

HIGH-VOWEL PATTERNING AS AN EARLY DIAGNOSTIC OF VOWEL-INVENTORY TYPE*

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Abstract

Vowel contrasts based on tongue root position are common in African languages. Many such languages (“/2IU/ languages”) have a tongue root contrast in high vowels, yielding two sets of phonemic high vowels, /i/, /u/ and /ɪ/, /ʊ/, as in the very common nine-vowel system /i ɪ e ε a ɔ o ʊ u/. Many other languages (“/1IU/ languages”) have an [ATR] contrast only in non-high vowels, as in the very common seven-vowel system /i e ε a ɔ o u/. The problem of determining, in the course of descriptive fieldwork, which type of vowel system is found in a language has sometimes proven surprisingly difficult in practice. The difficulty has revolved around the high [-ATR] vowels [ɪ], [ʊ], which have frequently been mistaken for other vowels, generally [i], [u] or [e], [o]. Confusion with mid [+ATR] vowels [e], [o] has been especially common, due to the auditory similarity of the two sets (Casali 1995a, 2008, Starwalt 2008). Largely in consequence, a good number of West African /2IU/ languages have been misanalysed as /1IU/ languages (Boyd 2015, Casali 1995a, Dakubu 1997, Rennison 1986, Schuh 1995). While it can sometimes be challenging to distinguish /2IU/ and /1IU/ systems solely on the basis of impressionistic phonetic data, however, the two systems show very striking differences in their typical phonological patterns (Casali 2003, 2008, 2016). These differences can furnish valuable clues to a language’s likely vowel-inventory type in early stages of phonological fieldwork. This paper outlines several specific diagnostic tests based on phonological patterning that can aid in vowel-inventory analysis. The proposed diagnostics rely on straightforward observations about the behavior and distribution of high vowels and relate to general tendencies for the high vowels [i], [u] to be more widely distributed in /1IU/ than in /2IU/ languages and for the same vowels to more readily trigger [+ATR] spreading in the latter.

1. Introduction

At a general level, this paper is concerned with some typological issues, related to markedness and assimilatory dominance of tongue root features ([ATR] / [RTR]), which have received much attention in the linguistic literature in recent decades (e.g., Akinlabi 1997, Archangeli & Pulleyblank 1994, 2002, Baković 2000, Calabrese 1995, 2005, Casali 2003, Causley 1999, Goad 1993, Krämer 2001, Leitch 1996, Polgárdi 1998, Pulleyblank 1996, Pulleyblank & Turkel 1996, among many others). In contrast to most previous studies, however, it is not primarily concerned with typological issues for their own sake, nor is it directly concerned with their implications for phonological theory. Rather, its primary focus is a methodological one. It aims to apply emerging typological findings to practical concerns that have been widely encountered in linguistic fieldwork. More specifically, it focuses on a particular issue that has posed significant practical challenges to the accurate identification of vowel phonemes in certain regions of Africa. In introducing these challenges, some general background on vowel systems with tongue root contrasts will be helpful.

Many African languages have vowel systems with a tongue root contrast only in non-high vowels (with no such contrast in high vowels), while many other languages have systems that have two sets of phonemic high vowels, /i/, /u/ and /ɪ/, /ʊ/ that contrast for a tongue root feature. These system types are referred to in Casali (2008) as /1IU/ and /2IU/ systems, respectively, and this terminological usage will be adopted in the current paper as well.¹ By far, the most common specific vowel inventory that conforms to the /1IU/ type is the familiar seven-vowel system shown in

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¹ The label /1IU/ is meant to reflect the existence of just one set of high vowels (typically a front vowel and back round vowel, designated “I” and “U” respectively). The label /2IU/ is meant to be mnemonic for the existence of two such sets. Both labels are meant to refer only to inventories in which [ATR] is contrastive to begin with (Casali 2008: 504).

(1) below, while the most frequently-encountered specific instantiation of a /2IU/ system is the very common nine-vowel system shown in (2).

(1)	Seven-vowel /1IU/ system		(2)	Nine-vowel /2IU/ system	
	i	u		i	u
	e	o		ɪ	ʊ
	ɛ	ɔ		e	o
				ɛ	ɔ
	a				a

The seven-vowel system in (1) is found in languages such as Dangme (Dakubu 1987) and Yoruba (Archangeli & Pulleyblank 1989), while the nine-vowel system in (2) occurs in such languages as Akan (Clements 1981, Dolphyne 1988) and Kalabari Ijo (Akinlabi 1997). Note that this nine-vowel system has a tongue root contrast in mid as well as high vowels. There are also /2IU/ languages that have a tongue root contrast *only* in high vowels, for example Kinande (Mutaka 1995), which has a seven-vowel /i ɪ ɛ a ɔ o u/ system that lacks phonemic mid [+ATR] vowels. Finally, there are variants of both /1IU/ and /2IU/ systems that have additional central vowels, including (among other types) both an eight-vowel /1IU/ system /i e ɛ a ə ɔ o u/ found in languages like Wolof and a ten-vowel /i ɪ e ɛ a ə ɔ o u/ /2IU/ system found in languages like Diola-Fogny (Sapir 1965) and Degema (Fulop et al. 1998, Kari 2007).

As they are laid out in chart format, /1IU/ and /2IU/ vowel systems show clear differences in the sets of vowels they contain. For this reason one might suspect that the problem of determining whether a particular language's vowel inventory is of one type or the other should be relatively straightforward in practice. It is obvious that the two common inventories in (1) and (2) above differ only in that the latter has two vowels, /ɪ/ and /ʊ/, which are not found in the former. As long as all of the vowels found in a language can be easily identified and transcribed phonetically in the course of fieldwork, one might fully expect that standard techniques of phonological analysis (e.g., looking for contrast or complementary distribution) should suffice to unambiguously determine the language's vowel inventory. It is not obvious why the problem of establishing the inventory of vowel contrasts should be especially challenging in languages with either of these system types.

As it turns out, however, the vowel qualities in /2IU/ systems are not necessarily as easily distinguished in all cases as the common transcription in (2) might imply. Many linguists engaged in fieldwork on /2IU/ languages have found the high [-ATR] vowels [ɪ], [ʊ] quite difficult to distinguish auditorily from other vowels, especially the mid [+ATR] vowels [e], [o]. The phonetic factors that give rise to the problem and the seriousness of its consequences for descriptive fieldwork are discussed in more detail below. In brief, however, it is fair to say that the problem has been a very serious one in the past. In a number of cases, inaccurate phonetic transcriptions in which [ɪ], [ʊ] were misheard as other vowels have led to incorrect phonemic analyses in which a /2IU/ vowel system was misidentified as a /1IU/ system. (See Boyd 2015, Casali 1995a, Dakubu 1997, Schuh 1995 for discussion.) While the level of difficulty presented by these phonetic factors may vary somewhat from context to context, the potential practical challenges are ones that must, in general, be taken seriously. Consequently, various avenues for addressing the difficulties are worth exploring. One such avenue, explored in this paper, involves clues from phonological patterning.

Such clues are especially worth exploring in light of a further reality. Accumulating typological evidence reveals that /1IU/ and /2IU/ languages exhibit some very different tendencies in their characteristic phonological patterning. These differences pertain to two areas: assimilatory dominance of [ATR] values (roughly, the question of which [ATR] value, [+ATR] or [-ATR], spreads) and distributional restrictions that have often been discussed in connection with the topics of markedness and positional neutralization (e.g., Beckman 1997, 1998). To the extent that such robust differences exist, they potentially give rise to observable differences

in phonological patterning that can serve as clues to the type of vowel system, /1IU/ or /2IU/, found in a language.

With respect to dominance relations, it now seems to be quite well established (Boyd 2015, Casali 2003, 2008, 2016, Causley 1999, Clements 2000, Leitch 1996) that assimilatory dominance of [+ATR] is extremely typical of /2IU/ languages, but not /1IU/ languages, in which [-ATR] vowels are more typically dominant. More recently, other work (Casali 2014, 2016) has provided evidence of an analogous difference involving markedness relations, as reflected in distributional tendencies (the general assumption being that unmarked sound classes are typically expected to have unrestricted distributions, while their marked counterparts may, in some cases, be distributionally restricted). In /2IU/ languages, [+ATR] vowels are not only typically dominant in assimilation processes, they are also often restricted from occurring in certain contexts (e.g., certain classes of function words), a type of pattern that has often been discussed in connection with positional neutralization and markedness (e.g., Alderete 2003, Beckman 1997, 1998, Casali 2016, Kiparsky 2006, Steriade 1993). Significantly, distributional restrictions on [+ATR] vowels are seen to affect not only *non-high* [+ATR] vowels, which are widely acknowledged to be marked relative to their [-ATR] counterparts (e.g., Archangeli & Pulleyblank 1994, 2002, Cahill 2007, Calabrese 1995), but *high* [+ATR] vowels [i], [u] as well, despite the fact that the latter are widely regarded as unmarked sounds.

At least as far as non-low vowels are concerned, /1IU/ languages conform to different distributional tendencies. High [+ATR] vowels [i], [u] clearly show unmarked patterning in /1IU/ languages, as might naturally be expected, given the complete absence of high [-ATR] [ɪ], [ʊ] in most such languages. There is also some suggestive evidence (Casali 2016) that mid [+ATR] vowels tend to pattern as unmarked sounds relative to their [-ATR] counterparts in /1IU/ languages as well.

The existence of such different characteristic tendencies in /1IU/ and /2IU/ languages is potentially quite surprising, and not something we should necessarily have anticipated finding on a priori grounds. Nevertheless, it is one that finds good empirical support (see Section 3 below). It thus makes good sense to explore its consequences, not only for phonological theory (Casali 2014), but with regard to possible practical applications to phonological fieldwork as well.

It is this latter type of concern that is addressed in the current study. The aim will be to develop a number of specific practical tests, based on different characteristic tendencies of /1IU/ and /2IU/ languages, which can suggest useful clues to a language's likely vowel system type in the course of fieldwork on a language whose vowel inventory is not yet known. As we shall see, these tests are, to a large degree, ones that make use of common and easily obtainable sorts of data that should normally be available even in the earliest stages of research on a language. They have the further advantage that they rely on patterns that can be identified based on *phonetically robust criteria*; they do not crucially depend on entirely accurate transcription of vowels in the potentially confusable auditory range occupied by similar-sounding high [-ATR] and mid [+ATR] vowels.

All of the diagnostic tests to be proposed revolve around observations related to the patterning of *high* vowels, and especially invariant high [+ATR] vowels [i], [u]. If the typological perspective assumed in this paper is correct, we anticipate some significant differences in the characteristic patterning of such vowels in the two systems, related to the expectations that 1) invariant high [+ATR] vowels should be potentially (and, in fact, often are) subject to more significant distributional restrictions in /2IU/ than in /1IU/ languages, and 2) the same vowels, in contexts where they clearly do occur, should potentially serve as triggers of [+ATR] spreading in the former but not the latter. These expected differences give rise to a number of potentially useful diagnostic tests, to be described in detail below.

The remainder of this paper is organized as follows. Section 2 describes in more detail the nature of the phonetic challenges that can make it difficult in practice to distinguish /1IU/ and /2IU/ systems in phonological fieldwork. Section 3 provides a brief overview of an emerging picture of tongue root markedness and dominance relations that forms the basis of the practical diagnostic tests proposed in this paper,

while the tests themselves are outlined in Section 4. The paper ends with a brief conclusion in Section 5.

2. Practical phonetic challenges involving high [-ATR] vowels

With the benefit of hindsight afforded by careful fieldwork and analysis, the tongue root harmony patterns of many /2IU/ languages can often be described in terms that suggest a rather neat and tidy system. Clear and convincing examples of contrast among the vowel phonemes can generally be given and regular patterns of vowel co-occurrence and affix harmony summarized in rather simple terms. Presenting a language's harmony system in clear terms is, of course, a desirable goal in a written description, and there have been many actual descriptions of tongue root harmony languages that have succeeded admirably on this score.

Unfortunately, however, the neat and tidy appearance of many harmony systems as summarized on paper might easily foster an impression that, at a purely descriptive level, /2IU/ tongue root harmony systems present no special challenges to fieldwork on an unfamiliar language. Such an impression would be seriously misleading. The regular patterns and clear categorical distinctions of typical /2IU/ harmony languages as presented on paper mask a potentially difficult and highly recurrent challenge to fieldwork in such languages. As linguists who have worked extensively with such languages are often all too keenly aware, consistently accurate phonetic transcription of some vowel qualities found in /2IU/ languages with ATR harmony can be quite difficult. The locus of the problem is that the high [-ATR] vowels [ɪ], [ʊ] often sound extremely similar to mid [+ATR] vowels [e], [o], and have often been mistranscribed as such in fieldwork on /2IU/ languages (see Casali 2002, 2008 and references therein). Perhaps less commonly, there are also languages (e.g., Koromfe, as described in Rennison 1986) in which [ɪ], [ʊ] can be auditorily confused with [i], [u] in at least some contexts (Casali 2008: 509).

Ultimately, the auditory similarity of [ɪ] to [e] and of [ʊ] to [o] lies in an acoustic reality. Within each pair, the two vowels tend to have very similar formant values. The auditory and acoustic similarity of high [-ATR] and mid [+ATR] vowels has been discussed in detail in various works (e.g., Anderson 1999, Boyd 2015, Casali 2002, 2008, Guion et al. 2004, Hess 1992, Schuh 1995, Snider 1990, Starwalt 2008).

