

Breathing-impaired speech after brain haemorrhage: A case study

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Abstract

Results are presented from an auditory and acoustic analysis of the speech of an adult male with impaired prosody and articulation due to brain haemorrhage. They show marked effects on phonation, speech rate and articulator velocity, and a speech rhythm disrupted by “intrusive” stresses. These effects are discussed in relation to the speaker’s very short breath-groups and consequent need to take breath within intonation-groups and even within rhythm-groups. The speaker appears to have various strategies for dealing with his speech problems to preserve the structural cohesion of his utterances, some seemingly more successful than others, including planning his frequent breath pauses, using falsetto phonation, control of pitch and inspiring air orally for rapid intake. Finally, it is suggested that these and other strategies designed to compensate for limitations and shortcomings in the speech production system should be recognized as a form of linguistic creativity.

Keywords: *Breathing-impaired speech, impaired prosody, speech rhythm, intonation, speech rate, pause, speech planning, falsetto*

Introduction

Speech, it is often said, is modified breathing (Abercrombie, 1967: 25; Ball & Rahilly, 1999: 20). While there is of course more to speech than mere changes to respiratory activity, the outward flow of air from the lungs is essential for normal continuous speech in all languages. In order to sustain lengthy stretches of speech free of interruptions for intakes of breath, maintenance of breathing is believed to switch from automatic regulation by the medulla oblongata in the brain stem to the neocortex where it comes under voluntary control (West, 2005: 122–124). The proportion of the breathing cycle taken up by the expiratory phase then increases from about 60% in quiet breathing to as much as 90% during speech (Borden, Harris, & Raphael, 1994: 64), lasting typically between 2 and 10 seconds although it can last as long as 25 seconds (Catford, 1977: 66). At typical speech rates for English of between 4.4 and 5.9 syllables per second (Goldman-Eisler, 1968: 24), it is thus not uncommon for speakers to produce 40–50 syllables or more before drawing breath. Speakers rarely pause simply to breathe (Cruttenden, 1997: 30). It seems that

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speakers plan their breathing around their speech rather than planning their speech around the need to breathe (Grosjean & Collins, 1979).

Disruption to speech breathing, and consequent failure to extend the expiratory phase of the cycle, can come about in everyone's experience of trying to speak when out of breath, or when excessively nervous or in a state of fear, but it is also reported as symptomatic of a number of pathological conditions such as Parkinson's disease (Mueller, 1971), motor neurone disease (Putnam & Hixon, 1984), Downs syndrome (Hallidie-Smith, 1985; Heselwood, Bray, & Crookston, 1995), and even deafness (Nickerson, 1975). Weismer (1997: 206), however, points out that the relationship between prosodic features such as speech rate and phrasing on the one hand, and speech breathing on the other, is not well understood. He cites a study by Till and Alp (1991) which shows that the need to breathe at short intervals after only a few syllables can be due to laryngeal hypovalving and is thus not necessarily evidence of a problem with speech breathing as such. It should be possible to use phonatory quality to detect laryngeal hypovalving which will tend during voiced speech to result in breathy or whispery phonation types due to air escaping continuously through all phases of the glottal cycle. Because air is used up more quickly than during modal voice phonation it has to be replenished sooner. Comparative volume velocity rates are given by Catford (1977: 95–101) of as much as 900–1000 cm³/s for extremely breathy voice, up to 400cm³/s for whispery voice, and up to about 350cm³/s for modal voice. The rate for highly breathy voice means that full lungs will empty in four or five seconds (Catford, 1977: 99) which is time enough to produce between 15–20 syllables at normal speech rates. Laver (1980: 132–133) points out, however, that most speakers with habitually breathy voice quality have much lower volume velocity airflow rates. We can probably regard the very high rates as pathological.

An alternative explanation for frequent intakes of breath during speech, and one that does implicate the speech-breathing mechanism, is that not enough air is brought into the lungs during each inspiratory phase of the breathing cycle to power more than a few syllables. The deeper the inspiration, the longer a speaker can talk before having to breathe in again (Proctor, 1980: 49). Shallow inspiration could therefore have much the same effect on speech as laryngeal hypovalving. Both will tend to reverse the normal relationship between speech planning and breathing such that speech has to fit in between intakes of breath. A possible strategy to offset the effects of short expiratory phases on speech planning would be to speak also on the inspiratory phase of the breathing cycle. However, the structure of the vocal folds are such that the aerodynamic-myoelectric action accepted as responsible for vocal fold vibration cannot be so readily set in motion by supraglottal pressure, and therefore the folds cannot vibrate as efficiently (Laver, 1994: 170). This is probably why speech on ingressive pulmonic air is not reported for any language. Where it has been observed it has tended to be voiceless. Fuller (1990), for example, reported pulmonic ingressive [f ↓] and [h ↓] before /ʔ/ in a dialect of the Austronesian language Tsou spoken on the island of Taiwan, although Ladefoged and Zeitoun (1993) were unable to subsequently verify his observations. Pulmonic ingressives have been reported by Gierut and Champion (2000) in a young boy diagnosed with functional phonological disorder. They describe the sound as “a voiceless ingressive fricative with no identifiable point of articulation”. There was no suggestion, however, that the boy had any problems with speech breathing or hypovalving.

The present case study provides an opportunity to look in detail, using auditory-perceptual and acoustic analysis, at the speech output of an adult with an acquired speech disorder exhibiting very short breath-groups to try to establish whether hypovalving or

shallow inspiration is implicated, to see how the realization of prosodic structure and aspects of segmental structure is affected by the need to plan speech around breath-intakes, and to attempt to gain some insight into how the speaker himself manages his speech production impairment.

Method

Subject

The subject of this study is a young man in his late-20s native to the town of Dewsbury in West Yorkshire, UK. He will be referred to as MT (not his real initials) in this paper to preserve his anonymity. He suffered an aneurysm with some light haemorrhaging resulting from a head injury about 20 months before the video-taped interview from which the data analysed below were taken, but no further medical details about his condition are available. It is not known which hemisphere was affected so this study can shed no light on the issue of the lateralization of prosodic functions in the brain (Van Lancker & Sidtis, 1992). His language functions show no signs of impairment, but first impressions of his speech are that it is slow and laboured, of variable intelligibility, lacking in fluency, and very high pitched for an adult male. Closer examination reveals a particular and persistent problem in his control of breathing during speech. His chest can clearly be seen to expand, his shoulders to rise and his nostrils to flare when he stops speaking to breathe in after just a few syllables. Sometimes at the end of a speaking turn he is seen, and heard, to release unused air through sudden relaxation of laryngeal and respiratory musculature, indicating that during speech he is attempting to exercise control over expiration.

Control speakers

For measures of speech rate, articulator velocity and segment durations, MT's speech is compared to that of an age-matched control speaker from the same accent area with no history of speech or language problems. He was asked to memorize each of a selection of 20 of MT's conversational turns (see Tables I and II) just prior to being recorded in order to try to avoid the characteristics of read speech, particularly the often reported faster speech and articulation rates (Robb, Maclagan, & Chen, 2004: 2). The author then "elicited" the utterance with the same cue the speech and language therapist used in the interview thus reproducing parts of the original interview conversation.

For measures related to tonicity, the author acted as the control speaker because of the problems inherent in ensuring that a linguistically naïve control would produce comparable intonation patterns and have the same distribution of e.g. high falls and low falls.

Data

The data are taken from a video recording with synchronised soundtrack of a semi-formal interview style conversation, lasting about 10 minutes, between MT and a speech and language therapist which took place in a recording studio. The subject gave consent for the recording to be used for teaching and research purposes. The conversation ranges over a number of topics, including places where MT has lived, his interests in music and reading, and the effect his speech difficulty has had on his life since his brain haemorrhage.

Analysis

False starts and single-syllable turns were excluded, leaving 45 conversational turns which were analysed into rhythm groups and intonation groups using the external and internal criteria given by Cruttenden (1997: 30–37). These are presented one intonation-group per numbered line in the Appendix with locations of stresses, nuclear tones and breathing pauses marked. All intonation-group boundaries coincided with major syntactic boundaries as is expected in normal speech (Cruttenden, 1997: 68) and often with the beginning and/or end of a conversational turn. Intonation-group and rhythm-group boundaries were not always easy to determine however, because MT frequently pauses for breath where breath-pauses are not expected, a behaviour that disrupts the fluency of his speech rhythm so that it is hard to decide if the syllable occurring immediately after the breath-pause is stressed or not, or is the start of what for him is a new intonation-group. In cases of this kind the syllable was assumed to be initial in a rhythm-group if (a) it was perceived as prominent, and (b) speakers would normally be expected to stress it. Clearly there is potential for some uncertainty here, but locations of rhythmic stresses are largely predictable in English on the basis of word-accent (Jones, 1972; Gimson, 1980). To compound the difficulty with respect to rhythm-groups, his speech gives the impression of being syllable-timed. Frequent use of the strong form of gradable words where weak or contracted forms would be expected, and the use of full-vowelling (see below) in place of reduced vowels and syllabic consonants, strengthens this impression—weak forms and contracted forms are in fact quite rare in the data. Their absence may be due to MT's interpretation of the advice given him by a speech and language therapist to “take my time and not rush things” when speaking which he refers to during the interview.

