

# Revisiting Phonological Generalizations in Australian Languages\*

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## 1 Introduction

**1.1 Aims and background** Australian languages are famous for their near-uniform phonemic inventories. Authors such as Busby (1980); Dixon (1980); Hamilton (1996); Dixon (2002); Butcher (2006), amongst others, have emphasized the similarity of phoneme inventories across the continent, using it as evidence of intensive lexical diffusion and linguistic convergence (Dixon 1997, Dixon 2002:547). Cross-linguistic surveys of Australian languages such as those just mentioned have repeatedly published claims regarding the patterns found in the ‘typical’ Australian language, as well as other phonological generalizations meant to apply more or less equally to all of the approximately 360 languages of the continent. The apparent uniformity of Australian languages also stands out in worldwide typological surveys (Maddieson, 1984; Mielke, 2008; Hunley et al., 2012).

Moreover, Australianists have often assumed that uniformity in the phonemic inventory is coupled with uniform phonotactics (Dixon, 2002:547). Otherwise unqualified statements about uniformity in inventory and phonotactics are also easily found in reference grammars of languages in the region (for one example among many, compare Goddard 1985:21, 43, 66, 323). This ‘typical’ inventory is given in Figure 1. This assumption is, in itself, surprising, given that there is no general assumption in phonology that associates uniformity in inventory size or composition with phonotactic generalizations such as syllable structure constraints or segment frequencies.

Such phonological uniformity, if real, is surprising and unusual given the country’s phylogenetic diversity. Pace Dixon (2002), there are approximately 28 phyletic families (Dixon, 1980; O’Grady et al., 1966), and the largest of these, Pama-Nyungan, has approximately 30 low-level subgroups.<sup>1</sup> Lexical differentiation among Pama-Nyungan subgroups is extensive and rates of lexical replacement are high (Bower & Atkinson, 2012). However, contra Dixon (2001, 2002), rates of borrowing are, for the most part, low (Bower et al., 2011; Bower & Atkinson, 2012). The only ways for this large number of languages to be so similar would be through intensive, continent-wide language contact; shallow linguistic relationships; or extreme conservatism in sound change. None of these assumptions is particularly plausible. Bower et al. (2011) show that levels of language contact are variable and in scale with other languages of the world. Bower & Atkinson (2012) find high rates of lexical replacement, implying that the linguistic relationships among subgroups of Pama-Nyungan are not particularly shallow.<sup>2</sup> Sound change conservatism has not been investigated but publications such as Alpher (2004); Koch (1996, 1997), and others, provide evidence for sound change in these languages. The claims of uniformity should thus be treated with skepticism.

In this paper, we revisit claims of uniformity in Australian languages by testing variation in aspects of the phoneme inventories and phonotactics of a representative sample of languages. We do this by utilizing

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<sup>1</sup> Pama-Nyungan covers nearly 90% of mainland Australia’s land mass and comprises approximately 260 languages. The remaining 27 Non-Pama-Nyungan families are found in the north of the country and have another 100 languages. This paper reports mostly on Pama-Nyungan languages, though Non-Pama-Nyungan languages from several families are included as well.

<sup>2</sup> Bower & Atkinson (2012) did not attempt to date their phylogenies. Published dates in the range of 4,000 years BP to more than 40,000 years BP are found in the literature (see Bower 2006). Whatever the correct age for Pama-Nyungan, we would require an order of magnitude shallower than the current smallest estimation for the degree of similarity to be plausible.

lexical data from a comparative database of Australian languages to build profiles of the languages from their phonologized lexicons. This paper introduces the data sources and provides information about the uniformity of inventory sizes, composition, phoneme frequency, and positional markedness. While our phonological typology project has broader aims, here we focus on the uniformity question, since it is a prerequisite to any subsequent investigations of Australian typologies.

This work is of particular importance to phonological typologies of Australian languages, but it has implications for wider phonological theory as well. The survey used here is the largest comparative database of a single language family. Rarely do we have the opportunity to conduct a large-scale typological investigation of related languages in this way. We also make a contribution to the role of typology in Optimality Theory. A large-scale survey of markedness patterns (in related languages) allows us to study occurring and non-occurring grammars. Finally, we can investigate the predictions of competing theories. For example, as discussed in Section 2.3 below, the loss of an apical contrast word-initially favors Steriade's (2001) perceptual theory of neutralization over de Lacy's (2000) sonority-based one.

