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The emergence of grammatical gender: an experimental study on the loss of informative classification

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Systems of grammatical gender are widespread, yet evidence on how these systems emerge is surprisingly scarce. We report on novel research using storyboard experiments in six Oceanic languages of Vanuatu and New Caledonia, to probe the initial stages in the emergence of grammatical gender from possessive classifiers. This would appear to be an unlikely source, yet we can demonstrate the development and investigate it through current experiments. Our storyboard experiments were designed to reveal the use of classifiers as reference tracking devices across units of discourse and in different interactional contexts. The particular interest is in the degree to which the use of these classifiers becomes fixed and hence redundant for given nouns. The general interest is the investigation of the way in which apparently useful distinctions are lost, as transparent classification becomes opaque.

1 Rationale for our Experimental Study

We find gender systems in a significant number of languages. Yet evidence of how these systems arise is limited. The best evidence points to sources with a semantic basis, and the semantic justification of the system may be preserved in gender systems or may be partly obscured (Corbett 2013). This fact already prompts the question as to why a potentially useful semantic distinction should not be fully retained. We report on research that is novel in showing an additional, and unlikely potential source for gender, namely possessive classifiers. These seem an improbable source, since they express the changeable relation of the possessor to the possessum. Again, we face the loss of useful information. Furthermore, the change is in progress; we have no tradition of texts for these languages, but we are able to conduct revealing experiments in the field.

We are intrigued by the old questions of where gender systems come from and what they do. These systems are increasingly seen as a part of a larger typological domain, namely nominal classification. In other words, instead of seeing gender and the various types of classifiers as forming a dichotomy (as in Dixon's 1982 influential account), we see them as differing along several dimensions, with numerous intermediate possibilities (Fedden & Corbett forthcoming). Against this background, an intriguing result was reported in Franjieh (2016), namely a system with certain gender-like properties, in a language (North Ambrym, Vanuatu) previously assumed to have possessive classifiers. Specifically, while possessive classifiers are used to signal the relation of the possessor to the possessum, which is changeable, speakers of North Ambrym are increasingly fixing the classifier, according to the lexical semantics of the noun. Now one of the dimensions (criteria) for analysing nominal classification systems is precisely **redundant vs informative**, and North Ambrym suggests a dramatic development along this criterion. We wished to investigate this change, both in North Ambrym and potentially in related languages, which have similar but usefully different nominal classification systems.

The interest of the change goes well beyond the specific languages of our study. There is no complete story of the rise of gender; rather we have a patchwork of evidence, which suggests how such systems may arise. Thus Greenberg (1978) pointed to the Daly languages of the Australian Northern Territory, where noun classifiers appear to develop towards a gender system. One of these languages, Ngan'gityemerri, has been studied in detail by Reid (1997). The system is illuminating. There are arguably fifteen gender values, assigned semantically (including male, female, canine, other non-human animates, striking instruments, and two types of spear). Nine genders have bound agreement markers, found on agreement targets, such as adjectives (Reid 1997: 181):

(1) *a-syensyerrgimi* *a = tyentyenmuy*
ANIMATE-white.rock.wallaby ANIMATE = tame
'a tame white rock wallaby' ('=' is used for clitics and '–' for affixes)

Six genders are indicated by optional freeform classifiers (Reid 1997: 177):

(2) *(syiri) magulfu* *(syiri) marrgu*
STRIKE cylindrical.fighting.stick STRIKE new
'a new cylindrical fighting stick'

Syiri is used for weapon-like objects that have a striking type of contact. Its first use in (2) is more classifier-like, while its second use approaches an agreement marker. The two types of realization shown in (1) and (2) form a single system: (i) for some gender values there is a noun classifier available (in addition to a marker on the noun and to a bound agreement marker); and (ii) while the use of the classifiers is optional, so too is agreement (Reid 1997: 168). Reid's fine study provides a window into the rise of gender systems; Ngan'gityemerri shows the development from freeform classifier to bound agreement marker, a process that is ongoing (Reid 1997: 211–222). While this picture is convincing, we must remember that the evidence concerns additional gender values within an already existing gender system. Thus, noun classifiers are a potential source of gender, but we do not see a system arising ex nihilo in Ngan'gityemerri. We do see a fascinating system, split in terms of exponence.

Nominal classification systems may also be split 'in the other dimension'; that is, there can be levels of semantic generality, with these being realised through similar means. A good example is the Northwest Amazonian language Bora-Miraña (Seifart 2005; 2018). Here we find around 60 rather specific classifying elements (such as 'one-dimensional, pointed'), and a second more general system, with fewer items (for animacy, sex and number). They all occur in the same morphosyntactic slots, in an agreement-like fashion. Taken together, the Ngan'gityemerri and the Bora-Miraña systems suggest that the development from more classifier-like to more gender-like patterns is not unitary: there are different paths of development.

As we put together the different pieces of evidence, one part of the story is less clear, namely how a 'useful' semantic distinction is given up, at least in part, leading to the system being less informative (and more redundant). As Seifart stresses (2018: 20–23), we have rather little evidence on how transparent classification becomes opaque. Our results from the languages of Vanuatu and New Caledonia can shed light on this. Thus, the local development, important for how gender systems can emerge, has wider significance for what it adds to the more general patchwork of evidence.

Where might we look for evidence of this change in progress? It has been claimed that different systems of nominal classification can function as reference tracking devices across large units of discourse (Contini-Morava & Kilarski 2013), though the evidence is not unequivocal (Feist 2020). Precisely for reference tracking, a fixed, gender-like system could be argued to have advantages, since if each noun has a single gender value (Corbett & Fedden 2016: 503), the anaphoric material (e.g., the pronoun) provides the hearer with a clear indication of possible

antecedents. As possessive classifiers allow freer association (and are thus more informative), they are less obviously purposed for reference tracking. It is precisely here that we look: we ask what happens when possessive classifiers are in the frame to be used for reference tracking.

Furthermore, corpora only exist in two of our six sample languages from Vanuatu and New Caledonia in our study, for North Ambrym and Vatlongos. There are no corpora for Merei, Lewo, Iaai and Nêlêmwa, which limits the possibilities for an in-depth corpus investigation. And where there is evidence, it is limited. Feist (2020) investigated the use of classifiers and gender in four languages as reference disambiguation aids. However, in the two languages in his sample that have classifiers, Mian (Trans-New Guinea, Papua New Guinea) and Kilivila (Austronesian, Papua New Guinea), the use of classifiers as reduced referential devices with no overt NP, occurred in only 3% to 5% of all instances of reference tracking in the collection of texts used. This limited use of classifiers without a full referential NP mirrors the lack of examples in the two corpora of Vatlongos and North Ambrym and provides further justification for an alternative approach (c.f. section 2.2 for reference tracking examples). We therefore designed an experimental approach using storyboards (Burton & Matthewson 2015) to elicit comparable targeted responses across our language sample, detailed in section 2.1.

The purpose of this study is not to investigate the use of possessive classifiers as devices for disambiguating between potential referents, for which see Feist (2020). We instead focus on the redundant vs informative criterion in nominal classification systems (Fedden & Corbett forthcoming). We are looking for the emergence of fixed (hence redundant) assignment. We expect possessive classifiers to show variable assignment, that is, with different classifiers functioning as the anaphor across large stretches of discourse, dependent on a particular semantic/pragmatic context (hence being informative). We are interested in instances where possessive classifiers become fixed, that is, where nouns are lexically specified according to which classifier they require, and therefore the same classifier must be used across large stretches of discourse to refer to the antecedent. This would indicate a development in the direction of canonical gender.

Note that assignment varies across the different types of nominal classification system. It is often thought that gender systems are redundant, since a given noun will be assigned to a single gender. This view has arisen, we believe, from the historical accident of the order of discovery and study of the different types of systems. Classical gender systems (redundant) and classifier systems (informative) were discovered and described. But then as new systems were found, they tended to be accommodated to these two poles, which means that the full range of variability has not yet been fully assimilated. Thus, there are nominal classification systems that, on most criteria, look rather like gender systems, but which allow reassignment of nouns, to different degrees. Good examples are Mawng (Australia), for which see Singer (2016: 63–64), and Savosavo (Solomon Islands), for which see Wegener (2012: 60–63). These systems are more informative than canonical gender systems. Conversely, the choice of classifier can be relatively fixed, and so less

informative, as in Chinese, Thai, and Hmong (Bisang 1993: 17). Given this range of systems, it is useful to have a baseline from which to measure, and we take redundancy (each noun has a fixed gender value) as the canonical baseline. The key consideration for this paper, however, is that we can investigate and document a progression from informative systems towards less informative (redundant) systems. We stress that what is redundant may still be useful. Thus, if a noun always has the same classification in the system, that provides no information directly, but it could aid reference tracking, since an antecedent can be established more readily if its assignment is fixed.

2 Oceanic Possession and Reference Tracking

We give an overview of Oceanic possession, with specifics on the constructions found in our sample languages, in section 2.1. We discuss the use of possessive classifiers as reference tracking devices in section 2.2, giving justification for our study.

2.1 Oceanic Possession

Oceanic possession is widely discussed in the areal literature (Lichtenberk 1985; 2009; 2018; Ross 2004; and Lynch et al. 2002, among others);[1] we give a brief overview of the possessive constructions found in the six sample languages in our study. These languages show a split in the class of nouns: some allow suffixation of a possessor index directly, whereas others cannot be directly suffixed. This two-way split is commonly termed 'direct' and 'indirect possession' in the Oceanic literature. In the typological literature it is called the alienability split (Bugaeva et al. 2022) or obligatory/optional possession (Bickel & Nichols 2013).