What matters for our present purposes is that the difficulty is quite widespread. /2IU/ languages in which [ɪ], [ʊ] sound clearly distinct from [e], [o] to most linguists who are not themselves native speakers of tongue root harmony languages would seem to be the exception, rather than the rule. Moreover, the difficulty has had very significant consequences for descriptive fieldwork. In cases where [ɪ], [ʊ] are consistently misheard (and mistranscribed) as other vowels, the natural outcome will typically be an analysis in which these vowels are missing in phonetic data, and are hence ultimately missing from a posited phoneme inventory. Actual cases of this type, in which a nine- or ten-vowel language has been incorrectly analyzed as a smaller inventory (most commonly /i e ɛ a ɔ o u/) due to a failure to correctly identify high [-ATR] vowels, have been quite widespread in African languages. (For relevant discussion, see Anderson 1999, Boyd 2015, Casali 1995a, 2008, Rennison 1986, Schuh 1995, Snider 1990). Some specific examples (which could be multiplied) of languages in which phonemic high [-ATR] vowels were missed in a descriptive analysis include the Kwa languages Akposso, Avatime, Gonja and Nkonya, the Gur language Konni, several Mbam (Bantu A) languages of Cameroon, the Bantu F language Rangi, the Nilo-Saharan language Fur and the Edoid language Okpe.²

² Direct discussion of the Akposso, Avatime, Gonja, Rangi, Fur and Okpe cases is found in Anderson (1999: 186-187), Schuh (1995), Nelson et al. (2016), Stegen (2000), Kutsch Lojenga (2006) and Omamor (1988), respectively. The Mbam cases are discussed in considerable detail in Boyd (2015). While Nkonya was originally analyzed as a seven-vowel /i e ɛ a ɔ o u/ system by Reineke (1972), subsequent work (Peacock 2007, Snider 1990) provides clear evidence of a nine-vowel /i ɪ e ɛ a ɔ o u/ system. While Konni was treated as a seven-vowel /i e ɛ a ɔ o u/ language in preliminary analysis by Naden (1986), detailed evidence for a nine-vowel /i ɪ e ɛ a ɔ o u/ system is presented in a later study by Cahill (2007).

Beyond cases in which the phonemic presence of high [-ATR] vowels was missed in a published or unpublished written description, I am aware, through personal conversations with colleagues who have done fieldwork in /2IU/ languages, of many cases in which a linguist took a long time to become aware of the presence of [ɪ], [ʊ] in a language. That is, the linguist initially heard and transcribed such sounds as [e], [o] (and/or [i], [u]), only becoming aware of the error after months of fieldwork. (This was true, for example, of my own early fieldwork on the Kwa language Nawuri carried out in the mid-1980s.) Though the error was eventually discovered and corrected in such cases before any publication resulted, the problems and incorrect initial analyses were ones that the linguists involved would undoubtedly have preferred to avoid. In some such cases, preliminary orthographies had already been proposed for a language based on an incorrect assumption of a seven-vowel /i e ε a ɔ o u/ inventory.

It is true enough that many cases in which a phonemic contrast involving high [-ATR] vowels was initially missed in phonological fieldwork occurred during earlier time periods, when less was reliably known about the geographic distribution of /2IU/ systems, their characteristic phonological behavior, or their attendant phonetic challenges. Nevertheless, it would be premature to suppose that the phonetic challenges posed by high [-ATR] vowels in such systems are unlikely to present significant difficulties to phonological fieldwork in the future. Anecdotal reports from colleagues engaged in relatively recent fieldwork (or who have provided consultant help to those engaged in such fieldwork) on /2IU/ languages leads me to believe that well-trained field linguists continue to struggle in some cases, at least initially, with the phonetic problems posed by high [-ATR] vowels. My own experiences in teaching graduate-level field methods courses using several /2IU/ African languages as the language of study leads me to the same conclusion. Even if it is true, as one might hope, that the likelihood of an incorrect initial analysis of a nine-vowel /i e ε a ɔ o u/ language as /i e ε a ɔ o u/ surviving without discovery into a published description of a language is less at present than in the 1960s or 1970s, due to greater awareness of relevant issues, it would be overly optimistic to lightly dismiss the challenges (which are not as widely recognized as they should be) that can arise. This being the case, any practical steps or sources of information that might help to shed light on the problem are to be welcomed. It is with this in mind that various potential clues from recurrent phonological patterning that bear on the likely vowel system of a language are discussed in the sections that follow.

Of course, the problem of phonetic misidentification of [ɪ], [ʊ] does not generally arise, as a direct challenge, in /1IU/ languages, in which such vowels are generally absent. It is quite likely true, in general, that if an unknown target language should in fact turn out to be of the /1IU/ type, the risk of misanalysis as a different system is rather low. (There have been far fewer cases in which /1IU/ languages have been misanalysed as /2IU/ languages than the reverse.³) Even so, the fact that /2IU/ languages have been so easily confused, in terms of their phonetic qualities, with /1IU/ languages suggests that a healthy measure of caution is needed before assuming that a language that seems to be of the /1IU/ type is in fact a /1IU/ language—at least in language families in which both types are reasonable a priori possibilities. The important point is simply that the descriptive problem is made more difficult in general by the potential phonetic confusability of /1IU/ and /2IU/ inventories. Thus, regardless of which type of language one is actually working with, any clues from phonological patterning that might be useful in confirming (or casting doubt on) initial conclusions that seem warranted by phonetic data are to be welcomed.⁴

To avoid any risk of misunderstanding, I also emphasize that I am not claiming that the phonetic similarity of high [-ATR] to mid [+ATR] vowels must present an

³ An apparent rare case of this type is the Kwa language Logba, which is described as a seven-vowel /1IU/ language by Dorvlo (2008) but had been treated in an earlier study (Dorvlo 2004) by the same author as having a nine-vowel /2IU/ system. See Dorvlo (2008: 21-23) for some brief discussion.

⁴ Some very brief discussion of the use of possible clues from phonological patterns in languages with potentially difficult auditory contrasts involving high [-ATR] vowels is found in Snider (1989b: 33).

equally difficult challenge in all fieldwork contexts involving /2IU/ languages or that the diagnostic clues proposed in this paper are absolutely crucial to successful analysis of a vowel system in all such languages. Clearly, many /2IU/ (and /1IU/) vowel systems have been successfully analyzed in the past without overt reliance on the tests proposed here (though, as noted above, the path to an ultimately successful analysis has not necessarily been simple and painless in all such cases). It also seems clear that the difficulty of the challenge encountered in a particular language is likely to depend on a range of additional factors. One very significant factor, of course, is the level of prior relevant experience of a researcher. Linguists who are native speakers of /2IU/ languages might well find that the task of auditorily distinguishing [ɪ], [ʊ] from [e], [o] presents no difficulty whatsoever. Linguists who are not native speakers of /2IU/ languages but have considerable prior fieldwork experience with /2IU/ languages might also plausibly be expected to cope more easily with the relevant contrasts in a new language research project than linguists with little or no prior experience with such languages. Other factors, including some degree of phonetic variability in the actual realization of the relevant vowel pairs across languages, will also likely make the phonetic challenges less acute in some contexts than others. My claim is simply that the challenges have proven difficult enough in general that potential clues of the sort proposed in this paper are very much worth attending to, even if they are not absolutely essential in all cases. This is especially so inasmuch as the tests to be outlined are, for the most part, ones that are easily applied without a huge investment of time and effort.

Finally, I also emphasize that the diagnostic tests presented in this paper are not intended to *replace* various other potentially valuable clues or reliance on tried and true analytical techniques, whether these involve evidence from native speaker intuition (Kutsch Lojenga 1996), instrumental phonetic analysis, or various standard procedures for investigating possible contrasts. Rather, they are simply a further potentially useful source of information that can, it is hoped, help to make the analytical challenges more tractable in many cases.

3. Characteristic dominance and markedness patterns in /1IU/ and /2IU/ systems

It has become increasingly clear that /1IU/ and /2IU/ languages exhibit some very significant differences in their characteristic phonological patterns related to both assimilatory dominance and markedness, as reflected in the distribution of vowel classes. In this section, I briefly summarize the relevant differences, first at a general level (Section 3.1) and then as they apply to high vowels in particular (Section 3.2). For reasons of space, and because much more detailed treatment and exemplification of the relevant differences is found elsewhere, the discussion below will not delve into full detail, but will simply aim to provide important general background to the specific diagnostic tests to be proposed in Section 4.

Some of the inventory-related differences in characteristic phonological patterning described in this section, and particularly those that pertain to markedness and distributional restrictions, have come to light only as a result of fairly recent research, summarized in Casali (2014, 2016). Consistent with this, the emerging typological perspective adopted here cannot, at this point in time, be considered a matter of consensus understanding. In fact, as readers who are highly familiar with theoretical work on markedness relations involving tongue root features will undoubtedly recognize, certain aspects of the typological picture summarized in this section are directly at odds with widely held assumptions about marked combinations of tongue root and height feature values. Specifically, it is often supposed that tongue root markedness relations are cross-linguistically invariant, since they are grounded in well-known phonetic functional factors involving articulatory difficulties inherent in producing certain combinations of tongue root and height features (Archangeli & Pulleyblank 1994, Baković 2000, Calabrese 1995, Jakobson 1980, Vaux 1996: 179). Most directly relevant for our current purposes is the widely-held assumption that high [-ATR] vowels [ɪ], [ʊ] are universally marked relative to their [+ATR] counterparts [i], [u], due to the fact that advanced tongue root position is highly

avored (and retracted tongue root position highly disfavored) in high vowels on articulatory grounds.

It can also be conceded that this mainstream view that both /1IU/ and /2IU/ languages should conform to the same set of functionally-motivated markedness generalizations is inherently a very reasonable one on a priori grounds, and one that can be supported with reference to certain diachronic tendencies as well. (See Casali 2014, 2016 for discussion.) Thus, a finding that its expectations are not borne out in reality might be regarded as quite surprising. Nevertheless, there is now good evidence to support the conclusion that markedness relations involving tongue root features are not invariant across inventory types in the ways that might very naturally have been expected. Most relevantly for our purposes, high [+ATR] vowels [i], [u] fail to pattern as unmarked vowels relative to their [-ATR] counterparts [ɪ], [ʊ] in /2IU/ systems (as they clearly do in /1IU/ systems). Rather, we find evidence of a surprising reversal (see below) under which high, as well as non-high [+ATR] vowels show marked patterning (manifested through distributional limitations) in /2IU/ languages.

More detailed presentation of evidence in support of this typological picture is presented in the work referred to just above. For our present purposes, I will simply assume its general correctness and will focus on exploring its practical applications to the practical analytical challenges described in Section 2 above.

3.1 General system-related differences involving markedness and dominance

3.1.1 /2IU/ systems

It now seems quite clear (Boyd 2015, Casali 2003, 2008, 2016) that assimilatory dominance of [+ATR] (but not [-ATR]) vowels is extremely typical of /2IU/ languages.⁵ Undoubtedly, the most familiar manifestation of [+ATR] dominance is a pattern in which a dominant, and invariantly [+ATR], suffix spreads its [+ATR] value leftward, causing any preceding root vowels to become [+ATR]. While this pattern has perhaps most frequently been discussed in connection with Nilo-Saharan languages, in which it is quite widespread, it is found in a considerable number of Niger-Congo languages as well (Casali 2003). It is illustrated in (3) below with examples from the Niger-Congo (Atlantic) language Diola-Fogny (Sapir 1965). These examples show an invariant and dominant [+ATR] reversion suffix [-ul] in its occurrence with two inherently [-ATR] verbs.

- | | | | |
|-----|-------------|---------------------------------------|----------------|
| (3) | [-ATR] verb | | Reversion form |
| | a. [b:p] | ‘to have a cord tied around the neck’ | [lo:p-ul] |
| | b. [bab] | ‘to close’ | [bɔb-ul] |

A similar pattern occurs in the Kwa language Akan, albeit with just a single dominant [+ATR] suffix, a suffix /-ni/ used to mark persons. This suffix is illustrated in the examples below (Casali 2012: 55, Dolphyne 1988: 84), where the symbol [æ] is used to represent a low [+ATR] vowel.

- | | | | | |
|-----|----------------|------------------------------|---|-----------|
| (4) | a. /latɛ-ni/ | ‘citizen of Larteh’ ([latɛ]) | → | [lateni] |
| | b. /o-sika-ni/ | ‘rich person’ | → | [osikæni] |

Although [+ATR] spreading from dominant suffixes might be regarded as the most prototypical manifestation of assimilatory dominance of [+ATR] vowels in /2IU/ languages, various other potential indicators of such dominance are robustly attested as well. These include, among other patterns, spreading of [+ATR] across word boundaries and systematic preservation of [+ATR] in cases where vowels of opposite

⁵ While potential indicators of [-ATR] spreading exist in a few languages, such patterns are typically of marginal productivity. (See Casali 2003 for discussion.)

[ATR] values undergo coalescence. (See Casali 2003, 2016 for more detailed discussion and examples of these and other relevant patterns.)

While the widespread existence of [+ATR] dominance in /2IU/ systems is likely rather well known, what is almost certainly less well known is that [+ATR] vowels also frequently pattern as *marked* sounds in various respects in the same systems. In many /2IU/ languages, [+ATR] vowels occur far less frequently (both lexically and in running text) than [-ATR] vowels (Casali 2002, 2016) and, more significantly for our purposes, they are often subject to various distributional restrictions, being systematically absent in certain contexts in which only [-ATR] vowels are found.

A context in which /2IU/ languages very often permit [-ATR] vowels to occur to the exclusion of [+ATR] vowels, and one which will be particularly important for our purposes (see Section 4.4 below) is in the independent forms of pronouns. Such a restriction seems to be particularly common in West African languages; a sample of West African /2IU/ languages that lack [+ATR] vowels in their independent pronouns is given in the Appendix to this paper. Other classes of grammatical words, e.g., demonstratives and determiners, also sometimes exclude [+ATR] vowels in /2IU/ languages. Plausibly, such patterns can be analyzed as cases of positional neutralization, in which a marked class of sounds ([+ATR] vowels) is systematically prohibited from certain weaker prosodic or morphosyntactic contexts. (See Casali 2014, 2016 for more detailed discussion.)