The remainder of the introduction details the data sources, collection and coding decisions, and sampling issues.

**1.2 Data and Methods** While there are several typologies of Australian phonemic inventories (Dixon, 2002; Hamilton, 1996; Maddieson, 1984; Mielke, 2008), these previous works have all relied on published grammatical descriptions of the languages. The descriptive documentation of Australian languages varies greatly in quality, from "comprehensive" reference grammars compiled by experts based on many years of fieldwork to cursory descriptions based on just a few hours with speakers. Many languages were described based on work with the last speakers as part of PhD projects. Experience of the linguists thus varies extensively, as well as their exposure to the language.

Some information is hard to glean from summary statements in reference grammars. For example, unless a frequency study was included in the grammar, there is no information about the relative frequencies of segments. Moreover, reference grammars do not contain uniform information; for example, some exhaustively list the clusters found in the language, while others give only summary statements by place and/or manner of articulation, while others list only the most common clusters. This makes systematic comparison across languages difficult.

Australian language documentation practice tends to use phonemicized orthographies. Almost all orthographies for Australian languages have been developed by linguists (there are very few indigenous writing traditions) and have tended to capture phonemic contrasts but, with few exceptions, not allophonic alternations.<sup>3</sup> In Bardi (Nyulnyulan, Non-Pama-Nyungan; see Bowern 2012; Bowern et al. 2012), for example, there is regular allophonic voicing of stops between vowels, but this is not reflected in the orthography. However, there are also morphophonemic lenition rules in both case affixes and in verb morphology, and these *are* represented in the orthography (see example (1) below):

- (1) a. Orthography: *bardag*; IPA [paɖak]
- b. *bardag* 'tree' ~ *bardogon* 'tree-LOC' (from underlying *bardaga-goon*)

This type of orthography makes studying phonemic patterns through published lexical material quite straightforward.

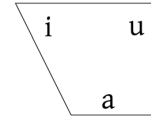
In order to derive the generalizations presented here, we used lexical materials drawn from Bowern's comparative database files of Pama-Nyungan and other Australian languages.<sup>4</sup> The database contains approximately 775,000 lexical items from all over Australia, of which the most reliably sourced were selected for use here.

To generate the sample for phonological testing, we used data from languages with standard orthographies. We concentrated on languages with longer lexical lists, only using shorter lists where no other

<sup>3</sup> It is unclear at this stage which kinds of allophonic variation are widespread. Languages without phonemic voicing contrasts, for example, vary in whether voicing varies freely in all positions (Dyirbal: see Dixon 1972:260ff or is conditioned by position in the word (e.g. Bardi: Bowern 2012:78. Languages vary in the extent to which high vowels are lowered around retroflex consonants (yes in Nyulnyul (McGregor, 2006), no in Bardi (Bowern, 2012)), or in final devoicing. We therefore have no information about how our results here would be affected by studying surface allophones rather than phonemes.

<sup>4</sup> See Bowern & Atkinson 2012 for details of the tree.

	Labial	Lamino-dental	Apico-alveolar	Retroflex	Palatal	Velar
Nasal	m	$\text{n̥}$	n	$\text{ɳ}$	$\text{ɲ}$	ŋ
Stop	p	$\text{t̥}$	t	$\text{ɖ}$	c	k
Liquid		$\text{l̥}$	l ɹ	$\text{ɭ}$	ʃ	
Glide	w		j			



**Figure 1:** ‘Standard Average Australian’ Phoneme Inventory

materials were available and a region or linguistic grouping was otherwise underrepresented. We sampled languages from all major Pama-Nyungan subgroups and non-Pama-Nyungan families for which wordlists were available. We made an effort to sample evenly across the country and to avoid oversampling from well-attested subgroups. For example, though the Wati (Western Desert) group has 73,000 data points and 26 varieties in the main database, we included only seven varieties from across the group. While we made an effort to sample evenly, some subgroups are much more sparsely attested than others. Accurate phonemic wordlists of any length are not available for most languages of the Southeast, for example.

