Chapter 8

Implosives in Bantu A80? The case of Gyeli

Nadine Grimm
University of Rochester

Implosive consonants in Bantu A80 languages are widely attested in the literature. The status that specific authors assign to them, however, differ significantly, ranging from mere phonetic contrasts to phonemic status or even absence in certain languages. Given this variety of language analyses, along with a controversy about necessary and sufficient features of implosive sounds, this paper aims at reassessing the range of implosives and non-implosives within A80 and especially Gyeli (A801). I show that though implosives are expected in Gyeli from previous literature, these sounds are better described as pre-glottalized stops with a relatively long prevoicing time. That raises the question whether this analysis might be more appropriate for other A80 languages as well. While this paper cannot provide any conclusive answer on the latter question, it hopes to raise awareness of the methodological problems associated with the present description of A80 implosives, encouraging a systematic re-evaluation of the data. It also encourages a discussion on how the general fieldworker should go about describing implosive(-like) sounds.

1 Introduction

The occurrence of implosives is areally expected in northwestern Bantu, as Clements & Rialland (2008: 58) have shown. Implosives have also been reported for several Bantu A80 languages, including Mpiemo, Shiwa, Kola, and Bekwel. Most authors agree that implosives in A80 languages have phonetic rather than phonemic status, but differ in how they view the relation between implosives and voiced stops, e.g., whether /ɓ/ is an allophone of /b/ or whether a language lacks /b/ altogether. There are also cases where different authors do not agree on the

Nadine Grimm. 2019. Implosives in Bantu A80? The case of Gyeli. In Emily Clem, Peter Jenks & Hannah Sande (eds.), *Theory and description in African Linguistics: Selected papers from the 47th Annual Conference on African Linguistics*, 135–153. Berlin: Language Science Press. DOI:10.5281/zenodo.3367134

presence or absence of implosive sounds in the same language, namely in Gyeli and Shiwa. This differing treatment of implosives in the A80 literature raises the question whether these consonants really are implosives in the first place in all of these languages.

Data from Gyeli, an endangered and understudied Bantu A80 language spoken by "Pygmy" hunter-gatherers in southern Cameroon, suggests that consonants which could be taken to be implosives are better described as phonemic voiced plosives that are phonetically realized with pre-glottalization and relatively long prevoicing, typically found in stem-initial position. During prevoicing, speakers expand their cheeks, increasing both the vocal tract size and amplitude before release of the voiced plosives /b, d/. The effects of this realization can easily be mistaken for an implosive, given that both implosives and pre-glottalized stops involve the manipulation of the larynx and the resulting waveform looks in many cases like that of a typical implosive. The cheek expansion clearly indicates, however, that the airstream mechanism in Gyeli is egressive. The case of pre-glottalized voiced stops in Gyeli may serve as a starting point to reconsider special voiced stops in A80 languages and clarify the status of implosives, at least in some languages.

In the remainder of the Introduction, I will critically review definitions of implosives provided by the literature and introduce the Gyeli language. In §2, I present the distribution of implosives and their phonetic/phonemic status in Bantu A80 languages. §3 provides a detailed discussion of voiced stops in Gyeli, while §4 concludes this paper and gives an outlook on future work that is needed.

1.1 Definitions of 'Implosives' in the literature

The average linguist venturing out into the field to describe an under-studied language has to be knowledgeable in all parts of grammar they intend to describe. More often than not, they are not necessarily expert phoneticians, though, and describing phenomena such as implosives, which have long been a source of controversy, can be very challenging. This is due to i) an apparently different airstream mechanism that was hard to perceive by some early linguists and ii) the nature of phonetic variation ascribed to implosives. Xi (2009), who gives an excellent overview of the historical development of implosive studies, points out that many linguists have had difficulties in accurately describing implosives because they were perceptually used to a pulmonic airstream mechanism. According to her, prior to the recognition of a glottalic airstream, these sounds were often described as pre-glottalized, laryngealized, or pre-nasalized stops which had a long-lasting impact, especially on descriptive linguists.

In order to analyze and name encountered phenomena as best as they can, descriptivist fieldworkers try to have a good understanding of at least the essential literature on specific topics. Textbook definitions often seem to come in handy, especially in terms of terminological issues and definitions. Textbook definitions typically summarize core features that are widely agreed upon in defining implosive sounds. Generally speaking, implosives seem to be plosives which are produced with an ingressive airstream due to larynx lowering. This view is represented, for instance, by Crystal (2008: 228), who states in his *Dictionary of Linguistics and Phonetics* that, "[the term implosives] refers to the series of PLOSIVE sounds it is possible to make using an airstream mechanism involving an inwards movement of air in the mouth (an INGRESSIVE AIRSTREAM)." Also general introductions to linguistics emphasize the ingressive airstream as a defining feature of implosives, for example by McGregor (2015: 41): "Implosives are produced by pulling the larynx downwards during oral closure, and releasing the oral closure, resulting in an audible inrush of air." In earlier classic textbooks, another assumed property of implosives was included in the definition, namely a glottalic airstream mechanism, as in, for instance, Fromkin & Rodman (1998).

The realization of phonemic segments are variable, however, and not every sound that is classified as an implosive is realized the same way, which has been noted already by, for instance, Greenberg (1970). This becomes very clear when looking at the phonetics literature where each of the defining core criteria for implosives have been challenged. Especially for sounds that seem to be at the fringe of an abstract implosive category, authors tend to give much wider definitions or, at least, question the relevance of any seemingly defining feature. There is controversy about categorizing 'unusual' implosives, encompassing all core features, namely i) airflow mechanism, which could be ingressive vs. potentially egressive and glottalic vs. not necessarily glottalic, ii) manner of articulation, which has been described as plosive vs. sonorant vs. non-obstruent, and iii) larynx lowering, which does not seem to be sufficiently defining, but a matter of degree.

