

TRACKING THE EMERGENCE OF SOCIOPHONETIC VARIATION

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ABSTRACT

A previous study in Newcastle revealed patterns of variation and change in consonants and vowels correlating with sociolinguistic, phonological and lexical factors. This paper describes an investigation of the speech of children aged 2;0 to 4;0 in the same community, which aims to understand how variant patterns come to be acquired. We focus on four children's productions of (t), a particularly complex variable in adult speech. The children demonstrate a sophisticated mastery of adult patterns, producing different variants in appropriate phonological contexts. The acoustic qualities of the allophones resemble those of adults, but both boys and girls adhere closely to the patterns of local women. This suggests that at this stage of development they are most influenced by the phonological/phonetic patterns of their mothers. We conclude that it is problematic to view acquisition of language-specific phonological units separate from the accent-specific variation which is important to construct of sociolinguistic identity.

1. BACKGROUND

It is well known that children acquire their accent at the same time as they acquire their phonology [e.g. 1, p.158]. However, very little work has attempted to track exactly how this occurs. The few closely-related previous studies [9, 13, 14] show complex and evolving patterns of variation in children at different stages of development. There is evidence that children as young as 3 have mastered complex and variable phonological rules, and gender differences may also begin to appear by the same age [13].

The aim of the present study (henceforth *ESV*) is to investigate how sociophonetic features develop in the speech of children from Newcastle upon Tyne, UK. A previous study on adult speakers from Newcastle (henceforth the *PVC* study: [2, 3, 5, 15, 16]) has shown extensive phonetic and phonological variation correlating with age (indicating changes in progress), sex, and/or socio-economic class.

Analysis in *ESV* centres on a range of consonant and vowel variables which were investigated in the *PVC* study. (t) is a particularly complex case, and is the subject of the present paper. First, adults use markedly different phonetic variants in word-initial, intersonorant, and word-final pre-pausal positions. Second, the intersonorant and pre-pausal variants are subject to sociolinguistic patterning, with gender appearing a particularly important factor. Third, syntactic/lexical effects are found, such that certain variants only occur in a restricted set of items.

Given the complexity of (t) variants in Newcastle English, it is clear that a child learning this variety faces a difficult task in correctly mastering them. Different phonetic

variants are not only subject to phonologically-governed allophony, they may also be used to signal sociolinguistic identity. We therefore assume, for example, that male and female learners must diverge at some point in order to adopt gender-appropriate variants. It is of course possible that major divergence might only occur much later; for instance, teenagers in Milton Keynes show a more marked divergence from their parents' dialectal features than younger children do [6]. However, considerations of this type have rarely entered research into the initial acquisition process, particularly from a phonetic perspective.

2. METHODOLOGY

2.1 Sampling, recording and analysis

Two studies are being carried out in parallel: (a) a cross-sectional study looking at patterns of variation in 40 children aged 2;0 - 4;0; (b) a longitudinal study of 8 children sampled at bi-monthly intervals between the same ages. The children are drawn from a similar community as the broadly-defined 'working class' cohort of the *PVC* study. All subjects are only children or the eldest child, and the mother is in all cases the primary care-giver. The children are monolinguals, and have no known speech or hearing disorders.

Children are recorded during free play sessions with the mother, and carrying out a picture-based word elicitation procedure. The mother is also recorded reading a word-list. Recordings are made using Trantec lapel radio microphones and a Sony TCD-D10 Pro II DAT recorder. Both auditory and acoustic analysis of variables are subsequently undertaken, the latter using Sensimetrics SpeechStation 2.

This paper presents preliminary findings from analysis of a subset of 4 children in the cross-sectional study: two girls (Hannah aged 4;0, Naomi aged 2;0) and two boys (Stephen 3;7 and Ryan 3;0). We focus on the acoustic patterns displayed by the children in (t) realisation, to assess the extent to which the children have acquired the allophonic and sociolinguistic patterns shown by the *PVC* adults. (Direct comparison will be made eventually with the *ESV* mothers' speech, both in adult-to-adult and child-directed speech.)