Wordlist length ranges from 240 to 9000 items per variety, with an average of c. 1600 items. Only unique lexical items from each language were included (that is, homonyms were combined for the purposes of counting words). This was necessary because many languages have data from more than one source, and so common lexical items would appear multiple times. The full comparative database contains not only reliably transcribed sources but also early wordlists and other materials not presented in phonemic orthographies.<sup>5</sup> It also contains dialectal materials. For this study, the total number of comparanda was 200,125 lexical items from 120 languages.<sup>6</sup>

Wordlists were converted to a single set of standard symbols. The relevant generalizations were extracted from the lists with a set of Python scripts which counted the phonemes, natural classes, clusters, etc in the relevant positions in the lists and returned statistics for each language and overall throughout the set. The unit of analysis is the citation form in the dictionary. While authors vary as to what “counts” as a citation form, informal Australianist practice is to use only inflected items in dictionaries. There are two ways in which this impacts our study. The first is for languages with noun class affixes (such as Yanyuwa (Kirtton & Charlie, 1996) or Worrorra (Clendon, 2000, 2001)); the second is the presence of verb morphology (e.g. Bardi (Bowern, 2012) or Burarra (Glasgow, 1994)). We might expect the presence of class markers and verbal morphology to skew counts for initial and final segments. However, this is the correct result. Firstly, we cannot make a general, principled distinction between languages where affixation is productive (such as Yanyuwa), versus languages where it is unproductive but nonetheless skews distributions of initial and final segments (Worrorra). We also want to avoid a situation where we use roots for some languages or word classes, but stems for others. We therefore use the ‘dictionary form’ as the unit of analysis, and treat differences between expected and observed distributions as explicanda.

**1.3 Problems in Phonological Typological Comparison** There are some issues in phonological typology which are relevant to our comparisons. However, most of these problems are not unique to the current paper, but apply to any comparative work (see also De Lacy forthcoming; Ohala 1986). One is the extent to which it is possible to rely on transcriptions, and whether transcription errors may lead to false generalizations. For example, linguists who are native speakers of English often report difficulties in distinguishing the cluster /nɲ/ from /ɲɲ/. If these clusters are conflated in the transcription of lexical items, it

<sup>5</sup> For example, though the Waka-Waka language (Waka-Kabi, Queensland; see Kite & Wurm 2004) has over 1000 items in our source, they are not consistently transcribed and so cannot be used to draw conclusions about the phonology of the language without extensive research.

<sup>6</sup> The original dataset included 120 languages, and these are the figures reported here. This dataset has since been expanded to 145 languages as more data has become available. Preliminary work indicates that the larger sample (which includes more Non-Pama-Nyungan languages, and more languages from the Cape York Peninsula, does not differ in any significant way from the more restricted sample.

will affect our generalizations, both about the frequency of /n/ vs /ɲ/, and about the composition of clusters.<sup>7</sup> Some transcription practices for Australian languages may introduce artifacts into the analysis. For example, Australianists usually treat sequences of /i/ and /u/ as vowel + glide (or vowel + glide + vowel) sequences *a priori*. It is therefore difficult to study glide distributions. We have avoided these topics here. However, the reliability of transcription is a factor in *all* typological work, not just this one. In fact, our generalizations should be more robust than generalizations drawn from many other analyses by linguists, because we derive all our generalizations directly from the lexical data rather than from grammatical descriptions.

A further problem involves the nature of phonological representation and the study of phoneme labels. Phonemes derive from contrasts within the systems of individual grammars. That is, claiming that Language X has a phoneme /k/ is a theoretical claim involving several orders of abstraction. Moreover, because of this, it is not clear that /k/ in one ‘Language’ is equivalent to /k/ in another (especially if /k/ in one language is specified for features such as voicing, which are absent from another language). Rather, it would be better to compare the phonological features which are active in each language. At this point, we recognize the theoretical difficulties of directly comparing phoneme labels and plan a fuller feature comparison in future work.

## 2 Results

We summarize here some of the main results. The reader is referred to Gasser & Bower (2013) for more extensive discussion of all these points.