In the *World Atlas of Language Structures*, a reference for typology and cross-linguistic comparison, Maddieson (2013) describes implosives as stops produced with a downward movement of the larynx, including the possibility of an inward airflow. Thus, an ingressive airflow is not a necessary, but an optional feature. Also Ladefoged & Maddieson (1996: 82) stress that the presence or absence of negative intra-oral pressure is a variable phonetic feature, proposing "a gradient between one form of voiced plosive and what may be called a true implosive." Lindau (1984) states that implosives may be non-glottalized, involving no glottal closure. Clements & Rialland (2008: 56) support this view, stating that "implosives

cannot be neatly distinguished from non-implosive sounds in terms of an alleged glottalic airstream mechanism."

Even the manner of articulation in implosives has been challenged. Clements (2000) views implosives as sonorants rather than stops. Later on, Clements & Osu (2002) define implosives rather as non-obstruent (non-explosive) stops which lack a build-up of air pressure, resulting in a weak burst at release.

Finally, a lowering of the larynx appears in many definitions of implosives which might then seem to be the only criterion left in defining implosives. Ewan & Krones (1974), however, hold that larynx lowering is not unique to implosives, but also found in certain voiced stops of English or French. As such, larynx lowering is not a sufficient feature. As with all other proposed phonetic properties of implosives, larynx lowering is also subject to variation, involving more or less lowering which, in turn, may have different effects on the airstream and blur the lines between voiced stops and implosives. Thus, Xi (2009: 11) explains that, "if the degree of lowering the larynx is attenuated, implosives are likely to change to voiced stops. Alternatively, for voiced stops, if the pre-voicing is prolonged by enlarging the supra-glottal cavity, it would drive the voiced stops change to implosives."

This controversy reflects a larger issue pertaining to the nature of categories: to what degree can the phonetic details of a category in one language be assumed to hold for the phonetic details of the same category in other languages? The short answer is that it can be assumed that there are likely to be differences. Even closely related languages such as Bantu A80 display different realization rules for the same segment, as is evident from the literature (see §2). What we do not know is the extent to which phonetic details of e.g., , plosives or implosives differ in terms of voicing details, energy of burst, or aspiration because the relevant literature does not give any information on this. Differences are, however, expected, as are similarities.

Knowing about the phonetic details of a segment in one language can serve as a starting point to investigate and/or re-evaluate categories and their extension across (related) languages, provided that their phonetic details become known as well. Ultimately, this will help answer questions on how we can establish categories for cross-linguistic comparison, given the wide range of phonetic variation, and how telling these categories are.

This brings us back to the practical issues of the descriptive fieldworker. How does one know, given all the within-category variation, that one is dealing with a realization of that category or something different? In this paper, I explore this question with a class of sounds in Gyeli that resemble implosives, but which I argue are pre-voiced stops, based on phonetic analysis rather than on perceptual

intuitions only. Assuming the generally agreed-upon core features of implosives–ingressive airstream, larynx lowering, and plosive manner of articulation–I will show that Gyeli prevoiced stops do not meet the criteria of ingressive airstream and larynx lowering, but that auditory effects similar to implosives are achieved through glottalization, prevoicing, and cheek expansion.

1.2 The Gyeli language and data

While I discuss implosive sounds across Bantu A80 languages in this paper, Gyeli is the main language of analysis and the only language for which I have first-hand data. In this section, I briefly provide some basic information on the language and my methodology.

Gyeli is a Bantu A80 language (A801, following Maho 2009) spoken in southern Cameroon by so-called "Pygmy" hunter-gatherers. The language is known under a variety of names, including Bakola, Bagyeli, and Bajele. There are about 4000–5000 speakers who currently still transmit the language to their children. Nevertheless, Gyeli is classified as an endangered language due to a rapidly changing environment that forces speakers to give up their traditional foraging subsistance strategy, adopting farming practices from neighboring agriculturalist Bantu groups. In total, Gyeli has eight contact languages, the most prominent of which are Kwasio (A80) as Gyeli's closest relative, Bulu (A70), and Basaa (A40). Currently, several Gyeli dialects are emerging, depending on the main contact language of regional Gyeli group.

Previous literature on Gyeli comprises a few grammatical descriptions of different Gyeli varieties which also differ in terms of their degree of coverage. The most substantial work comes from Grimm (2015) who provides a complete grammar of the variety spoken in Ngolo, i.e., the Bulu contact region. An earlier description of 'Bajɛle' by Renaud (1976) investigates the phonology and nominal morphology of the Gyeli variety spoken around Bipindi, i.e., in the Kwasio area. There is also an unpublished manuscript on the dialect of Lebdjom, i.e., the Basaa contact region, by Ngue Um (2012). Other linguistic work on Gyeli include an ethnobotanic study of tree names by Letouzey (1995) and a study of color category innovation in language contact by Grimm (2014). There are no previous phonetic studies of Gyeli other than Renaud's (1976) observations in his phonological description.

Data on the Gyeli language stems from my own fieldwork conducted in Cameroon between 2010 and 2014. The analysis of the relevant sounds (voiced plosives which are potential candidates for implosives) was done including both tokens from carefully pronounced word list recordings and tokens from natural text.