In summary, [+ATR] vowel quality in /2IU/ languages is typically both dominant and distributionally marked. In contrast, [-ATR] quality is recessive and unmarked and can be seen as a kind of default. The claim that [+ATR] vowels should show marked patterning as a class is entirely convergent with traditional assumptions about markedness (see Rice 2007 and references therein), under which the marked value of a feature is equated with the one that is dominant in assimilation.⁶ Moreover, while it has not been discussed much in recent years, the assumption that [+ATR] vowels are both dominant and marked seems to have been a fairly prominent theme in descriptive and typologically-oriented studies of ATR harmony systems from earlier decades. (See, for example, Bole-Richard 1981, Kutsch Lojenga 1991, 1994, Stewart 1967, Tchagbalé 1976.⁷)

3.1.2 /1IU/ systems

While [+ATR] dominance is highly typical of /2IU/ languages, the same is not true of /1IU/ languages (Casali 2003, 2008, 2016, Goad 1993, Leitch 1996, Steriade 1995). More common in /1IU/ systems are various manifestations of [-ATR] dominance, described in Casali (2003). It can be noted, however, that evidence for assimilatory dominance of [-ATR] in many /1IU/ languages is not as strikingly obvious as are the indicators of [+ATR] dominance found in many /2IU/ languages. For example, whereas [+ATR] spreading from dominant [+ATR] suffixes is extremely widespread in /2IU/ systems, the analogous phenomenon of spreading from dominant [-ATR] suffixes is attested only to a marginal degree in /1IU/ systems (Casali 2016). Evidently (and for reasons that are not necessarily clear), [-ATR] is simply much less prone to certain “dramatic” forms of spreading than [+ATR] is.⁸

What is arguably most striking about /1IU/ languages in comparison with their /2IU/ counterparts, as far as assimilatory tendencies are concerned, is not so much the

⁶ In formal analyses of /2IU/ systems, such asymmetries have often been analyzed (e.g., Causley 1999, Casali 1996, 2003, Cahill 2007, Akinlabi 1997, Goad 1993, Snider 1989a, Steriade 1995) in terms of a representational difference, with [+ATR] (or a privative feature [ATR]) serving as the active, specified, value and [-ATR] quality being unspecified.

⁷ A further noteworthy characteristic feature of /2IU/ languages, which is plausibly related to both assimilatory dominance and markedness, is a recurring tendency (discussed under the label *inherent [-ATR] effects* in Casali 2012), for morphemes that generally harmonize for [ATR] to surface in a [-ATR] form, rather than a [+ATR] form, in cases where they occur in some contexts in which harmony proves inapplicable. Such patterns can be taken to indicate that [-ATR] quality is functioning in a kind of default role in the languages concerned (Casali 2003, Casali & Leitch 2002).

⁸ The same can be said of most other vowel features as well. We do not commonly find dominant suffixes that spread [+round], or [-high], leftward onto root vowels, for example.

robust occurrence of blatantly obvious [-ATR] spreading patterns, but rather consistent *assimilatory inertness* of [+ATR] vowels. It is extremely typical to find certain contexts in /1IU/ languages in which [+ATR] vowels, and especially high [+ATR] vowels, occur underlyingly in syllables that precede or follow syllables with non-high [-ATR] vowels. In /2IU/ languages, such underlyingly disharmonic sequences are very commonly resolved by spreading of [+ATR], often in ways that involve changes to underlying [-ATR] vowels in roots as well as affixes. (The common case of [+ATR] spreading from a dominant [+ATR] suffix is a relevant instance of this type.) Not so in /1IU/ languages, in which various disharmonic sequences are far more frequently tolerated.

A striking example of this, discussed in Casali (2016), involves the common tendency for /1IU/ languages to permit co-occurrence of high [+ATR] and mid [-ATR] vowels within root morphemes. A well-known case of this type occurs in Yoruba, as illustrated in the examples in (5) with data adapted (with minor symbol changes) from Archangeli & Pulleyblank (1989).

- | | | |
|-----|---------------|------------|
| (5) | a. ilè | ‘land’ |
| | b. itó | ‘saliva’ |
| | c. èbì | ‘guilt’ |
| | d. òkí | ‘egret’ |
| | e. èwù | ‘clothing’ |
| | f. òrū | ‘heaven’ |

Similar patterns are found in Logba, a seven-vowel /**i e ε a ɔ o u**/ Kwa language of eastern Ghana, as illustrated by the forms below, from Dordvlo (2008).

- | | | |
|-----|-------------------|--------------------|
| (6) | a. tué | ‘to miss a target’ |
| | b. à-gùtó | ‘bat’ |
| | c. i-síkpé | ‘ring’ |
| | d. à-tsòlí | ‘saliva’ |
| | e. i-nfíó | ‘worm’ |
| | f. à-mènù | ‘stomach’ |

Such disharmonic root-internal sequences involving high [+ATR] and mid [-ATR] vowels are much less commonly found in /2IU/ languages.

We can readily understand why such sequences are typically not resolved by spreading of [-ATR] in most /1IU/ languages, given that such spreading would result in a type of sound (i.e., a high [-ATR] vowel [ɪ] or [ʊ]) that is not freely tolerated in the /1IU/ system. However, it is not obvious why, if [+ATR] spreading were a regular possibility in these languages, the disharmonic sequences should not be resolved by such spreading, leading to fully harmonic sequences (which are well attested in most such languages) that combine high and mid [+ATR] vowels (so that, for example, a Logba underlying form like /à-tsòlí/ ‘saliva’ would surface as [à-tsòlí], rather than the actual form [à-tsòlí] shown in (6d)). In effect, surface disharmonic sequences of the sort exemplified in (5) and (6) constitute a clear missed opportunity for [+ATR] to spread. As we shall see, such missed opportunities abound in other contexts in /1IU/ languages also. Clearly, /1IU/ languages do not exhibit the same strong general tendency for [+ATR] quality to spread that is observed in /2IU/ languages.

/1IU/ languages also pattern differently from /2IU/ systems in the typical markedness relations they evidence. We have noted above that distributional restrictions on [+ATR] vowels are common in /2IU/ languages. In contrast, marked patterning of [+ATR] vowels as a class certainly cannot be said to characterize /1IU/ systems. Most obviously, it is quite clear that such systems do not treat [+ATR] as the marked value in high vowels. On the contrary, the vast majority of /1IU/ languages disallow high [-ATR] vowels [ɪ], [ʊ] altogether (effectively treating [+ATR] as the unmarked value in high vowels). Moreover, there is at least reasonably good preliminary evidence, presented in Casali (2016), to suggest that *mid* [+ATR] vowels

are also frequently unmarked relative to their [-ATR] counterparts in /1IU/ languages. At least, there are /1IU/ languages (notably, seven-vowel /i e ε a ɔ o u/ languages of Bantu Zone C, described in Leitch 1996) in which [+ATR] vowels [e], [o] have a systematically wider distribution than [-ATR] [ε], [ɔ].^{9,10}

3.2 Differences in the characteristic patterning of high vowels

While system-related differences in the patterning of non-high vowels exist as well, it is differences in the typical behavior of high vowels in the two systems that are our primary focus in this paper. Such differences are of interest because they are particularly clear and striking, and because they are typically very amenable to investigation in early stages of fieldwork. In light of this focus on high vowels, it will be helpful, as background to the specific diagnostic tests to be proposed below, to briefly take a closer look at general ways in which high vowels are expected to pattern differently in /1IU/ and /2IU/ systems.

In /1IU/ systems, in which phonemic high [-ATR] vowels /ɪ/, /ʊ/ are entirely absent, the [+ATR] vowels [i], [u] are naturally expected to pattern as unmarked high vowels. We do not expect them to be subject to distributional restrictions, but rather expect that they will typically be both common and widely distributed, potentially occurring in all morphosyntactic positions.

In addition to being unmarked, the same high [+ATR] vowels are also expected to be phonologically *inert* in a typical /1IU/ language. That is, they are not generally expected to be either triggers or targets of assimilatory spreading of tongue root features. They are not expected to be triggers of [+ATR] spreading for the simple and general reason that [+ATR] does not typically function as the dominant [ATR] value in /1IU/ languages. The failure of /i/, /u/ to serve as *targets* of assimilatory spreading is due to other factors. While it is generally expected that unmarked sounds are prone to function as targets of assimilatory spreading, this natural expectation is offset by a further factor, which is that the natural result of spreading [-ATR] quality onto the vowels /i/, /u/ would be a class of sound, a high [-ATR] vowel, that is disallowed in most /1IU/ systems.

Of course, there is nothing phonologically incoherent about a process, were it to occur in a /1IU/ language, that creates *allophonic* vowels [ɪ], [ʊ] by leftward spreading of [-ATR] from underlying [-ATR] vowels /ε/, /a/, /ɔ/. And in fact, an allophonic process of exactly this type is found in a few /1IU/ languages, e.g., Ekiti Yoruba (Orie 2003). Nevertheless, allophonic patterns of this type, though seemingly very natural, turn out (for reasons that are not necessarily well understood) to be rather uncommon in /1IU/ languages. Far more commonly, the high [+ATR] vowels /i/, /u/ are simply immune to spreading of [-ATR] quality from neighboring vowels.

A natural consequence of the fact that high [+ATR] vowels [i], [u] are generally very common and widely distributed on the one hand, while they are, on the other hand, typically inert, is that these vowels very commonly occur in disharmonic sequences in which they precede or follow a non-high [-ATR] vowel [ε], [ɔ] or [a] in an adjacent syllable. Such disharmonic sequences commonly occur in various morphosyntactic contexts, to be discussed below.

In contrast to their typical behavior in /1IU/ languages, high [+ATR] vowels in /2IU/ languages are rarely inert with respect to assimilatory processes. On the

⁹ While it certainly cannot be claimed that markedness relations in *low* vowels are plainly opposite in /1IU/ and /2IU/ systems (since a low and phonetically retracted vowel [a] shows completely unmarked patterning in both system types), there are some significant differences in the phonological patterns displayed by low vowels in the two types of inventories as well. It is at least conceivable that these are related in some way to the behavioral differences exhibited by non-low vowels in the two system types. (See Casali 2014 for some speculative discussion.)

¹⁰ Just as marked and dominant patterning of [+ATR] vowel quality in /2IU/ languages has often been formally analyzed in terms of underspecification of [-ATR] quality (e.g., using a privative feature [ATR]), /1IU/ languages have often been effectively analyzed (e.g., Archangeli & Pulleyblank 1989, 1994, Leitch 1996, Thomas 1992) in terms of underspecification of [+ATR] quality, with [-ATR] (or its privative analog [RTR]) serving as the uniquely specified value.

contrary, in contexts in which invariant high [+ATR] vowels [i], [u] occur to begin with, their overwhelming tendency is to serve as triggers of [+ATR] spreading. One manifestation of this reality is that it is relatively uncommon to find word-internal, and especially root-internal, disharmonic sequences involving high [+ATR] and mid [-ATR] vowels, in /2IU/ languages.¹¹ The diagnostic significance of this, and various other common manifestations of [+ATR] spreading in /2IU/ languages, is discussed in more detail below.

High [+ATR] vowels in /2IU/ systems also differ from their counterparts in /1IU/ systems in their distributional and markedness-related patterning. Whereas the high vowels [i], [u] pattern like unmarked sounds in /1IU/ languages, the same vowels are frequently subject to distributional restrictions relative to their unmarked [-ATR] counterparts [ɪ], [ʊ] in /2IU/ languages. As discussed above, this is a potentially surprising generalization, and one that is at odds with widely-held theoretical assumptions. It is, nevertheless, a generalization that is well supported empirically.

As discussed previously, it is quite common for /2IU/ languages to show prohibitions against [+ATR] vowels, including high [+ATR] vowels, in certain classes of grammatical (function) words, e.g., independent (non-bound) forms of pronouns. In addition, a good case can be made that most /2IU/ languages also show systematic prohibitions against the occurrence of high (and non-high) [+ATR] vowels in prefixes, suffixes, or both. That this is the case is not immediately obvious, since nearly all /2IU/ languages permit surface instances of [i], [u] in both prefixes and suffixes (to the extent that they have affixes of both types to begin with), at least as a result of assimilation to [+ATR] root vowels. However, there are reasonable grounds for supposing that recessive (harmonically alternating) prefixes and suffixes in /2IU/ languages are inherently [-ATR]. The essential arguments, presented in more detail elsewhere (Casali 2008, in preparation), hinge in part on the observation that most affixes with high vowels in /2IU/ languages fall into one of two categories: those that alternate harmonically with root vowels, and those that have a consistently [+ATR] high vowel [i] or [u] and spread their [+ATR] quality onto [-ATR] root vowels. (A third logical possibility, invariant high [+ATR] affixes that trigger no changes in preceding [-ATR] root vowels, is not very commonly attested in /2IU/ languages, as we have noted.) In languages in which *both* types are found, the standard, if not virtually universal, analysis has been to assume that affixes of the former type have inherently [-ATR] vowels /ɪ/, /ʊ/, while those of the latter type have inherently [+ATR] vowels /i/, /u/. From this perspective, it makes perfect sense to analyze the many /2IU/ languages that have *only* the former, alternating, type of affix as lacking inherently [+ATR] vowels in affixes. In effect, this entails some kind of distributional restriction on the occurrence of [+ATR] vowels in affixes, whether this is stated as a restriction on the underlying forms of affixes, as in older generative approaches, or in alternative terms that are more compatible with standard practice in OT. (See Casali 2003, in preparation, for more detailed discussion of the latter possibility.)