Deciding whether an intonation-group boundary occurred at a breath-pause was also a problem in some half dozen or so cases. Where it coincided with a syntactic boundary it could in principle be an intonation-group boundary so a judgment had to be made as to whether indeed it was and whether a boundary would normally be expected there. Intonational analysis divided the data sample up into 79 complete intonation-groups and two incomplete ones (lines 44 and 53 in the Appendix). Although there is some inevitable uncertainty about the number, the discussion and conclusions are not dependent on the precision of this figure.

Analysis into breath-groups was carried out by noting all locations of breath intakes where these occurred within an intonation-group or between intonation-groups forming a syntactically and semantically cohesive stretch of speech such that speakers would not be expected to pause for breath at that point. The latter are referred to hereafter as a “close-knit sequence” of intonation-groups and are marked on the transcript in the Appendix by a downward arrow at the beginning of the line just after the intonation-group boundary marker, e.g. lines 3, 4 and 5. As mentioned above, it was usually clear to see on the video when he took a breath. Had there been no video footage and the analysis had had to be carried out entirely from an audio recording, the case study presented in this paper would not have been possible in its present form. The value of having visual as well as audio data, as advocated by a number of researchers (e.g. Abercrombie, 1967; Kelly & Local, 1989; Müller, Damico, & Guendouzi, 2006; Hesekwood & Howard, forthcoming), is thus strongly borne out.

Narrow phonetic transcription using the conventions of the IPA supplemented by ExtIPA (Duckworth, Allen, Hardcastle, & Ball, 1990; Bernhardt & Ball, 1993; Ball, Code, Rahilly, & Hazlett, 1994) was undertaken on parts of the data where it was felt to be particularly interesting and revealing to do so.

The speech was digitized at a sampling rate of 11025Hz using Speech Station 2 software. The low sampling rate was chosen in order to see more clearly spectral events in the region below 5kHz and to obtain better information about voice pitch (Ladefoged, 2003: 26). Acoustic analysis was used to investigate voice quality and linguistic use of fundamental frequency (F0). Duration measurements of breath-groups and breathing pauses were taken from speech waveforms. A sample of 20 utterances (about 25% of the data) comprising either a single intonation-group or a close-knit sequence were measured in this way in order to get, firstly, a measure of raw speech rate from syllable counts, and secondly to get a measure of the speech rate once the breathing pauses had been factored out. This is similar to the procedure for obtaining articulation rate (Nishio & Niimi, 2001: 311; Robb, Maclagan, & Chen, 2004: 2) except that pauses that were not breathing pauses were not removed. There were few non-breathing pauses. It is impossible to know whether MT used his breathing pauses for other purposes as well, such as syntactic planning and word-finding (Cruttenden, 1997: 30–32). Additionally, segment durations were taken from waveforms to investigate articulator velocity.

Results

Speech rate

MT typically takes about three times longer to produce his utterances than the control speaker. Table I gives some comparative measurements.

While the control speaker's rate does vary across the twenty utterances in the sample, it stays more or less within the typical limits given by Goldman-Eisler (1968: 24) of 4.4–5.9 syllables per second. In stark contrast, MT's rate rarely reaches even half the minimum rate, and averages a mere 1.86 (range=1.26–2.63) which is slow even for speakers with brain lesion damage. The average rate for a group of nine males with brain lesions reported in Huot, Ryalls and Le Dorze (1999: 217) was 3.44 syllables per second with a range of 2.7–4.6. MT's slower speech rate as measured in syllables per second is partly accounted for by the breath-pauses, partly by a tendency for what shall be called "full vowelising" (the use of full vowel qualities where reduced vowels or syllabic consonants would be expected), and partly by generally slower articulatory movements as reflected in longer segment durations. Each of these contributory causes needs to be looked at to evaluate as far as possible approximately how much each is responsible for the slow raw rate.

The effect of breath intakes on speech rate

Table II shows MT's corrected speech rate (speech rate minus breath-pauses). By factoring out the breath-pauses his mean rate in the sample increases from 1.86 to 2.19 syllables per second but is still far short of the minimum typical rate of 4.4, and well short of the rates in Huot et al. (1999). Where a breath-pause is preceded by a stop with no audible release, and/or followed by a stop, it is not possible in the acoustic record to isolate the durations of the hold phases of the stops. Durational values will therefore be slightly inflated in some cases but this also affects the measurements from the control speaker.

The samples in Tables I and II total 205 syllables in MT's pronunciations. At a speech rate of 1.86 syllables per second this amounts to a total speech time of 110.2s. With the breath pauses taken out, the corrected rate of 2.19 syllables per second would produce 205 syllables in 93.6s. At the typical minimum rate of 4.4 syllables per second a speaker would

Table I. MT’s speech rate compared to a control from a sample of 20 utterances. Number of syllables in brackets relate to the control speaker’s use of contracted forms and elision of unstressed syllables compared to MT, and MT’s use of epenthetic vowels in clusters. ||=intonation-group boundary.

Utterance	No of syllables	Martin		Control	
		duration	sylls/sec	duration	sylls/sec
1. <i>I am a work-shy bum</i>	6 (5)	4.06	1.48	.93s	5.38
2. <i>and I spend most of my time</i> <i>lying about</i> <i>doing nothing</i>	15	6.83	2.20	2.63	5.70
3. <i>I used to be very keen</i> <i>on an Australian band</i>	14	8.5	1.65	2.43	5.76
4. <i>I used to be quite keen on reading as well</i>	11	6.54	1.68	2.12	5.19
5. <i>that is something else</i> <i>that is very difficult now</i>	13 (11)	7.07	1.84	2.22	4.96
6. <i>I would quite like to hear them again</i>	8 (7)	4.58	1.75	1.27	5.51
7. <i>I was supposed to be doing</i> <i>English</i> [ɪŋɡəlɪʃ] <i>and History</i>	15 (13)	7.35	2.04	2.21	5.88
8. <i>I think mainly the nineteenth and twentieth centuries</i>	14	8.41	1.66	2.78	5.04
9. <i>not being able to speak as clearly as I would like</i>	13	11.12	1.16	2.66	4.89
10. <i>some British and American</i>	8	3.17	2.52	1.53	5.23
11. <i>she told me to take my time</i> <i>and not rush things</i>	11	8.75	1.26	2.38	4.62
12. <i>they’re very obscure</i> [ɒb’skʊ:ə]	6 (5)	2.93	2.05	1.21	4.13
13. <i>I do go there as well</i>	6	2.87	2.09	1.35	4.44
14. <i>a lot of dead-end jobs</i>	6	3.89	1.54	1.31	4.58
15. <i>that is a good question</i>	6 (5)	2.28	2.63	1.08	4.63
16. <i>I also lived in Liverpool for a long while</i>	12	5.49	2.19	2.04	5.88
17. <i>and we go swimming every</i> [’ɛvəlɪ] <i>week</i>	9 (8)	5.52	1.63	1.72	4.65
18. <i>because I had a brain</i> [bʰeɪm] <i>haemorrhage</i>	10 (9)	5.41	1.85	1.58	5.70
19. <i>and I’m also doing a course in journalism</i>	13	6.99	1.86	2.16	6.02
20. <i>it is a correspondence course</i>	8 (7)	3.82	2.09	1.69	4.14
	Mean		1.86		5.12
	SD		.38		.60

only take 46.6s to produce them all. On the basis of the samples taken we can therefore conclude that interruptions for breathing account for around 26% of the difference between MT’s speech rate and the typical minimum.

The effect of “full voweling” on speech rate

Many vowels which would normally be reduced, such as gradable words in their weak forms, and unstressed syllables in polysyllabic words, are produced by MT as full vowel qualities. That is to say, the vowels of strong forms are used in weak-form contexts, e.g. prepositional and infinitival *to* pronounced [tu:] instead of [tə] in “*used to be keen on*”, *of* pronounced [ɒv] instead of [əv] in “*a lot of work*”, *was* pronounced [wɒz] instead of [wəz] in

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Table II. MT's articulation rate (speech rate minus pauses). Locations of breath-intakes marked by downward arrow, breath-holdings by an asterisk.