2 Implosives in Bantu A80

When describing a language, related and neighboring languages can give valuable hints as to what one might expect to find. In the case of Gyeli, one might expect to find implosive sounds. Implosives are attested in Bantu A80 languages as well as more broadly in northwestern, eastern coastal, and southeastern Bantu languages. Maddieson (2003: 28) states that these languages often have at least one implosive, which is most frequently a bilabial. According to him, Bantu implosives have certain phonetic features in common. First, they are typically produced without glottal constriction. And second, lowering of the larynx is crucial in Bantu implosive production, having a double effect. On the one hand, the lowering increases the amplitude of vocal fold vibration during closure, resulting in a strong voicing at the release. On the other hand, the larynx lowering during production causes an ingressive airstream.

Taking these diagnostics into account, when analyzing implosive sounds in spectrograms and waveforms, there are a few things one would expect to find, and also a few that one would *not* expect to find. In terms of the absence of glottalization, there should be no indication of a glottal closure. A glottal closure might be visible through a higher amplitude in the waveform or signs of 'noise' in the spectrogram. A glottal closure can, however, also be indicated by the absence of a visible stop closure altogether when it accompanies another stop, since overlapping gestures of glottal and other stop closures might result in the "suppression of any audible burst or frication when it is released," as Ladefoged & Maddieson (1996: 73) explain. Regarding the effects of larynx lowering, one would expect to see the increasing amplitude of vocal fold vibration in a typical cone shape that occurs in the waveform right before the release as well as an increase in F0. The release, in turn, should have a comparatively stronger voicing than potential voiced plosive counterparts. The diagnostic of an ingressive airstream that is attributed to Bantu implosives cannot be inferred from spectrogram or waveform analyses; instead, special techniques for airflow and air pressure need to be used (see, for instance, Demolin 2011 for a discussion on aerodynamic techniques for phonetic fieldwork.) There might be other cues to airflow though, for instance observing the movement of both the larynx and the cheeks. I will return to these diagnostics in §3.

While implosives have been widely reported for Bantu A80 languages, there is only one phonetic study of these sounds by Nagano-Madsen & Thornell (2012) on Mpiemo. Therefore, the following discussion cannot provide a comparison of phonetic features, but rather outlines differing phonemic status and possibly dis-

tribution of implosives in those A80 languages for which data on implosives (or their absence) is available. What becomes apparent in this comparison is that implosive sounds in A80 receive a very different treatment in terms of their phonemic vs. phonetic status. This differing treatment seems puzzling, especially when accounts differ substantially on even the same language. It first brings us back to the issue of deciding what sounds should be labelled as implosives. Beyond this, is also raises the questions of how much phonetic variation or similarity there really is in A80 'implosives' and in how far this phonetic variation is played out on the phonological level.

Table 1 summarizes the status of potential implosives[1] within the phonemic plosive series in a representative sample of A80 languages.[2] Most authors agree that implosives in A80 languages, if present, have phonetic rather than phonemic status. Cheucle (2014: 461) even reconstructs voiced stops in Proto-A80 as implosives. Despite this tendency, there is still a lot of variation in the description of voiced plosives and/or implosives in several respects, including i) their general presence or absence, ii) the type of voiced plosive/implosive (e.g., bilabial, alveolar, palatal, velar), and iii) their phonemic status.[3]

There are three accounts of Gyeli (A801), describing different varieties of the language. Each account differs in its assessment of voiced plosives/implosives. In Grimm's (2015) analysis, the Gyeli variety spoken in Ngolo (Bulu contact area) has no implosives at all. Voiced plosives /b/ and /d/ in stem-initial position are realized with preglottalization and relatively long prevoicing. This account is explained in detail in §3. In comparison, Renaud (1976: 49) suggests the presence of a bilabial implosive in the Gyeli variety spoken around Bipindi (Kwasio and Basaa contact area). The implosive is, however, only a phonetic variant of [b] occuring before the vowels /u, o, õ, ɔ, ɔ̃, a, ã/ in both C_1 and C_2 position. The implosive realization is, according to Renaud (1976), in free variation with an egressive glot-

[1] Square brackets indicate phonetic status while slashes / / indicate phonemic status.

[2] There are, of course, more A80 languages, as classified by Maho (2009). Also Cheucle (2014) gives an excellent overview of A80 languages and the existing literature. Sufficient description for comparison, however, is mainly restricted to the languages listed in Table 1 which almost cover the major languages, with the exceptions of A82 (So) and A87 (Bomwali) for which there is no data.

[3] Obviously, there are differences across languages pertaining to the phoneme inventory and realization rules. Bantu A80 languages differ most noticeably in the presence or absence of palatal stops and labio-velars. Some languages also lack the voiceless bilabial stop. There are also some commonalities though, including bilabial, alveolar, and velar places of stop articulation, and voicing contrast as a distinctive feature. For reasons of space, I refrain from discussing prenasalized plosives and affricates. Realization rules, if not involving implosive allophones, are not described here. It should only be noted that they may differ across languages and/or authors' descriptions.