Regardless of whether this particular conceptual understanding of the difference between recessive and dominant affixes in /2IU/ languages is strictly correct,¹² it is observationally true that many /2IU/ languages do not have non-alternating suffixes with high [+ATR] vowels [i], [u], and very few have prefixes with a non-alternating vowel [i] or [u]. In this respect, /2IU/ systems differ quite drastically from /1IU/ languages, in which such affixes with non-alternating [i] or [u] are commonplace. Moreover, in /2IU/ languages that *do* have suffixes with invariant high [+ATR]

¹¹ In many /2IU/ languages with nine-vowel /i e ε a ɔ o u/ systems, in which a phonemic low [+ATR] vowel is absent, the high [+ATR] vowels [i], [u] do occur root-internally with the low [-ATR] vowel [a]. Under a familiar analysis, this can be attributed to a constraint against low [+ATR] vowels, which blocks spreading of [+ATR] to /a/. Co-occurrence of [i], [u] with [a] is not universal in nine-vowel /2IU/ languages, however. In some such languages (e.g., Konni; Cahill 2007) /a/ becomes a mid [+ATR] vowel [e] preceding and/or following /i/, /u/. In many other nine-vowel /i e ε a ɔ o u/ languages, /a/ is realized as an allophonic non-high central [+ATR] vowel preceding and/or following the same vowels (Casali 2003).

¹² For one alternative view, see Baković (2000).

vowels [i], [u], such vowels usually serve, as we have noted, as triggers of [+ATR] spreading.

The different general tendencies involving the distribution of non-alternating high [+ATR] vowels in the two vowel system types can be summed up straightforwardly as follows:

1. In /1IU/ languages, [i] and [u] are typically found in all positions, including lexical (e.g., noun, verb) roots, function words, and both prefixes and suffixes (to the extent that these affix types occur in a language to begin with). In addition, they are typically inert, failing to spread their [+ATR] quality to neighboring [-ATR] vowels. In consequence, they frequently participate in disharmonic sequences with non-high [-ATR] vowels (including the mid [-ATR] vowels [ɛ] and [ɔ]).
2. In /2IU/ languages, non-alternating high [+ATR] vowels are always found in lexical roots. They may be absent in some (or all) categories of function words, and they may or may not be permitted in suffixes. They will usually not be found in prefixes. (See Section 4.1 below.) Where they do occur, they are most typically dominant, spreading their [+ATR] quality to neighboring vowels.

4. Practical diagnostic tests for vowel-inventory type

In this section, we will look at some ways in which differences in the typical patterning of high vowels in /1IU/ and /2IU/ systems can be employed as potential clues to aid in the identification of a language's likely vowel-inventory type in descriptive fieldwork. The prototypical scenario assumed throughout the discussion is one involving early stages of fieldwork being carried out in a language whose vowel system is not yet clearly known, in a language family and/or region in which both /1IU/ and /2IU/ systems are reasonably likely a priori possibilities. I emphasize that the presentation is intended to be illustrative, rather than exhaustive. No claim is intended that the specific tests proposed here are the only possible diagnostics based on phonological patterning. The aim is simply to illustrate how some potential sources of clues that seem reasonably promising might be put to use in practice.

The diagnostics we will be concerned with are ones that have the advantage of being highly amenable to investigation. For the most part, they can be carried out on a modest sample of data of sorts (e.g., wordlists) that are often collected during early stages of fieldwork. Moreover, the tests are robust, in that the relevant general patterns can be identified without needing to conclusively determine whether vowels with phonetic qualities that lie in the potentially ambiguous intermediate range are in fact mid [+ATR] or high [-ATR] vowels. This is because the proposed tests can either be conducted using only observations about vowels whose phonetic identification is typically straightforward (i.e., [i], [u], [ɛ], [ɔ], [a]) or, in some cases, because it will suffice to observe the presence, in a particular context, of "intermediate" vowels that could, based on their approximate auditory quality, be either mid [+ATR] or high [-ATR] vowels, without needing to immediately and unequivocally decide between the two alternatives.

4.1 Diagnostic clues based on prefix patterning

A context in which observations about the patterning of high vowels is likely to be particularly revealing in many languages is prefix position. Of course, tests involving this context are only possible in languages that have prefixes (and ideally, a reasonably extensive system of prefixes) to begin with. Fortunately, many African languages, and particularly West African languages, do have reasonably full arrays of prefixes. Robust systems of noun class prefixes are found in some (though by no means all) groupings of the region, for example Guang (Snider 1990), or various Ghana-Togo Mountain languages (Blench 2001). Even in West African language families in which prefixes of this type are lacking, it is often the case that pronominal

prefixes occur as verbal subjects and in possessive NP constructions. Verbal tense/aspect prefixes with high vowels are also found in many languages.

It is also significant that the prefixes that do occur in many West African languages are often highly productive inflectional affixes that can occur with large numbers of roots. This is generally the case with pronominal and tense/aspect prefixes, which can typically be combined with all sorts of verb roots. An advantageous consequence of this is that it is often possible to investigate the phonological patterning of a particular prefix that shows a high vowel in some contexts by *proactively eliciting* specific examples that combine the prefix with root vowels whose qualities are of special interest. For example, if one wishes to investigate how a particular verbal prefix is realized before roots containing a certain vowel, say [ɔ], a linguist is not necessarily dependent on scouring a data corpus for relevant examples that happen to meet the desired criteria. Rather, it will in many cases be a straightforward matter to construct examples in which verb roots that are known to have the vowel [ɔ] are combined with the prefix being investigated and ask a native speaker language consultant how these examples are pronounced.

A very common pattern in /1IU/ languages is one in which a range of prefixes have high [+ATR] vowels that are 1) phonetically invariant, surfacing with a vowel [i] or [u] before both [+ATR] and [-ATR] root vowels and 2) fail to trigger any assimilation in following root vowels. Such behavior is entirely in keeping with the unmarked status of high [+ATR] vowels in /1IU/ languages and with their general assimilatory inertness as [+ATR] vowels (with [-ATR] / [RTR] more typically functioning as the active value in /1IU/ languages). An example of such a pattern, which might be referred to as the *inert-[iu]-prefix pattern*, occurs in Logba (Kwa, Ghana), described in Dorvlo (2008). As is often the case in /1IU/ languages that manifest this pattern, it applies quite generally in Logba, affecting a range of prefixes. These include, among others, a singular noun class prefix [u-], shown in (7), a noun class prefix [i-], shown in (8), a prefix [i-] found on cardinal numbers, illustrated in (9) and a second person plural subject pronoun prefix [ani-], seen in (10).

(7) Logba singular noun class prefix [u-]

- | | |
|-------------|---------|
| a. [ú-kú] | ‘bone’ |
| b. [u-dzí] | ‘heart’ |
| c. [u-dzɛ] | ‘woman’ |
| d. [ù-sà] | ‘nest’ |
| e. [u-kplɔ] | ‘table’ |

(8) Logba noun class prefix [i-]

- | | |
|------------|----------|
| a. [i-tí] | ‘soil’ |
| b. [i-jú] | ‘thorn’ |
| c. [i-na] | ‘person’ |
| d. [í-gbɛ] | ‘spear’ |
| e. [i-vó] | ‘foam’ |

(9) Logba number prefix [i-]

- | | |
|------------|---------|
| a. [i-kpɛ] | ‘one’ |
| b. [i-ɲɔ] | ‘two’ |
| c. [i-ta] | ‘three’ |
| d. [i-na] | ‘four’ |
| e. [i-nú] | ‘five’ |
| f. [i-glo] | ‘six’ |

(10) Logba 2pl subject person pronoun [**ani-**]¹³

- | | | | | | |
|----|----------------|------------|------------|---------------|--------------------------------|
| a. | ani-tsí | loo | | | ‘You sit.’ (2008: 257) |
| | 2PLU-sit | ADR | | | |
| b. | anu | kpɛ | esi | ani-sa | ‘You and Esi left.’ (2008: 60) |
| | 2PLU.IND | CON | Esi | 2PLU-leave | |

Patterns of this sort are quite common in languages which, like Logba, have a seven-vowel /1IU/ system. Some other /1IU/ languages that manifest the inert-[iu]-prefix pattern are Anufo (Adjekum et al. 1993), Babole (Leitch 2003), Denya (Mbuagbaw 2002), Durop (Kastelein 1994), Mbosi (Bedrosian 1996/1997), Siwu (Ring et al. 2002) and Yasa (Bôt Dieudonné 2011).

Although it is quite common in /1IU/ languages, the inert-[iu]-prefix pattern is not at all typical of /2IU/ languages. Prefixes with invariant high [+ATR] vowels do occur in a few /2IU/ languages, for example the Mbam languages Nen and Tuki (Boyd 2015) and the Bantu D languages Budu and Vanuma (Kutsch Lojenga 2009). In all known such /2IU/ cases, however, such a pattern occurs only marginally, in just a few prefixes, and does not represent the general pattern for high prefix vowels, as it does in Logba. Nor, even in these rare /2IU/ cases, is the pattern that occurs exactly the same as the inert-[iu]-prefix pattern found in /1IU/ languages like Logba. Very interestingly (but not, perhaps, surprisingly, in light of the general markedness and dominance tendencies found in /1IU/ and /2IU/ systems), the exceptional [+ATR] prefixes in these languages are dominant, and impose their [+ATR] value on a following [-ATR] root vowel.

The inert-[iu]-prefix pattern is so highly expected and almost boringly familiar in /1IU/ languages that its extreme rarity in /2IU/ languages could be seen as quite surprising. As discussed above, however, the general absence of prefixes with invariantly [+ATR] high vowels in the vast majority of /2IU/ languages can be regarded as a kind of markedness avoidance effect, related to the generally marked status of [+ATR] vowels as a class in /2IU/ languages.

What is far more frequently found in /2IU/ languages, of course, is a familiar pattern in which a prefix that has [+ATR] [i] or [u] before a root with an unambiguously [+ATR] vowel will surface with the corresponding [-ATR] vowel [ɪ] or [ʊ] before any root with an unambiguously [-ATR] vowel. In other words, what we usually find is simply garden-variety ATR harmony. Such a pattern is illustrated by the examples in (11) below, from Nawuri, a nine-vowel /i ɪ e ɛ a ɔ o ʊ u/ Guang (Kwa) language of eastern Ghana (Casali 2002: 12; see also Snider 1989c, 1990). These examples illustrate the behavior of a plural/mass noun class prefix [i-] ~ [ɪ-] in its occurrence with both unambiguously [+ATR] and unambiguously [-ATR] vowels.

(11) Nawuri plural noun class prefix [i-] ~ [ɪ-]

- | | | | |
|----|---------|------------------------|---------|
| a. | [ì-bú] | | ‘rooms’ |
| b. | [í-líŋ] | | ‘roots’ |
| c. | [í-fé] | (V _{i/e} fɛ) | ‘ropes’ |
| d. | [ì-kpá] | (V _{i/e} kpa) | ‘paths’ |
| e. | [í-bó] | (V _{i/e} bɔ) | ‘holes’ |

Some comments are in order here about the presentation format used in (11). With the hindsight afforded by various phonological studies of the language (e.g., Casali 1995b,c, 2002, Snider 1990), it is now clear that the prefix vowel in (11c-e) is in fact a high [-ATR] vowel. As has been repeatedly emphasized, however, the problem of reliably distinguishing high [-ATR] and mid [+ATR] vowels in

¹³ The label ADR in (10a) indicates an addressive particle.

impressionistic phonetic data in early stages of fieldwork is not always trivial. In keeping with this, the forms in (11c-e) are accompanied by alternate transcriptions, in parentheses, in which the prefix vowels have been represented noncommittally using a symbol $V_{/e}$ that is meant to designate a front vowel which might, based on its approximate auditory quality alone, be potentially either [e] or [ɪ]. The assumption here is that the choice between these options could be potentially difficult in the earliest stages of fieldwork, and the notation is intended to reflect this.

What is crucial here is that, even if the exact identity of the prefix vowels in (11c-e) is not yet known with certainty, two things are quite clear. First, it is entirely obvious that such a pattern is not the same as the inert-[iu]-prefix pattern found in languages like Logba. The differences between the two patterns are quite clear; whether the prefix vowel in (11c-e) is a mid [+ATR] or a high [-ATR] vowel, it is clearly not [i-]. Second, the alternations in (11) are ones that should at least be strongly suspected of involving ATR harmony, given how exceedingly common such patterns are on the whole.

In what follows, I refer to a pattern of this type as the *alternating-[iu]-prefix pattern*. Some other /2IU/ languages that display such a prefixal pattern include (among many others) Akan (Casali 2012), Akposso (Anderson 1999), Diola-Fogny (Sapir 1965), Ebira (Adiva 1989), Kalabari Ijo (Akinlabi 1997), Chumburung (Snider 1990), Malila (Kutsch Lojenga 2008), Mmala (Boyd 2015), Nkami (Akanlig-Pare & Asante 2016), Tafi (Bobuafor 2013) and Yangben (Boyd 2015).

Just as the inert-[iu]-prefix pattern in Logba is a very general one in the language (and many other /1IU/ languages), the alternating-[iu]-prefix pattern also applies quite generally in Nawuri (and many other /2IU/ languages), affecting various other prefixes as well. Importantly, the existence of such a pattern is something that should plausibly become clear even in fairly early stages of fieldwork on such a language, as long as the relevant prefixes are commonly occurring ones (as is the case in Nawuri). To the extent that the inert-[iu]-prefix pattern observed in Logba is highly typical of /1IU/, but not /2IU/ languages, while the pattern observed in Nawuri is highly typical of the latter but not the former, as has been suggested, early observations of these patterns can be very helpful as clues to a language's vowel inventory.