**2.1 Inventory homogeneity** We first address the claim (Dixon, 2002; Hamilton, 1996; Dixon, 1980) that Australian languages have homogenous phoneme inventories. Our results confirm a general impression of uniformity across inventories, with some core inventory facts common to all (or nearly all) of the languages. The consonants [p, t, k, m, n, ŋ, ɬ, w, j] and vowels [i, u, a] appear in all 120 languages sampled. The strong tendency of languages to have symmetrical stop-nasal series (Dixon 1980:125) was also confirmed, though there are several exceptions to this. The Jarrakan language Miriwoong (Kofod, 1978), for example, has a lamino-dental stop /t̪/ but no corresponding nasal /ɲ/. There is, however, significant diversity in the sample, both in phoneme inventory size and composition.

Another source of variation in inventory composition includes the utilization of a laminal distinction, contrasting lamino-dental and lamino-palatal places of articulation. While all of the languages in our sample make use of at least one of the laminal stops /t̪/ and /c/, only 65% of them contrast the two. There is also variation in voicing. 33% of the sample language have a voicing distinction in at least one place of articulation; the extent of the systems vary too, along with the environment(s) in which the contrast is realized. For example, Yandruwandha and Wangkumara are both Karnic languages (Bower, 1998; Breen, 2007) and have comparably sized lexica in the sample (of approximately 2200 items). Both languages show high frequency of /d/ vis-à-vis /t/, but the reverse for /j/ vis-à-vis /c/. In Wangkumara, /b/ and /p/ are roughly equally common, while in Yandruwandha, /p/ outnumbers /b/ by a factor of 9.

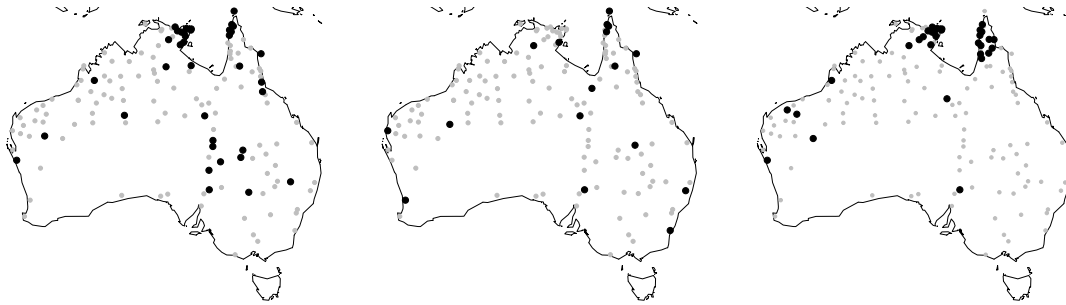
Patterns in inventory variation are in some cases areal and/or genetic. Other patterns are seemingly ‘random’, in that the languages with the feature are spread across the country with no clear patterns. Examples of each are given in Figure 2. Languages with a phonemic glottal stop, for example, are concentrated in the Cape York Peninsula and Arnhem Land, but also found elsewhere. This pattern is a mixture of areal (within Arnhem Land, where the languages belong to several different phylic families) and genetic (a change in Proto-Yolŋu which descends into the daughter languages). Likewise, the distribution of voicing contrasts is genetic in some cases (a shared sound change in several languages where a vowel length contrast has been reanalyzed as a voicing distinction on the following obstruent) and ‘random’ in others.

While the stereotype is that Australian languages only have three vowels, only 21 languages (13% of the total) have only the three phonemic vowels /i/, /a/, /u/ without length distinction. Another 42 (26%) have three vowel positions, with a length contrast. These languages are plotted in Figure 3.

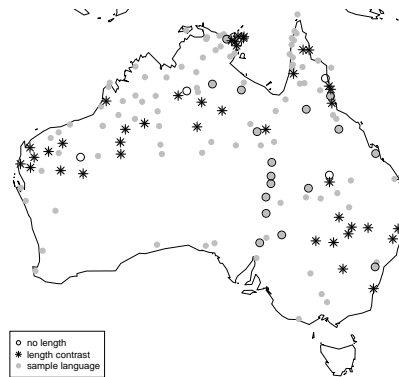
Length distinctions are common in the sample, with 81% of the languages making use of length in at least one vowel (if they have a single length distinction, it is in /a/ ~ /a:/). More than half (54%) of the languages in the sample have long/short pairs for all of /i/, /u/, and /a/.<sup>8</sup>

<sup>7</sup> The composition and distribution of clusters is investigated by this project, but not discussed in this paper.