2.2 Variables

Three inter-related variables are investigated here:

- (1) voice onset time of (t) in word-initial position (e.g. *toy*)
- (2) (t) in non-initial intersonorant position (e.g. *water, get off*)
- (3) (t) in word-final pre-pausal position (e.g. *cat, parrot*)

Although VOT was not investigated in the *PVC* study, it is addressed in *ESV* so that we may take stock of the entire range of allophones of (t) produced by the children. It also enables us to draw comparisons with the few previous

instrumental studies of infants' production abilities, where VOT is a frequently investigated variable (e.g. [11]).

2.3 Acoustic patterns

2.3.1 Initial position: VOT. It has been shown (e.g. [8, p. 349]) that a voicing lag of 25ms is the minimum required to signal a voiceless aspirated stop. Acquisition studies [11] have also shown that English-speaking children can usually produce a voicing contrast in initial stops by age 2;0. VOT is here measured, as usual, from the release burst of the stop to the onset of periodic noise signalling vocal fold vibration.

2.3.2 Inter-sonorant position: glottalisation and [ɹ]. In adult speech, non-word-initial (t) is usually 'glottalised' between two sonorants. The main acoustic correlates of this are full voicing throughout the stop portion, accompanied by a period of creaky phonation which is often as short as 2 pulses [3, 4]. The oral release is usually masked by the creaky phonation [3, 4]. Thus *water* and *heat up* may be most adequately transcribed as [wɑːɾɹ] and [hiːɾ ʊp]. Spectrographic examples from adult speakers are provided in [4].

In a restricted set of common monosyllabic verbs and nouns the variant [ɹ] may also be found, thus [gɛɹ ɒf] for *get off* [5]. In the *ESV* data the principal acoustic features sought are therefore (i) presence of full voicing; (ii) presence of creak; (iii) formant structure with low F3.

2.3.3 Word-final pre-pausal position: pre-aspiration and [ʔ]. In contrast with the context described in 2.3.2, pre-pausal (t) is almost never glottalised in adult speech. Common variants in this context include [tʰ] and, for some speakers, strongly pre-aspirated stops [3] (see further 2.4). In acoustic terms the latter may appear either as a period of high-frequency frication *before* the voiceless stop 'gap', or as a breathy continuation of a preceding vowel. An example from adult speech can be seen in [IMAGE 0327_01.TIF]. This example of *kite* is produced by Hannah's mother, and shows a distinct portion of high frequency fricative energy prior to the stop closure.

The rare glottalised forms in pre-pausal context invariably occur in a restricted set of words. These are mainly common monosyllabic non-lexical words such as *what, it, that*, and common monosyllabic verbs such as *got* [5]. The acoustic correlates of these variants include creaky voice (as in 2.3.2), which may be accompanied by patterns indicative of a glottal plosive articulation.

2.4 Sociolinguistic patterns

The variants described in 2.3.3 are socially sensitive within the local adult community. The use of pre-aspirated variants in pre-pausal position is significantly associated with working class female speech amongst young adults (and is virtually absent in the 45-65 age group [3, 5, 16]).

The glottal forms in pre-pausal position are not only lexically restricted, they also mark an ongoing change in Newcastle English. They almost entirely exclusive to the speech of young working class women [3, 16].

3. RESULTS

Acoustic and auditory analysis has been carried out of all relevant tokens produced by the four children. The main patterns are described first according to phonological context.

3.1 Word-initial position

Voice onset time measures are displayed in Table 1 (showing mean scores, standard deviations and overall ranges) and Figure 1 (showing the overall spread of tokens for each child).

	N	mean (ms)	s.d.	range (ms)
Stephen	22	114	80	35 - 380
Ryan	45	86	32	27 - 175
Hannah	23	111	63	47 - 316
Naomi	10	63	22	28 - 90
<i>all</i>	<i>100</i>	<i>96</i>	<i>55</i>	<i>27 - 380</i>

Table 1. VOT patterns, word-initial position.