Slightly more must be said here, however, about the conclusions that can be reliably drawn from the robust existence in a language of patterns of the Nawuri type (i.e., the alternating-[iu]-prefix pattern). For a couple of reasons, drawing inferences from the existence of this pattern to the conclusion that a language has a /2IU/ system, and not a /1IU/ system, is less immediately straightforward than might be supposed. One reason is simply that harmonic alternations between high [+ATR] vowels [i], [u] and high [-ATR] vowels [ɪ], [ʊ] are not altogether unexpected in a /1IU/ language. Although the vowels [ɪ], [ʊ] do not occur as phonemes in /1IU/ languages, it is entirely reasonable to expect that they might occur as *allophones* of /i/, /u/ before [-ATR] vowels [ɛ], [a], [ɔ], as discussed above. Such an allophonic assimilation process could well give rise to alternations in [ATR] quality in prefixes. And, as we have noted, essentially such a process does occur in a few /1IU/ languages. As naturally expected as this kind of allophonic alternation might be, however, it turns out to be rather uncommon in /1IU/ languages in actuality. In contrast, neutralizing [ATR]-based alternations involving high [-ATR] and high [+ATR] prefix vowels are commonplace in /2IU/ languages. This means that while it would be impossible to absolutely exclude the possibility that a language displaying a pattern of the type in (11) might turn out to be a /1IU/ system (with [ɪ], [ʊ] as allophones of /i/, /u/), this is inherently far less likely than the alternative that it is a /2IU/ system.

A second reason why a pattern of the general form exemplified in (11) might conceivably be expected in /1IU/ as well as /2IU/ languages involves the possibility, which might be difficult to exclude on auditory grounds alone, that the lower prefix vowel allomorphs (i.e., the forms (c-e) in (11) above) might actually be mid [+ATR] vowels (i.e., [e], in the case of (11c-e)). A pattern in which certain prefix vowels are realized as [i], [u] before unambiguously [+ATR] vowels [i], [u] but as [e], [o] before vowels [ɛ], [ɔ], [a] could be viewed as a kind of height harmony process involving the

feature [-high]. There is no obvious reason why such a process should not be expected to affect prefix vowels in a /1IU/ system.

Nevertheless, while a height harmony process in which high root vowels [i], [u] condition high [+ATR] prefix vowels [i], [u] while root vowels [ɛ], [a], [ɔ] condition mid [+ATR] vowels [e], [o] seems a plausible enough pattern in a /1IU/ language, actual cases of this type in /1IU/ languages do not appear to be at all common.¹⁴ On the other hand, garden-variety [ATR] alternations in prefixes are extremely common in /2IU/ languages. For this reason alone, a pattern that is superficially of the type in (11) (i.e., the alternating-[iu]-prefix pattern) stands a much greater a priori likelihood of being a case of [ATR] harmony in a /2IU/ language than it does of being a case of height harmony in a /1IU/ language.

It can also be noted that, in Nawuri and most other languages that show the alternating-[iu]-prefix pattern, the hypothesis that the alternations might involve a feature [high] rather than [ATR] can be readily disconfirmed by observations involving additional data. If the alternations are indeed [ATR]-based, and if the language has, as most /2IU/ languages do, phonemic mid [+ATR] vowels as well as high [-ATR] vowels, root vowels of intermediate auditory quality (i.e., those which are impressionistically in the general range of [ɪ] or [e] in the case of front vowels, [ʊ] or [o] in the case of back vowels) will likely divide into two sets, based on their phonological behavior. Root vowels which are in reality high [-ATR] /ɪ/, /ʊ/ should condition the lower sounding prefix vowels (which are, in reality, themselves high [-ATR] vowels), while those which are in reality mid [+ATR] vowels /e/, /o/ should condition unambiguously high [+ATR] prefix vowels. And this is in fact what we find in Nawuri, as seen in the following additional examples (from Snider 1989c, with minor symbol adjustments).

- | | | | |
|------|-------------|--|-----------|
| (12) | a. [i-dʒo] | (id ₃ V _{o/o}) | ‘yams’ |
| | b. [i-geeʔ] | (igV _{i/e} ʔ) | ‘valleys’ |
| | c. [i-dʊʊʔ] | (V _{i/e} dV _{o/o} ʔ) | ‘traps’ |
| | d. [i-pnʔ] | (V _{i/e} pV _{i/e} ʔ) | ‘tails’ |

Once again, it may not be entirely clear, in early stages of fieldwork, whether the prefix vowel in (12c,d) is [ɪ] or [e] on auditory grounds alone, nor would it necessarily be easy to tell whether the root vowel in each form is a high [-ATR] or mid [+ATR] vowel. (As in (11), this ambiguity is represented once again in parenthetical forms that abstract away from precise identities of the potentially uncertain vowel qualities.) Even so, it is quite clear that the roots in (12c,d) pattern differently from those in (12a,b) by conditioning different prefix vowels. The prefix vowel in (12a,b) is a clear high [+ATR] vowel [i], while the prefix vowel in (12c,d) is clearly something else, whether this “something else” should turn out to be [ɪ] or [e]. Such behavior is readily intelligible under the assumption that the two root classes have different vowels, with different [ATR] values, and it should naturally suggest such a hypothesis. Since the

¹⁴ What may be rather well attested in /1IU/ languages is a different kind of height harmony in which a prefix that surfaces with a high [+ATR] vowel [i] or [u] before roots with [i], [u] surfaces with a mid [-ATR] vowel [ɛ] or [ɔ] before roots with [ɛ], [ɔ], [a]. Such a pattern occurs in the Ghana-Togo Mountain (GTM) language Tuwuli (Harley 2005), for example. A similar, but more complex three-way height harmony is found in the GTM language Selee (Agbetsoamedo 2014). In this process, a prefix vowel is realized as a high [+ATR] vowel before roots with [i], [u], as a mid [+ATR] vowel before roots with [e], [o] and as a mid [-ATR] vowel before roots with [ɛ], [ɔ], [a], as illustrated in triplets like [si-ni] ‘okra’ vs. [se-kle] ‘rivers’ vs. [sɛ-ka] ‘tails’, where the prefix in all three cases is the same Class 4 noun prefix. A similar pattern is also found in the Bantu language Zimba (Connie Kutsch Lojenga, p.c.) and, to a limited degree (applying to certain tense/aspect prefixes), in Logba (Dorvlo 2008). Alternation of high [+ATR] with mid [-ATR] vowels can be naturally understood, in a /1IU/ language, as a kind of re-pairing effect in the sense of Baković (2000). That is, since high [-ATR] vowels [ɪ], [ʊ] are generally disallowed in such languages, high underlyingly [+ATR] vowels that become [-ATR] through assimilation to /ɛ/, /ɔ/, /a/ are forced to lose their [+high] value as well, surfacing as licit non-high [-ATR] vowels. While it is outside the scope of this paper, the cross-linguistic extent and behavior of such processes is an interesting topic that merits further research.

prefix vowel in (12a,b) is a clear [+ATR] vowel, the natural hypothesis is that the root vowels in (12a) and (12b) are also [+ATR] vowels, i.e., [o] and (long) [e], respectively. The root vowels in (12c,d) must then presumably be [-ATR]: (long) [o] in the case of (12c), (long) [ɪ] in the case of (12d). (This hypothesis that the roots in (12a) and (12c) have different vowels, as do those in (12b) and (12d), should naturally be checked by soliciting native speaker judgments on whether the relevant vowels are the same or different.)

The same superficial patterns in (12) are not easily reconciled with the alternative hypothesis that the language is a /1IU/ system and the alternations in question involve a simple height harmony process. If the language has a /1IU/ system, then all of the root vowels in (12) must be mid [+ATR] vowels, since high [-ATR] vowels do not occur contrastively in a /1IU/ system. We are then faced with the problem of explaining why the same root vowel /o/ should behave inconsistently, triggering different allomorphs of the same prefix in (12a) and (12c), and why the same root vowel /e/ should trigger different prefix vowels in (12b) and (12d).

The practical significance of the foregoing observations should be clear. Since the inert-[iu]-prefix pattern is highly typical of /1IU/ but not /2IU/ languages, a language that shows such a pattern, and especially a language in which the pattern is very robust, is far more likely to have a /1IU/ than a /2IU/ system. On the other hand, a language that does not manifest the inert-[iu]-prefix pattern as a robust pattern, but instead has prefixes whose behavior generally conforms to the alternating-[iu]-prefix pattern in (12), is far more likely to have a /2IU/ than a /1IU/ system.

The kinds of specific practical steps required to identify the relevant high-vowel prefix pattern in a language are also fairly obvious and very straightforwardly applied. Where a robust system of noun class prefixes exists, as in both Logba and Nawuri, many relevant examples will typically occur even in fairly common vocabulary such as is found on standard wordlists. Most of the nouns cited as examples above, in both languages, are in fact quite common ones, and a number of them (e.g., 'rope', 'path', 'tail', 'thorn', 'person', as well as the numbers one to five in (9) above) are even found on the Swadesh 200 wordlist. Of course, in order to make observations about alternations (or lack of alternations) in vowel quality in particular prefixes, it is necessary to have done enough morphological analysis to know which surface elements count as instances of the same prefix. However, the general techniques involved in such basic morphological analysis are familiar ones that need no special comment here.

There are also many West African languages that lack extensive systems of noun class (or other nominal) prefixes but which do have verbal prefixes of various types, for example subject pronoun and/or tense-aspect prefixes, whose harmonic behavior is worth investigating. (Such patterns should, of course, be investigated in languages that do have extensive noun class prefix systems as well.) Eliciting enough relevant data involving such prefixes may require more extensive and systematic data gathering, as revealing examples are not necessarily likely to show up, for example, in a standard wordlist. What is needed, of course, are sets of verbal paradigms in which prefixes being investigated occur with verb roots containing various different vowels. Particularly useful at an early stage are verb roots containing auditorily unambiguous high [+ATR] vowels [i], [u] or non-high [-ATR] vowels [ɛ], [ɔ], [a]. Typically, it is easy enough to find examples of verb roots of both types in a standard wordlist of even moderate length. The problem then becomes to determine, through elicitation of relevant paradigms, whether various prefixes that surface with a high [+ATR] vowel before roots with [i] or [u] also surface with a high [+ATR] vowel before roots with [ɛ], [ɔ], [a] (yielding the inert-[iu]-prefix pattern found in Logba) or alternate with lower sounding vowels of intermediate quality (yielding the alternating-[iu]-prefix pattern found in Nawuri) that occur before such roots.

4.2 Diagnostic clues based on suffix patterning

To a first approximation, most of the same considerations discussed at length above in connection with prefixes are relevant to the case of suffix patterns involving

high vowels as well. For this reason, the treatment of diagnostics related to suffix patterns will be comparatively brief, focusing largely on considerations that may apply differently in the case of suffixes. We will begin, however, by noting some respects in which typical suffix behavior is similar to what is observed in prefixes.

Just as in the case of prefixes, a highly expected pattern in languages with a /1IU/ system is one in which high suffix vowels surface invariantly in a high [+ATR] form [i] or [u] in their occurrence with both [+ATR] and [-ATR] root vowels. Such a pattern, which we will refer to as the *inert-[iu]-suffix pattern*, occurs in Logba as well. One suffix that displays such a pattern is a second person singular object pronoun suffix [-wú], whose behavior is illustrated in the examples in (13) below (from Dorvlo 2008).¹⁵

- | | | | | |
|------|----|-------------------------------------|--|-------------------------|
| (13) | a. | Me-zi-wú | | ‘I carry you.’ |
| | | 1SG-carry-2SGOBJ | | (2008: 294) |
| | b. | a-gbé ó-bó-kpɛ-wú | | ‘A dog will bite |
| | | CM-dog SM.SG-FUT-eat-2SGOBJ | | you.’ (2008: 145) |
| | c. | i-vagblawo=é ó-lá-wú | | ‘The teacher beat you.’ |
| | | CM-teacher=DET SM.SG-beat-2SGOBJ | | (2008:230) |
| | d. | i-ɖawa i-kó-wú | | ‘You will be healed of |
| | | CM-madness SM-get.over-2SGOBJ | | madness.’ (2008: 306) |

Other Logba suffixes with invariantly [+ATR] vowels include a first person plural object pronoun suffix [-tu], a second person plural object pronoun suffix [-nu], and a derivational suffix [-ji] that is attached to stative verbs to form an adjective designating the quality referred to by the verb.

In contrast, the inert-[iu]-suffix pattern is not common in /2IU/ languages. What we more commonly find instead is a pattern in which there is alternation between [+ATR] vowels [i], [u], which occur following roots with [+ATR] vowels, and lower sounding vowels of intermediate quality, which occur following roots with unambiguous [-ATR] vowels [ɛ], [a], [ɔ]. Such a pattern is entirely analogous to the Nawuri prefix pattern seen in (11) above, and it will be appropriate to refer to it as the *alternating-[iu]-suffix pattern*. It is illustrated by the Nawuri examples in (14) below (from Casali 1995b: 133-135, 2002: 14), which show an agentive suffix that surfaces as [-pu], with a high [+ATR] vowel, following roots with unambiguous [+ATR] vowels, and as a suffix with a lower sounding vowel (which is in reality [ɔ]) following roots with unambiguous [-ATR] vowels.