<sup>8</sup> These languages may have additional vowels in their inventory as well, which may or may not instantiate a length



**Figure 2:** Languages with a) Voicing Distinctions; b) Phonemic Fricatives; c) Glottal Stops.



**Figure 3:** Languages with three vowel places

**2.2 Phoneme Frequencies** Inventory sizes range from 16 (Dyirbal) to 38 (Nhanta); this excludes prestopped segments (see, for example, Hercus, 1972).<sup>9</sup> Inventory composition is summarized in Figure 4, and distributions of inventories by size are given in the maps in Figure 5. These inventories are not exhaustive for all languages (Yir-Yoront (Alpher, 1990), for example, has more vowels than the 5 shown here). The heat map shows the 50 languages with the largest wordlists, as individual language frequencies may be misleading for the shorter lists. Work is in progress on testing subsets of the lists for languages with longer lexical lists, to gauge the potential for this effect. A comparison of token versus type frequency for Bardi (Bower, 2012), using a corpus of 100,000 words and a lexicon of 4200 items, did not reveal substantial differences.

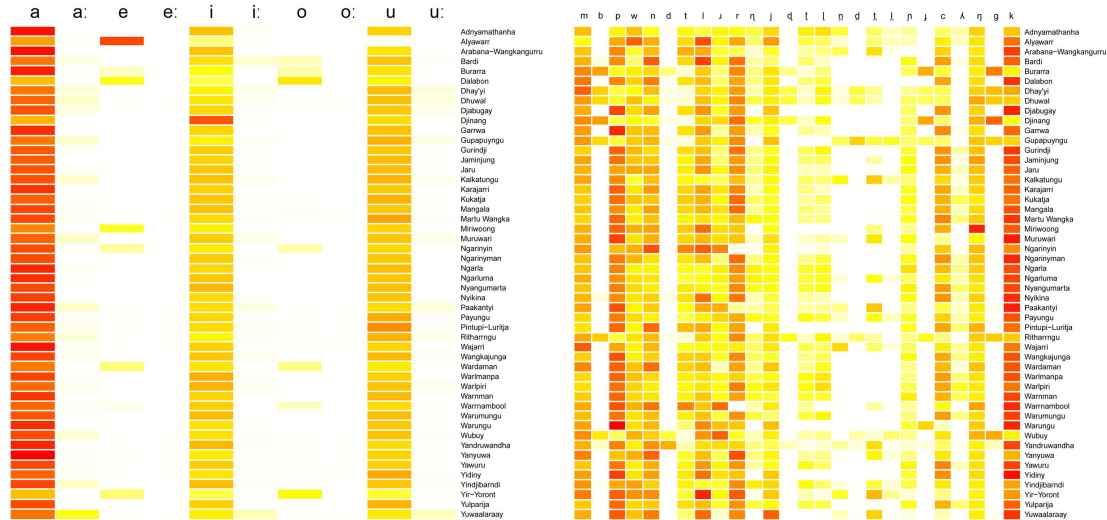
Let us first consider vowels. Figure 4 reveals that even with languages with three vowels, the vowels are of different frequencies, with a disproportionate number of /a/ vowels. This pattern is repeated across most of the languages of the sample; moreover, many of the exceptions to this pattern are due to previously-identified sound changes. For example, in Djinang (Waters, 1989), final \*/a/ has undergone sound change to /i/, as have many vowels around palatals.<sup>10</sup> While /a/ is disproportionately frequent across the sample, /i/ and /u/ are in roughly equal frequencies.

The symmetry of the consonant inventory belies variation in the functional load of several contrasts. For example, even in languages with a contrast between lamino-dental and lamino-palatal consonants, the lamino-dentals have a comparatively low frequency. Two exceptions are Yir-Yoront (Alpher, 1991) and Muruwari (Oates, 1988), where the lamino-dental stop /t̪/ has higher frequency than the palatal stop /c/. This varies by manner of articulation as well.

contrast. 42 languages have only those three vowels.