The rationale for this differing terminology is that nouns that are directly possessed tend to be semantically inalienable (including body parts, kin terms, part-wholes, and personal possessions). Nouns that are indirectly possessed are more likely to be easily transferable from one possessor to another. The following example from Iaai shows a direct possessive construction ((3)a) with a kin term directly suffixed by a possessor suffix. Example ((3)b) shows an indirect possessive construction where the possessor suffix does not attach directly to a possessed noun, but instead to one of a set of possessive classifiers.

(3) **Iaai:** Dotte (2017: 341)[2]

a. *hinyö-k*
mother-1SG
'my mother'

b. *haalee-k* *kuli*
ANIMAL.CL-1SG dog
'my dog (pet)'

[1] For comparison with Malayo-Polynesian see Schapper & McConvell (2024).

[2] Example glosses for possessive constructions have been standardised across the paper, but original transcriptions kept.

It is the possessive classifiers, as in ((3)b), which are our focus. The number of such possessive classifiers varies considerably; the number found in each of our sample languages is shown in **Table 1**.

Language	**Number of possessive classifiers**
Merei (Santo island, Vanuatu)	3
Lewo (Epi island, Vanuatu)	3
Vatlongos (Ambrym island, Vanuatu)	4
North Ambrym (Ambrym island, Vanuatu)	5
Nêlêmwa (Grand-terre, New Caledonia)	>19
Iaai (Ouvea island, New Caledonia)	>23

Table 1: The sample languages and their number of possessive classifiers.

The possessive classifiers in Oceanic languages are often called relational classifiers (Lichtenberk 1983), since they encode the relation (intended or actual) between the possessor and possessed, rather than a particular salient attribute of the referent of the possessed noun. Hence, they are informative. Nouns can often occur with different classifiers, depending on the relationship that the speaker highlights. Example (4) from Iaai shows that the noun *wââ* 'fish' can occur with three different possessive classifiers depending upon the interactional context. This same noun can occur with the FOOD classifier if the speaker intends to eat the fish; with the CATCH classifier if they want to highlight that they caught the fish; or with the GENERAL classifier if they want to highlight another use not specified by the available set of classifiers in their repertoire, for example if they wish to sell the fish.

(4) **Iaai:** Dotte (2017: 346)

a. *ö-k* *wââ*
FOOD.CL-1SG fish
'my fish (to eat)'

b. *hanii-k* *wââ*
CATCH.CL-1SG fish
'my fish (caught)'

c. *anyi-k* *wââ*
GENERAL.CL-1SG fish
'my fish (to sell)'

Both the New Caledonian languages in our sample, Nêlêmwa and Iaai, have more 'open' systems of classifiers; speakers are able to create new classifiers when a particular need arises. This is a productive process in Iaai and Nêlêmwa. New classifiers can emerge from existing directly possessed nouns, or from verbs by attaching possessor suffixes. To take an example from Iaai, the verb *tûö* 'to smoke' can be used as a classifier for possessions which you can smoke by the addition of possessor suffixes, e.g., *tûe-n sigââ* 'his/her cigarette (SMOKE.CL-3SG cigarette)' or *tûe-n paep* 'his/her pipe (SMOKE.CL-3SG pipe)'. The Vanuatu languages in our sample do not allow the creation of new classifiers; their class of classifiers is closed.

In contrast to the widely held view that Oceanic possessive classifiers are relational classifiers, the North Ambrym language has a much stricter relation between noun and classifier, with the majority of nouns only being able to occur with just one classifier. For example, *we* 'water' in (5) can occur only with the DRINK classifier, regardless as to whether the possessor intends to drink the water or not:

(5) **North Ambrym:** Franjieh (2016: 95)

a. *mwe-ng* *we*
DRINK.CL-1SG water
'my water (for drinking, washing, etc.)'

b. **mwene-ng* *we*
GENERAL.CL-1SG water
Intended: 'my water'

Across the Oceanic languages, the directly possessed nouns tend to be a closed class, disallowing new members. In contrast, the class of indirectly possessed nouns is open, allowing new words, such as borrowings, to be possessed. Across the sample languages, the Vanuatu languages fit this description well. However, the two New Caledonian languages appear to have a semi-open class of directly possessed nouns. In Iaai, indirectly possessed nouns and verbs can be a source of new directly possessed nouns. Equally, directly possessed nouns act as a source for new possessive classifiers, which are an open class in Iaai.

Possessive classifiers are not homogenous within and across languages. We make a distinction between major and minor classifiers. Major classifiers occur with a large number of nouns and can allow neologisms or borrowings. Minor classifiers typically occur with only a handful of nouns and are essentially closed to new ones. North Ambrym has two minor classifiers: FIRE and BASKET. The latter classifier allows just a handful of nouns that refer to traditionally made baskets, whereas borrowings such as *bak* 'bag' are disallowed, and instead occur with the major GENERAL classifier. As minor classifiers occur with only limited numbers of nouns, there is a possibility that these are more likely to diminish in use. For example, speakers of North Ambrym

are happy to possess *arrbol* 'basket' with either the BASKET or the GENERAL classifier with no change in semantics. Similar examples can be found in Iaai and Nêlêmwa, which have varying numbers of minor classifiers, with a shift in use to major classifiers.

The possessive classifiers in the languages of Vanuatu in our sample show signs of heterogenous semantic domains. Thus, the labels given to the classifiers are mnemonic devices, which refer to commonalities in the semantic domain across languages. For example, the FOOD classifier in North Ambrym can also occur with nouns referring to tools, utensils, crockery, units of time and some kinship terms. The DRINK classifier in North Ambrym, Vatlongos and Lewo also occurs with nouns referring to buildings and mats. In Vatlongos and Lewo the DRINK classifier also encodes some items of clothing. Generally, the possessive classifiers in the languages of New Caledonia in our sample cover more homogenous semantic domains, due to the large number of classifiers that have carved up the semantic space in more fine detail. However, there are some classifiers which do have heterogenous semantic domains. The ANIMAL classifier in Iaai is typically used for domesticated animals, though some speakers also use it for domesticated trees and plants they look after.

Both North Ambrym and Nêlêmwa also have a further indirect construction which uses prepositions to link possessor and possessed. We include this here, since these indirect prepositional possessive constructions occur in speakers' responses to some of the storyboards. In North Ambrym the general associative preposition *ne* can encode a looser connection between possessor and possessed. Schneider (2011: 385) discusses similar constructions across other languages of Vanuatu, describing them as "where two NPs are juxtaposed in a difficult to define, not-quite-possessive relationship." Often these constructions can be used when the 'possessor' is inanimate, such as *rrem* 'yam' in example (6), where it is not an intrinsic part of *saaroan* 'story', but it is what the story is about:

(6) **North Ambrym:** Franjieh (2012: 256)
Saaroan ne rrem lo mi yi a
story.NMLZ ASS yam then REC.PST[3SG] like DEM
'The story of the yam is like this'

Furthermore, the general associative preposition in North Ambrym can be used for some part-whole relationships as well, such as internal body parts (7).

(7) **North Ambrym**: Franjieh (2012: 253)
Olvaa ne ni
Brain ASS 1SG
'my brain'

Schneider (2011) discusses the potential difference between indirect and associative constructions as being defined by control, where associative constructions encode a lack of control of the possessor over the possessed.

Nêlêmwa, unlike the other sample languages, does not have a GENERAL possessive classifier. Instead, Nêlêmwa[3] uses an indirect linker *i* shown in example (8):

(8) **Nêlêmwa** (Bril 2012: 72)
bu *i*[4] *na*
hook LINK 1SG
'my hook'

In Nêlêmwa, we have found that some directly possessed nouns can also be possessed using the general linker preposition (though this is speaker-dependent), thus making the use of the linking preposition not restricted to a particular class of noun:

(9) **Nêlêmwa** (elicited – no semantic difference)
a. *balâ-ny*
ball-1SG
'my ball'
b. *balâ* *i* *na*
ball LINK 1SG
'my ball'

2.2 Reference Tracking

In the sample languages, possessive classifiers can function as reference tracking devices. In these instances, possessive classifiers can be used without a possessed noun. The possessed noun is either recoverable from prior discourse or evident from context. In example (10) from Vatlongos, a section of discourse between a pigeon and a heron on the reef, the first instances of the *a-* FOOD classifier occur with the possessed noun *tiei* 'clam' ((10)a). However, the second occurrence of the FOOD classifier occurs on its own without the possessed noun ((10)c). Here, the classifier functions as a reference tracking device, and refers back to the first mention of *tiei* 'clam'.

(10) **Vatlongos** (Ezekiel & Ridge 2014)
a. *Ui,* ***tiei*** ***tei*** ***a-van*** *xitak*
INTJ clam one FOOD.CL-1SG this_one
'"Hey there's a clam for me over here!"
b. *e* *koh* *bitene* *inou* *mu* *na-pus-i;* *na-danga* *ioxor*
CONJ heron 3SG.say.IND 1SG first 1SG-see-OBJ 1SG-stay_behind.IND there

[3] Nêlêmwa is not alone in not having a GENERAL possessive classifier: related languages found in northern New Caledonia such as Zuanga-Yuanga also lack a GENERAL classifier and have prepositional possession (Bril 2023).