- (14) Nawuri agentive suffix [-pu] ~ [-pɔ]

- | | | | |
|----|-------------|--|--------------------------------|
| a. | [ò-ɲi-pù] | (V _{ɔ/o} ɲipu) | ‘expert (lit. knowing person)’ |
| b. | [ò-tìri-pù] | (V _{ɔ/o} tiripu) | ‘needy person’ |
| c. | [ò-séé-pû] | (V _{ɔ/o} sV _{1/e} :pu) | ‘fetish priest’ |
| d. | [ó-dǝǝ-pô] | (ɔdǝǝpV _{ɔ/o}) | ‘farmer’ |
| e. | [ó-kpám-pô] | (ɔkpampV _{ɔ/o}) | ‘hunter’ |
| f. | [ò-lóó-pó] | (ɔlV _{ɔ/o} pV _{ɔ/o}) | ‘weaver’ |

Here as well, it is quite clear in retrospect, based on various descriptive studies, that the suffix vowel in the last three examples, in (14d-f), is in fact a high [-ATR]

¹⁵ The label CM indicates a noun class prefix (“class marker”), while SM indicates a subject marker (prefix) and DET a determiner suffix. FUT indicates a future tense prefix. Dorvlo’s examples show some variation in how the boundary preceding the 2sg object suffix is represented. In some cases this morpheme is preceded by a hyphen, in others by “=” and in others by a full space. Nevertheless, he clearly describes object pronouns (2008: 57-58) as suffixes. Accordingly, I have consistently used a hyphen in the transcriptions in (13) to separate the [wú] object suffix from a preceding morpheme, regardless of the boundary symbol used in Dorvlo’s own transcription.

vowel. Even where this is not clear in the early stages of fieldwork, however, what is noteworthy is that the pattern plainly differs from the inert-[iu]-suffix pattern illustrated by the Logba examples in (13). Moreover, it should be fairly clear, even in early stages of fieldwork, that the pattern in (14) is consistent with—and highly suggestive of—garden variety tongue root harmony between a root and following suffix.

In many /2IU/ languages, the alternating-[iu]-suffix pattern illustrated in (14) is the only pattern found with high suffix vowels. However, quite a few other /2IU/ languages exhibit a second pattern as well. In this pattern, certain suffixes have invariant (non-alternating) high [+ATR] vowels [i], [u] just as in the inert-[iu]-suffix pattern that commonly occurs in /1IU/ languages. In contrast to the latter, however, such invariant high [+ATR] vowels are not inert, but dominant, in that they spread their [+ATR] value leftward onto a [-ATR] root vowel. As it turns out, such a pattern, which will be referred to as the *dominant-[+ATR]-suffix pattern*, also occurs in Nawuri, though only in a single suffix, a diminutive suffix /-bi/. The behavior of this suffix is illustrated in the examples below (Casali 1995b, GILLBT 1999), which show this suffix following a root with a high [+ATR] vowel /u/ and a non-high [-ATR] vowel /ɔ/, in (15a) and (15b) respectively. In the latter case, the inherently [-ATR] root vowel and preceding [-ATR] prefix vowel undergo [+ATR] spreading from the /-bi/ suffix.

(15) Nawuri diminutive suffix /-bi/

Noun	Diminutive form	
a. [gu- dundun]	[gu- dundumbi]	‘charcoal’
b. [gɔ- lɔ]	[golo- bi]	‘pot’

This pattern is clearly distinguishable, in general, from the inert-[iu]-suffix pattern commonly found in /1IU/ languages, although, as discussed in slightly more detail below, a deeper level of analysis may be required to detect such a pattern than is required in the case of the other patterns.

We have seen three different strongly attested patterns involving high suffix vowels: the inert-[iu]-suffix pattern, exemplified by the Logba examples in (13), the alternating-[iu]-suffix pattern, exemplified by the Nawuri examples in (14), and the dominant-[+ATR]-suffix pattern, exemplified by the Nawuri examples in (15). The first of these patterns is highly typical of /1IU/ systems but not /2IU/ systems, while the other two are both commonly found only in the latter. The diagnostic implications of this complementary distribution of patterns based on inventory type are clear. A language in which the inert-[iu]-suffix pattern occurs, and especially in which such a pattern occurs as a very general one, is far more likely to be a /1IU/ than a /2IU/ language. On the other hand, a language whose high suffix vowels give rise to either or both of the other two patterns is more likely to be a /2IU/ language.

To a large extent, the practical steps needed to apply these diagnostics to suffixes in a language are virtually the same as in the case of prefixes. The same data collection criteria largely apply, as does the same general approach of identifying particular suffixes that have clear instances of high [+ATR] [i], [u] following roots with high [+ATR] vowels and investigating how the same suffixes behave following roots with unambiguously [-ATR] vowels. Notwithstanding these general similarities, however, a few further comments seem warranted in light of certain complexities that arise in connection with suffixes. One potential complicating factor arises from the fact that, in contrast to prefixes, suffixes are more commonly derivational, rather than inflectional, in at least some Niger-Congo subfamilies. (This is the case with the well-known verbal extensions in Bantu, for example.) In some languages, such derivational suffixes may be at least partly lexicalized and not necessarily fully productive. This can make them harder to identify, and it may make the task of finding a large enough set of relevant examples more challenging than in the case of highly productive inflectional affixes that can be freely combined with many roots.

A second potential complicating factor is the existence of a common pattern found in suffixes that has no strongly attested analog in prefixes. This, of course, is the dominant-[+ATR]-suffix pattern, exemplified in the Nawuri data in (15). In addition to increasing the number of possibilities that must be attended to, this pattern poses some potential challenges due to its superficial similarity to the inert-[iu]-suffix pattern commonly found in /1IU/ languages. In both patterns, we observe certain suffixes with non-alternating high [+ATR] vowels. This may well be the most immediately obvious characteristic of both patterns, and further information is needed to distinguish them. In cases where a dominant [+ATR] suffix is a common and productive one that occurs with many different roots, alternations in the quality of underlying [-ATR] vowels in roots to which the suffix is attached may occur so commonly that it is difficult not to notice some such instances, even without specifically looking for them. In the case of less common and productive suffixes of this type, however, it may well be easy enough to miss the crucially revealing alternations in early fieldwork.

While there is likely no sure-fire method for overcoming this difficulty, it is worth emphasizing that the crucial difference between the dominant-[+ATR]-suffix pattern and the partially similar inert-[iu]-suffix pattern lies in the effect of a suffix on preceding [-ATR] root vowels. Hence, where a suffix seems, based on initial inspection, to have an invariant high [+ATR] vowel, it is important to search for possible examples in which the suffix follows roots containing unambiguous [-ATR] vowels /ɛ/, /a/, /ɔ/. It may also be possible in some cases to proactively construct relevant examples by eliciting forms in which the suffix is combined with roots already known to contain inherent /ɛ/, /a/, /ɔ/ vowels. In the case of the Nawuri diminutive suffix /-bi/ exemplified above, for example, one might select (from a database of lexical entries) various nouns referring to animals (to which a diminutive meaning is naturally applicable) that contain these non-high [-ATR] vowels in their roots and elicit diminutive forms of the same nouns constructed with /-bi/.¹⁶

Before leaving this topic, there is yet one further suffix pattern whose existence should be noted. As a reviewer for this journal has pointed out, there are also /2IU/ languages in which high [-ATR] suffix vowels are invariant, surfacing in a [-ATR] form following both [-ATR] and [+ATR] root vowels, and without triggering any changes in a preceding root vowel. For example, a number of /2IU/ Tano languages that are related to Nawuri have agentive suffixes that are cognate with the Nawuri suffix [-pu] ~ [-pɔ] illustrated in (14) above but which fail to harmonize and show up consistently in a [-ATR] form. One such case occurs in the North Guang language Nkami, as illustrated in the examples below (Akanlig-Pare & Asante 2016: 38), which show the non-harmonizing behavior of an invariant agentive/identity suffix [bɔ]:

- | | | | |
|------|------------|--|------------|
| (16) | [o-dʒi-bɔ] | (odʒibV _{o/o}) | ‘glutton’ |
| | [lewu-bɔ] | (lV _{u/e} wubV _{o/o}) | ‘deceased’ |

Other Tano languages showing this pattern include Akan (O’Keefe 2003), Chumburung (Hansford 1988, Keith Snider field notes, Snider 1990), Gonja (Nelson et al. 2016), Gua (Obiri-Yeboah & Rose 2017), Nkonya (Peacock 2007) and apparently (based on limited data in Snider 1990) Krachi.¹⁷

By itself, the observation that this pattern occurs in a language is not necessarily very useful as a diagnostic of vowel-inventory type, at least at an early stage of fieldwork at which the high [-ATR] (as opposed to mid [+ATR]) category of the suffix vowels cannot be easily confirmed based on auditory impressions alone. The reason is that an analogous pattern to (16) in which the vowel of certain suffixes is an

¹⁶ A list of seemingly useful candidates, drawn from the Nawuri wordlist in Casali (1995b), might include such forms as [kɔŋkɔŋ] ‘bat’, [lɔŋɔ] ‘rabbit’, [pááŋé] ‘cricket’ and [dʒímbwááŋé] ‘cat’.

¹⁷ The reviewer also raises the question of whether the pattern involving disharmonic high [-ATR] suffix vowels exemplified in (16) might in fact turn out to be *more common* than the alternating-[iu]-suffix pattern exemplified in (14). While my own experience to this point would lead me to believe that the latter pattern represents the more common case, I concede that the question is one that could really use more systematic investigation.

invariant mid [+ATR] vowel [o] is a natural enough possibility in a /1IU/ language (and is attested in at least some /1IU/ languages, for example the Bantu C language Ntomba, as described by Leitch 1996). As long as this possibility cannot be dismissed on impressionistic phonetic grounds, the possibility of a /1IU/ system remains in play.

Nevertheless, while a suffix pattern of this fourth type is not, all by itself, necessarily very helpful in diagnosing vowel-inventory type, it should typically be the case that further observations about attested and unattested suffix patterns in the same language will prove more helpful in deciding the issue. For example, all of the /2IU/ Tano languages cited above are missing the inert-[iu]-suffix pattern; they have no suffix vowels that are invariantly [i] or [u] and fail to spread [+ATR] leftward onto a preceding [-ATR] root vowel. Absence of such a pattern is, as previously noted, highly typical of /2IU/ but not /1IU/ languages. This furnishes a potential clue that the languages in question are of the former type. In addition, four of the languages, Akan (Casali 2012, Dolphyne 1988, O'Keefe 2003), Chumburung (Hansford 1988: 145), Gua (Obiri-Yeboah & Rose 2017) and Nkonya (Peacock 2007: 21), show the same dominant-[+ATR]-suffix pattern that is evident in Nawuri, a pattern that is also highly expected in /2IU/ but not /1IU/ languages. Thus, while the additional possibility of disharmonic suffixes with [ɪ], [ʊ] may complicate the picture in some languages, there is still reason for general optimism that investigation of high-vowel patterning in suffixes will yield potentially valuable clues to vowel-inventory type in many cases.

4.3 Diagnostic clues based on root-internal co-occurrence

As discussed in Section 3 above, root-internal co-occurrence of high [+ATR] vowels [i], [u] with mid [-ATR] vowels [ɛ], [ɔ] is fairly typical of /1IU/, but not /2IU/, languages. This suggests a natural diagnostic that might be employed to help determine, in early stages of fieldwork, whether a particular language is of the /1IU/ or the /2IU/ type. The question to be investigated is the obvious one: does the language under study freely permit such root-internal sequences, or not? If it does, this suggests a higher likelihood that the language has a /1IU/ system. If not, this suggests that it more likely has a /2IU/ system.

The issues here are in principle so straightforward that there is relatively little else that needs to be said about the matter. There are, however, a few points of a practical nature that should be briefly touched upon.

On an optimistic note, it is worth pointing out that, as with the other tests we have looked at, the effective application of this particular diagnostic does not crucially depend on being able to accurately distinguish potentially confusable high [-ATR] and mid [+ATR] vowels. The reasons for this are clear: the diagnostic test involving co-occurrence does not refer to such vowel qualities at all, but only requires reference to vowel qualities ([i], [u], [ɛ], [a], [ɔ]) whose identification is generally not problematic.

On a less encouraging note, it is necessary to recognize some methodological challenges in connection with this same diagnostic test as well. One of these relates to the quantity of data required to employ the test. Reliable observations about co-occurrence possibilities and gaps must be based on a reasonable sample size. While it is difficult to say exactly how much data is needed, a sample of a couple of hundred words, based on something like the Swadesh 200 wordlist, may well be insufficient (other than, perhaps, for the purpose of making a crude initial assessment).

A more significant, and potentially challenging, factor derives from the fact that observations about root-internal vowel co-occurrence naturally presuppose that roots have been accurately identified. This, of course, entails a certain amount of morphological analysis. Moreover, the task of fully identifying root morphemes in a sample of lexical data is not necessarily trivial. While it may well be straightforward enough to identify most affixes in a sample of data, at least in the case where these are productive, the problem of distinguishing compound words from words with simple roots in a language requires a reasonably good understanding of the meanings associated with roots in a database, and it is generally quite easy to miss the fact that

certain stems are compounds in early stages of analysis.¹⁸ (The task may be somewhat easier in language families in which noun and/or verb roots show a strong tendency to conform to recognizable canonical shapes in terms of their CV sequences.) And this is potentially significant, because compound stems can often be disharmonic with respect to ATR agreement in both /1IU/ and /2IU/ languages.

This does not mean that the root-internal co-occurrence diagnostic cannot be used to good effect in practice. It does mean, though, that its successful application may require more thorough and tedious data collection and analysis than some other diagnostics. Even where rigorous and systematic application of the diagnostic is not feasible in the earliest stages of fieldwork, however, it is still helpful to be generally aware of the potential significance of disharmonic roots that combine high [+ATR] and mid [-ATR] vowels, and to be alert to possible forms of this type as they are encountered. A simple informal observation that potential roots of this type are frequently encountered in a language could suggest the high likelihood of a /1IU/ system, and indicate that a more systematic investigation of root-internal co-occurrence (based on thorough morphological analysis) is warranted.