Utterances	No of syllables	Martin		Control	
		duration minus breath pauses	sylls/sec corrected	duration	sylls/sec
1. <i>I</i> ↓ <i>am</i> <i>a</i> ↓ <i>work</i> ↓ <i>-shy</i> * <i>bum</i>	6	2.93 4=1.13s	2.05	.93s	5.38
2. <i>and</i> <i>I</i> <i>spend</i> ↓ <i>most of my time</i> ↓ <i>lying about</i> ↓ <i>doing nothing</i>	15	5.51 3=1.32	2.72	2.63	5.70
3. <i>I</i> ↓ <i>used to</i> ↓ <i>be very keen</i> ↓ <i>on</i> ↓ <i>an</i> ↓ <i>Australian band</i>	14	6.19s 7=2.31	2.26	2.43	5.76
4. <i>I</i> <i>used to be</i> ↓ <i>quite keen on</i> ↓ <i>reading</i> ↓ <i>as well</i>	11	5.24 3=1.30	2.10	2.12	5.19
5. <i>that is something else</i> ↓ <i>that is</i> ↓ <i>very difficult now</i>	13 (11)	6.27 2=.8	2.07	2.22	4.96
6. <i>but</i> * <i>I would quite like to hear them again</i>	9 (8)	4.50 1=.58	2.00	1.45	5.52
7. <i>I was supposed to be doing</i> ↓ <i>English</i> [ɪŋɡəlɪʃ] ↓ <i>and</i> ↓ <i>History</i>	15 (13)	6.07 3=1.28	2.47	2.21	5.88
8. <i>I</i> <i>think</i> ↓ <i>mainly</i> ↓ <i>the</i> ↓ <i>nineteenth</i> ↓ <i>and</i> ↓ <i>twentieth</i> * <i>centuries</i>	14	6.47 5=1.94	2.16	2.78	5.04
9. <i>not</i> ↓ <i>being</i> ↓ <i>able to speak</i> ↓ <i>as clearly</i> ↓ <i>as I would like</i>	13	9.9 4=1.22	1.31	2.66	4.89
10. <i>some British and American</i>	8	3.17 (no breath pauses)	2.52	1.53	5.23
11. <i>she</i> ↓ <i>told me</i> ↓ <i>to</i> ↓ <i>take my time</i> ↓ <i>and</i> ↓ <i>not rush</i> ↓ <i>things</i>	11	6.39 6=2.36	1.72	2.38	4.62
12. <i>they're</i> <i>very</i> ↓ <i>obscure</i> [ɒbskʉ:ə]	6 (5)	2.7 1=.23	2.22	1.21	4.13
13. <i>I do go there as well</i>	6	2.87 (no breath pauses)	2.09	1.35	4.44
14. <i>a lot of</i> ↓ <i>dead-end</i> ↓ <i>jobs</i>	6	2.80 2=1.09	2.14	1.31	4.58
15. <i>that is a good question</i>	6 (5)	2.28 (no breath pauses)	2.63	1.08	4.63
16. <i>I</i> ↓ <i>also lived in</i> ↓ <i>Liverpool for a long while</i>	12	4.83 2=.66	2.48	2.04	5.88
17. <i>and</i> ↓ <i>we</i> ↓ <i>go</i> ↓ <i>swimming</i> ↓ <i>every</i> ['evəli] <i>week</i>	9	3.93 4=1.60	2.30	1.72	4.65
18. <i>because</i> ↓ <i>I</i> ↓ <i>had</i> ↓ <i>a brain</i> [bə'leɪn] ↓ <i>haemorrhage</i>	10	4.35 4=1.07	2.07	1.58	5.70
19. <i>and</i> ↓ <i>I'm also</i> ↓ <i>doing</i> ↓ <i>a course</i> ↓ <i>in</i> ↓ <i>journalism</i>	13	5.48 5=1.51	2.37	2.16	6.02
20. <i>it is a correspondence course</i>	8 (7)	3.82 (no breath pauses)	2.09	1.69	4.14
	Mean		2.19		5.12
	SD		.32		.60

"*I was supposed to be*". Similarly, schwa vowels expected in polysyllabic words such as *American* and *supposed* are pronounced with full vowel qualities ([a] in the first and last syllables of the former, [ɛ] in the first syllable of the latter). He sometimes uses a full vowel where a syllabic consonant is expected, e.g. *couple* pronounced as [k^həp^həl], and frequently breaks up clusters with an epenthetic vowel, e.g. *brain* as [bə'leɪn]. Because full vowels have

a greater duration than reduced vowels (Shockey, 2003: 22–27), the result is speech that gives the impression of being syllable-timed so that the normal durational difference between unstressed and stressed syllables in English is not so perceptually salient. His slow articulator velocity means that any unstressed syllables will have a greater duration and thus tend to sound unreduced even if the timbre is that of a reduced vowel. The greater incidence of full vowels increases the duration of rhythm- and intonation-groups and therefore leads to a lower number of syllables per second. By comparing his full-vowel syllables with the reduced syllables of the control speaker, we can get an estimate of the extent to which full-vowelling is responsible for MT's slow speech rate.

A sample of 23 gradable words and two polysyllabic words (*American*, *Liverpool*) providing 26 relevant vowel tokens in all were measured for vowel duration and compared across the two speakers. Table III gives the results, revealing that MT's full vowels take on average about four and a half times as long as the control speaker's corresponding reduced vowels in the same utterance contexts.

In the data about one in six or seven vowels would be expected to be reduced. The minimal normal rate of 4.4 syllables per second would throw up an average of two reduced vowels for every three seconds of speech. With each one being about four and half times normal duration, full-vowelling would account for about 12% of the shortfall in speech rate. Adding the effect of breathing pauses and full-vowelling together accounts for about 38% of the shortfall.

Table III. Durations of vowels in unstressed syllables in MT's speech compared to the control speaker.

	MT	Control
<i>am a work-shy</i>	[ei] 375ms	57
<i>a lot of work</i>	[ā] 187	42
<i>is a good</i>	[ə] 138	43
<i>had a brain</i>	[ə] 286	44
<i>doing a course</i>	[ei] 196	40
<i>It's a correspondence</i>	[ə] 111	39
<i>on an Australian</i>	[a] 245	44
<i>mainly the nineteenth</i>	[i] 225	56
<i>that is</i>	[a] 196	33
<i>Liverpool for a long</i>	[ɔ] 92	11
<i>used to be</i>	[u:] 332	61
<i>used to be</i>	[u] 167	55
<i>like to hear</i>	[u] 173	48
<i>supposed to be</i>	[u:] 221	25
<i>able to speak</i>	[u:] 295	53
<i>told me to take</i>	[u:] 335	37
<i>a lot of work</i>	[u:] 307	54
<i>English and history</i>	[ʊə] 210	40
<i>but they're</i>	[ə] 179	55
<i>I was supposed to</i>	[ɒ:] 212	51
<i>reading as well</i>	[ɹ] 292	90
<i>as clearly</i>	[ɹ] 273	43
<i>as I would like</i>	[ɹ] 257	63
<i>American</i>	[a] 148	84
<i>American</i>	[ā] 122	39
<i>Liverpool</i>	[ɔ:] 206	50
mean	222.3ms	49.4
SD	72.6	16.0