[4] There are two linkers in Nêlêmwa. The linker *i* is used with human possessors and the linker *o* is used with collective/non-specific human or inanimate determiners (Bril 2012: 72).

na-ketteh hira-k teviei na-ketteh na-pus-i vari.
1SG-look neck-1SG long 1SG-look 1SG-see-OBJ at_once
but the heron said: "I saw it first when I was back there I saw it, my neck is long and I saw it at once."

c. *Ma mai bitene bos ta,* ***a-m.***
then pigeon 3SG.say.IND 3SG.good.IND just FOOD.CL-2SG
So the pigeon said: "Okay fine, it's yours."'

In our sample, five of the six languages allow full possessed noun elision when the referent of the possessed noun in a possessive classifier construction is recoverable from prior discourse or from pragmatic/external context. However, North Ambrym allows only partial elision of the possessed noun of a classifier construction. In example (11), instead of the possessed noun, the partitive marker *ge* (PTV) must occur. The antecedent of the possessive phrase is *bwehel* 'bird' mentioned first in the sentence. The possessive phrase is interpreted as 'his (food) one'.

(11) **North Ambrym** (Franjieh 2018: 41)
[***Bwehel***$_x$ *ge mōrō rrya bya le*], *Batik bya rrō fne* [***a-n***$_x$ *ge*].
bird REL 3DU.REAL carry go DEM Batik go PROG roast FOOD.CL-3SG PTV
'The (two) birds which they carried there, Batik went and roasted his one.'

In the available corpora of Vatlongos and North Ambrym, the use of classifiers as reference tracking devices is rare. As both languages have limited documentation, they have small corpora: Vatlongos has a total corpus of 51,302 tokens and North Ambrym 31,788 total tokens. **Table 2** shows that the classifier constructions only make up a small part of the total number of indirectly possessed noun tokens in both corpora.

Language	Total indirectly possessed noun tokens	Total classifier with possessed noun tokens (% of total indirectly possessed noun tokens)	Total classifiers without possessed noun tokens (% of total classifier tokens)
North Ambrym	3886	427 (10.99%)	20 (4.68%)
Vatlongos	8514	1133 (13.31%)	45 (3.97%)

Table 2: Details of the language corpora for North Ambrym and Vatlongos.

3 Methodology

3.1 Participants

The Participants were 125 adults over the age of 18 from the language communities in Vanuatu and New Caledonia. A power analysis was conducted using G*Power (v3.1.9.7), ensuring the sample is appropriate for detecting small-medium effects (Faul et al., 2009). The sample included

68 (54.4%) male and 57 (45.6%) female participants. Their ages ranged between 18 and 80 years (M = 44.37, SD = 15.46). The level of education was measured in years of formal education and ranged between 0 and 23 years (M = 8.89, SD = 4.00). Further participant information broken down by language is shown in **Table 3**. Participants were recruited using convenience and snowball methods via contacts in each language community. Favourable ethical opinion was obtained from the University of Surrey prior to the study.

Language	Participants	Sex		Age		Years of education	
		Male	Female	M	SD	M	SD
Merei	21	13	8	32.52	13.12	6.14	4.10
Lewo	22	13	9	41.86	13.11	8.27	2.33
Vatlongos	22	8	14	39.82	13.69	8.05	3.07
North Ambrym	22	12	10	43.77	14.00	7.09	2.47
Nêlêmwa	19	12	7	57.95	15.85	10.47	3.49
Iaai	19	10	9	50.32	11.26	14.11	3.74

Table 3: Demographic information for each language community.

3.2 Experimental Setup

The storyboard experiment was conducted alongside two other experiments – a possessive labelling task and an eye-tracking task. Only the storyboard experiment will be discussed here; the other two experiments will be reported elsewhere. The order of experiments was randomised across participants. Testing took place across 56 days in the six language communities during July to October 2022. One to four participants were tested on each of the data collection days. All participants were provided with information about the study and gave informed consent. For participants in Vanuatu, the information sheet and consent form were read aloud in Bislama (the lingua franca of Vanuatu) and oral consent recorded. Participants in New Caledonia read the information sheet and signed written consent forms in French (the lingua franca of New Caledonia). For Iaai and Nêlêmwa, the experiments were conducted either at a participant's home on a veranda or underneath a shelter, or in the building where the experimenter was staying. For North Ambrym, Vatlongos, Lewo, and Merei, the experiment was set up in a house on a table. Participants were reimbursed for their time with small monetary payments (Vanuatu) or gifts (New Caledonia), following the different cultural norms.

3.3 Materials and Design

Eight storyboards were designed to investigate how different interactional contexts affected the use of classifiers as anaphoric reference tracking devices across stretches of discourse. Each storyboard consisted of four images that represented different interactions related to a target noun (see **Figure 1**).

Figure 1: Storyboard targeting 'fish' with different interactions: catching (top left), carrying home (top right), eating (bottom left), and selling (bottom right).[5]

A representative sample of nouns were chosen to test across all six languages, combining variation in frequency and variation in cognitive salience. Corpora exist for North Ambrym and Vatlongos (c.f., Table 2); nouns with similar semantic definitions that appeared in both corpora were chosen as a starting point, resulting in 116 nouns. These nouns were cross checked with results from a prior free-list experiment (see Franjieh et al. 2022 for methodology). The free-list experiment elicited the most salient nouns associated with each classifier in each language. Cognitive Salience Index (CSI) scores (Sutrop 2001) were calculated to give an indication of

[5] These gorgeous illustrations we commissioned from Erin Aniker. They are being reused in literacy materials for schools in Vanuatu and New Caledonia. To date, these literacy materials include thematic dictionaries/grammars for four languages (North Ambrym, Lewo, Vatlongos and Iaai) and for storybooks for five languages (North Ambrym, Lewo, Vatlongos, Merei and Iaai). They are provided free of charge to the schools and are available for download at: https://nominal-categorisation.surrey.ac.uk/projects/optimal-categorisation/outreach/.

the psychological saliency of the association of each noun to a particular classifier. CSI scores combine the frequency and mean position of a term within a list, across all participants. They range from 0 to 1, with 1 denoting maximum salience. The maximum CSI score of each noun across the sample languages was used to divide the list of 116 nouns into four ranks (>0.75 = 1; >0.5 and <=0.75 = 2; >0.25 and <=0.5 = 3; <=0.25 = 4). Token frequency was normalised per 10,000 words and averaged across both the North Ambrym and Vatlongos corpora. The list of 116 nouns was then divided into four frequency quartiles.

Abstract nouns, nouns referring to large entities (e.g., home, cliff), superordinate terms (e.g., animal, thing, fruit), and nouns relating to people and their relationships (e.g., old woman, teacher) were removed. This was because abstract nouns, superordinate terms and large entities are hard to create concrete images for. In some languages, people and relationship terms are possessed using the direct construction, rather than with a classifier. Equally, these nouns are hard to fit into different interactional contexts.

The remaining list of 66 nouns was used as a basis for developing the eight storyboards. Two nouns from each CSI rank were chosen, which were mapped onto being either high frequency (top two frequency quartiles) or low frequency (bottom two frequency quartiles) nouns. However, the third CSI rank nouns all corresponded to high frequency nouns (top frequency percentile) so it was not possible to fully choose a high and a low frequency noun for the third CSI rank. Nevertheless, this technique enabled us to select eight nouns ranging in cognitive salience and frequency. The order of the eight storyboards (c.f. **Table 4**) was randomised for each participant.

Target Noun	**Picture number and interactional context**	**Max CSI rank**	**Frequency quartile**
Fish	1: catch 2: carry home 3: eat 4: sell	1	2
Sugarcane	1: cut 2: carry home 3: eat 4: sell	1	3
Firewood	1: collect/gather 2: carry home 3: make fire with 4: sell	2	3

(Contd.)

Target Noun	Picture number and interactional context	Max CSI rank	Frequency quartile
Water	1: catch 2: carry home 3: drink 4: wash with	2	1
Yam	1: dig up 2: carry home 3: eat 4: sell	3	1
Pig	1: catch 2: carry home 3: eat 4: sell	3	1
Fly	1: catch 2: carry home 3: eat 4: sell	4	4
Rat	1: catch 2: carry home 3: eat 4: sell	4	1

Table 4: the eight storyboards, their interactional contexts, CSI rank and frequency quartiles.

3.4 Procedure

Prior to data collection, experimental protocols were translated into Bislama and French and were checked by a French and a Bislama native speaker. The protocols were then back translated into English to validate the translations. Participants were first read the instructions below in either Bislama or French. Participants were encouraged not to repeat the possessed noun in the stories, so as to elicit classifiers used anaphorically without a possessed noun. Participants were shown the story on a laptop screen. The story was presented one picture at a time and the Bislama/French text read out. Then the storyboard was presented again picture by picture and the participant was asked to retell the story in their language. Often the French or Bislama version was repeated during this time as a prompt. Answers were recorded directly onto the laptop underneath each picture.

Instructions

There are eight short stories to look at. I will explain each story first in Bislama/French and then I would like you to retell the story in your language. Each story has four pictures. For each picture I want to know how you say that the object in the picture belongs to the man or the woman in the picture.

After the first picture you do not need to repeat the name of the object, just the word meaning 'his' or 'hers'. For example, if the first picture is of a man and a woman making coffee, you can say 'they are making their coffee'. If the next picture shows the man drinking the coffee, you should say 'he is drinking his one' but not 'he is drinking his coffee'.