Table 1: Status of voiced stops/implosives in A80 languages

Language	Implosives	Restrictions	Plosive series	Source
Gyeli (A801)				
Gyeli (Ngolo)	no		/p, b, t, d, ɟ, k, g, ʔ/	Grimm (2015)
Bajele (Bipindi)	ɓ	free variation with [b]	/p, b, t, d, ɟ, k/	Renaud (1976)
Bakola (Lepdjom)	/ɓ, ɗ, ƒ/	stem-initial	/p, ɓ, t, ɗ, ƒ, k, kp/	Ngue Um (2012)
Shiwa (A803)	no		/p, b, t, d, k, g/	Ollomo Ella (2013)
	[ɓ, ɗ, ƒ]	none	/p, b, t, d, k, g/	Dougère (2007)
Kwasio (A81)	no		/p, b, t, d, c, ɟ, k/	Lemb (1974)
Makaa (A83)	no		/b, t, d, c, ɟ, k, g, kp/	Heath (2003)
Bekol (A832)	no		/(p), b, t, d, c, ɟ, k, g, kp/	Henson (2007)
Njem (A84)	no		/p, b, t, d, c, ɟ, k, g, kp, gb/	Beavon (2006)
Konzime (A842)	no		/p, b, t, d, c, ɟ, k, g, kp, gb/	Beavon (1983)
Bekwel (A85b)	[ɓ, ɗ, ƒ, ɠ]	in C_1	/p, ḅ, b, t, ḍ, d, c, ɟ̣, j, k, g̣, g, (kp), (gb)/	Cheucle (2014)
Mpiemo (A86c)	[ɓ, ɗ]	before low vowels in C_1	/p, b, t, d, c, ɟ, k, g, kp, gb/	Thornell & Nagano-Madsen (2004)
	/ɓ, ɗ/	in C_1, not before /i, u/	no information	Beavon (1978)

talized stop. Preceding the vowels /i, e, ɛ, ẽ/, /b/ is realized as a modal voiced stop with a particularly strong burst, including inflating the cheeks and a *battement* (beat) of the lips. The third account of Gyeli concerns the variety spoken in Lebdjom (Basaa contact area). Ngue Um (2012: 3) assigns phonemic status to bilabial, alveolar, and palatal implosives whose occurrence is restricted to the stem-initial position. According to him, there are no voiced plosives, but only voiceless ones. This seems typologically unexpected.

Shiwa (A803),[4] represents another controversial case as to the presence or absence of implosives. According to Ollomo Ella (2013) and Puech (1989), Shiwa has

[4]Ollomo Ella (2013: 51) classifies Shiwa as A833 rather than A803, but I stick with Maho's (2009) classification.

no implosives, neither phonologically nor phonetically, but a plain plosive series of bilabial, alveolar, and velar plosives, all distinguished by a voicing contrast.[5] In contrast to their analysis, Dougère (2007: 56) asserts that all voiced stops in Shiwa are generally realized as implosives in all environments, i.e., word/stem initially and intervocalically.

For Kwasio (A81), Makaa (A83), Bekol (A832), Njem (A84), and Konzime (A842), no implosives are reported, neither phonemic nor phonetic. As to Kwasio, all principal authors – Lemb (1974), Dieu (1976), and Yemmene (2004) – describing the phonology agree that there is a voicing opposition between at least bilabial and alveolar plosives, but no indication of a phonetic realization of implosives for any of these obstruents. For Makaa, Heath (2003) does not report any implosives either, but states that the phoneme /b/ lacks a voiceless counterpart /p/. The same holds for Bekol as described by Henson (2007) who reports that instances of [p] are so rare and only found in loan words that it might not be a phoneme in the language. For Njem, Beavon (2006) outlines the phonetic realization of the entire stop series (bilabial, alveolar, palatal, and velar), but implosives are not among the variants. In Konzime, labial and alveolar stops are "released with oral cavity friction" before high vowels, according to Beavon (1983: 134), but do not exhibit implosive features.

Cheucle (2014: 147) describes all voiced stops – bilabial, alveolar, palatal, and velar – as having an implosive realization in C_1 position in Bekwel. She treats this feature as phonetic rather than phonemic and remarks that the degree of implosion varies across speakers.

Finally, Mpiemo receives a different treatment of implosives by different authors. Beavon (1978) views bilabial and alveolar implosives as having phonemic status which are opposed to their voiced stop counterparts. According to him, they are restricted to C_1 position and precede all vowels except for /i/ and /u/. In contrast to this, Thornell & Nagano-Madsen (2004) assign phonetic status to bilabial and alveolar implosives in Mpiemo, categorizing them as allophones of /b/ and /d/. They also observe the same distribution of voiced stops and implsoives as Beavon: voiced stops occur before /i/ and /u/ and nasals, in all other stem-initial environments, they are realized as implosives. Figure 1 shows a bilabial implosive of Mpiemo as presented by Thornell & Nagano-Madsen (2004: 172).

The implosive exhibits a typical cone-shape amplitude increase during closure. In fact, Nagano-Madsen & Thornell (2012), in their detailed phonetic study of Mpiemo implosives, state that this amplitude increase during closure is a strong

[5] In addition to Ollomo Ella's (2013) plosive series, Puech (1989) also posits a phonemic voiced palatal stop.

