Child Kriol has stop distinctions based on VOT and Constriction Duration

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Abstract

We present acoustic analyses of stop productions by 16 Kriol-speaking children from two communities in the Northern Territory, Australia. Kriol has been characterised as having a variable phonological inventory and lexical items, presenting children with a difficult language-learning task. Our results suggest, on the contrary, that these children have canonical lexical specifications, and also indicate that their experience with L2 English in a school setting has not resulted in a shift towards more English-like Voice Onset Time and Constriction Duration settings. Indeed, the results are consistent with recent adult Kriol data and indicate that Kriol phonology is stable and shows no obvious evidence of decreolisation.

Index Terms: Kriol, VOT, constriction duration, first language acquisition.

1. Introduction

North Australian Kriol (hereafter Kriol) is an English-lexified creole spoken in Northern Australia by approximately 20,000 people [1], making it the most widely spoken Indigenous language (after English/Aboriginal English). Kriol is a recent contact language, having developed in the past 100 years [2] [3] [4] [5]. Many Indigenous communities are still undergoing language shift to Kriol [2] [4].

Kriol has often been described as exhibiting high degrees of phonological and lexical variation both within and between speakers [5] [6] [7]. Such a scenario would constitute an unusual and potentially very challenging 'moving target' for children acquiring L1 Kriol from birth: how do children identify word-learning targets and attune to their L1 phonological system in an environment of substantial (and often contradictory) phonetic and phonological variation?

This phonological and lexical variation has been described as falling along a 'creole continuum' [5] [6] [8] ranging from substrate-like to English-like, resulting in the absence of, for instance, stop voicing contrasts and fricatives at the basilectal end, and presence of those stop contrasts as well as (some) fricatives at the acrolectal (English) end of the continuum [6].

It has been argued that this variation is the result of a process of decreolisation as (increasing) interaction between creole speakers and speakers of the superstrate language leads to the introduction of lexical variants and constructions (more) consistent with the lexifier norm [5]. It is also argued that the relative position of an individual along the continuum at any given time is explained by reference to the speaker's conversational partner and sociolinguistic context [5].

Recently, [10] have argued that 'variability' in Kriol is not a result of decreolisation. Rather, they argue that observed 'variation' can be ascribed to three factors:

a) the unpredictable relationship between cognate Kriol and English lexemes, with respect to voicing and constriction;
b) differences in VOT boundaries between Kriol and English, leading to erroneous perception of [k] for some instances of Kriol /g/, for instance; and most importantly;
c) L2 speakers of Kriol participating in earlier research.

This view is consistent with recent experimental work with L1 adult Kriol speakers, suggesting in fact a stable phonological inventory identical to neither the substrate languages nor to English. According to [4] [10] [11], adult L1 Kriol, like English, has two series of stops, distinguished via long-lag/short-lag VOT [12] in initial position. Unlike English, however, Kriol word-medial stops are distinguished primarily by constriction duration (CD) differences of approximately 50-100ms (voiceless > voiced stops), depending on place of articulation [10]. This is similar to CD differences between 'fortis' and 'lenis' stops in some of the substrate languages: Ngalakgan, Ngandi, and Ritharrngu [13] [14]. English word-medial voiced and voiceless stops only differ minimally in terms of CD [15] [16], and this distinction is not perceptually relevant in connected speech [16]. See Figures 1 and 2 for (American) English and Kriol VOT and CD based on [15] and [10], respectively.

Given the role of English in the mainstream community and particularly in the schooling of Kriol-speaking children in the NT, the question of whether children's language is shifting towards the lexifier and away from the current adult L1 Kriol norm is of great theoretical and practical importance both within creolistics and from a second language/bilingualism perspective. Creolistics would frame a shift from L1 Kriol VOT/CD implementation towards more English-like VOT/CD implementation as decreolisation, while a second language/bilingualism perspective would frame such a shift (in one direction or the other) within an L1-to-L2 or L2-to-L1 transfer framework. Patterns of shift away from an L1 and towards an L2 phonetic stop voicing specification have been amply documented in the second language literature (see for instance [17] [18] [19] [20] [21]).

Similar patterns of drift or shift have also been demonstrated in studies of bilingual children, including Spanish-German bilinguals [22], and in very recent studies of Greek-German bilingual children, who, in both cases, must negotiate distinct phonetic realisations of stop voicing contrasts. Greek and Spanish have a distinction realised as pre-voiced vs short-lag aspirated stops, while the German distinction like English is short-lag aspirated vs long-lag aspirated [23]. Greek-German bilingual children enrolled in a German-language school produce more Greek voiced stops with German voicing setting, than comparable Greek-German bilingual children enrolled in Greek language school, and conversely those enrolled in Greek school similarly produce more Greek-like voiced stops in German [23]. Similar, but not

identical, patterns have been observed for early Japanese-English bilingual children [24].