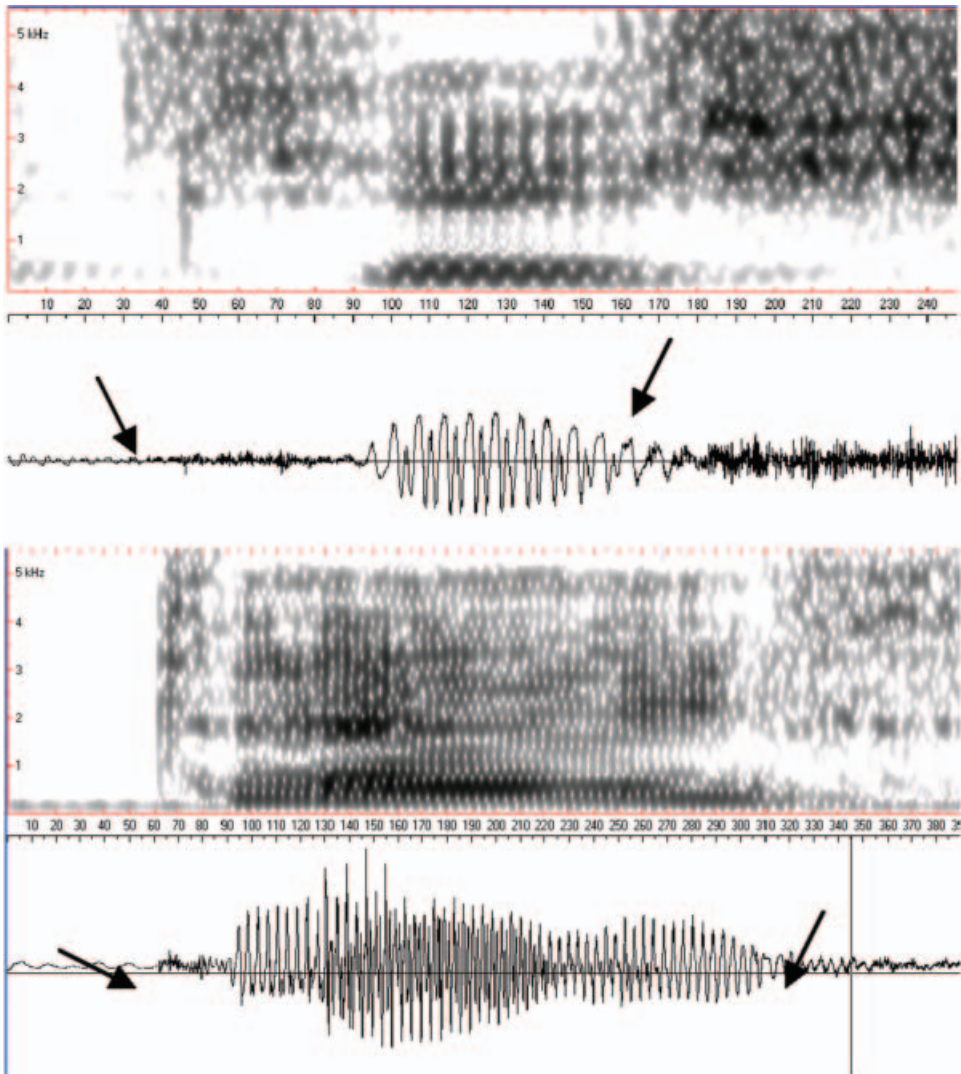


Figure 1. The three-segment sequence /tɪʃ/ from “British” comparing control speaker (upper) with MT (lower) for speed of tongue movement. Measurements taken between arrowed points—release of /t/ to onset of friction for /ʃ/.

Table IV. Measurement (ms) of return of active articulator over seven CVC sequences. Martin takes on average nearly twice as long to make the same gesture cycle as the control speaker.

	Martin	Control
vəp <i>Liverpool</i> labial-labial	206	50
Lɒt <i>a lot of</i> apical-apical	247	92
sɪns <i>since</i> apical-apical	229	163
dɪd <i>didn't</i> apical-apical	217	95
dɪd <i>did</i> apical-apical	268	191
tɪʃ <i>British</i> apical-apical	255	129
kɪŋ <i>asking</i> dorsal-dorsal	132	95
Mean	222	116
Equivalent gestures per second	4.5	8.6

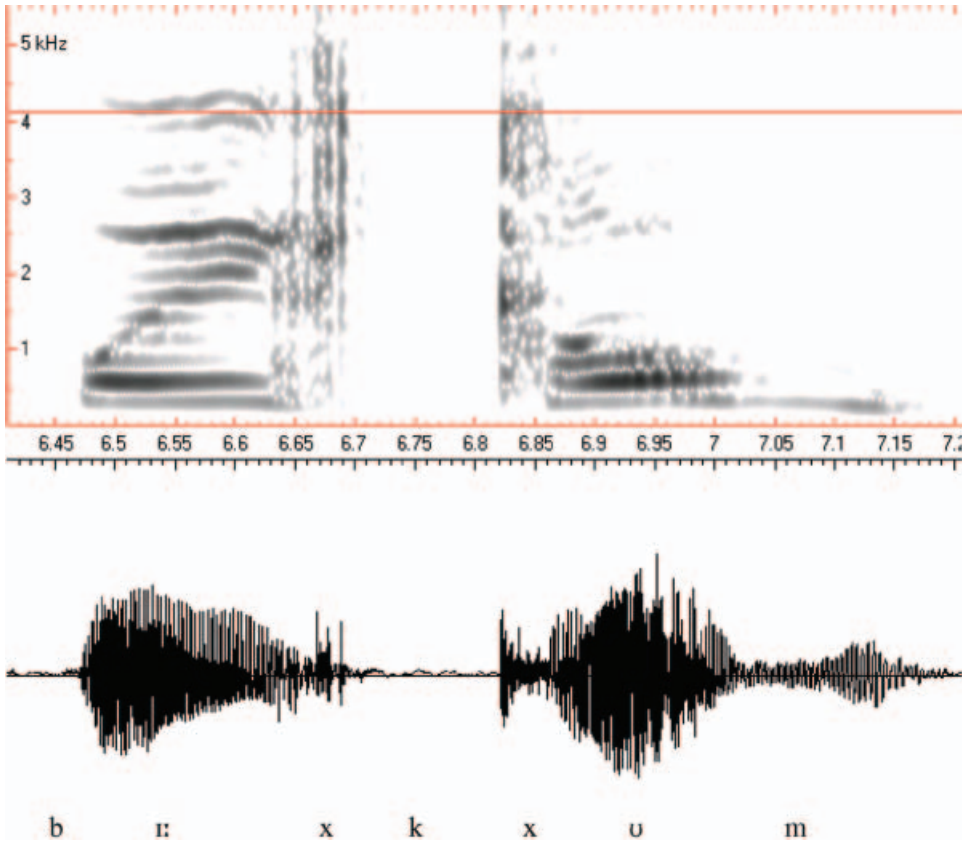


Figure 2. Realization of intervocalic /k/ in *become* with 67ms of voiceless friction in the approach and 40ms in the release phase, indicative of slow tongue movement throughout the gesture.

The occurrence of a long full vowel in the first syllable after a breath-pause if a short reduced vowel is normally expected can lead to a listener perceiving the syllable as stressed because of the fact that increased vowel duration is an acoustic correlate of stress in English, with increased perceived length functioning as the corresponding auditory correlate (Laver, 1994: 512; Cruttenden, 1997: 13). Later in this paper the notion of “intrusive stress” is introduced in discussing this phenomenon.

The effect of slow articulation on speech rate

In order to capture something of the rate at which MT’s articulators move, measurements were taken over seven three-segment stretches of CVC type and compared with the control speaker. Segment sequences were chosen in which the same active articulator is involved in the production of the first and third segments, thus approximating data from a diadochokinetic task but avoiding the artificiality of non-linguistic repetition which may be a different kind of motor activity from the realization of linguistic utterances (Ackermann & Hertrich, 1993: 76; Ziegler, 2002; Weismer, 2006). For example, in the word “British”, measurement was taken on the waveform from the release of [t] to the first appearance of aperiodicity for the realization of [ʃ] (see Figure 1). Table IV presents the

measurements showing that MT takes about twice as long to execute the same articulatory gesture cycle (away from the passive articulator for [t] and back to the passive articulator for [ʃ]) as the control speaker.

Extrapolating this to a measure of number of articulatory gesture-cycles per second indicates that MT can only manage about half the rate of the control speaker. Slowness of articulator movement therefore seems to be the largest factor responsible for MT's slow speech rate, accounting for most of the remaining 62% or so of the shortfall between his rate and the normal minimum. Further evidence of this can be seen in Figure 2, a spectrogram and waveform of the word "become" in which the /k/ is realized not only with slow fricated release, but also with a 67ms period of friction in the approach phase indicating a very slow approach of the tongue dorsum to the velum. This feature is typical of MT's velar plosive articulations throughout the data. Low articulator velocity is consistent with his head injury having adversely affected his motor speech control.

Lethargy of articulator movement does not necessarily mean that relative timings involving co-ordination of different structures, such as voice onset time (VOT), will be retarded. Ackermann and Hertrich (1993: 85) observed that VOT values were normal or even reduced in speakers whose articulations were slow. In normal speakers slower rates of speech have been found to have increased voiceless VOTs compared to faster rates and also to have increased variance, but not to affect voiced VOTs so much (Volaitis & Miller, 1992). VOT values are normally expected to distinguish voiceless from voiced plosives in English (Docherty, 1992) but MT's clearly do not (see Table V). His voiceless VOT values are low despite his slow speech rate and slow articulator velocity. While it is true that voiceless plosives are typically less aspirated in the geographical region MT is from compared to most varieties of UK English (Wells, 1982: 370; Jones, 2007), the complete lack of any consistent tendency for VOT to function as a voicing cue is not typical. The variability in the VOTs of the voiced and the voiceless plosives is such that the ranges overlap extensively both at the low end where only voiced values are expected, and at the high end where only voiceless values are expected.