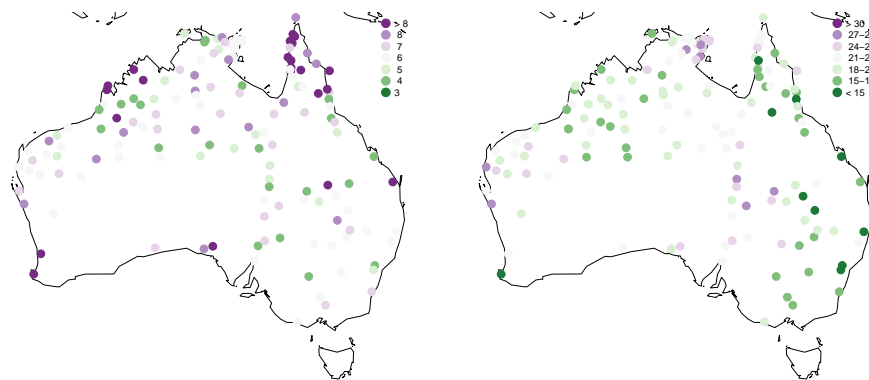
<sup>9</sup> We do not currently treat prestopped nasals and laterals as unit phonemes because of the difficulty in distinguishing them from clusters in our data. One of the common arguments among Australianists for treating [dn], [dl], etc sequences as unit phonemes rather than clusters is that they violate sonority sequencing (Clements, 1988), which Australian languages are said to avoid. However, this argument from typology is circular. We leave this at present for future work.

<sup>10</sup> The exact conditioning environment of the change is complex.



### Figure 4: Phoneme Frequencies

A final point to note is that the dataset shows several clear counterexamples to claims that typological markedness mirrors intra-language frequency (Greenberg 1966:60ff., Paradis & Prunet 1991:11; though see De Lacy 2006 for reasons for considering this a poor metric for markedness (in the sense of markedness as it relates to grammatical competence)). For example, for languages which have both /g/ and /k/, /g/ occurs more frequently; for languages with a lamino-dental vs. apical distinction, the lamino-dental stop is more frequent.



**Figure 5:** a) Vowel Inventory Size; b) Consonant Inventory Size

**2.3 Word-Initial Positional Effects** It has often been observed that the neutralization of phonemic contrasts tends to be avoided in certain ‘prominent positions’ within a word or syllable (Trubetzkoy, 1939; Alderete, 1995; Casali, 1997; Beckman, 1998; Smith, 2005), such that the set of contrasts expressed in prominent positions is the maximal one in the language, whereas the set of contrasts found in non-prominent positions a (potentially proper) subset of those. These prominent positions include stressed syllables, syllable onsets, and, most relevant to this study, word-initial position (Beckman 1998, *inter alia*). This claim fails in the context of Australian languages, however; across the continent, the set of segments allowed in word-initial position is a subset of those allowed elsewhere (Dixon, 2002).

All of the languages in our sample restrict the segments which may appear in word-initial position. Languages vary in their permissiveness, allowing between 36% (Kurrama) and 96% (Alyawarr) of their inventory word-initially. The mean proportion which is licit in that position is 65%.

While the exact nature of these restrictions varies language to language, there are patterns to be found. Dixon (2002:554-55) suggests a hierarchy governing which segments languages will permit word-initially, and with what relative frequencies. According to his observations, peripheral segments (labials and velars) should be more common than laminals, which in turn should outnumber apicals. Regarding manner of articulation, Dixon claims that stops and nasals should be most common word-initially, followed by glides, while liquids will be rare. Our results show that his generalizations hold up (though with some exceptions), but that they can be further refined to more precisely describe the attested distributions.

Over three quarters of the 200,125 total words in the sample begin with a non-glide consonant. Another 19% are glide-initial; only 15% begin with a vowel. No language in the sample requires words to be vowel-initial, and all allow both glides and non-glide consonants in initial position. Individual languages, however, vary widely in the distribution of these segments word-initially. Non-glide consonants appear initially in between 22% (Barrow Point) and 94% (Dhay'yi) of the words in any given language, while the number of words beginning with a glide ranges from 2% (Anmatyerre) to 29% (Adnyamathanha). While no language entirely bans initial consonants or glides, there are 33 languages in our sample (28% of the total) that disallow initial vowels, and an additional 34 in which vowel-initial words make up less than 1% of the total lexicon.<sup>11</sup> On the opposite end of the spectrum, 69% of Alyawarr's words are vowel-initial.