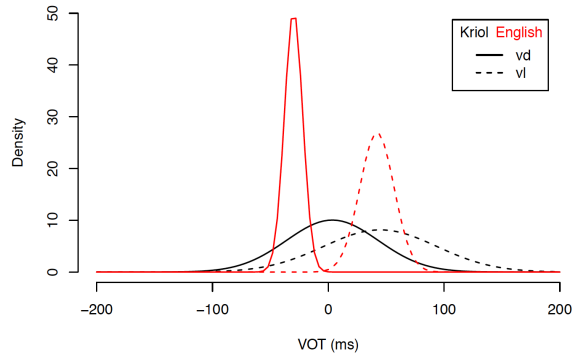

Figure 1. *Density curves of the distribution of VOT in voiced and voiceless stops in Kriol (black) and English (red). Fully drawn lines = voiced stops, dotted = voiceless stops. English and Kriol VOT based on [15] and [10], respectively.*

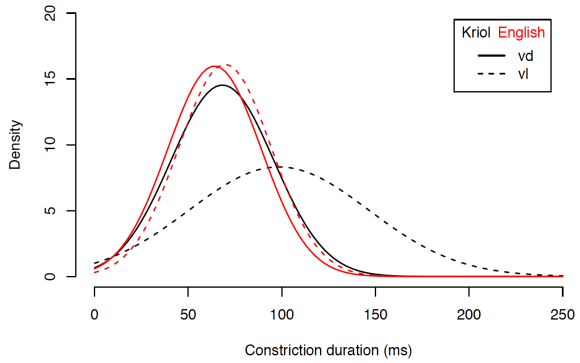

Figure 2. *Density curves of the distribution of CD in voiced and voiceless stops in Kriol (black) and English (red). Fully drawn lines = voiced stops, dotted lines = voiceless stops. English and Kriol CD based on [15] and [10], respectively.*

Finally, the present research addresses previous observations that child speech is more variable than adult speech, particularly in subsegmental elements such as VOT [25] [26] [27] [28]. Such variability does not, however, necessarily obscure language-specific consonant boundaries. Rather, [29] concludes that children produce the same contrasts as adults *'despite also exhibiting more variability in their production of individual vowels*' (p 1).

The question of excess variability of course remains pertinent with respect to consonants, and particularly interesting in the context of a language for which the claim has been made that even adult users are highly variable. In the following section, we describe our method for eliciting stop productions from children acquiring L1 Kriol.

2. Method

2.1. Participants

We recruited 16 children (9 female, range = 4;8 to 10;0) for participation in the present study. 13 participants lived in Beswick/Barunga and three in Numbulwar, in the Northern Territory, Australia. All were L1 Kriol speakers and attended the preschool program (1 participant) or the foundation (grades 0-2) program (15 participants) at Wugularr Primary School or Numbulwar School. All children were acquiring English as a second language (L2) at school: teaching at Wugularr and Numbulwar is conducted in English by mainly non-Indigenous teaching staff. Indigenous, Kriol-speaking support staff are, however, often present.

All children were reported to have normal hearing, but we did not conduct hearing screening in order to verify this. As recurrent otitis media is common in many Indigenous communities, it is possible that some of the children may have had some undiagnosed hearing impairment. The participants were recruited by word of mouth, through the first and second authors' existing contacts in the community. Parental consent and child assent was attained for all participants.

2.2. Materials

The recordings for the acoustic study of Kriol stop production by primary school-aged children were based on the selection of 24 easily depictable Kriol nouns, such as *door /duwa/*, *book /buk/*, *cat /ket/,* for which a highly salient and easily recognisable photograph was selected (See Figure 3).

/baik/	/kofi/	/bakit/	/buk/
/taiga/	/do:g/	/kerit/	/ket/
/babul/	/pigi/	/be:d/	/wota/
/te:dul/	/teibul/	/tiʃu/	/tuṯ/
/spaida/	/geko/	/duwa/	/sebɻa/
/balu:n/	/pelikin/	/epul/	/guwana/

Figure 3. *Examples of pictures used in the elicitation task, and full list of elicited target words in IPA.*

To ensure that each of the 24 items would be known to children, the items were selected in consultation with two literate L1 Kriol speakers, one of whom is trained in early childhood education, and who has previously been involved with the creation of Kriol literacy materials for preschool and early primary school children. The 24 items all contained voiced and voiceless stops /p t k b d g/ in either initial or medial position, or both, in a wide range of vowel contexts. We avoided consonant clusters wherever possible.

2.3. Elicitation procedure

We elicited the Kriol lexical items in the following way: each participant was seated at a table in a quiet room in front of a PowerPoint presentation containing pseudo-randomised repetitions of the 24 pictures. Each picture was displayed with the pre-recorded Kriol prompt *Wanem dijan?* ('What is this?'), spoken by an unfamiliar native female Kriol speaker. The task was explained to the children in Kriol, as well as in English.