MT's atypical voiceless VOT behaviour is consistent with Hoit, Solomon, and Hixon's (1993) findings that VOT can vary in proportion to lung volume. However, the higher than expected values for voiced plosives would not be predicted if only lung volume was implicated. It may therefore be a problem with the co-ordination of laryngeal and supralaryngeal activities (Hardcastle, Barry, & Clark, 1985), or it may be a difficulty in controlling glottal aperture (Auzou et al., 2000: 146).

Table V. VOT values for MT's plosives in stressed syllables by place of articulation.

	voiced	voiceless
labial	n=6 range=12-46 mean=21.0	n=4 range=15-36 mean=23.25
coronal	n=6 range=14-23 mean=18.33	n=4 range=03-41 mean=21.25
dorsal	n=4 range=08-48 mean=30.75	n=7 range=11-52 mean=32.0
overall	n=16 range=08-48 mean=23.36	n=15 range=03-52 mean=25.5

Breath-groups and breath-pause locations

The locations of breath pauses within the utterances were determined from watching the video and by listening for the sound of inspiration. MT's shoulders rise, his chest expands and he often flares his nostrils when he breathes in. Table VI shows the location of breath intakes within intonation-groups and close-knit sequences classified according to three types. These types are defined in relation to rhythm-group boundaries as follows:

- (1) At an expected rhythm-group boundary—i.e. MT breathes in immediately before a syllable on which he places stress, and which would be expected to be stressed either as rhythmic stress or a tonic syllable. This is the most common location for his disruptive intakes of breath (50.9%), indicating that he tries to ensure that he has a sufficient reservoir of air to make the following syllable stressed. While rhythmic fluency is adversely affected, rhythmic structure in terms of stress locations is maintained. An example of this type is:

||A | lot of ↓| dead – end ↓|jobs | || ↓ = breath intake

- (2) At an extra unexpected rhythm-group boundary—i.e. the next syllable after a breath pause sounds stressed but would not normally be expected to have stress. Such stressed syllables shall be called “intrusive” stresses. This is the next most common location (30.5%). Taking a breath at a point which would normally be within a rhythm-group has the effect of creating an unexpected rhythm-group boundary which disrupts the normal rhythm by introducing an intrusive stress. It may be that he finds it hard to prevent stress on the first syllable after an intake of breath because the initiatory power released by relaxation pressure is hard for him to control. But, if there is not a great deal of air in his lungs to begin with, it seems unlikely that the subglottal pressure would be high enough to be responsible for this intrusive stress effect. His strong tendency to full-vowelling (see above) is perhaps more likely to be the main contributing factor in the perceived occurrence of intrusive stresses. These unexpected perceptual prominences are likely to make it harder for listeners to process and comprehend his speech output. An example of this type is:

|| | But ↓| they're | very ↓| ob | 'scur'e |||

Normally we would expect the rhythmic structure to be:

|| | But they're | very ob | 'scur'e |||

(it would probably be more usual for “*but they're*” to be in a pre-head here, but a stress on “*but*” is possible). The stresses on “*they're*” and “*ob*” are classed as intrusive and have full vowel qualities—[ðɛ:] and [ɒb], the latter normal for northern English varieties (Wells, 1982: 363).

Table VI. Locations of 118 breath intakes within intonation-groups and close-knit sequences in the data.

Location type	Number	Percentage
(1) At expected RG boundary	60	50.9
(2) At extra unexpected RG boundary	36	30.5
(3) RG-internal	22	18.6

- (3) Not preceding a stress (whether expected or intrusive)—i.e. the syllable after the breath intake does not sound stressed, and would not be expected to be stressed. This type only accounts for 18.6% of the disruptive breath intakes, supporting the suggestion that prevention of intrusive stresses is a problem for him. While this type does disrupt the fluency of the rhythm, it does not alter the rhythmic structure in terms of the occurrence of stressed syllables. This type is exemplified by:

||| not ↓being ↓able to | speak ↓as | clearly ↓as I would | 'like | |||

Types (1) and (3) have in common that they do not alter the rhythmic structure of the utterance, although they do introduce interruptions to the fluency with which the rhythm is realized due to the time it takes to draw breath. Together, they account for almost 70% of disruptive intakes of breath. Type (2), accounting for the remaining 30%, also introduces interruptions to the fluency, but in addition the intrusive stresses alter the perceived rhythmic structure.

From a listener's point of view, it is probably harder to process an utterance if both fluency *and* structure are disrupted, compared to disruption of only the fluency. Whether MT is in some sense aware of this, and tries, with around 70% success, to preserve the expected rhythm, we can only speculate. However, the fact that his placing and choice of nuclear tone is pragmatically appropriate (see below) except in one case which seems to be due to insufficient initiatory power, strongly suggests that his prosodic competence is intact. It is the *realization* of the prosodic structures that is impaired, largely because of his speech-breathing problem. A further indication of his intact competence is that all expected stressed syllables do receive stress even if sometimes it is not as perceptually prominent as it might be in the mouth of a speaker without MT's difficulties.

In addition to looking at where MT does pause for breath, it can be revealing to see also where he does not pause for breath. The fact that not once in the data does MT pause to breathe in within a polysyllabic word indicates a strategy to preserve the integrity of word-form boundaries. Neither does he ever insert a breath-pause into a syllable which would be possible in certain contexts where a syllable constituent could migrate to a neighbouring syllable, e.g. *lot of* (line 24) could be produced as [lɒ ↓ tɒv] or *do go* (line 67) could be produced as [du:g ↓ əv]. Even pausing for breath within a vowel would not be impossible—introducing hiatus within vowels is attested in dysfluent speech (Mowrer & Fairbank, 1991). The frequency with which the different types of breath-intake locations arise in the data strengthens the conclusion that there is some attempt on the part of the speaker to accommodate his breathing to rhythmic structures as much as he can in order to preserve larger items such as rhythm groups—in other words, to plan his breathing around his speech. Garman (1990: 229) has suggested that rhythmic schemata may be the basis for articulatory planning. If this is so, then there is evidence that the schemata are intact in MT's case.

Breath-groups and numbers of syllables

The assumption is made for this analysis that each conversational turn in the data would normally be produced within one breath-group where breath-group is defined for current purposes as a stretch of speech produced on one continuous exhalation. What is clearly abnormal in conversational speech is breathing in within the boundaries of an intonation-group or close-knit sequence of intonation-groups, and particularly so at locations where there is no major syntactic boundary (Grosjean & Collins, 1979: 110–112). Cruttenden

(1997: 68) points out that “we can produce a far longer number of syllables and words on one breath than is ever used in intonation-groups”. Any speaker with normally-functioning speech breathing could therefore very comfortably manage the longest of the intonation-groups in the data which has 14 syllables (line 25 in the Appendix, no. 8 in Tables I and II) on one exhalation and also the close-knit sequences in Tables I and II. Catford (1977: 66) calculates that breath-groups normally last between two and ten seconds during speech and can reach 25 seconds if necessary. At even the minimum normal rate of 4.4 syllables per second, 14 syllables would take 3.18 seconds, well within normal breath-group duration limits. MT, however, breaks line 25 into six breath-groups taking 8.41s to produce it. Figure 3 compares the number of syllables per intonation-group with the number of syllables per breath-group in the sample of MT’s speech.

Sixty-six and a half per cent of MT’s breath-groups are only one, two or three syllables long, yet only 13.6% of the intonation-groups are under four syllables in length. The average number of syllables produced on one breath by MT is 3.1 compared to the average number of syllables per intonation-group in the data of 6.3. Speakers would normally produce at least one intonation-group per breath-group in which case the columns would either exactly match (one intonation-group per breath-group) or the relationship would be the reverse of Figure 3 with the numbers of syllables in breath-groups exceeding the numbers in intonation-groups. In MT’s case nearly a quarter of his breath-groups consist of only one syllable, whereas there are no monosyllabic intonation-groups in the analysed data. It also shows that he did not produce any of the 12 intonation-groups consisting of more than nine syllables without taking at least one additional breath. His problem with using expiration to power speech manifests itself when he tries to complete an intonation-group without pausing for breath. Line 08 of the transcript in the Appendix is an example. The antepenultimate word is unintelligible and MT is clearly struggling with insufficient air having used most of it up on the preceding five syllables. Another example occurs in line 19 where he has almost run out of breath just before the word “else” which is produced with him visibly pushing out the last remaining usable air of his expiratory reserve volume. This word has been preceded by six syllables since his last breath intake. In both cases the syllable he struggles with is a tonic and therefore requires more initiatory power.