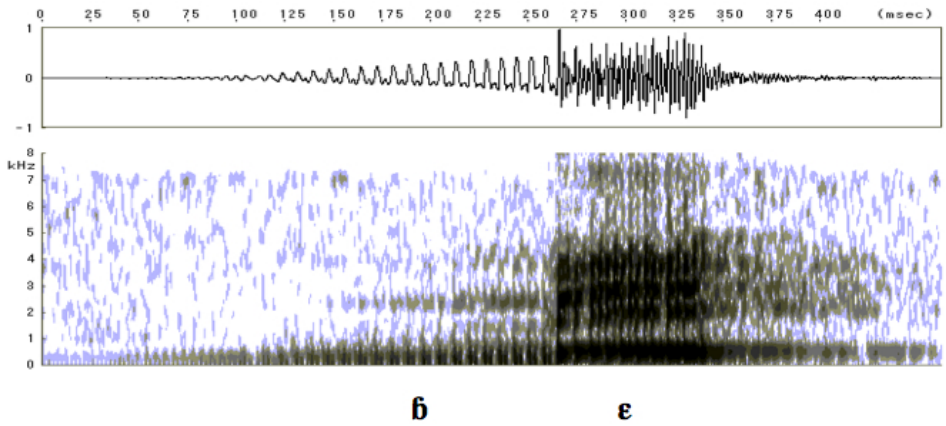

Figure 1: Bilabial implosive in Mpiemo

acoustic correlate of implosives in Mpiemo. In contrast, their egressive counterparts show a decreasing voicing amplitude. Other characteristics of Mpiemo implosives, according to the authors, include a glottalic ingressive aistream, full voicing (which also holds for egressive plosives), an increased F0 during occlusion (while F0 decreases in voiced plosives), and a closure duration for implosives which is generally longer than that for voiced stops. Implosion at release, however, is not a consistent phonetic feature. Keeping the phonetic Mpiemo implosive features in mind as well as Maddieson's (2003) general remarks about Bantu implosives, I now turn to describing the phonetic features of voiced stops in Gyeli.

3 Prevoiced stops in Gyeli

Despite expectations inherited from the literature on other Gyeli dialects and comparison to related languages, I argue that the Gyeli variety spoken in Ngolo (Bulu contact region) does not have implosives, neither on a phonemic nor on a phonetic level. According to Grimm's (2015) description, the phonemic distinction the language makes is between voiced and voiceless stops. Bilabial voiced plosives occur word- and stem-initially, and in medial position they are realized as [β]. Alveolar voiced stops are found in word-medial position, but I am concentrating my analysis on those in initial position since it is not to be assumed that

a medial position would host implosives if initial positions do not. Velar voiced stops are almost exclusively limited to word-medial positions, so they do not qualify as potential implosives.

Gyeli bilabial and alveolar voiced stops in word- and stem-initial position are realized with glottal constriction and prevoicing before the burst. At the same time, speakers inflate their cheeks to varying degrees before release. As such, these sounds have a few phonetic/acoustic features in common with what are typically taken as features of implosives, including glottalization, amplitude increase before release, and often a strong burst at release. Especially the cone-shape amplitude increase before release, as observed in the waveform in Figure 3, makes Gyeli prevoiced stops look like typical implosives so that one might be inclined to analyze them as implosives at least phonetically. There is, however, good evidence to assume that these sounds are produced with an egressive airstream. The key argument that also explains the cone-shape amplitude increase is the speaker's expansion of the cheeks which goes against assuming an ingressive airstream. At the same time, variation in the degree of cheek expansion within the same and across different speakers suggests that implosive-like phonetic features are not stable enough to label Gyeli voiced stops as implosives. In the following, I will compare Gyeli voiced stops to Bantu and Mpiemo implosives, showing that they are not the same class of sounds. I will also provide a more detailed analysis of Gyeli voiced stops along a variety of parameters, including voicing, amplitude, intensity, and closure duration. I am restricting my illustrations to bilabial voiced plosives due to space limitation. It should be noted though that the same features apply to stem-initial alveolar voiced stops.

3.1 Glottalization

What Maddieson (2003: 28) generally says about Bantu implosives, namely that they are produced without any glottal constriction, does not apply to Gyeli voiced stops. There is glottal constriction throughout, accompanying the entire bilabial or alveolar closure. This might be visible as 'noise' in the spectrogram in the circled area of Figure 2.[6] This could mean two things. On the one hand, one might want to say that Gyeli voiced stops could still be implosives which just exhibit different acoustic features than the majority of Bantu implosives. On the other hand, one could take this as a cue that Gyeli voiced stops are indeed different from implosives found in other Bantu languages. The criterion of glottalization alone is, as also discussed in §1.1, inconclusive. Data from Mpiemo also illustrates that

[6]Glottalization effects might not be as obvious in every token; in Figure 3, for instance, it is not.

the degree of vocal fold constriction might be subject to variation across speakers (Nagano-Madsen & Thornell 2012: 75).

3.2 Voicing

As can be seen in both Figure 2 and Figure 3, voiced stops in Gyeli are fully voiced, from the onset through the offset of the closure. This is a feature they have in common with voiced stops as well as implosives in Mpiemo (Nagano-Madsen & Thornell 2012: 74).