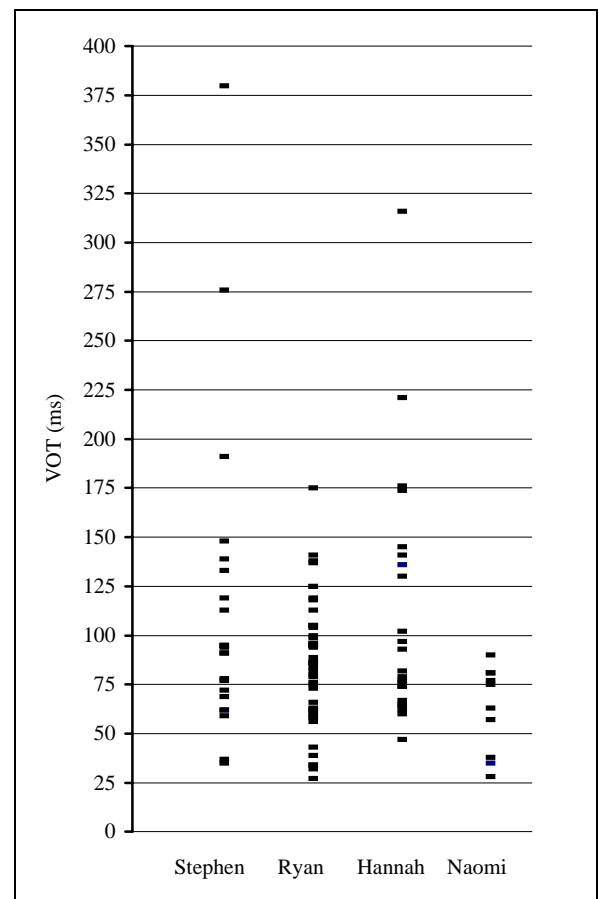


Figure 1. VOT measures, range per child.

All 100 tokens produced by the children may be described as voiceless aspirated plosives: release bursts are followed by a VOT lag with a duration of at least 27ms. All tokens therefore pass the minimum of 25ms appropriate for voiceless aspirated stops [8], and the vast majority are comfortably longer than this. Each child varies considerably in VOT length, as indicated by the wide ranges and large standard deviations in Table 1, but the data as a whole show very similar patterns to those found for two-year-old American children [11].

3.2 Intersonorant position

Table 2 summarises the acoustic patterns observed in intersonorant tokens. (Figures are not given for the approximant [ɹ] variant which may occur in restricted contexts in mature speech, since only 1 example was found. This was produced by Ryan, in the phrase *you got it*, where the (t) of *got* was produced as a labial approximant [ɸ]).

	N	full voice	burst	pre-asp	creak
Stephen	30	6	25	6	10
Ryan	38	15	23	9	13
Hannah	31	22	18	0	16
Naomi	16	7	11	0	2
<i>all</i>	<i>115</i>	<i>50</i>	<i>77</i>	<i>15</i>	<i>41</i>

Table 2. acoustic features, intersonorant position.

Almost half the tokens are fully voiced, with the remainder tending to contain only short (< 20ms) gaps in voicing. Two thirds of the examples contain release bursts. These two factors suggest that the children produce a [d]-like phone by default in this position, which is indeed the impression gained from auditory analysis. All four children, particularly the three older ones, produce a significant number of examples with creaky voicing, which is the most salient feature in adult speech. A co-ordination difference occurs in the children's speech, however; whereas in adult speech the creaky voicing occurs more or less simultaneously with any oral gesture, the children tend to produce creak on the vowel segment(s) adjacent to the [d]-like phone. [IMAGE 0327_02.TIF] represents the phrase *get onto the...*, spoken by Hannah. The (t) of *get* is fully voiced, and followed by distinct creak at the onset of the following vowel. A similar creaky portion indicates the (t) after the [n] of *onto*. The two boys also produce a few tokens containing pre-aspiration (but far fewer than they do in final position - see 3.3).

3.3 Pre-pausal position

The main acoustic features for this context are listed in Table 3.

	N	voice	burst	pre-asp	creak
Stephen	38	2	35	19	2
Ryan	54	2	34	48	15
Hannah	24	0	18	14	4
Naomi	10	0	4	4	0
<i>all</i>	<i>126</i>	<i>4</i>	<i>91</i>	<i>85</i>	<i>21</i>

Table 3. acoustic features, pre-pausal position.

The variants produced are overwhelmingly voiceless, and most (72% overall) contain a plosive release burst. In the majority of cases the plosive is clearly alveolar, as indicated by F2 transitions and confirmed by auditory analysis. However, a few cases involve creaky phonation and/or what is audibly a glottal stop. This is particularly true for Ryan, apparent in 15/54 tokens (28%). In Ryan's speech an auditory percept of [ʔ] is usually cued by a period of what seems to be breathy rather than creaky phonation, tailing off quite abruptly into silence, and often with no clear release (see [IMAGE 0327_03.TIF]). Interestingly, 11 of his 15 'glottal' tokens occur in the items *what*, *that*, *it*, and *got* - i.e. examples of those few items which attract glottals in this context in adult speech (2.3.3).