Some stories will sound a bit strange, but I want you to translate them even though they sound strange.

I will write down what you have said and ask you to help translate it. I will record what you say on the audio recorder.

The instructions explicitly asked that, after establishing the referent of the possession in the first picture using a noun, the participant was to avoid further uses of that noun and instead use just the possessive classifier, if possible. If a participant gave a response that deviated from expected, they were prompted to reformulate, using a classifier without a possessed noun. If a participant only used a noun as the referring device in the second, third or fourth picture, they were asked if it was possible to replace the noun with just a possessive classifier. Similarly, if a participant gave a full possessive construction consisting of classifier and possessed noun, they were asked if it was possible to say the sentence again, without the possessed noun. The goal of the experiment was not to uncover whether possessive classifiers can occur on their own without a possessed noun as a reference tracking device, but whether the classifiers used as reference tracking devices would vary according to the interactional contexts shown by the different pictures of the storyboards. All responses were recorded from the participants.

4 Results and Analysis

The data were analysed in four ways. First, we analysed only the responses where classifiers were used anaphorically without a possessed noun (4.1). Second, we included all possessive constructions used by participants, including directly possessed nouns, prepositional possession, and classifiers that occurred with a possessed noun (4.2). Third, we analysed the patterns of classifier responses (4.3). Finally, we analysed the results for each individual storyboard (4.4). All statistical tests were conducted using R software (R Core Team 2023).

4.1 Classifiers used Anaphorically

We isolated all responses where participants used the possessive classifiers anaphorically without a possessed noun. We did this to track the use of classifiers across discourse units to see whether

they matched or differed from their antecedent. The following types of responses were excluded: (i) no possessive construction, (ii) a directly possessed noun, (iii) a preposition, or (iv) a classifier with a possessed noun. This is a strict view of the use of classifiers as reference tracking devices, since we excluded classifiers that occur with a possessed noun. Then in section 4.2 we offer a less strict analysis, which includes all possessive constructions.

A minimum of two classifiers used anaphorically per storyboard were required in order to assess whether participants used a matching or non-matching strategy. The first picture of each four-picture storyboard sets the scene and introduces the target noun. Participants were not required to use a possessive phrase to introduce the target noun. However, some participants did use a classifier construction, which we counted in our analysis. In the subsequent three pictures (pictures 2, 3 and 4), only anaphoric uses of classifiers were counted. The amount of data required to determine if the anaphoric uses of classifiers matched an antecedent was either:

1. A minimum of two anaphoric occurrences of classifiers for pictures 2, 3 and 4. (see **Table 4** for the interactional contexts for each picture).
2. A minimum of one anaphoric occurrence of a classifier for pictures 2, 3 and 4 and a classifier used for picture 1.

We give two glossed examples from the experiment below from the fish storyboard. Example (12), from North Ambrym, shows the introduction of the noun *myaalo* 'fish' in the first picture. The possessive classifiers in pictures 2–4 are all used anaphorically within the text to refer back to the antecedent *myaalo* 'fish'. The North Ambrym example shows a matching strategy, as all classifiers are the same, regardless of the contextual interactions.

(12) **North Ambrym**

1. *Jon nyerō Meri mōrō a kokoō letee te mōrō sene myaalo*
   John 3DU Mary 3DU.REAL go fish coast CONJ 3DU.REAL catch fish
   'John and Mary went to catch fish at the coast and they caught fish'
2. *Jon nyerō Meri mōrō rrya* ***arō*** *ge bya bsaō*
   John 3DU Mary 3DU.REAL carry FOOD.CL.3DU PTV go home
   'John and Mary carried theirs home'
3. *Jon myar ma gte te ma ngne* ***an*** *ge*
   John hunger 3SG.REAL bite CONJ 3SG.REAL eat.TR FOOD.CL.3SG PTV
   'John was hungry and he ate his'
4. *Meri me a lon maket te bya foone* ***an*** *ge*
   Mary 3SG.REAL go in market CONJ go sell FOOD.CL.3SG PTV
   'Mary went to the market and sold hers'

Example (13), from Iaai, shows the noun *wââ* 'fish' being introduced for the first picture along with the FOOD classifier. The further three instances of classifiers are all used anaphorically

without a possessed noun and refer back to the antecedent *wââ* ‘fish’. The Iaai example shows a non-matching strategy as different classifiers are used across an individual storyboard.

(13) **Iaai**[6]

1. *Ioane me Maria ödrume he ka thutri* ***ödru*** ***wââ***
   John conj Mary 3DU.PRS go CONJ catch FOOD.CL.3DU fish
   ‘John and Mary went and caught their fish’
2. *Ödrume hmetu hnyabai me* ***hanidru***
   3DU.PRS return home CONJ CATCH.CL.3DU
   ‘they returned home with theirs’
3. *Ioane e be han, ame omesökâ* ***haniiny***
   John 3SG want eat 3SG.PRS cook CATCH.CL.3SG
   ‘John was hungry, he went and cooked his’
4. *Maria ame salemâ* ***haniiny***
   Mary 3SG.PRS sell CATCH.CL.3SG
   ‘Mary went and sold hers’

Table 5 shows different permutations of dummy data to explicate the permissible responses accepted for analysis detailed above, where CL indicates ‘classifier with possessed noun’; ANA

		Pic 1	Pic 2	Pic 3	Pic 4	analysable
P01	**Response**	NO	ANA	ANA	ANA	yes
	Accepted	✓	✓	✓	✓	
P02	**Response**	NO	CL	CL	ANA	no
	Accepted	✓	X	X	✓	
P03	**Response**	CL	CL	ANA	ANA	yes
	Accepted	✓	X	✓	✓	
P04	**Response**	CL	NO	CL	ANA	yes
	Accepted	✓	X	X	✓	
P05	**Response**	NO	ANA	CL	CL	no
	Accepted	✓	✓	X	X	

Table 5: Example dummy permissible responses included for analysis.

[6] It is interesting that the initial classifier in example 13–1 is the FOOD classifier, rather than the CATCH classifier. As Oceanic classifier systems are relational, they can encode intended relations as well as actual relations. Here it is the intention to eat the fish that is encoded, rather than the actual relation of catching it.

indicates ‘anaphoric use of a classifier’; and NO indicates ‘no possessive construction’. A classifier with a possessed noun was only included for analysis if it occurred as a response for the first picture as this was acceptable to introduce the target noun and function as the antecedent for future anaphoric uses of classifiers. Any further instances of classifiers with possessed nouns were deliberately omitted in this analysis (but see section 4.2 for an analysis where they are included).

Table 6 shows the different classifiers used anaphorically across the sample languages. One important by-product of this methodology is that we were able to describe three different classifiers that had previously not been documented (marked by an asterisk in **Table 6**).[7]

Merei (3)	**Lewo (3)**	**Vatlongos (4)**	**N. Ambrym (4)**	**Iaai (12)**	**Nêlêmwa (12)**
GENERAL	GENERAL	GENERAL	GENERAL	GENERAL	STARCH
CONSUMABLE	FOOD	FOOD	FOOD	FOOD	MEAT
*CARRY	DRINK	DRINK	DRINK	DRINK	VEGETABLE
		LAND	FIRE	FIRE	DRINK
				CATCH	SUGARCANE
				LAND	PLANT
				PLANT	ANIMAL
				SUGARCANE	CATCH-LINE
				CHEW	BURDEN
				BURDEN	WEAPON
				ANIMAL	*CONTENTS-GATHER
				THOUGHT	*CONTENTS-WEAPON

Table 6: Classifiers used anaphorically by participants across the sample languages. Classifiers marked with an asterisk had not been previously documented.

[7] A brief explanation of the previously undescribed classifiers is given here. For Merei, the *sor-* CARRY classifier is used for items that are carried and resembles the semantics of the BURDEN classifiers described for Nêlêmwa (Bril 2012: 367) and Iaai (Dotte 2017). The example from the firewood storyboard: *sor-na tavaiabu* ‘his carried firewood (CARRY.CL-3SG firewood)’. For Nêlêmwa, the *shâ-yalavi-* CONTENT-GATHER classifier occurred in the rat storyboard. On further elicitation we found that the classifier is used for items that are collected by gathering, such as *shâ-yalavi-ny büa* ‘my gathered blue-giant clams (CONTENT-GATHER-1SG blue-giant clam)’. We found that this classifier can also be used with *kuvic* ‘yam’. An alternative construction was offered using the general linking preposition, with our consultant saying that it has an identical meaning to the classifier usage: *shâ-yalaw i na* ‘my gathered possessions (content-gather LINK 1SG)’. This alternative construction was also given by a participant in one of the storyboard responses. The second classifier, *shâ-ââdaxi-* CONTENT-WEAPON, is used for animals that have been killed by your weapon. This classifier was given in the pig storyboard. On further elicitation, our language consultant also gave *shâ-ââdaxi-ny dia* ‘my deer, killed with a weapon (CONTENT-WEAPON-1SG deer)’.

Responses were coded into a dichotomous variable to indicate one of two strategies: either matching classifiers used anaphorically across a storyboard, or non-matching (different) classifiers used anaphorically across a storyboard.

Figure 2 shows the mean percentage of matching classifiers used anaphorically across all storyboards by language. North Ambrym, with over 90% mean matching responses, shows a different pattern to the other languages in the sample. This supports previous research illustrating that North Ambrym has largely fixed assignment of classifiers (Franjieh 2018), in contrast to the other five languages. We investigate this further to establish whether these five languages show statistically significantly different patterns to North Ambrym.