4.4 Diagnostic clues based on high-vowel patterns in independent pronouns

A further diagnostic relies on observations about high vowels, or potential instances of high vowels, in the independent forms of pronouns. By independent forms, I mean free (rather than bound) or “stand-alone” forms of pronouns that can occur, for example, as single-word utterances given in response to a question. These also typically correspond to the citation forms of pronouns, elicited, for example, using a wordlist.

It is not immediately obvious, based on any widely familiar assumptions, why such forms should be of any special relevance to questions surrounding the type of vowel inventory of a language. Nevertheless, there is good evidence that /1IU/ and /2IU/ languages exhibit different characteristic tendencies with respect to the sets of vowels that are likely to occur in their independent pronoun inventories. These differences are plausibly related to the different general markedness tendencies, discussed in Section 3 above, exhibited by the two vowel system types.

In both /1IU/ and /2IU/ systems, it is highly likely on a priori grounds that at least some high vowels will occur within the full set of independent pronouns. In positional neutralization patterns involving height (not tongue root) features in Niger-Congo languages, high and low vowels are often favored, while mid vowels are sometimes avoided (Beckman 1997). This, combined with the sheer statistical likelihood that high vowels, which are typically common enough in general, might show up in one or more of a language’s personal pronouns, makes it inherently unlikely that a language might turn out to have only low and mid vowels in its independent pronouns. And in fact, such cases, though attested (as in the Ghana-Togo Mountain language Avatime, described in Schuh 1995), do not appear to be very common. While high vowels as a general class are highly likely to occur in some pronominal forms in both /1IU/ and /2IU/ systems, however, important differences are expected when it comes to the question of *which* high vowels we expect to find.

¹⁸ This was my own experience in early fieldwork carried out on Nawuri in the mid-1980s. Quite a few words that were initially assumed to have monomorphemic stems were later discovered to be compounds. At a minimum, identifying a word as a compound requires familiarity with one or more component roots. In addition, the problem of identifying roots may be rendered more complicated by the application of phonological processes, as in the case of Nawuri [gótʃútúúʔ], a name for a particular funeral rite, which is formed from a singular noun class prefix /ga-/ and roots /tʃu/ ‘water’ and /tʊʊ/ ‘throw’. In this case, the identity of the second root is potentially obscured (at least to a linguist who has not yet worked out the full system of phonological rules) by rightward spreading of [+ATR] onto the underlying long vowel /ʊʊ/. (The vowel of the noun class prefix is similarly affected by leftward spreading of [+ATR].) The same word also illustrates a second important factor, which is that rapid identification of compounds may be hindered in some cases by lack of adequate cultural knowledge on the part of an expatriate linguist. Before one is aware what the funeral rite consists of (and that it involves a particular use of water) there might be no clear reason to equate the first stem syllable with the root /tʃu/ ‘water’.

In /1IU/ languages, the answer to this question is quite simple. Since such languages contain only high [+ATR] vowels /i/, /u/ to the exclusion, at least phonemically, of high [-ATR] vowels /ɪ/, /ʊ/, we naturally expect that any high vowels found in pronouns will be [+ATR] vowels [i], [u]. The same high [+ATR] vowels are, of course, also a logical possibility in independent pronouns in /2IU/ languages as well. As noted in Section 3.1.1 above, however, it seems to be quite common, at least in West Africa, for independent pronouns in /2IU/ languages to contain only [-ATR] vowels.

Based on these considerations, it is possible to suggest a couple of tests that might reasonably be applied. First, and perhaps most usefully, a language that lacks any instances of [i] or [u] in its inventory of independent pronouns is more likely, and perhaps far more likely, to be a /2IU/ than a /1IU/ system. On the other hand, it seems justifiable to propose at least tentatively (and pending further research) that a West African language that does have some high [+ATR] vowels in its independent pronoun inventory is more likely a /1IU/ than a /2IU/ system (since /2IU/ systems with [+ATR] vowels in independent pronominal forms are seemingly the exception, at least in much of West Africa).

The ultimate robustness of this latter diagnostic must depend in part on how strong the typological tendency for /2IU/ languages to have only [-ATR] vowels in their independent pronouns turns out to be. It would also be useful to have a clearer picture of how much this tendency varies by geographic region and/or language family. These are questions that merit more systematic investigation. As a partial illustration of the reality of the difference in pronoun vowel patterns, at least as a tendency, however, I include, in an appendix, a sample of the independent pronouns found in a modest set of West African languages, including languages of both the /1IU/ and /2IU/ varieties. For this sample, at least, presence of [i], [u] in some independent pronouns is highly characteristic of /1IU/ languages, while absence of such vowels (and of [+ATR] vowels more generally) in independent pronouns is characteristic of /2IU/ languages. And while the sample was essentially obtained via quick and unsystematic browsing of readily available sources, I think it is reasonably suggestive of an important difference in characteristic tendencies. At least, it is not at all difficult to find /2IU/ West African languages in which independent pronouns contain only [-ATR] vowels, and /1IU/ languages in which some independent pronouns do contain [i], [u] are also quite common, as would be expected.

It can be noted that the /2IU/ languages in the appendix sample, almost without exception, show one or more high [-ATR] vowels in their independent pronouns. That high-vowel contrasts should be positionally neutralized to [-ATR] in /2IU/ languages is entirely expected under the view of tongue root markedness relations outlined in Section 3 above. In practice, it may not always be easy, in early fieldwork, to determine whether pronominal vowels of intermediate impressionistic height are [ɪ], [ʊ] or [e], [o] in a language that lacks any [+ATR] vowels in its independent pronouns. In languages in which [i], [u] are entirely absent in independent pronouns, however, phonological considerations make the former possibility a much more likely one. Cases in which high [-ATR] vowels occur in independent pronouns to the exclusion of their [+ATR] counterparts are highly expected in /2IU/ languages. Cases in which mid [+ATR] vowels occur to the exclusion of any high vowels in the same context are much less expected, in either /1IU/ or /2IU/ languages.

Finally, while allowance must be made for some uncertainty surrounding the ultimate reliability of this proposed diagnostic, it should be appreciated that it has one very important practical advantage: it is extremely easy to apply. The task of eliciting the independent pronouns in a language is a simple one that can be carried out very quickly. Such pronouns are also included in some standard wordlists, for example the SIL Comparative African Wordlist (Snider & Roberts 2004).

4.5 Diagnostic clues based on vowel epenthesis in loanword adaptation

The final diagnostic to be examined is one that must be proposed rather tentatively at this point, as it is based on some potential differences in phonological

patterning that have not been systematically examined in very many languages. Moreover, since it involves a type of phenomenon that is often not explicitly treated in descriptive studies, and especially shorter studies, the task of testing its predictions against a large sample of languages would not necessarily be easy. Nevertheless, the differences are ones that are clearly expected under the emerging picture of markedness presented in Section 3 above, and there are reasonably promising initial indications, based on a modest number of cases, that the expectations are borne out. They are discussed here in the hope that they may prove useful in some cases and that the proposals presented here may serve as a stimulus to further research on the issues.

The particular diagnostic we will look at involves vowel epenthesis in loanword adaptation. We will focus specifically on cases, which are common in West African languages, in which a particular vowel is consistently used as an epenthetic vowel in the adaptation of loanwords, to break up inadmissible consonant clusters and/or prevent the occurrence of an inadmissible word-final consonant. Such a phenomenon occurs, for example, in Yoruba (Kenstowicz 2006) as illustrated by the English loanwords below. (Here, and in some other language examples given in this section, tone marks found in the original source have been omitted for typographic clarity.)

(17) Some Yoruba loanwords

English source	Yoruba word
a. 'bat'	[baati]
b. 'silver'	[silifa]
c. 'muffler'	[mɔfila]
d. 'gazette'	[gasɛɛti]
e. 'sick'	[siiki]
f. 'dozen'	[dɔsini]
g. 'prefect'	[pirifɛti]
h. 'receipt'	[risiiti]
i. 'alarm'	[alaamu]
j. 'gum'	[gɔɔmu]

In Yoruba, as well as in various other languages that display such a phenomenon, the epenthetic vowel employed is a high vowel. Most typically, the vowel is a front unrounded vowel, though in some languages this vowel will assimilate to a neighboring round vowel or labial consonant, as in the examples in (17i,j) above. Setting aside the effects of assimilation to neighboring consonants or vowels, it is widely assumed that the particular high vowel that is epenthesized will be an *unmarked* one in the language (Rice 2007). What now becomes relevant is the expectation (Section 3 above) that /1IU/ and /2IU/ languages conform to different, and essentially opposite, markedness relations in high vowels. In /1IU/ languages, in which [+ATR] vowels [i], [u] clearly pattern as unmarked vowels (their [-ATR] counterparts /ɪ/, /ʊ/ being phonemically absent), we naturally expect to find a high [+ATR] vowel, generally [i], functioning as the epenthetic vowel, as indeed we find in the Yoruba examples above. In /2IU/ languages, on the other hand, the assumption that [+ATR] vowels (including high [+ATR] vowels) are marked relative to their [-ATR] counterparts might lead us to expect, all else equal, that the epenthetic vowel should be a high [-ATR] vowel, presumably [ɪ]. However, it is also generally the case in /2IU/ languages that high [-ATR] vowels are subject to ATR harmony, so that the vowel [ɪ] is not expected in words that contain [+ATR] vowels. In light of this, it is not surprising that the most typical pattern in /2IU/ languages is one in which an epenthetic high vowel harmonizes for [ATR] with other vowels in the word, as in the examples below (drawn from Akanlig-Pare & Asante 2016: 26) from Nkami, a Guang language of Ghana.

(18) a. Some Nkami loanwords with [-ATR] vowels

English source	Nkami word	
'plaster'	[pɪlasta]	(pV _{i/e} lasta)
'block'	[bɔlɔgɔ]	(bɔlɔgV _{o/o})
'plate'	[pɪlɛtɪ]	(pV _{i/e} lɛtV _{i/e})
'silver'	[sɪlɪba]	(sV _{i/e} lV _{i/e} ba)
'torch'	[tɔɔtʃɪ]	(tɔɔtʃV _{i/e})
'cup'	[kɔɔpɔ]	(kɔɔpV _{o/o})

b. Some Nkami loanwords with [+ATR] vowels

English source	Nkami word
'blade'	[biledi]
'fridge'	[firidʒi]
'bread'	[bulodo]
'soap'	[sopu]
'boat'	[bootu]

Several comments about these examples are in order. First, just as in the Yoruba examples in (17), epenthetic vowels undergo assimilation for rounding in some cases as well. Second, in keeping with the notational practice followed to this point, the parenthetical forms on the right in (18a) are meant to allow for a measure of uncertainty, should such forms be encountered in early fieldwork, on the question of whether certain vowels are mid [+ATR] or high [-ATR] vowels.¹⁹ Regardless of this, however, it should be clear enough that the epenthetic vowels in these forms differ phonetically from the high [+ATR] vowels used epenthetically in words like those in (18b), and it should also be clear that they sound at least approximately like high [-ATR] vowels. Moreover, the alternations in impressionistic auditory height make perfect sense in terms of a garden-variety ATR harmony process, assuming that the epenthetic vowels in (18a) are in fact high [-ATR] vowels. In contrast, the same forms would be disharmonic, and more difficult to make sense of, if the epenthetic vowels were [e] / [o] (since the resulting phonetic forms would contain disharmonic sequences of mid vowels, in forms like [tɔɔtʃe] and [kɔɔpɔ], that are not very commonly found in either /1IU/ or /2IU/ languages).

At any rate, it is clear, even allowing for some uncertainty in phonetic transcription, that the general pattern in (18) is different from the one in (17) above. While more research is needed, there are some good preliminary reasons to suspect that the pattern in (17), in which an epenthetic vowel is consistently high and [+ATR], is highly typical of /1IU/ but not /2IU/ languages, while the pattern in (18), in which the epenthetic vowel is [+ATR] only in words with [+ATR] vowels, is typical of /2IU/ but not /1IU/ languages. For one thing, such a difference in the patterning of epenthetic high vowels is entirely analogous to other differences in the patterning of the two inventories we have looked at (it is highly similar, for example, to the different prefixal patterns involving high vowels examined in Section 4.1 above), making the existence of the difference seem inherently plausible. In addition, my own initial investigations, based on a modest sample of languages, are consistent with the conclusion that the pattern in (17) is typical of /1IU/ languages, while the pattern in (18) is typical of /2IU/ languages. In addition to Yoruba, /1IU/ languages that appear to show the epenthetic pattern in (17) include Ewe (Wornyo 2016), Ga (Mensah 1992), Iyala Ogoja (Armstrong 1968, Orie 2002), Logba (Dorvlo 2008) and Tuwuli

¹⁹ Akanlig-Pare & Asante (2016: 23) explicitly note that "as far as Nkami is concerned, /ɪ/ and /ʊ/ are highly distinct as there is no difficulty in identifying them from adjacent height vowels /i, u, e, o/." However, they also implicitly acknowledge, on the same page, that the identification task might sometimes prove challenging for linguists who are not themselves native speakers of ATR harmony languages. Our concern here, at any rate, is simply to outline a diagnostic test, involving epenthetic vowels, which should be largely immune to any such auditory difficulties.

(Harley 2005). In addition to Nkami, /2IU/ languages that appear to conform to the epenthetic pattern in (18) include Chumburung (Hansford & Hansford 1989), Gonja (author's own data), Igbo (Orie 2002), Konni (Cahill 2007) and Nawuri (GILLBT 1999).