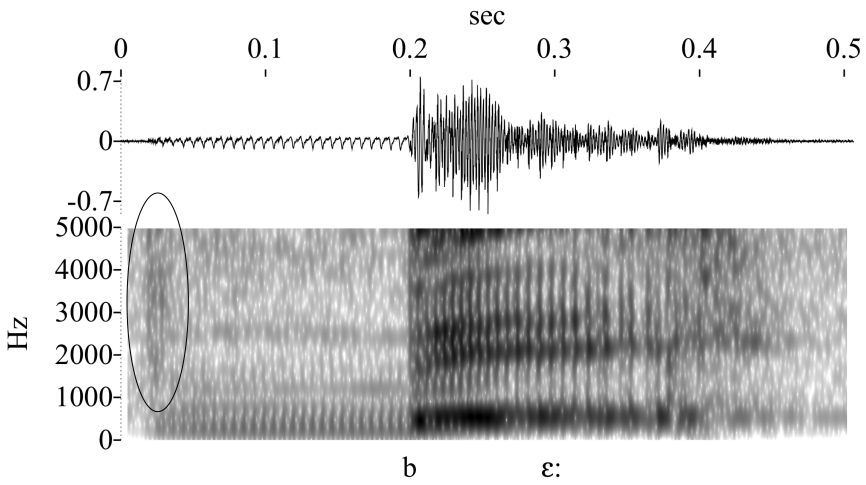

Figure 2: Production of [b] in *bɛ̀ɛ̀* 'shoulder', speaker 1

3.3 Voicing amplitude

While Nagano-Madsen & Thornell (2012) convincingly show for Mpiemo that implosives are correlated with an increasing voicing amplitude during closure and voiced stops with a decreasing one, this distribution does not map onto Gyeli stops in any way. Rather, what one finds is a high degree of amplitude variation both speaker-internally and across different speakers which correlates with the degree of cheek inflation. For instance, [b] in the lexeme *bɛ̀ɛ̀* 'shoulder' might differ significantly in its voicing amplitude. In Figure 2,[7] the voicing amplitude is neither increasing or decreasing, but remains level throughout the closure because cheek expansion is minimal in this token. In contrast, the same lexeme in

[7]Both Figure 2 and Figure 3 have been produced in Praat.

Figure 3[8] is produced with a steadily rising amplitude. Though this token looks suspiciously like an implosive, it is not. The amplitude increase is explained by an extreme case of cheek expansion. This distribution does not seem to depend on variability between speakers, but even the same speaker produces tokens with a voicing amplitude more on the level side of the spectrum and other tokens with amplitude increase.

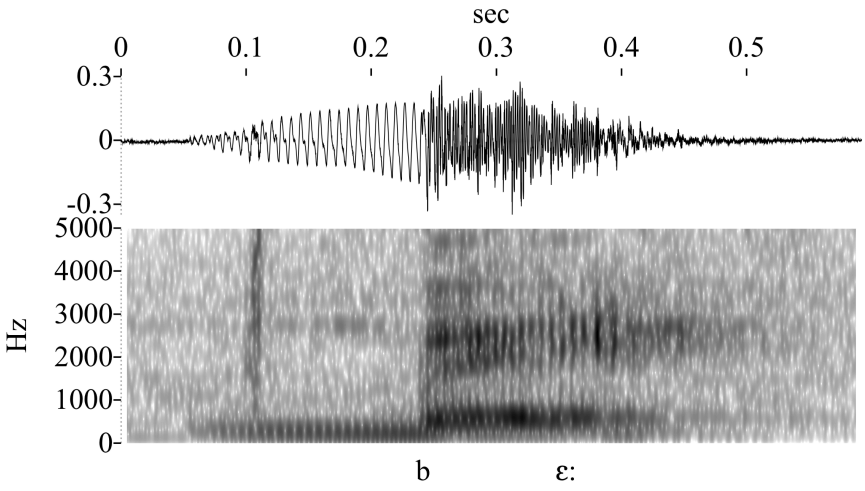

Figure 3: Production of [b] in *bɛ̀ɛ̀* 'shoulder', speaker 2

Cheek expansion during stop prevoicing, even if minimal, is a feature of every initial voiced stop in Gyeli and does not depend on the phonetic environment. Thus, in contrast to Renaud's (1976) analysis of the Bipindi variety of Gyeli, either realization similar to Figure 2 or Figure 3, or even an amplitude increase in between these two extremes, is found before any of the seven vowels /i, u, e, o, ɛ, ɔ, a/.[9]

[8]The noisy part around 0.1sec into the recording seen both in the waveform and the spectrogram is some background noise and not part of the human speech production. Unfortunately, background noise cannot be completely avoided in fieldwork. I nevertheless choose to present this token since it has the sharpest amplitude increase while representing the same lexeme which makes it comparable.

[9]Video recordings of natural Gyeli text, that may show cheek expansion, are available in the DoBeS archive, found under the language name 'Bakola'. In this paper, I rely on my long familiarity with the language and speakers. Systematic video recordings of voiced stop production are a future project.

3.4 Intensity

Nagano-Madsen & Thornell (2012: 75) state for Mpiemo that "Intensity showed a good correlation with voicing amplitude and F0 and it is higher/ increasing for implosives than for plosives." In comparison, there does not seem to be a general difference in average F0 between those tokens of [b] which show a level or an increasing amplitude. Average F0 for the tokens in Figure 2 and Figure 3, for example, are both within the range of 135 to 145Hz. There is, however, a difference in the intensity curve which raises steadily in tokens with increasing voicing amplitude while the intensity in level amplitude tokens is first relatively low and then shows a sudden and sharp increase towards the offset of the closure.

3.5 Closure duration

Closure durations of voiced plosives vary a lot depending on speaking rate (careful vs. fast speech), the lexical vs. grammatical function of a morpheme or stem, and the environment (intonation phrase initial vs. medial). 200 tokens of [b][10] have been measured for closure duration in different environments, covering accompaniment by different vowels and different functional environments (grammatical morpheme vs. lexical stem).

Generally, closure duration does not seem to depend on the quality of the following vowel, as shown for lexical and word-initial occurrences in Table 2.[11] Closure durations are rather similar and no distinction can be made between, for example, high and low vowels.