When a child provided a correct response, the experimenters gave positive feedback. Incorrect responses (for instance 'bible' for 'book' or 'water' for 'bottle') received feedback about the desired name. Each picture was displayed until the child responded, or until it was clear that no response would be given, at which point the item was skipped.

Responses were recorded using a PMD660 Marantz flash-RAM digital recorder with a DPA d:fine headset microphone. All recordings had a 16-bit sampling depth with a sampling rate of 44.1 kHz.

2.4. Acoustic analyses

We extracted a total of 1388 VOT measurements (950 word-initial and 438 word-medial) and 438 word-medial CD measurements. Some target items were produced multiple

times in association with one presentation of a target; repetition did not disqualify tokens from analysis.

Tokens which were incomplete or interrupted by background noise, laughter, or contact with the microphone were excluded from analysis. Only items where the child produced the intended utterance (or a semantically related word which included the original target consonant in the intended position: 'cup' for 'coffee', 'pig pig' or 'bird bird' for 'pig' or 'bird', 'sea turtle' for 'turtle') were included in this analysis. Excluding non-target responses resulted in a loss of 3.1% of the VOT data and 1.98% of the CD data.

The acoustic recordings were analyzed in *Praat*. VOT was defined as the time between the burst/release of the relevant stop and the onset of voicing. Voicing measurements were taken at the zero crossing before the second clear periodic wave. Constriction duration was measured as beginning at the initial stop closure (the end of the preceding vowel's clear F2) and ending at the stop burst.

2.5. Predictions

The present study tests three competing hypotheses, H1, H2, and H3. According to **H1**, Kriol remains highly variable in terms of VOT contrast production, and Kriol children will produce highly variable VOTs and CDs between Kriol lexical items, as well as highly variable VOTs and CDs within Kriol lexical items (e.g. between repetitions of the same lexical item by a given child, and in the VOT and CD settings implemented for a given lexical item by different children). Such a pattern of behaviour would be attributable to an inherently unstable target language, because speakers move between basilectal and acrolectal inventories/lexical targets.

According to **H2**, child Kriol reflects current adult Kriol differentiation of stops, and child Kriol speakers will implement VOT and CD contrasts similar to VOT and CD contrasts in the adult Kriol input. Any variation observed should be commensurate only with the variability normally found in child language. In other words, child Kriol will provide evidence for a series of voiced and a series of voiceless stops, differentiated by VOT and CD.

Finally, under the assumption that Kriol is undergoing a process of decreolisation resulting in variation in VOT and CD, **H3** would predict that child Kriol would exhibit some variation in VOT and CD realisation, but any convergence in the VOT and CD measurements would be due to convergence with the norm for the acrolectal variety or the superstrate (English). In other words, the VOT and CD values will be somewhat variable but tending towards an English-like differentiation of voiced versus voiceless stops.

3. Results

3.1. Group results

The group results are presented in *Figure 4* (VOT) and *Figure 5* (CD) below. On the whole, the results are consistent with **H2**: A series of independent *t*-tests of voiced vs voiceless VOT were significant ($p < .001$) for all contrasts in word-initial position. Word-medially, *t*-tests of voiced vs voiceless VOT were significant ($p < .001$) for /k g/ and /p b/. For CD, *t*-tests were significant ($p < .001$) for /p b/, /t d/, and /k g/.

Together, these results indicate that young Kriol-speaking children use VOT and CD information to differentiate Kriol stops /p b/, /t d/, and /k g/ in a way that is very similar to that of adult Kriol speakers (Figures 1 and 2). There is no indication in this dataset that child Kriol speakers are acquiring a target language in which VOT and CD contrast maintenance is optional. Nor does the importance and consistent use of CD information indicate that these stop contrasts have been acquired through contact with L2 English: it is clear that Kriol children produce voiceless stops differing markedly from voiceless stops in English as VOT is the primary cue in English while Kriol relies also on CD (Fig. 2).