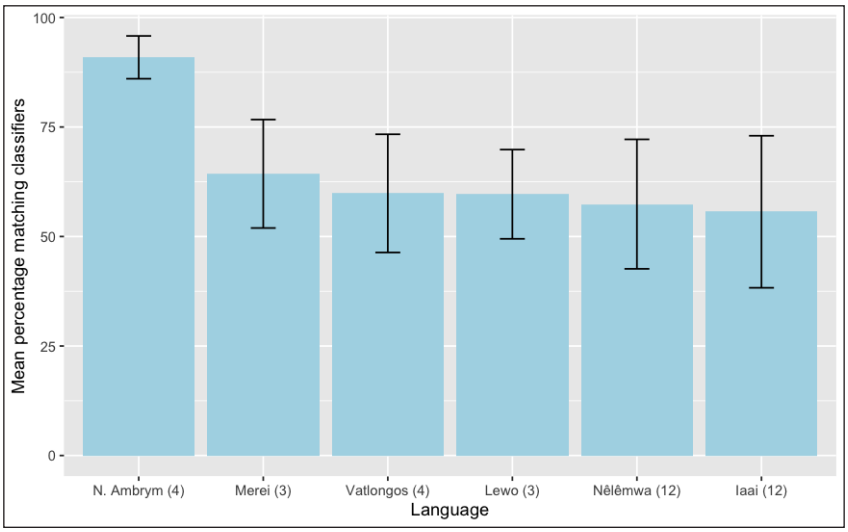

Figure 2: Bar plot showing the mean percentage of matching anaphoric strategies for each sample language (total number of classifiers across all participants for each sample language given in brackets). Error bars show the 95% confidence intervals.

There were fluctuations in the number of matching strategies according to storyboard across languages (c.f. **Figure 7**). To account for these differences, we ran a binomial generalised linear mixed model with random intercepts.[8] The dependent variable was the matching/non-matching strategy for a storyboard, with language as the fixed effect. The model had two random effects – individual storyboard and participant. Models were created in R using the *glmer* function from the *lme4* package (Bates et al. 2015). **Table 7** gives an overview of the results. R^2 values were calculated using the *MuMIn* package in R (Bartoń 2024). There were 870 observations, 124 participants and 8 storyboards.[9] Iaai was used as the reference level for the fixed effects of language.

[8] We thank a reviewer for suggesting this approach. We explored other modelling strategies but found them to hold less explanatory power. Results for ANOVA and a GLMM with a single random intercept of individual storyboards can be found in the supplementary files.

[9] For one Iaai participant all their responses did not meet the criteria for inclusion described previously and were omitted from this analysis. This participant's responses were included in the subsequent analysis in section 4.2.

	Model			
Fixed Effects	**Estimate**	**Standard Error**	***z***	***p***
Intercept	.166	.405	.409	.682
Lewo	.353	.499	.709	.478
Merei	.664	.512	1.296	.195
Nêlêmwa	.282	.547	.515	.607
North Ambrym	2.669	.562	4.750	**<.001**
Vatlongos	.361	.503	.718	.473
Random Effects	**Variance**		**SD**	
Storyboard	.121		.348	
Participant	1.510		1.223	
	Marginal R^2		**Conditional R^2**	
Theoretical R^2	.153		.433	

Table 7: Generalised Linear Mixed Model for anaphoric possessive constructions. Significant p values for fixed effects in bold.

The model shows that the dependent variable is more often 1 (a matching strategy) in North Ambrym than in Iaai, and there is no significant difference between any other languages and Iaai. The model shows that North Ambrym is a significant predictor of matching reference tracking strategies. The model's R^2 values show that — when including the random effects of storyboard and participant — the model can account for 43.3% of the matching strategies.

4.2 All Possessive Constructions

Although we asked participants to give an anaphoric use of a classifier after the target noun was introduced, not every participant did so, even after prompting. This resulted in some instances where the minimum amount of data for analysis was not met (c.f. section 4.1), especially for the two New Caledonian languages (Iaai and Nêlêmwa) shown in **Table 8**. These missing data were due to several reasons. First, some participants saw each picture within a storyboard as an individual scene to be described, rather than as part of a continuous story. In these instances, participants preferred to give a classifier with a possessed noun, rather than use a classifier anaphorically without a possessed noun. Second, some missing data stemmed from participants using a directly possessed noun or avoiding a possessive phrase by giving just the noun without

a classifier. Finally, in the case of Nêlêmwa, there is no GENERAL classifier, instead a general preposition is used, which must occur with a possessed noun (c.f., example (8)).

In Nêlêmwa we found examples where different participants could use a particular noun with either possessive classifiers or with the general linking preposition. For the yam storyboard, one participant used *kuvic* 'yam' only with the linking preposition: e.g., *kuvi i ye* (yam LINK 3SG), whereas another participant varied in choice between the *ââ-* PLANT classifier or the *caa-* STARCH classifier for *kuvic* 'yam'. Another example from Nêlêmwa involves *wi* 'water', which could be either directly possessed *wi-n* 'water-3SG' or referred to anaphorically with the DRINK classifier, *kêâ-*, even by the same participant.

In order to account for the missing data, we investigated the use of possessive constructions across the four pictures in each storyboard regardless of their type. The following types of constructions were included for comparison:

- Possessive classifiers used anaphorically without a possessed noun
- Possessive classifiers with a possessed noun
- Directly possessed nouns
- Prepositional possessive constructions

Language	Total potential data points	Missing data including only classifiers used anaphorically (without a possessed noun)	Missing data including all possessive constructions
Merei	168	13 (7.74%)	0
Lewo	176	0	0
Vatlongos	176	2 (1.14%)	2 (1.14%)
North Ambrym	176	1 (0.57%)	0
Iaai	152	51 (35.55%)	6 (3.95%)
Nêlêmwa	152	63 (41.45%)	4 (2.63%)

Table 8: Data points and missing data points per language.

The analysis sought to discover whether the same strategy (matching vs. non-matching) was used across the four pictures of a storyboard. As we include all types of possessive constructions, this led to an increase in the number of categories used for the comparison for the following languages, in addition to those given in **Table 6**:

- For Iaai, participants also used directly possessed nouns and two previously undescribed classifiers: WASH and BATHE.[10]
- For Nêlêmwa, participants also used directly possessed nouns, and the general prepositional possessive construction (example (8)).
- For North Ambrym, participants also used an associative preposition (example (6)).

Table 9 shows the most frequent possessive construction used across each storyboard. Speakers of Merei have a preference for the GENERAL and CONSUMABLE classifiers — the two main classifiers in the language. Speakers of the three languages of Central Vanuatu — Lewo, Vatlongos and North Ambrym used the FOOD or DRINK classifier more than other classifiers. Speakers of the two New Caledonian languages — Nêlêmwa and Iaai — who have access to larger inventories of classifiers, used a mix of classifiers. Note that these are just the most frequent classifier used for each storyboard, and this does not show whether participants used a matching or a non-matching strategy, which will be discussed below.

	Merei	**Lewo**	**Vatlongos**	**North Ambrym**	**Nêlêmwa**	**Iaai**
Firewood	GENERAL	FOOD	GENERAL	FIRE	BURDEN	BURDEN
Fish	CONSUMABLE	FOOD	FOOD	FOOD	MEAT	CATCH
Fly	GENERAL	FOOD	FOOD	FOOD	GENERAL PREPOSITION	CATCH
Pig	GENERAL	FOOD	FOOD	FOOD	ANIMAL	ANIMAL
Rat	GENERAL	FOOD	FOOD	FOOD	MEAT	CATCH
Sugarcane	CONSUMABLE	DRINK	DRINK	DRINK	SUGARCANE	GENERAL/ FOOD
Water	GENERAL	DRINK	DRINK	DRINK	DRINK	DRINK
Yam	GENERAL	FOOD	FOOD	FOOD	PLANT	FOOD

Table 9: Most frequent classifier per storyboard.

[10] For Iaai, the *hûe-* WASH classifier occurred with the noun *köiö* 'water' in the water storyboard: *hûe-n köiö* 'his washing water (WASH.CL-3SG water)'. This might be related to the verb *hneû/hnûû* 'to wash' Ozanne-Rivierre 1984: 62). The *sûe-* BATHE classifier also occurred with the noun *köiö* 'water' in the water storyboard: *sûe-n köiö* 'his bathing water (BATHE.CL-3SG water)'. This classifier is more transparently derived from the verb *sooû/sûûa* 'to wash' (Ozanne-Rivierre 1984: 104), though translated as *'to bathe (se baigner)'* by the participant.

Figure 3 shows the mean percentage of matching classifiers used anaphorically across all storyboards by language. North Ambrym's pattern of matching responses is greater than all other languages in the sample. In contrast, both Nêlêmwa and Iaai have the fewest mean matching responses, compared to all other languages.