Occurrences of [b] in grammatical morphemes tend to be much shorter than those occuring in lexical stems. While the noun class prefix *be-* has an average duration of about 50ms (unless produced very carefully), [b] in *bénó* 'buttock' measures around 160ms. Both tokens are word-initial. Tokens that are lexical, but not word or phrase inital (e.g., preceded by a noun class prefix or a subject marker) tend to have a shorter duration than their word-initial counterparts. Thus, the second occurrence of [b] in *be-bénó* 'buttock' only has a closure length of around 80ms, which is still longer that [b] in the prefix which is 30ms in this instance. Closure durations are also longer in very careful speech or to emphasize a particular word. In these cases, the voicing amplitude is not necessarily higher,

[10] These measurements comprise tokens of various prevoicing amplitude patterns, i.e., those that are more similar to Figure 2 and those that are more similar to Figure 3. The reason for this is that there is no binary distinction, but rather a scale which, however, does not seem to affect closure duration. Thus, VOT is the same for low amplitude and amplitude increase tokens.

[11] Only a few tokens were available for [b] before /o/; this might have skewed the results.

Table 2: Closure durations of voiced bilabial plosives

V	Average duration	Lexical example	Duration
i	[b] = 108ms	bì̀jɔ 'hit'	[b] = 130ms
u	[b] = 108ms	búlɔ 'fish (v.)'	[b] = 130ms
e	[b] = 105ms	bé 'pit'	[b] = 81ms
o	[b] = 120ms	bógɛsɛ 'enlarge'	[b] = 157ms
ɛ	[b] = 115ms	bɛ̀ 'sow'	[b] = 145ms
ɔ	[b] = 103ms	bɔ̀ndì̀ 'black colobus monkey'	[b] = 137ms
a	[b] = 100ms	báβɛ̀ 'disease'	[b] = 151ms

but closure duration is relatively longer. In any case, longer closure times might correlate with the percept of implosives while shorter closure times sound more like modally voiced stops.

3.6 Airstream mechanism

A final consideration in terms of phonetic features concerns the airstream mechanism involved in the production of plosives. While no aerodynamic data were collected for Gyeli so far (and also Nagano-Madsen & Thornell (2012) base their phonetic analysis of Mpiemo implosives on data that does not include airflow mechanisms or laryngographic measurements), statements about the airflow can be made with some certainty by observing speakers. Especially for voiced stop tokens that involve an increasing voicing amplitude, Gyeli speakers tend to achieve an increase of the vocal tract size by expanding the cheeks. This has already been noted by Renaud (1976) and confirmed by Grimm (2015). To expand the cheeks, the airflow has to be egressive. At the same time, this gesture excludes a significant lowering of the larynx. I take this as the key argument not to consider Gyeli voiced stops as implosive realizations.

4 Conclusion and outlook

The findings in Gyeli, as well as the treatment of implosives and their relation to voiced plosives in the A80 literature, have several implications. First, it seems that a fundamental issue in the description of A80 implosives is a terminological question. In the absence of any decisive criteria to clearly identify implosives,

scholars may categorize a range of sounds as implosives which, in fact, might be very different from one another.

This leads to methodological implications. On the one hand, it shows how important it is to provide (basic) phonetic information in grammatical descriptions. These are, however, often insufficient or absent altogether. On the other hand, the phonetic description of sounds in a language might seem daunting to fieldworkers whose expertise lies in other areas of grammar. It might be useful for expert phonetician fieldworkers to develop some general guidelines for descriptive linguists, comparable to the many questionnaires on, for instance, information structure or object marking.

Multiple theoretical implications are at stake. On a micro-areal level, a better understanding of implosive(-like) sounds in Gyeli and other A80 languages enables us to clarify whether these consonants indeed display a high degree of variation or whether they are more uniform than currently suggested by the literature. Since all languages in the area are closely related and in intense contact with one another, one might expect to find significant similarities also in the phonetic realization of sounds. This does not mean that the phonetic features of a particular phoneme in one language hold for other languages in the area as well. But given that authors have differing treatment of implosives vs. voiced stops in the same language in several cases of A80, it is possible that these languages share certain features which are interpreted in different ways. Thus, important questions still need to be answered: what phonetic features do these sounds in A80 have in common, if anything, and in which respects do they differ? A possible parameter of variation could be, for instance, an oropharyngeal expansion which, according to Ladefoged & Maddieson (1996: 55), may constitute "a continuum that links modally voiced stops to implosives." Obviously, more phonetic analyses are needed to answer these questions, which then help to answer yet others, for instance about their phonemic or allophonic status and their alleged free variation. For future work it would also be desireable to include a more systematic data comparison of different A80 languages, using aerodynamic techniques as well as measuring larynx movement.

Implosive(-like) sounds in A80 may also provide an interesting window onto language contact phenomena. In this area of intense language contact and a high degree of multilingualism among speakers of all languages, it would be fascinating to investigate to what degree implosives or some acoustic features of them are borrowed. Gyeli speakers, for example, are known to imitate their linguistic neighbors deliberately in order to increase their prestige. While the closest related language, Kwasio, does not seem to have implosives, other neighboring

languages such as Basaa do. One could hypothesize that Gyeli voiced stops are a partial imitations of implosives found in other languages, just without borrowing larynx lowering and an ingressive airstream, which are acoustically replaced by glottalization and a voicing amplitude increasing through expanding the cheeks.

On a broader level, it is, of course, important for fields such as typology, historical linguistics, or language classification to know whether one is comparing conceptually the same or different sounds. Clarifying whether certain sounds in some Bantu sub-families are really implosives might change the extension of assumed linguistic areas and might better our understanding of language relations in respect to their genealogical classification.

Acknowledgments

I would like to thank two anonymous reviewers and Joyce McDonough for their careful reading of this paper and their helpful and constructive comments they gave me. I also thank the ACAL participants, especially Bonny Sands, Didier Demolin, and Firmin Ahoua.