Dixon claims that all peripherals may be found in initial position (Dixon 2002:555); this is not quite true. All languages in this sample allow both of the peripheral nasals (/m/ and /ŋ/) and at least one labial and one velar stop. However, 59% of languages with a voicing contrast elsewhere collapse it initially.<sup>12</sup> This pattern represents a novel finding of this study, and introduces exceptions to Dixon's claim: in those languages with a /p/~/b/ and /k/~/g/ contrast elsewhere in the word but no initial voicing distinction, only half of the peripheral stops in the inventory may actually appear word-initially.

It is the case, as Dixon says, that all languages allow laminals in initial position, though in many cases they are far less frequent than he claims (Dixon 2002:555). Initial apicals appear in all but two languages, Yingkarta and Kurrama, and in less than 1% of words in an additional eight languages. While they are certainly less common than laminals, appearing in over 20% of words in only two languages, Ngamini (21%) and Dalabon (20.1%), and then only marginally so, there is not such a large difference as Dixon suggests when he writes that they should occur "only in a few words" (Dixon 2002:555). Indeed, in 46% of languages apicals account for 10% or more of initial segments.<sup>13</sup>

Across the dataset, the four most common initial segments, which together account for more than half of the words in the sample, are all peripherals: /k/, /p/, /m/, and /w/. The palatal /c/ and velar /ŋ/ each account for approximately 8% of initial segments, followed by /j/, with 6.9%. These numbers generally conform to Dixon's assertion that peripherals should be the most common segments in initial position. Farther down the list, however, the data is less straightforward. The plain apical stop /t/ is twice as common than either of the laminals /t/ or /c/. Within the nasals the same pattern holds: The peripherals and /ŋ/ are the most common of this group, but apical /n/ is twice as common as lamino-dental /ɲ/. For both stops and nasals, the retroflex segment accounts for less than one half of one percent of the total. In aggregate, Dixon's predictions hold up: peripherals account for 51% of word-initial segments, laminals for 15%, and apicals for 8%. A closer look at the data, however, suggests a somewhat more nuanced place of articulation hierarchy for initial consonants: retroflexes < dentals < apico-alveolars < palatals < peripherals.

Dixon's predictions for initial consonants based on manner of articulation are again largely borne out by the data here. The one refinement of his generalization which our corpus suggests is to draw a distinction between oral stops and nasals; Dixon considers them to be equally prevalent, occurring in "many" words in all languages, when in fact stops occur word-initially in twice as many words (48% of the total) as nasals do (25%). Both of these, as Dixon suggests, are more common than glides (19% of words), while liquids, accounting for just under 4% of word-initial segments, are indeed rare. Vowels, which do not figure in Dixon's hierarchy, account for 4.7% of word-initial segments.

<sup>11</sup> This includes seven languages, including Wardaman, Mangala, and Warrnambool, with only a single vowel-initial item. Note that there is a potential confound here in that some writers of grammars may have analyzed /u-/ or /i-/ initial words as exhibiting an on-glide, because of the expectation that Australian languages tend to disprefer vowel-initial words. We have no way of investigating this problem with the current data.

<sup>12</sup> The maintenance of word-initial voicing in 41% of the languages is also a novel finding, since Australian languages are generally assumed to collapse voicing distinctions except after continuants.

<sup>13</sup> Compare this though to the 89% of languages in which laminals account for at least 10% of initial segments.

The tendency of Australian languages with an apical contrast to collapse it word-initially has often been observed, but our data shows that its prevalence is overstated. Rather than being “almost always” the case (Dixon 2002:555), a full 37% of the 104 languages in this sample which maintain a contrast between plain and retroflex apical stops elsewhere in the word maintain it word-initially as well. This generalization too can be refined beyond previous observations. The apical contrast is more often maintained in contrastively voiced segments than contrastively unvoiced ones, and in nasals more often than in stops.