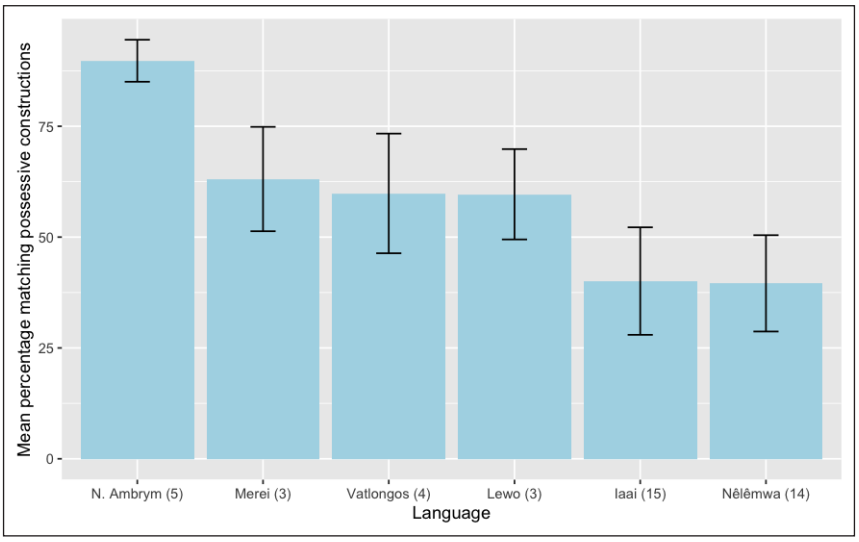

Figure 3: Bar plot showing the mean percentage of matching strategies for each sample language (total number of possessive strategies across all participants for each sample language shown in brackets). Error bars show the 95% confidence intervals.

The results show both similarities and differences to the analysis given in section 4.1, which looked at the strict anaphoric use of classifiers. In both analyses, the results show that North Ambrym has a higher number of instances of matching classifiers compared to the other languages. When considering all possessive strategies, used anaphorically or non-anaphorically, the two New Caledonian languages (Iaai and Nêlêmwa) have much lower matching responses across the storyboards (c.f. **Figure 3**). This indicates that they have more variable classification systems compared to the Vanuatu languages. The three Vanuatu languages other than North Ambrym, that is Merei, Vatlongos and Lewo, have intermediate systems, which have a slight preference for using the same possessive strategy across the storyboards.

Multiple linear regression was conducted to investigate whether the percentage of non-matching possessive strategies used by each participant was affected by the number of different possessive constructions used across the storyboards and the language spoken. Homoscedasticity was confirmed with a Breusch-Pagan test result of $x^2 = 1.175$ $p = .278$. However, the Shapiro-Wilk test showed the residuals were non-normal, $W = .970$, $p = .006$. Despite this, given the nature of our data, transformation of the data or exclusion of valid data points that presented as outliers, were deemed more problematic as approaches than cautionary

interpretation of the findings (see Pek, Wong & Wong 2018 for a review). The model was significant, $F(6,118) = 12.02$, $p < .001$, indicating at least one predictor significantly affects the percentage of non-matching strategies. The model explains 35% of the variance in number of non-matching strategies, with an adjusted R^2 of .348. The number of possessive constructions that a participant used across storyboards was a significant predictor $t(3.449) = 7.461$, $p < .001$, indicating a strong positive effect on the percentage of non-matching possessive strategies. Only the North Ambrym language was a significant predictor $t(–2.819) = –27.826$, $p = .006$, indicating a strong negative effect on the percentage of non-matching possessive strategies.

Similar to the analyses detailed in section 4.1, we ran a GLMM with random intercepts. The dependent variable was the matching/non-matching strategy for a storyboard for all possessive constructions, with language as the fixed effect. The model had two random effects — individual storyboard and participant. **Table 10** gives an overview of the results. There were 988 observations, 125 participants and 8 storyboards. Iaai was used as the reference level for the fixed effects of language.

	Model			
Fixed Effects	**Estimate**	**Standard Error**	***z***	***p***
Intercept	–.570	.347	–1.645	.100
Lewo	1.073	.419	2.559	**.011**
Merei	1.260	.427	2.948	**.003**
Nêlêmwa	.050	.434	.0115	.908
North Ambrym	3.159	.479	6.594	**<.001**
Vatlongos	1.085	.423	2.565	**.010**
Random Effects	**Variance**		**SD**	
Storyboard	.200		.447	
Participant	1.084		1.041	
	Marginal R^2		**Conditional R^2**	
Theoretical R^2	.194		.420	

Table 10: Generalised Linear Mixed Model for all possessive constructions. Significant p values for fixed effects in bold.

The model shows that the dependent variable is more often 1 (a matching strategy) in North Ambrym, Merei, Vatlongos and Lewo than it is in Iaai. There was no significant difference between Nêlêmwa and Iaai. This model gives a nuanced picture as all the Vanuatu languages are significant predictors of matching strategies, with North Ambrym the most significant. The R^2 values in the model show that when including the random effects of storyboard and participant, the model accounts for 42% of the matching strategies.

To investigate if the three Vanuatu languages of Lewo, Merei and Vatlongos function as intermediate systems different to North Ambrym on the one hand, and Iaai and Nêlêmwa on the other hand, we re-ran the GLMM with Vatlongos as the reference level. **Table 11** shows the results for the fixed effects of language.

	Model			
Fixed Effects	**Estimate**	**Standard Error**	***z***	***p***
Intercept	.515	.328	1.567	.117
Iaai	–1.085	.423	–2.565	**.010**
Lewo	–.012	.403	–.029	.977
Merei	.175	.410	.426	.670
Nêlêmwa	–1.035	.420	–2.464	**.014**
North Ambrym	2.074	.460	4.508	**< .001**

Table 11: Generalised Linear Mixed Model with Vatlongos as the intercept. Significant p values in bold.

The model shows that the dependent variable is more often 1 (matching strategy) in North Ambrym than in Vatlongos and that the dependent variable is more often 0 (non-matching strategy) in Iaai and Nêlêmwa than in Vatlongos. There is no significant difference between Lewo and Vatlongos or Merei and Vatlongos. The model confirms that Merei, Lewo and Vatlongos function as intermediate systems.

To visualise the difference between participants and languages, **Figure 4** shows the cumulative percentage of participants using a matching strategy across storyboards. The eight storyboards are represented on the x-axis, where the number 8 represents the percentage of participants who used matching strategies for all eight storyboards. The number 7 represents the cumulative percentage of participants who gave matching strategies for either all eight storyboards, or seven out of eight of the storyboards. **Figure 4** gives a clear representation of the differences between

the languages, with three clusters of clines. North Ambrym, with the most matching strategies, has over 35% of participants using a matching strategy for all eight storyboards, with 90% of participants using a matching strategy for either all storyboards, or seven out of eight storyboards. The three other Vanuatu languages (Merei, Vatlongos and Lewo) all have smaller percentages of participants using matching strategies for all eight storyboards (between 9% and 14%), rising to between 22% and 32% for all eight storyboards and for seven out of eight storyboards. It is important to note therefore, that some speakers in these languages do prefer to use a matching strategy regardless of interactional context. There were no speakers of the two New Caledonian languages, Iaai and Nêlêmwa, who gave a matching strategy for either all eight storyboards or seven out of eight storyboards. Around 16% of speakers of Iaai and Nêlêmwa used matching strategies for six out of eight of the storyboards. These three clusters confirm the mixed model analysis above.

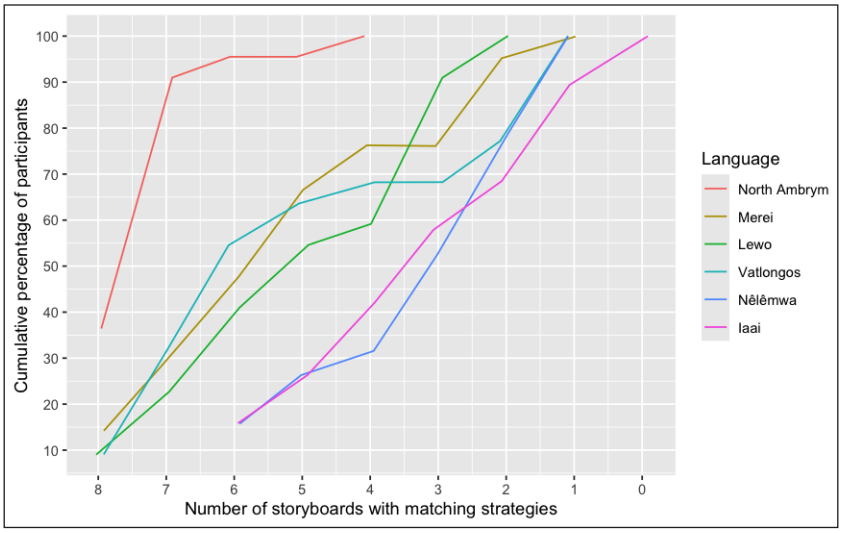

Figure 4: Line plot showing the cumulative percentage of participants using matching strategies across the storyboards.

4.3 Response patterns

In this section, we provide a brief overview of the use of classifiers across each language and storyboard to get a better understanding of how speakers of each language use their system. To get a more in-depth understanding, we then abstract away from the semantic/mnemonic labels used to compare across languages in a more equal way.

For understanding the move towards fixed assignment in classification system, we have to investigate what types of matching and non-matching strategies were chosen by the participants across the storyboards, and whether certain strategies are preferred. The storyboards followed a similar four picture pattern of (i) finding or catching a particular object, (ii) returning home with it, (iii) doing something natural with it (e.g., eating, drinking, making fire), and (iv) doing

something less obvious, such as selling or washing with it. As each language has a varying inventory of classifiers, which embody different semantic domains, and a number of other possessive constructions, it is not a simple task to compare like for like. In order to create a fair comparison across languages, we abstracted away from the semantics of each possessive construction and instead focussed on whether a particular construction was used and then if it was repeated later in the story. There are five logical values based on the four possible responses for a storyboard:

- 0: no possessive strategy given. For example, if only a noun, a pronoun or zero anaphor was used by a participant in a particular response.
- 1: the first possessive construction used. For example, a particular possessive classifier, such as FOOD or DRINK, or a directly possessed noun or prepositional construction. Any further uses of the same strategy will also receive this code.
- 2: the number given to the second different possessive construction used and any uses of that same construction thereafter.
- 3: the number given to the third different possessive construction used and any uses of that same construction thereafter.
- 4: the number given to the fourth different possessive construction used.