If this should indeed turn out to be the case, such differences constitute a further potentially useful diagnostic of vowel system type. Where the non-alternating epenthesis pattern in (17) is observed to apply in a language, a natural tentative conclusion is that the language's vowel system is likely of the /1IU/ type. A language that shows the alternating pattern in (18), on the other hand, is more likely a /2IU/ system.

Moreover, while it might be tempting to regard loanword phonology as a supplemental or marginal topic and not something that is appropriate to investigate in the initial stages of fieldwork on a language, there are some promising and surprisingly simple steps that might be taken, in at least some contexts, to quickly and actively investigate the patterning of epenthetic vowels in loanwords. To begin with, certain common loanwords from English are often found in languages of anglophone countries like Ghana and Nigeria. Some recurring loanwords of this type are listed in (19), along with some languages in which they have been observed to occur.²⁰

(19)	Source word	/1IU/ language examples	/2IU/ language examples
	'blade'	Yoruba [bileedi]	Nawuri [bileedi]
	'ball'	Ewe [bɔlu]	Nawuri [bɔɔli], Chumburung [bɔɔri], Konni [bɔli], Nkonya [bɔɔlo]
	'bag'	Yoruba [baagu]	Chumburung [baagi], Gonja [baagi]
	'gum'	Yoruba [gɔɔmu]	Nawuri [gɔmpo]
	'brush'	Ga [blɔfi]	Chumburung [birɔsi]
	'silver'	Yoruba [silifa]	Nkami [siliba]
	'cup'	Ewe [kɔpu], Logba [kɔpu]	Nkami [kɔɔpo], Gonja [kɔɔpo], Nawuri [kɔɔpo], Nkonya [kɔɔpo], Tafi [kɔpo]
	'pass'	Iyala Ogoja [paasi]	Igbo [paasi]
	'police'	Ewe [polisi]	Gonja [porifi]
	'store'	Ewe [sitɔ]	Nawuri [sɔtɔ]

It seems likely that a careful attempt to elicit items on such a list of potential loanwords (which might ideally be expanded with further promising possibilities) would, in many languages in anglophone countries, be rewarded with several useful items that would reveal which, if either, of the two common high-vowel epenthesis patterns exists in the language. In turn, such a clue might then suggest, in keeping with the criteria outlined above, a reasonable hypothesis as to the likely vowel system type found in the language. Given the ease, at any rate, with which such an experiment might be carried out in practice, its use in the context of fieldwork on languages in anglophone West Africa certainly seems at least worth investigating.²¹ Presumably it should be equally possible to construct lists of likely, and potentially revealing, loanwords from French for investigation in francophone countries.

²⁰ The examples in (19) are from the following sources: Chumburung: Hansford & Hansford (1989), Ewe: Wornyo (2016), Ga: Mensah (1992), Gonja: author's own data, Igbo: Orie (2002), Iyala Ogoja: Orie (2002), Konni: Cahill (2007), Logba: Dorvlo (2008), Nawuri: GILLBT (1999) and author's own data, Nkami: Akanlig-Pare & Asante (2016), Nkonya: Nkonya Language Website (<http://nkonya.wycliffe.ca/Dictionary/index.html>), Tafi: (Bobuafor 2013), Yoruba: Akinlabi (1993), Kenstowicz (2006), Orie (2002).

²¹ I can cite an example from my own experience in this connection. During the course of fieldwork on the Gonja language of Ghana in August 2015, my language consultant was able to very quickly supply a couple of dozen Gonja loanwords, based in part on a list of suggested possibilities. From the actual pronunciations of the words in this list, it became clear that the loanword vowel epenthesis pattern in the language conforms to the general pattern expected of /2IU/ languages, as exemplified in (18).

4.6 Possible effects of ongoing diachronic change

A question that might reasonably be asked about the diagnostics outlined above is how their application might be affected in the case of a language whose vowel inventory is in the process of changing. The question is relevant because there is in fact good evidence that original /2IU/ vowel systems in some West African language families have undergone diachronic reduction to /1IU/ systems through loss of the high [-ATR] vowel phonemes /ɪ/, /ʊ/ (Casali 1995a, Elugbe 1983, Ford 1973, Painter 1972, Stewart 1970, Williamson 1983). A very natural expectation is that such scenarios could generate languages whose patterns fail to conform in various respects with the expectations of the diagnostics proposed above.

As an example, consider the case of a nine-vowel /i e ε a ɔ o u/ language that is undergoing historical change and in which the vowels /ɪ/ and /ʊ/ are in the process of being lost by merger of [ɪ], [ʊ] with [i], [u] (with the former being replaced by the latter). Such loss is known or believed to have occurred in a number of West African language families, for example Tano (Casali 2003 and references therein). A plausible assumption is that a change of this type would most likely begin in weak positions such as affixes and function words and only later occur in strong positions (roots of content words) as well. This should give rise to a stage of the language at which [ɪ], [ʊ] no longer occur phonetically in affixes or function words, having been replaced in such positions by [i], [u], but continue to occur in lexical roots in contrast with other vowels. Such a language would still qualify as a /2IU/ system, in virtue of its [ATR] contrast in roots. However, it is easy to see that at least some of the diagnostics proposed in this paper would fail in such a case. In the absence of any further changes, such a language would presumably display the inert-[iu]-prefix and/or inert-[iu] suffix pattern (depending on whether it had prefixes and/or suffixes to begin with), contrary to the expectations of the diagnostics outlined in Sections 4.1 and 4.2 above, under which these patterns are assumed to be far more typical of /1IU/ languages. The diagnostic based on high-vowel patterns in independent pronouns (Section 4.4) would also likely fail to apply as expected, since any high vowels in pronouns or other function words would be [+ATR] [i], [u] and not [-ATR] [ɪ], [ʊ].

To the extent that such scenarios actually occur, we must conclude that the diagnostics in this paper may prove unreliable in cases of languages whose vowel inventories are in the process of transition. I do not believe, however, that such cases are likely to be very commonly encountered in practice. Evidence presented in Casali (2014, 2016) argues that /2IU/ languages in which high [-ATR] vowels /ɪ/, /ʊ/ are restricted to strong positions, as might be expected to occur under the transitional scenario just outlined, are comparatively rare at best. While there can be no guarantee that a language being investigated in fieldwork will not turn out to be a language of this type, in which case the diagnostic tests outlined here will at least partially fail, this does not mean that these tests are not useful, but only that they are not completely infallible. The claim is simply that they are likely to be reliable enough, to be well worth applying in practice.

5. Conclusion

Due to a tendency for high [-ATR] vowels [ɪ], [ʊ] to be easily confused with other vowels, and especially mid [+ATR] vowels [e], [o], the problem of accurately and efficiently determining whether or not a language has a tongue root contrast in high vowels has proven to be a surprisingly challenging one in practice. For this reason, it makes good sense to pay close attention to potential clues from phonological patterning in conducting fieldwork on a language whose vowel-inventory type is not yet known, at least in regions of Africa (including much of West Africa) in which both /1IU/ and /2IU/ languages are frequently encountered. This is especially so inasmuch as /1IU/ and /2IU/ vowel systems exhibit some striking differences in their recurrent phonological tendencies. These different characteristic

tendencies give rise to a number of practical diagnostic tests that can be employed in early stages of fieldwork to aid in assessing a language's likely vowel system type.

We have looked at five such diagnostics, all of which involve observations about the patterning of high vowels in particular contexts. The patterns of interest include:

- The patterning of high vowels in prefixes.
- The patterning of high vowels in suffixes.
- Root-internal co-occurrence of high [+ATR] and mid [-ATR] vowels.
- Occurrence or non-occurrence of high [+ATR] vowels in independent pronouns.
- Epenthetic high vowels in loanwords.

While the specific conclusions that are warranted vary from context to context, all of the proposed tests hinge on some general expectations which, though surprising on a priori grounds, are well supported by accumulating typological evidence. Specifically, we expect to find, under an emerging model of tongue root markedness and dominance relations argued for in Casali (2014, 2016), that high [+ATR] vowels [i], [u] should typically pattern as both unmarked and inert in /1IU/, but not /2IU/, languages. In the former, the wide distribution of [i], [u] and their failure to trigger [+ATR] spreading should frequently give rise, in various contexts, to sequences in which these vowels co-occur with mid [-ATR] vowels [ɛ], [ɔ], without affecting the latter. In contrast, disharmonic sequences combining [i], [u] with [ɛ], [ɔ] are much less freely expected in /2IU/ languages in consequence both of the fact that invariantly [+ATR] high (and non-high) vowels are often distributionally restricted in such languages and of the fact that, where such vowels do occur, they typically function as triggers of [+ATR] spreading.

In addition to showing reasonable promise as diagnostics, the particular tests we have looked at are ones that should, for the most part, be relatively simple to apply. Relying as they do on common and familiar sorts of data that should typically be easy to obtain, they should, in many cases, be capable of investigation quite early in a language research project.

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Appendix: Independent pronouns in some West African languages²²

/2IU/ languages

Language	1sg	2sg	3sg	1pl	2pl	3pl	Source	Family
Abouré	mí	wó	jí	jé	vé	ámí	Burmeister (1982)	Kwa
Abron	mí	wó	ní	jé	hó	bé	Ravenhill (1982: 119)	Kwa
Akan	mi	wu	no	jen	mo	won	Casali (2012)	Kwa
Anyi	mí	wó	jí	je	é↓mó / á↓mó	bé	Burmeister (1988)	Kwa
Avatime	mē	wō	jē	blō	mlō	bā	Schuh (1995)	Kwa
Birifor	māa	fōō	wò	sì	jīn	bà	Dundaa (2013: 178)	Gur
Chumburung	mó	fó	mò	àní	mòní	bámó	Snider (1989c)	Kwa
Dagaare	maa	foo	ono	timu	jenu	bana	Schaefer (2009: 103, citing Dakubu 2005)	Gur
Dazaga ²³	tàní	ntà	mèré	tintá	nintá	màrá / mòrá	Walters (2016)	Saharan
Diola-Fogny	inye	aw	ɔ	oli / walal	mojul	bokɔ / kɔ	Sapir (1965: 70)	Atlantic
Ebira	èmi	èwo	oni	èji	èwo nmi	éni	Adiva (1989)	Nupoid
Efutu	mí	ówó	mó	àní	ání	àmò	Obeng (2008)	Kwa
Gichode	méí	fó	mò	àjé	fàjé	mómó	Snider (1989c)	Kwa
Gonja	má	fó	mò	àpí	mìpí	bómó	author's unpublished data	Kwa
Konni	máníŋ	fíníŋ	wóníŋ	tíníŋ	níníŋ	báníŋ	Cahill (2007)	Gur
Koromfe ²⁴	məkɔ	ŋkɔ	dəkɔ	okɔ	nakɔ	bakɔ	Rennison (1997: 237)	Gur
Krachi	mé	fó	mò	àlí	bàrí	bòò	Snider (1989c)	Kwa
Nawuri	mé'	fó	mò	àné'	fàné'	bámó	Snider (1989c)	Kwa
Nzema	mámí	wómɔ	jímɔ	jémɛ	bémɛ	bémɛ	Burmeister (1988)	Kwa
Safaliba	màáɲ	íná	óná	tònóò	jáná	báná	Schaefer (2009)	Gur
Tafi	mí	wó	jí	blō	wōnō	balí	Bobuafor (2013)	Kwa

²² The pronominal forms shown for several languages, including Anufo, Dagaare, Dangme, Nzema, Safaliba and Supyire are labeled as “emphatic” or “strong” in the descriptive source consulted. In some other cases, including all of those taken from Snider’s (1989c), the forms shown are the citation forms supplied for an elicited wordlist.

²³ The vowel [i] found in some Dazaga pronouns is analyzed by Walters (2016: 24-25) as non-phonemic. Its underlying source in these pronouns is not fully clear.

²⁴ The vowel [ə] found in some Koromfe pronouns is described by Rennison as a prosodically weak and [ATR]-neutral vowel.

/1IU/ languages

Language	1sg	2sg	3sg	1pl	2pl	3pl	Source	Family
Anufo	míní	wóró	jírí	jéré	ám↓béré	béré	Burmeister (1988)	Kwa
Babole	àmé	àwé	èí	bí↓sé	bí↓né	bá↓ngó	Leitch (2003)	Bantu C
Baule	mí	wó / ó	jí / í	é / jé	á↓múãN	bé	Burmeister (1988)	Kwa
Dangme	ímí	mò	lè	wò	ɲè	mè	Dakubu (1987: 75)	Kwa
Duop	ɲmí	ɲó	ɲmóɲ	ibôn	ɲbôn	ɲbè	Kastelein (1994)	Cross River
Ewe	ɲe	wo	éja	míawó	miawó	wóawó	Duthie (1996)	Kwa
Ewondo	ma	wa	ɲé	biá	miná	bó	Redden (1979: 55)	Bantu A
Kako	mi	wɛ	ɲɛ	wùsɛ	wùnɛ	bo	Ernst (1992: 76)	Bantu A
Logba	àmú	àwú	o ɔlé ijé	atú	anú	a alé	Dorvlo (2008)	Kwa
Mboshi	ngá	nò	wà	bísí	bíní	báà	Bedrosian (1996/1997)	Bantu C
Selee	ami	afo	nwo	awo	aje	ma	Agbetsoamedo (2014)	Kwa
Supyire	ure	kure	lire	pire	jire	cire	Carlson (1994 :157)	Gur
Siwu	mɛ	fɔ	wũ	bo	mi	ma	Ring et al. (2002)	Kwa
Tuwuli	jĩ	nɔ	je	boe	mi	be	Harley (2005)	Kwa
Yoruba	èmi	ìwɔ	òũ	àwa	èjĩ	àwɔ̃	Bangboşe (1966: 107)	Defoid