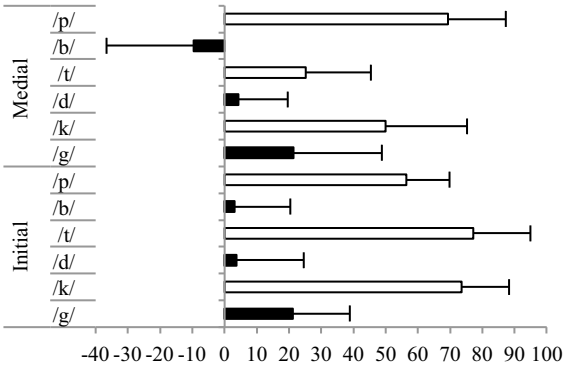

Figure 4. *Group means (ms) for word-initial and -medial VOT. Error bars indicate SD (plus values for positive entries, minus values for negative entries)*

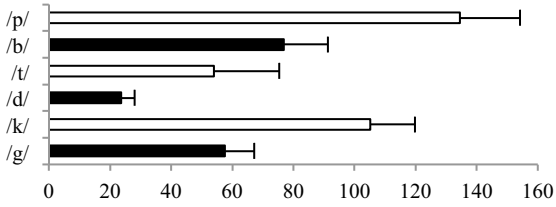

Figure 5. *Group means (ms) for word-medial CD measures. Error bars indicate SD (plus values for positive entries).*

3.2. Individual results

In order to examine whether the global results reported above were in fact characteristic of the Kriol stop production of all the children in this study, we conducted individual analyses for each child, collapsing across place of articulation. Word-initially, *all* 16 children produced voiced versus voiceless stops with systematically different VOTs ($p = .003$ or less in each case). Word-medially, four children (ages 5;4, 5;7, 6;3; 7;0) did not provide enough tokens for individual analysis. *T*-tests of the remaining 12 children's medial VOT and CD productions showed that five children maintained a contrast in both VOT and CD, while another five produced a VOT distinction, and four a CD distinction. Two children (B3 [5;4] and B12 [7;0]) did not produce a medial contrast in VOT or CD. As is evident from Figures 6 and 7, however, all children with *non-significant* individual results, however, produced voiceless VOT and CD values consistently longer than their voiced counterparts, except B2 (who produced a CD contrast).

Interestingly, the children who failed to produce a medial VOT distinction were not the younger cohort (5;2, 5;4, 6;1, 7;0 of age), so we find it unlikely that lack of a VOT-based distinction reflects a developmental trend, such that older children have acquired the word-medial distinction but younger children have not. Further, given the clear trend in the VOT and CD values among the children whose results were not significant, we find it plausible that the lack of significant individual differences in VOT and CD is due to lower numbers of medial tokens in the study. Finally, the fact that

CD appears to be a primary cue to the Kriol medial /p b/, /t d/, and /k g/ contrasts indicates that these contrasts are indeed Kriol and not transferred from L2 English into Kriol.

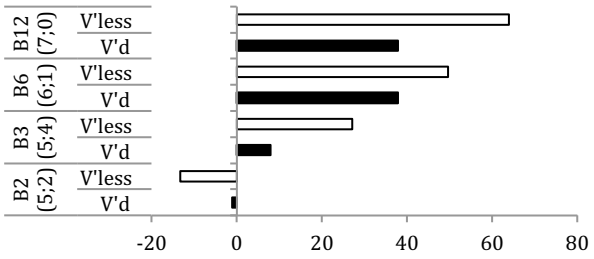

Figure 6. *Individual VOT means (ms) for children with non-significant t-test results. Child age in parenthesis. B indicates that the participants were from Beswick.*

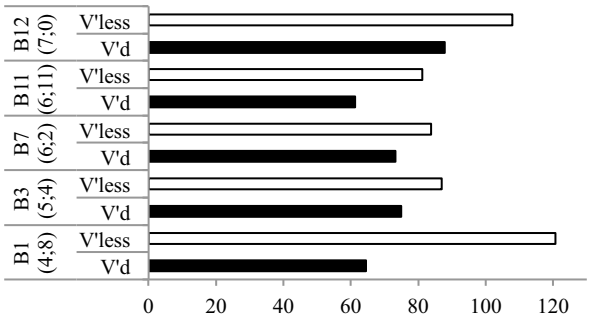

Figure 7. *Individual CD means (ms) for children with non-significant t-test results. Child age in parenthesis. B indicates that the partipants were from Beswick.*

4. General discussion

There is no doubt that the Kriol-speaking communities in Northern Australia, such as Beswick and Numbulwar, have been undergoing a complex process of language shift for a number of decades [2] [4]. This has contributed to pervasive views of Kriol as an inherently variable language, presenting unique language learning challenges for its users.

However, the effects of this pattern of language shift on the sound system of Kriol have not been instrumentally examined until now. This study demonstrates that the Kriol-speaking children tested here form a largely homogenous group, exhibiting little variation in stop voicing production. Moreover, the characteristics of their stops are not different from adult Kriol but differ from English stops. From these results we can infer the following. Kriol (in these communities) is not undergoing a rapid change in the production of obstruents sufficient to cause a difference between two generations of speakers. Kriol is also not approaching English; that is, is not decreolising, at least in the case of obstruent production. In addition, given that the adults recorded by [10] were from Ngukurr and Numbulwar, and the children discussed here from Beswick and Numbulwar, the results also strongly suggest that there is not a major dialect difference between these communities.

5. Acknowledgements

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