What is even more striking across all four children is the prevalence of the pre-aspirated pattern. An example is shown in [IMAGE 0327_04.TIF], which is an example of pre-pausal *coat* spoken by Ryan. Ryan in fact produces it in 89% of cases, and both boys produce far more pre-aspirated tokens in this context than in intersonorant position (Table 2). Recall that in adult speech this acoustic pattern is largely restricted to young working class females (and, indeed, the mothers of all four children show high incidence of this pattern).

4. DISCUSSION

4.1 Acoustic patterns by phonological context

Examining the patterns produced across the three phonological contexts, two facts are immediately striking.

First, it appears that the children tend to produce grossly different patterns in each context: voiceless aspirated stops initially, voiced stops with regular creak in intersonorant position, and voiceless pre-aspirated stops pre-pausally. Thus they appear to have made good progress in acquiring different allophones for the different phonological contexts.

Secondly, the acoustic patterns produced in each context are remarkably close to those used by adults in Newcastle. Adults typically produce intersonorant (t) as a laryngealised stop, while the children show a high incidence of [d]-like phones with adjacent creak. In pre-pausal position the children all display the pre-aspirated pattern particular to the subset of the adult community to which their mothers belong.

4.2 Developmental differences

Certain differences are apparent across the children which may indicate developmental changes. The youngest child, Naomi, produces fewest tokens of intersonorant creak, while all four children show an immaturity in co-ordination of the laryngeal and supralaryngeal gestures compared with the PVC adults.

Ryan's performance in pre-pausal position suggests he is aware of a relatively complex incoming change affecting Newcastle English, whereby glottals are becoming acceptable in this context, but only in a restricted set of items (2.3.3). Ryan is in general much the most articulate and mature of these four children, speaking for longer and with a large

vocabulary, suggesting that he would be the most likely to have mastered complex patterns of this type.

The intersonorant [ɹ] variant is overwhelmingly absent, which may be explained by reference to both its physical and its phonological complexity. It is well documented that the approximant [ɹ] tends to be acquired late in general, because of the relative difficulty of co-ordinating tongue retroflexion or bunching with both voicing and lip-rounding [e.g. 10]. In the case of the [ɹ] variant used for intersonorant (t) there are also tight restrictions on the set of lexical items which accommodate it in adult speech.

4.3 Sociolinguistic factors

The children use high levels of pre-aspiration in pre-pausal position, which in the adult community is strongly associated with young working class females. It is found far less among young men, and is virtually absent among older speakers. We may therefore interpret the children's patterns as supportive of claims (e.g. [7]) that children are likely in the early stages of development to be most influenced by their primary caregiver.

Further evidence in this regard may be supplied by Ryan's use of glottals in pre-pausal *what* etc. For the majority of Newcastle adults glottal variants are not permissible in this context. The only subset of speakers in the *PVC* sample who behaved counter to this were once again the young working class females [5]. Informal analysis of Ryan's mother's speech confirms that she does indeed use a relatively high proportion of glottals in this context.

5. CONCLUSION

The data presented here are preliminary, and our conclusions necessarily tentative. However, certain clear points emerge.

Our findings suggest first of all that it is not straightforward to separate acquisition of contrastive phonological units from acquisition of the allophonic and socially-marked features which make up a child's developing sociolinguistic identity. Context- and accent-specific allophones are present very early, although some of the more physically complex (such as [ɹ], and the correct co-ordination of creaky phonation with oral gestures) seem to develop more slowly than others.

The apparent closeness of the children's patterns to those of the mothers raises important questions concerning the actual targets which the children aim for in acquisition. Patterns which are particular to the mothers' speech, including features which are undergoing change in the local accent, appear to be acquired readily by the children. Acquisition studies which take as a point of departure the assumption that there are *language-specific* goals, rather than accent-specific ones, may therefore be inappropriately assessing the child's task in acquisition.

Variation in speech is typically regarded as a problem by linguists (but see [12]), and discussions of both adults' and children's phonology usually seek to reduce variation as much as possible. Overall our findings support an approach to representational learning in which variability in the stimulus is functional rather than *dysfunctional*.

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