References

Beavon, Keith H. 1978. *Provisional description of the segmental phonemes and noun classes of the Mpyémó language (Bijugí dialect)*. SIL Cameroon.

Beavon, Keith H. 1983. A phonology of Konzime. *Africana Linguistica* 9. 109/136.

Beavon, Keith H. 2006. *A phonology of Njyem*. SIL Cameroon.

Cheucle, Marion. 2014. *Étude comparative des langues makaa-njem (bantu A80): Phonologie, morphologie, lexique. Vers une reconstruction du proto-A80*. Lyon, France: Université Lumière Lyon 2. (Doctoral dissertation).

Clements, George N. 2000. Phonology. In Bernd Heine & Derek Nurse (eds.), *African Languages: An Introduction*, 123–160. Cambridge: Cambridge University Press.

Clements, George N. & Sylvester Osu. 2002. Explosives, implosives and nonexplosives: The linguistic function of air pressure differences in stops. In Carlos Gussenhoven & Natasha Warner (eds.), *Laboratory Phonology 7*, 299–350. Berlin, New York: Mouton de Gruyter.

Clements, George N. & Annie Rialland. 2008. Africa as a phonological area. In Bernd Heine & Derek Nurse (eds.), *A Linguistic Geography of Africa*, 36–85. Cambridge: Cambridge University Press.

Crystal, David. 2008. Implosives. In *A Dictionary of Linguistics and Phonetics*, 6th edn. Hoboken, NJ: Wiley.

Demolin, Didier. 2011. Aerodynamic techniques for phonetic fieldwork. In *Proceedings of the 17th International Congress of Phonetic Sciences*, 84–87.

Dieu, Michel. 1976. Les consonnes du ngumba: Recherche en phonologie générative. In *Bulletin de l'ALCAM*. Yaounde: ONAREST.

Dougère, Lucie. 2007. *Première approche phonologique, morpho-syntaxique et diachronique du chiwa du Gabon (ogooué-ivindo)*. Université de Lyon 2. (MA thesis).

Ewan, William G. & Robert Krones. 1974. Measuring larynx movement using the thyroumbrometer. *Journal of Phonetics* 2. 327–335.

Fromkin, Victoria & Robert Rodman. 1998. *An introduction to language*. 6th edn. Orlando: Harcourt.

Greenberg, Joseph H. 1970. Some generalizations concerning glottalic consonants, especially implosives. *International Journal of American Linguistics* 36(2). 123–145.

Grimm, Nadine. 2014. Color categories in language contact: "Pygmy" hunter-gatherers and Bantu farmers. *Proceedings of the Berkeley Linguistics Society* 38. 31–46.

Grimm, Nadine. 2015. *A grammar of Gyeli*. Berlin: Humboldt Universität zu Berlin. (Doctoral dissertation).

Heath, Teresa. 2003. Makaa (A83). In Derek Nurse & Gérard Philippson (eds.), *The Bantu languages*, 335–348. London, New York: Routledge.

Henson, Bonnie J. 2007. *The phonology and morphosyntax of Kol*. Berkeley: University of California. (Doctoral dissertation).

Ladefoged, Peter & Ian Maddieson. 1996. *The sounds of the world's languages*. Oxford: Blackwell.

Lemb, Pierre. 1974. *Esquisse phonologique du mvumbo*. DESS Thesis, Yaoundé.

Letouzey, René. 1995. Noms d'abres des pygmées bagielli dans le sud-ouest du Cameroun. *Journal d'Agriculture Tropicale et de Botanique Appliquée* 22(1). 23–45.

Lindau, Mona. 1984. Phonetic differences in glottalic consonants. *Journal of Phonetics* 12. 147–155.

Maddieson, Ian. 2003. The sounds of the Bantu languages. In Derek Nurse & Gérard Philippson (eds.), *The Bantu languages*, 15–41. London, New York: Routledge.

Maddieson, Ian. 2013. Glottalized consonants. In Matthew Dryer & Martin Haspelmath (eds.), *The World Atlas of Language Structures Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology.

Maho, Jouni F. 2009. *New updated Guthrie list*. http : / / goto . glocalnet . net / mahopapers/nuglonline.pdf.

McGregor, William. 2015. *Linguistics: An introduction*. London: Bloomsbury Academic.

Nagano-Madsen, Yasuko & Christina Thornell. 2012. Acoustic properties of implosives in Bantu Mpiemo. In *Proceedings of Fonetik 2012*, 73–76.

Ngue Um, Emmanuel. 2012. Bakola sketch grammar.

Ollomo Ella, Régis. 2013. *Description linguistique du shiwa, langue bantu du Gabon: Phonologie, morphologie, syntaxe, lexique*. Paris: Paris 3, Sorbonne Nouvelle. (Doctoral dissertation).

Puech, Gilbert. 1989. Les constituants suprasyllabiques en chiwa (Bantu A.80). *Pholia* 4. 217–227.

Renaud, Patrick. 1976. *Le bajeli. Phonologie, morphologie nominale*. Vol. 1 and 2. Yaounde: Les dossiers de l'ALCAM.

Thornell, Christina & Yasuko Nagano-Madsen. 2004. Preliminaries to the phonetic structure of the Bantu language Mpiemo. *Africa & Asia* 4. 163–180.

Xi, Cun. 2009. *A phonetic study on implosives in China*. University of Science & Technology, Hong Kong. (Doctoral dissertation).

Yemmene, Patrice A. 2004. *Phonological sketch of Kwasio*. Yaounde: BASAL.