This collapse raises some theoretical issues. As mentioned above, the general expectation is that the word-initial segment, falling in a prominent position, will maintain all of the language’s contrasts; that is clearly not the case here. Both Smith (2005) and de Lacy (2000) point out instances in a number of languages where the set of contrasts found in prominent positions is a subset of those found elsewhere in the word, as is the case here. De Lacy suggests an analysis of such cases based on the sonority hierarchy. Because prominent positions are defined in terms of their prosodic properties (i.e. their status as or within roots, syllables, morae, etc.) any constraints referring to them, according to de Lacy, should only be able to also refer to other prosodic properties, such as sonority, and not properties, such as place features, which arise from other planes. Therefore markedness in these positions must be defined in terms of sonority, which forms an implicational hierarchy. Since high-sonority onsets are dispreferred, for example, if a given segment is allowed in onsets in a prominent position, any less-sonorant segment will also be allowed there. By this metric, any language which allows, say, glides in word-initial onset position, must also allow the less-sonorant class of nasals in that position. Acceptability can only be defined in these terms, and not in terms of place of articulation, so while a language can differentiate between glides and nasals in prominent positions they cannot differentiate between, say, /m/ and /n/, unless one can be determined to be more sonorous than the other.

This analysis proves inadequate for Australian languages, where distinctions are made precisely on the basis of place of articulation. If any argument has been made that /t/ is more sonorous than /t̤/ or vice versa, we are not aware of it. This pattern is problematic in any case, as some languages neutralize to the plain apical stop, while others neutralize to the retroflex, which de Lacy’s framework predicts should be impossible. If we are to take de Lacy’s analysis as basically correct, initial neutralization as found in Australian languages cannot be analyzed as the result of its occurrence in a prominent position, though this may at first glance appear to be the relevant property.

A more promising line of inquiry stems simply from the fact that these segments are initial, and that some acoustic cues to the identity of a segment are better transmitted on word-medial segments than word-initial ones. As Steriade (2001) points out, though most major place distinctions between consonants are best preserved when they appear pre-vocalically, it is in post-vocalic position that the alveolar/retroflex distinction is most clearly audible, leading that contrast to be more often collapsed in post-consonantal and, most relevantly here, word-initial position. More specifically, the cues which differentiate /t̤/ from /t/ and thereby signal the distinction between the two are primarily carried in the VC transition, rather than in the CV transition as with other contrasts (Bhat 1973, Ladefoged & Maddieson 1986:12, *inter alia*). Given this fact, is it unsurprising that we should find so many languages in which the apico-alveolar and post-apical/retroflex series are fail to contrast word-initially, as the cues necessary to license the distinction are missing when the word in question is not immediately preceded by another vowel-final word. Of course, in continuous speech the cues for retroflexion could still be realized on the preceding vowel; however, like other contrasts which are collapsed initial (such as gemination contrasts), the positional effect still obtains.

A final puzzle remains as to why it is the retroflex series which most often surfaces in cases of neutralization and not the plain apical, when it is specifically the cues to retroflexion which are lost word-initially, and why the tendency for neutralization is lower for nasals and voiced obstruents than for voiceless ones. This may stem from the fact that there are other acoustic cues to retroflexion than simple those found in the VC transition; closure duration, burst amplitude, and voice onset time (Anderson & Maddieson 1994, Dart 1991:127) may also play a role. A more complete account of the direction of neutralization is left for future work.

**2.4 Word length** According to Dixon (2002:553), “most Australian languages have no monosyllabic words at all (outside interjections). Others show a few . . . The canonical word pattern is disyllabic, beginning with a single consonant (not a vowel or a consonant cluster).” In our sample, in contrast, nearly half the languages (48%) have more than 50 monosyllabic words in the corpus, and in 20% of the languages,



monosyllabic words make up more than 10% of the vocabulary.<sup>14</sup> It is true that in most languages (80%), the modal word length is two syllables. However, in 6 languages (mostly from the Paman subgroup of Pama-Nyungan), monosyllabic words outnumber disyllabic ones, while in 25 languages, trisyllabic words predominate.

### 3 Conclusions

In conclusion, the relative homology of Australian phoneme inventories—as described in reference grammars—masks other variation. This variation occurs in inventory composition to a greater extent than claimed in the literature. We also find considerable evidence for variation in phonotactics. Some generalizations about the phonological typology of Australian languages, such as the presence of monosyllabic words, are simply incorrect. Others were missed, because the relevant patterns were treated as exceptional or rare. A third set of generalizations (such as positional neutralization effects) have been refined. This work shows the potential for phonological typologies of large language families to shed light on predictions from phonological theory; for example by challenging phonetic explanations of apical contrast collapse.

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<sup>14</sup> A few language datasets include affixes, although most do not. We count only languages with more than 50 monosyllabic items here to exclude languages where the sole monosyllabic forms are affixes and interjections.

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