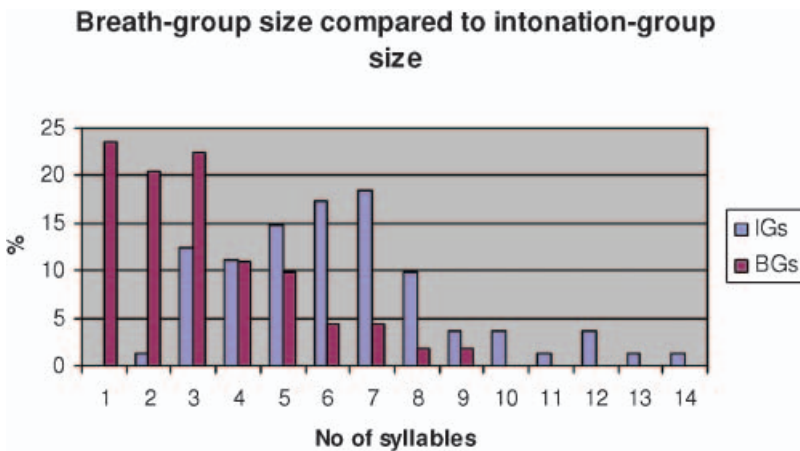


Figure 3. Mismatch between breath groups and intonation groups in MT’s speech.

Phonation

To assess whether MT's need for breath intakes within intonation groups is due to laryngeal hypovalving, his phonatory function was examined using perceptual and acoustic analysis. As noted above, he speaks with a very high pitch for an adult male, his voice sounding strained but not at all breathy or whispery—indeed, high pitch is not a characteristic of breathy voice (Laver, 1980: 133). MT's voice spectrum is typical of falsetto phonation: a relatively high amplitude F0 with a markedly negative spectral tilt (Laver, 1980: 120) measured by taking the difference between the first and second harmonics (Hayward, 2000: 235; Gordon & Ladefoged, 2001: 397); low amplitude upper harmonics; and low levels of inter-harmonic noise. An example is given in Figure 4. Acoustic analysis shows that his F0 is consistently over 200Hz, reaching around 380–390Hz in some tonic syllables, and occasionally exceeding 400Hz. While Laver (1980: 119) cites Hollien and Michel (1968) for an average male falsetto range of 275–634Hz, Li and Yiu (2006) state that the frequency boundary between modal and falsetto phonation varies more in pathological populations than in normal populations. MT's voice sounds falsetto at considerably lower frequencies than 275Hz which is consistent with Li and Yiu's assertion.

There is nothing to suggest laryngeal hypovalving. Lack of perceived breathiness or whisperiness, and the lack of interharmonic noise on the spectrum, are not consistent with the escape of quantities of subglottal air during MT's voiced speech. Although vocal fold closure is typically incomplete in falsetto phonation (Catford, 1977: 101; Laver, 1980: 118–119), volume velocity is low. Falsetto phonation is achieved through the vibration of the stretched and thinned edges of the vocal folds (Laver, 1980: 118) which, being a reduced mass, require less aerodynamic energy relative to modal voice. The speaker may therefore be deliberately (though of course not necessarily consciously) employing falsetto phonation to achieve voicing more easily with reduced aerodynamic resources—that is to say, falsetto may be his speech production mechanism's solution to a problem of sustaining subglottal pressure at levels high enough to drive phonation when the pressure is not sufficient for modal voice. The evidence thus points to MT's problem being one of inspiring enough air for speech rather than in preventing continuous transglottal airflow. That is to say, he does not waste air so much as fail to fill his lungs sufficiently in the first place. Indeed, on several occasions MT can be observed to release subglottal air at the end of a speaking turn with what appears to be a sudden relaxation of laryngeal and intercostal/

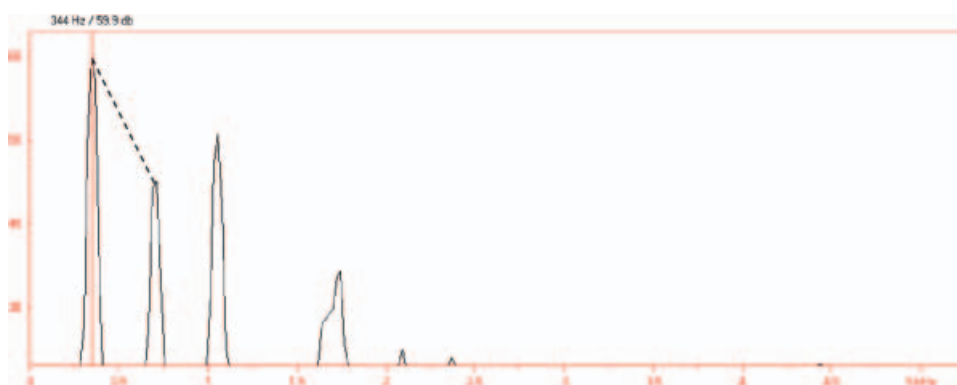


Figure 4. Falsetto voice quality – F0 (at cursor)=344Hz, spectral tilt (dotted line)=-14.9dB; low-amplitude upper harmonics and absence of inter-harmonic noise. Spectrum taken 95ms into the tonic syllable /ei/ vowel in *Australian*.

abdominal tension, an indication that he has been over-economical in his use of air during the course of the utterance.

Use of F0 for stress

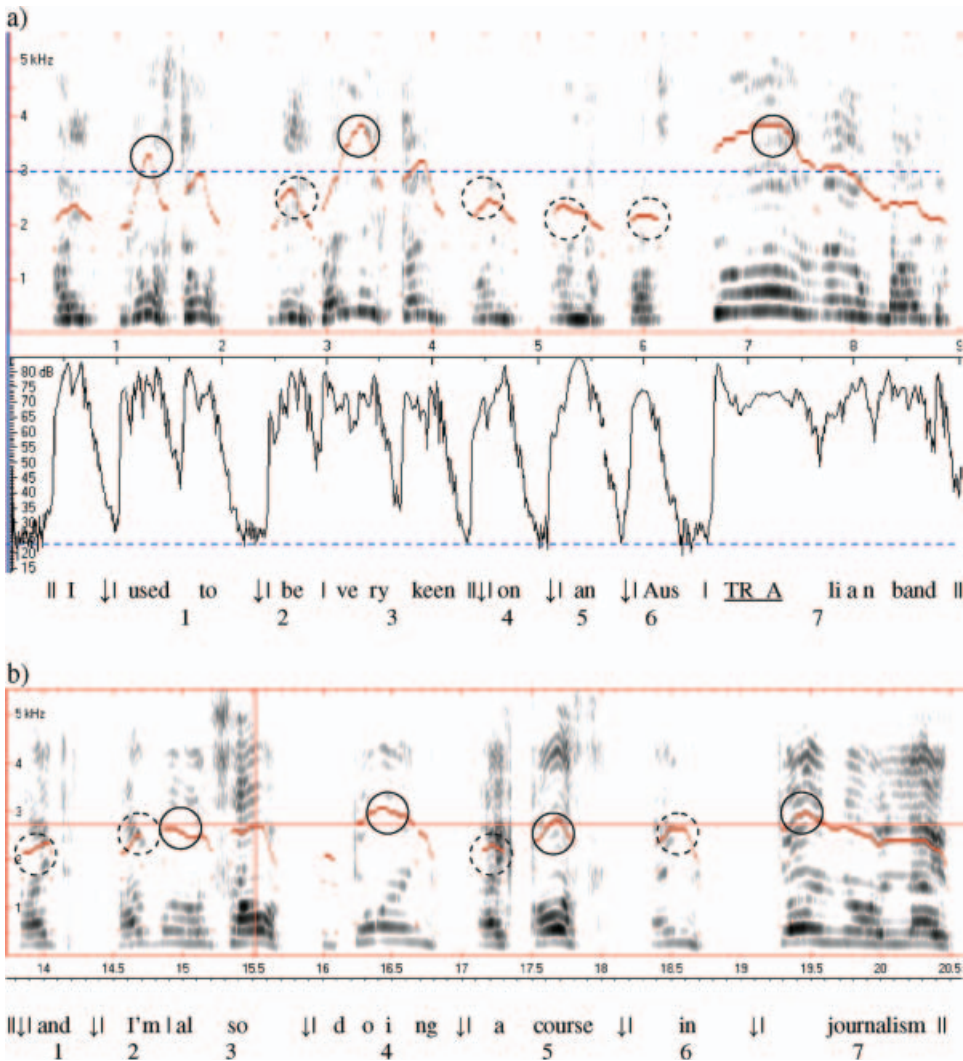
Stress is a complex phonetic phenomenon involving changes in the perceptual parameters of pitch, length and loudness in stressed syllables compared to adjacent unstressed syllables. In acoustic terms, these manifest as changes in F0, duration and intensity. These changes are most obvious in the vowel of the syllable, but there may also be differences in the consonants. To illustrate how MT realizes stress, two of his intonation-groups forming a syntactically and semantically cohesive utterance will be examined in some acoustic detail in relation to pitch/F0 and length/duration. Loudness/intensity has been left out of account as it is not a good indicator of stress and is the least important of the three auditory/acoustic parameters for stress in English (Ladefoged, 2003: 91–93). A key question is whether the intrusive stresses resulting from his breath-intakes (type 2) are acoustically different from the expected stresses.