Table 12 gives some fictitious data to show how the patterns are coded. Fictitious data is shown for eight different participants and their responses to the fish storyboard. Different classifiers are shown in small caps – GEN 'general classifier', FOOD 'food classifier', BURDEN 'burden or carry

Picture	**Participants**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	GEN fish	FOOD fish	fish	fish	fish	CATCH fish	FOOD fish	fish
2	GEN	FOOD	FOOD	GEN	GEN fish	BURDEN fish	BURDEN fish	fish
3	GEN	FOOD	FOOD	FOOD	FOOD	FOOD	FOOD fish	FOOD fish
4	GEN	FOOD	FOOD	GEN	FOOD	GEN	BURDEN	GEN
Pattern	1111	1111	0111	0121	0122	1234	1212	0012
Matching	Yes	Yes	Yes	No	No	No	No	No

Table 12: Example pattern coding for fictitious data for eight participants for the 'fish' storyboard.

classifier'. Some responses have both a classifier and a possessed noun, other cells have anaphoric use of classifiers without a possessed noun, and yet other cells have just a noun which does not appear in a possessive construction. The pattern row gives a four-digit code corresponding the pattern used by the participant, outlined above. Participants 1–3 used matching strategies, and participants 4–8 used non-matching strategies.

Descriptive statistics for the number of pattern responses for each language are shown in **Table 13**.

language	mean	sd	median	IQR
North Ambrym	2.273	0.550	2.000	1.000
Vatlongos	3.409	1.403	3.000	2.750
Merei	3.857	1.315	4.000	2.000
Lewo	3.955	1.214	4.000	2.000
Nêlêmwa	4.368	1.212	4.000	1.500
Iaai	4.895	1.150	5.000	1.500

Table 13: Descriptive statistics for number of possessive strategy patterns across the sample languages, sorted from lowest to highest mean number of patterns.

We conducted an analysis of variance using the *rstatix* package (Kassambara 2023). The ANOVA shows a significant difference between number of patterns given by participants across languages $F(5, 119) = 12.579$, $p < .001$, $\eta p^2 = .346$. Pairwise comparisons comparing individual languages indicated that North Ambrym had significantly lower numbers of patterns than all other languages (largest $p < .002$). Iaai participants gave significantly more patterns than Lewo, Merei, Vatlongos and North Ambrym (largest $p = .012$). Nêlêmwa participants gave significantly more pattern responses than North Ambrym and Vatlongos (largest $p = .005$). **Figure 5** shows the mean number of patterns across the language sample. The pattern closely mirrors that shown in **Figure 3**, revealing that languages with more matching possessive strategies used lower overall patterns. This is expected as there were only 9 matching possessive strategies (patterns that either have 0 or 1), lower than the twenty patterns for non-matching possessive strategies (patterns that have 2 or higher in them).

The stacked bar plot in **Figure 6** illustrates the different patterns used across the languages. In order to simplify the data, patterns where there were insufficient numbers of classifiers to be counted as either matching or non-matching are not included. Patterns such as 0000, 0100 or 0010, where only one or no classifiers were given for a storyboard amounted to 3.95% of the data for Iaai, 2.63% for Nêlêmwa, and 1.14% for Vatlongos.

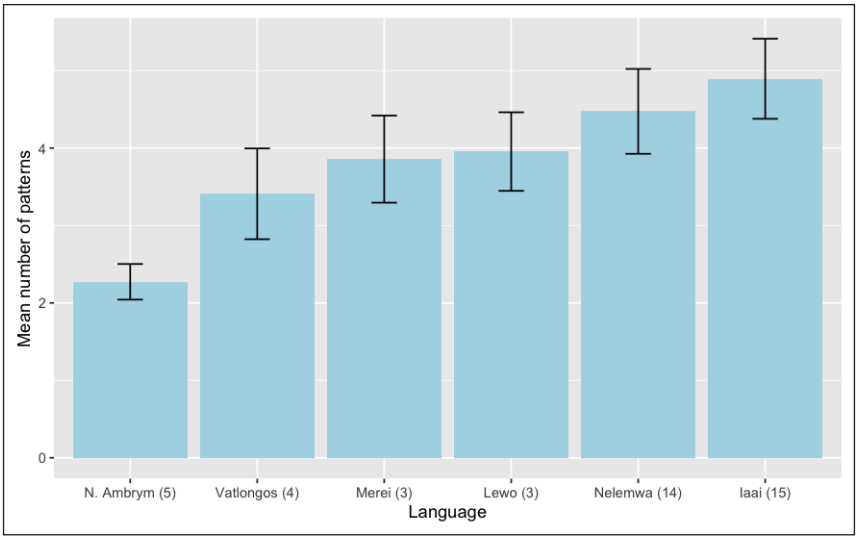

Figure 5: Bar plot showing the mean number of patterns for each sample language (total number of possessive strategies across all participants for each sample language shown in brackets). Error bars show the 95% confidence intervals.

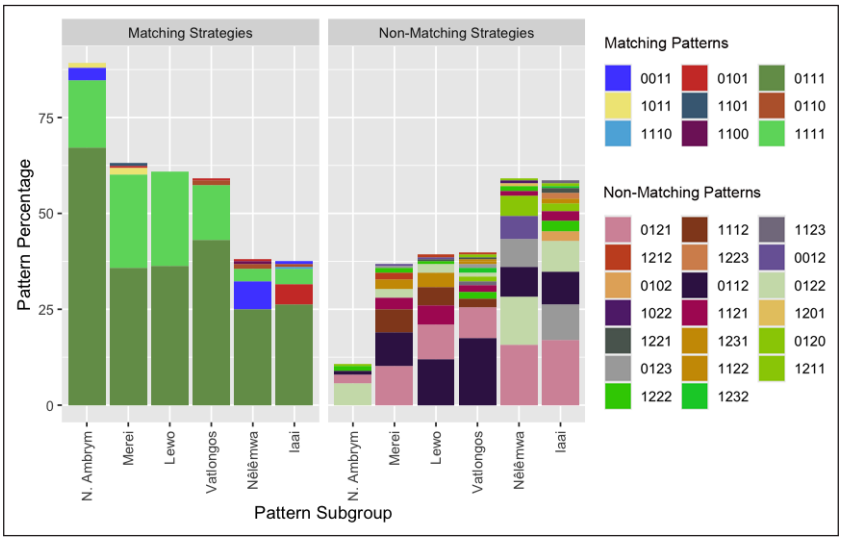

Figure 6: Stacked bar plot showing matching and non-matching strategies across the sample languages.

Table 14 shows a summary of the highest frequency patterns for both matching and non-matching strategies. Out of the nine fixed patterns, the 0111 pattern had the highest frequency across all languages. Out of the twenty variable patterns, 0121 had the highest frequency for Merei, Nêlêmwa and Iaai. 0112 had the highest frequency for Lewo and Vatlongos, and 0122 was the highest percent for North Ambrym.

Language	total matching patterns	Highest frequency matching pattern	total non-matching patterns	Highest frequency non-matching pattern	Total patterns
N. Ambrym	4	0111 (67.05%)	5	0122 (5.68%)	9
Merei	5	0111 (35.71%)	10	0121 (10.12%)	15
Lewo	2	0111 (36.36%)	10	0112 (11.93%)	12
Vatlongos	4	0111 (43.18%)	15	0112 (17.61%)	19
Nêlêmwa	6	0111 (25%)	12	0121 (16.45%)	18
Iaai	6	0111 (26.32%)	14	0121 (17.11%)	20

Table 14: Total number of patterns, matching and non-matching with details of highest frequency patterns for matching and non-matching.

Individual languages were analysed using paired samples t-tests comparing the total number of unique matching and non-matching patterns. North Ambrym showed significantly more matching patterns than non-matching patterns ($t = 6.736$, $p < .001$). All other languages had no significant difference between the frequency of matching and non-matching patterns (lowest $p = .752$).

4.4 Individual Storyboard Analysis

The storyboards investigate eight different target nouns that differ both in noun frequency and saliency. **Figure 7** details the percentage of matching possessive strategy across individual storyboards (same criteria as section 4.2) for all participants across each sample language. The x-axis shows each individual storyboard in left to right descending order according to average matching possessive strategy percentages across all six languages (i.e., 'firewood' has the highest mean agreement percentages across the six languages, and 'water' has the lowest mean agreement percentages).

Chi-squared tests with Yates' continuity correction showed that there were significant differences between storyboards and whether participants used a matching or non-matching strategy in their response (either anaphorically or with a possessed noun). There was a significant difference for Merei, with a moderate association ($X^2 = 17.485$, $p = .015$, V = .323[11]). Both Lewo ($X^2 = 32.273$, $p < .001$, V = .428) and Vatlongos ($X^2 = 21.016$, $p = .004$, V = .428) showed

[11] Cramér's V calculated using the *rcompanion* package in R (Mangiafico 2024).

