languages typically are selected by linguists, use the IPA, and/or reflect the judgments of a single speaker rather than the variety of spellings that may occur in naturalistic written speech produced by native speakers of the language. Moreover, these resources do not track lexical frequency; a wealth of research has demonstrated that frequency drives effects in experimental linguistics and is therefore important to control for. In the present study, the native-speaker co-author was able to judge which nouns were too infrequent to include in the study, but we were unable to control for more nuanced differences in frequency among experimental items. In ongoing work, we aim to compile a lexical frequency corpus for Lubukusu modeled on a similar corpus of Setswana by Kgoro-Lotshwao & Otlogetswe (2023). Given evidence that native speakers'

subjective frequency ratings can effectively be used in the design of an experimental linguistic study (Kgolo & Eisenbeiss 2015; Ciaccio et al. 2020), we hope that this resource will enable future experimental work on Lubukusu – including but certainly not limited to work using the triad method – to control for properties of nouns that we were unable to account for here, such as frequency, as already mentioned, and also phonological and orthographic similarity.

We have demonstrated that speakers do not consciously make reference to abstract grammatical gender when choosing between triples of words, instead favoring semantic similarities and overt noun class prefixes. In future work, we plan to pursue the larger question of the representation of abstract gender in the mental lexicon of Lubukusu speakers using methods that tap into real-time language processing. Such methods – especially eye-tracking in the Visual World Paradigm (Tanenhaus et al. 1995) – have been effectively used to investigate speakers’ representation of abstract gender in the mental lexicon in many languages while circumventing challenges related to reliance on written form (e.g. Fuchs 2021; Sá-Leite et al. 2023; Fuchs & Zeng 2024). Such work is to-date rare in the literature on noun class and grammatical gender in Bantu languages, with the notable exception of Zeller et al. (2022), who, using EEG, found that during real-time language processing Zulu speakers show differential sensitivity to agreement errors in number versus gender.

6 Conclusion

This paper investigated whether we could find evidence that Lubukusu speakers make reference to abstract grammatical gender features when making explicit noun similarity judgments (Carstens 1991). Following previous studies (Burton & Kirk 1976; Lawyer et al. 2024), we used a triad study, an offline task in which participants judge which of three presented words is least like the others. Consistent with prior work, we found evidence that participants rely salient nominal noun features such as semantic category and noun class morphology in making these judgments. We crucially introduced an experimental manipulation into this paradigm that allowed us to disentangle the role of the overt form of the noun class prefix from that of abstract gender, and in doing so we found that the latter does not seem to guide participants’ judgments in the task. We concluded that there is no evidence that speakers consciously make use of abstract gender when calculating similarities/differences between nominals in an untimed triad study; however, we discuss the limitations of this methodology and outline ways in

which this question can be addressed using tasks that investigate real-time language processing.

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