The utterance chosen for analysis is “*I used to be very keen || on an Australian band*” (lines 09 and 10). Its rhythmic structure is indicated in the prosodic transcription in Figure 5a by rhythm-group boundaries marked with a vertical division; breath-intakes are indicated by a downward arrow. Another example is given in Figure 5b, the utterance “*and I’m doing a course in journalism*” (line 60).

The stresses at the start of rhythm-groups 2, 4, 5 and 6 in Figure 5a, and in rhythm-groups 1, 2, 5 and 6 in Figure 5b, are what are being called “intrusive” and can be attributed to their location immediately after an intake of breath. Their pitch-peaks are identified on the spectrogram by dotted circles on the pitch trace. It can be seen that these tend to be lower than the pitch-peaks of those syllables which are expected to be stressed, identified by solid circles. The horizontal reference lines are at 300Hz in Figure 5a and 271Hz in Figure 5b. MT’s use of F0 is not categorical in distinguishing intrusive from expected stresses but there is a markedly consistent tendency. The mean F0s of 18 expected stresses and sixteen intrusive stresses, taken from the intonation-groups in lines 02, 06, 07, 11, 12, 25, 40, 47, 55 and 60, are 301Hz and 256Hz respectively. Even though the ranges overlap considerably at the top end (256–334Hz, 208–334Hz), the probability is greater that a lower F0 will be found in intrusive stresses. This distribution can be construed as further evidence that MT is prosodically competent. It seems that although he cannot always prevent a post breath-intake syllable from being perceived as stressed, he does attempt to ensure that the pitch of syllables with intended stress rises above those with intrusive stress. He thus demonstrates some degree of control over, and appropriate deployment of, F0 as an indicator of stress.

It is noticeable in Figure 5a that the peaks of the intrusive stresses are in fact lower in pitch than the unstressed syllables—the “*to*” of “*used to*”, and the “*keen*” of “*very keen*”—yet they are perceptually more prominent, probably partly because they come immediately after amplitude minima corresponding to the pauses where he breathes in (see the dashed reference line on the power display in Figure 5a), but full-vowelling may be mostly responsible for the perception of stress. Table VII compares durations for the vowels in “*be, on, an, Aus-*” from MT and the control speaker, showing that MT takes over two and a half times as long to produce them.

It is an interesting feature of MT’s conversational turns that the presence of silent breath-pauses does not destroy in the listener the perceived cohesion of successive rhythm-groups



Figures 5a and 5b. F0 of intrusive stresses (dotted circles) compared with rhythmic stresses (solid circles).

as parts of a larger whole. He tries to take up where he left off. When speech resumes after the pause the pitch is not inappropriate for its place in the utterance except in some cases of intrusive stress, suggesting that the rhythm and its pitch movements have been fully

Table VII. Vowel durations of MT's intrusively stressed syllables in Figure 5 compared to the control speaker.

	MT	Control
<i>be</i>	173ms	98
<i>on</i>	219	87
<i>an</i>	245	44
<i>Aus</i>	200	77
mean	209	76.5

Table VIII. Extent of turn-final falling tones in Hz and semitones for MT and the author. Domain of fall (tonic syllable+tail) underlined. Number in column 1 refers to line number in Appendix.

Utterance part	Tone	MT	Control
<i>Thanks for <u>asking me</u></i>	HF	324–168	149–110
01		156	39
<i>play no more</i>	HF	324–183	156–97
08		141	59
<i>Australian band</i>	HF	394–208	162–97
10		186	65
<i>the Go-Betweens</i>	HF	356–178	162–95
11		178	67
<i>They're very <u>obscure</u></i>	HF	334–197	165–102
12		137	63
<i>the Beatles</i>	HF	306–155	141–94
13		151	47
<i>for <u>ages</u></i>	HF	368–169	160–87
14		199	73
<i>English and <u>history</u></i>	HF	298–158	172–92
23		140	80
<i>I didn't <u>graduate</u></i>	HF	324–190	160–87
27		134	73
<i>any <u>money</u></i>	HF	334–182	140–97
32		152	43
<i>to become <u>famous</u></i>	HF	315–184	172–92
37		131	82
<i>eighteen <u>months ago</u></i>	HF	315–167	138–87
41		148	51
<i>as I would <u>like</u></i>	HF	334–190	150–103
55		144	47
<i>a bit <u>lazy</u></i>	HF	306–174	151–104
63		132	47
Mean extent of fall for HFs		152.1Hz	59.7Hz
Range			
In semitones		131–199	39–82
Range		10.4	8.4
<i>doing <u>nothing</u></i>	LF	270–200	125–80
05		70	45
<i>hear them <u>again</u></i>	LF	298–183	118–88
15		115	20
<i>a lot of <u>work</u></i>	LF	225–181	114–93
24		44	21
<i>twentieth <u>century</u></i>	LF	290–147	140–89
25		143	51
<i>British and <u>American</u></i>	LF	283–173	137–102
26		110	35
<i>very difficult <u>now</u></i>	LF	288–172	119–97
20		116	22
<i>in Liverpool for a long <u>while</u></i>	LF	256–186	108–78
31		70	30
<i>it didn't work <u>out</u></i>	LF	225–186	140–90
38		39	50
<i>now and <u>again</u></i>	LF	298–184	139–96
43		114	43
<i>and not rush things</i>	LF	290–190	131–92

Table VIII. Continued.

Utterance part	Tone	MT	Control
48		100	39
<i>what I want to <u>say</u></i>	LF	269–177	137–90
50		92	47
<i>I do a lot of <u>that</u></i>	LF	306–187	140–88
58		119	52
<i>a course in <u>journalism</u></i>	LF	297–188	137–99
60		109	38
<i>a correspondence course</i>	LF	306–200	120–92
61		106	28
<i>go there as <u>well</u></i>	LF	298–200	129–102
67		98	27
<i>quite <u>ambitious</u></i>	LF	276–177	141–91
71		99	50
<i>a couple of <u>times</u></i>	LF	283–153	133–91
74		130	42
Mean extent of fall for LFs		98.5Hz	37.7
Range		39–143	20–52
In semitones		7.5	6.0
Range		3.8–11.8	3.5–8.0

planned in advance but punctuated in their execution by the speaker's need to breathe in much more frequently than is normal.

Use of F0 for tonicity

The interruptions to rhythm brought about by MT's breath-intakes together with his intrusive stresses inevitably have a disruptive effect on intonational contours. Auditory analysis of his intonation shows, however, that there are no discourse-inappropriate nuclear tones, and acoustic analysis shows that the tones are realized with the kind of overall F0 excursions that would be expected, despite local disturbances due to breath-intakes. Because of his high F0, measurement in Hz makes his excursions seem large in comparison to the control speaker, but conversion to semitones normalizes for this difference in absolute frequencies. Table VIII presents Hz and semitone values for fourteen turn-final high falls, and seventeen turn-final low falls and compares them with my productions of the same utterances produced with the same tonicity. Falls were chosen because they are the most common turn-final tones in the data and posed fewer problems for F0 measurement. They were classed as high if there was a step-up to the start of the tone (Cruttenden, 1997: 50) and as low if there was not. In my productions and in those of MT the mean extent of the fall in F0 is greater for high falls than for low falls—8.4 semitones compared to 6.0 for myself, 10.4 compared to 7.5 for MT. The greater absolute extent of MT's falls may be due largely to the longer time it takes him to produce the syllables over which the nuclear tone is realized, i.e. the opposite effect to truncation. But the clear relative differences in extent of high and low falls indicate MT is able to appropriately use, and distinguish between, the two types.