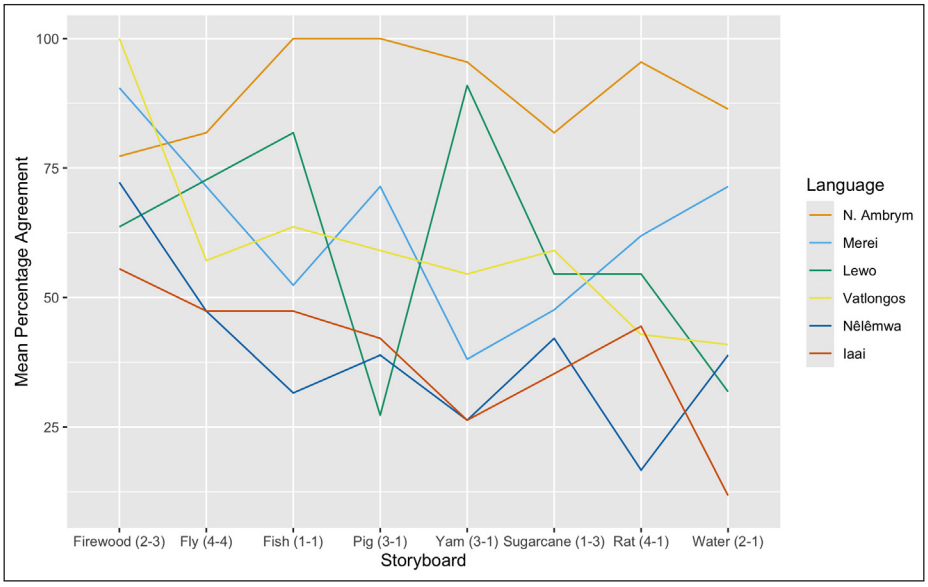

Figure 7: Matching possessive strategies (%) across each storyboard and language. The brackets after each storyboard name indicate the CSI rank followed by the frequency quartile.

significant differences, with a relatively strong association. For North Ambrym, expected values were less than 5 for non-matching strategies, hence a Fisher's test of exactness was conducted, which resulted in a significant difference, but with a moderate association ($p = .038$, V = .278). Nêlêmwa has a moderate association ($X^2 = 14.459$, $p = .044$, V = .313). For Iaai, a Chi-squared test was non-significant ($p = .179$).

For the languages with significant differences and a relatively strong association (Lewo and Vatlongos), Bonferroni corrected pairwise comparisons (adjusted $p = .003$) were conducted by comparing adjusted standardised residuals. Lewo showed significantly fewer matching strategies for the pig storyboard and significantly more matching strategies for the yam storyboard. Vatlongos showed significantly more matching strategies for the firewood storyboard.

5 Discussion

A clear cline emerges from the analyses of the storyboard data in our language sample. In our experiment the North Ambrym language is set apart from the other languages, since it has significantly higher matching anaphoric uses of classifiers. North Ambrym has a mean anaphoric use of matching classifiers of above 90%, with the lowest standard deviation amongst the language sample (c.f., section 4.1). Participants from North Ambrym used the same classifier anaphorically more consistently across an individual storyboard than participants from other languages, indicating that the North Ambrym classifier system bears comparison with a system which is redundant in having fixed assignment and which allows anaphoric agreement (in this respect comparable to many gender systems).

When taking into account different types of possessive constructions (section 4.2), used either anaphorically or non-anaphorically, North Ambrym's system still had more uses of matching strategies across a storyboard. At the other end of the cline, both Nêlêmwa and Iaai with large (and fairly open) systems of classifiers had higher amounts of non-matching reference tracking strategies in a storyboard, indicating a lack of fixed assignment. In the middle of the cline are Merei, Lewo and Vatlongos. Participants from these three languages used on average more matching possessive strategies than non-matching strategies. The GLMM confirmed that North Ambrym had significantly more matching strategies than Merei, Lewo and Vatlongos, and Iaai and Nêlêmwa had significantly more non-matching strategies. Language, storyboards, and individual variation accounted for 42% of the overall variation in the GLMM. We did not have enough participants to stratify the sample for age or gender and this may be the reason for the lower explanatory power of the model. Multiple linear regression revealed that the more different possessive constructions a participant used across the storyboards, the more likely they were to use non-matching reference tracking strategies. This supports the findings that Iaai and Nêlêmwa, with the largest inventory of classifiers in the sample, had the highest amount of non-matching reference tracking strategies. Furthermore, the only language to have an effect on the number of non-matching reference tracking strategies was North Ambrym, with a significant negative effect, supporting the difference of this language to the others in the sample.

By abstracting away from the different semantics of the possessive constructions, we identified different patterns of matching and non-matching strategies used by participants (section 4.3). North Ambrym, with a more fixed (redundant) assignment system showed significantly fewer different patterns of reference tracking strategies overall than all other languages. Both Iaai and Nêlêmwa, had significantly more patterns of reference tracking strategies available than most other languages. Individual paired t-tests for each language demonstrate that North Ambrym does use significantly more matching strategies than non-matching strategies, indicating a system which is more gender-like in this respect.

Investigations of matching responses across the eight storyboards in each individual language (section 4.4) revealed only minor differences for Lewo and Vatlongos, but these differences were not shared by other languages. There is little evidence suggesting an overall effect of particular storyboards on whether participants used more matching responses. This also points to there being little influence of our linguistic measure of frequency and our psychological measure of salience on participants' matching strategies.

6 Conclusion

The data presented reveals that – within classifier systems – redundancy can develop, as systems of assignment become fixed, and this brings them closer to grammatical gender. North Ambrym had previously been presented as showing this phenomenon (Franjieh 2016; 2018). However, North Ambrym's system had not been rigorously tested for use in anaphoric

contexts. By comparing North Ambrym against other similar Oceanic languages with varying inventories of classifiers, we have shown that North Ambrym has an average of just over 90% of instances of matching classifiers in the storyboard experiment, with the lowest levels of variation amongst participants.

Languages with large inventories of classifiers are less likely to develop fixed assignment systems. Participants who used more possessive constructions in their responses resulted in a higher amount of different matching and non-matching strategies. This points to a situation where participants from languages with more possessive constructions, such as Iaai and Nêlêmwa, used a higher amount of non-matching strategies. The other languages in our sample, Merei, Lewo and Vatlongos with smaller inventories of classifiers showed around 50% matching strategies. The results from Merei reveal that the mean number of matching strategies was higher than 50%, showing that participants were more likely to use matching rather than non-matching strategies. This should be taken together with the results from the mixed effects logistic regression, which showed that the languages of Vanuatu (North Ambrym, Lewo, Merei and Vatlongos) had significantly more matching strategies than those of New Caledonia (Iaai and Nêlêmwa). North Ambrym also had significantly more matching strategies than Merei, Lewo and Vatlongos with Iaai and Nêlêmwa having significantly more non-matching strategies. Individual participant variation is also an important factor in predicting matching strategies, revealing that some speakers are more likely to have stricter (more fixed) reference tracking systems, indicating a move towards a more gender-like system. Potentially, Merei, Vatlongos and Lewo may be showing initial signs of moving towards greater redundancy overall (a more fixed assignment system).

Evidence is accumulating from different languages around the world showing that there is no sharp dividing line between classifier systems and grammatical gender. Our evidence from Oceanic classifier systems shows that systems with small inventories of classifiers have the potential to become fixed in their assignment of noun to classifier. The data presented here provides a further argument for treating grammatical gender and classifiers as part of the same general domain of nominal categorisation.

Grammatical gender is defined by its participation in agreement (Hockett 1958: 231; Corbett 1991: 1). Yet agreement itself is subject to different views, particularly on the potential domains of agreement. Specifically, some would restrict agreement to the phrase and the clause, while others allow for agreement across larger syntactic units of discourse, so that anaphoric agreement is included in a broader definition (see Corbett 2006: 21–23, 41–42, 227–230; Enger 2013; Haig & Forker 2018; Paparounas & Akkuş 2023). Whatever one's position on that issue, the fixed assignment of noun to classifier, coupled with use in reference tracking, as we have demonstrated with North Ambrym, are key components in the development towards a gender-like system. And more generally, we have seen how useful distinctions can be reduced, as transparent classification becomes more opaque.

Abbreviations

Non-standard glosses are listed below.

ANIMAL	domestic animal classifier
ASS	associative
CATCH	catch classifier
CL	classifier
CONJ	conjunction
DRINK	drink classifier
FOOD	food classifier
GENERAL	general classifier
INTJ	interjection
LINK	linking preposition
PTV	partitive
REAL	realis

Data availability/Supplementary files

The individual participant data files, Python coding files and R analysis files can be found on the following link: https://doi.org/10.5281/zenodo.14250835 and on our project website: https://nominal-categorisation.surrey.ac.uk/projects/optimal-categorisation/experiments/.

Ethics and consent

This research has undergone a full ethical review and been granted ethical approval by the University of Surrey's ethics committee.

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Competing interests

The authors have no competing interests to declare.

Authors' contributions

Conceptualisation, Funding Acquisition: Michael Franjieh, Alexandra Grandison, Greville G. Corbett; Methodology, Formal Analysis, writing – Original Draft: Michael Franjieh, Alexandra Grandison, Anne-Laure Dotte, Greville G. Corbett; Investigation: Michael Franjieh, Anne-Laure Dotte; Data Curation and Visualisation: Michael Franjieh.

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