Other discourse-appropriate uses of tones further supports the view that MT's prosodic competence, and thus his ability to plan his prosody, is not in question. An example is presented in Figure 6. The utterance is “*I suppose the main difficulty is || not being able to speak as clearly as I would like*”. It has a topic-comment (theme-rheme) structure in which the

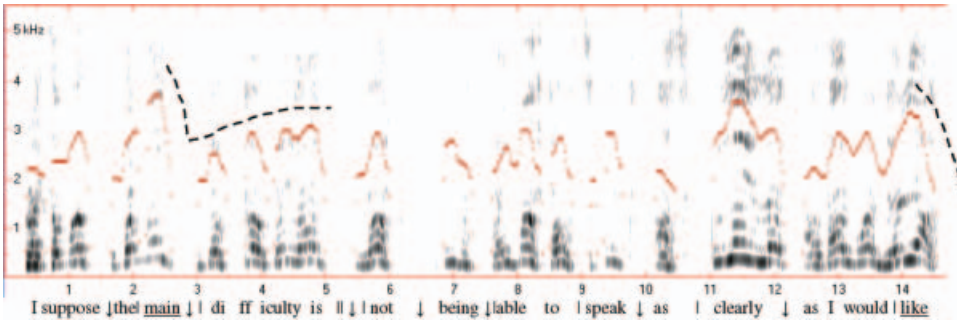


Figure 6. MT’s use of pitch to realize nuclear tones. Note the breath-pause after the falling part of the fall-rise tone.

topic occurs before the copula and the comment after it in the form of a non-finite object complement. It is structured in MT’s production into two intonation-groups with the boundary after “*is*”. A typical intonation pattern for topic-comment structures is a fall-rise on the topic if the speaker wishes to highlight it (Tench, 1996: 83–84), followed by a fall on the comment if it is sentence-final (Cruttenden, 1997: 91). This is exactly what MT does. The fall tone also appropriately signals the end of his turn. The overall F0 movement for the two nuclear tones is picked out with a dotted line over the pitch trace.

Placing the nuclear tone to begin on *main* is appropriate because this is new information in a narrow-focus intonation-group: the interviewer has just asked him what difficulties his speech problem presents him with. The comment part of the structure is a narrow-focus intonation-group in which the old information concerns the ability to speak and the new information his desire to speak clearly. The nuclear tone is expected to begin on the final major-class lexical item in the new information (Cruttenden, 1997: 80) which it does—the word “*like*”. The high fall rather than low fall is appropriate given his close involvement with the matter under discussion (Cruttenden, 1997: 97).

Only in two intonation-groups does MT interrupt the course of the nuclear tone with a breath-pause (lines 40 and 54). Both involve a fall-rise tone with the breath-pause coming after the falling part as in Figure 6 (also shown in Figure 7). The rising part begins after the breath-pause with the F0 at an appropriate frequency so that the phonetic cohesion of the fall-rise tone is maintained across the interruption. It would appear that in general MT

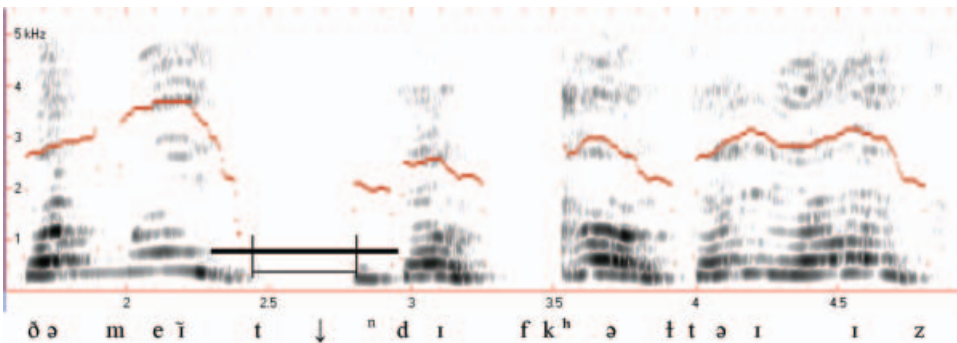


Figure 7. Velic action gesture interrupted intra-segmentally by a breath-pause. Duration of velic action gesture indicated by thick bar, the interruption by the line between the vertical strokes.

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successfully avoids disrupting the nuclear tone with breath-pauses and that when he fails to avoid it he nonetheless preserves the tone's phonetic identity, a fact that suggests the F₀ contour has been fully planned but the breath-pause has interrupted its execution.

Velic action

A noticeable feature of MT's speech is mistiming of velic action which sometimes causes a target plosive to be realized as a nasal, e.g. *did* > [dɪn], and sometimes target nasals to be realized as plosives, e.g. *being* > [bi:d], *I'm* > [aɪd], *in* > [ɪd]. A particularly interesting example occurs in his pronunciation of the phrase "the main difficulty" as [ðə | meɪt ↓ | ⁿdɪfɪk:^hətəɪ] (see Figure 7—part of the utterance in Figure 6 above).

The syllable rhyme of *main* is realized as [eɪt] with anticipatory nasalization of the vowel and a voiceless oral stop. Nasality re-appears in the form of pre-nasalization on the following /d/ of *difficulty* after a breath intake. Rather than describe this in terms of a complicated set of segmental substitutions involving two separate openings of the velopharyngeal port, it may be better to approach it from a gestural perspective and see it as one velic action gesture in the sense defined in articulatory phonology (Browman & Goldstein, 1989, 1992). The onset and offset of the gesture are at appropriate and expected points (see Figure 7) but there is an interruption because of the breath-intake. As with rhythm and the intonation contours of interrupted nuclear tones, the evidence is that the planning of the velic gesture made no concessions to MT's speech breathing problem which has affected only the execution of the gesture, not the gesture itself. In order to breathe in through his mouth, he closes the velopharyngeal port and opens the glottis, but he does so just before the alveolar articulation of the /n/ thus creating the conditions for a realization of /t/. The alveolar closure is then audibly released in order to allow oral inspiration after which the velopharyngeal port opens again to complete the realization of the nasal. The velic gesture has its expected place in the articulatory phonetic structure of the utterance but is interrupted by the basic need of the peripheral system to replenish its air supply as quickly as possible. According to Proctor (1980: 49), about five times as much air can be inspired orally per unit of time than can be taken in through the nose. It seems that MT values keeping the interruption as short as possible over keeping the nasal gesture continuous. If this is the motivation, and the fact that MT often flares his nostrils when inspiring air nasally within an intonation-group or close-knit sequence of intonation-groups suggests a deliberate attempt to breathe in quickly, then we have more evidence for regarding his communicative competence as intact, and for crediting him with the development of strategies to limit the damage to communication caused by his lack of fluency. Unless we know in this particular instance that the breath-intake was oral and not nasal, we cannot make much sense of the sequence of events in Figure 7. There is no transcription convention in the IPA or ExtIPA to differentiate nasal and oral breathing but in cases such as this it would be helpful. A suggestion is to place the nasalization diacritic over the downward/upward arrow to denote nasal breathing, e.g. [↓, ↑].

Realizations of /r/ and /l/

The English median approximant /r/ and lateral approximant /l/ belong to the general class of liquids which are known to be problematic for speakers with various different pathologies (Heselwood & Howard, 2002) as well as for children acquiring English (Grunwell, 1987: 225). Of these two liquids it is generally /r/ which causes the most difficulties, sometimes

indeed being realized as [l] by young children (Grunwell, 1987: 225). MT has a difficulty with the production of /r/ and with maintaining a clear phonetic distinction between /r/ and /l/. Although MT's difficulties with these sounds are not due to immaturity, it is interesting to note that certain classes of sounds seem to be problematic for speakers across a range of pathologies with very different etiologies, and liquids seem to form one such class.

All MT's realizations of /l/ are alveolar lateral approximants except for one in word-final position (*Liverpool*) which has a lateral approximant component but terminates in a voiceless plosive, i.e. [t̟]. The majority of his realizations of /r/ (16/23) are also alveolar lateral approximants thus raising the question of neutralization of the /l-r/ opposition. Clearly there is not *complete* neutralization, for while all realizations of /l/ are lateral, there are non-lateral as well as lateral realizations of /r/ thus testifying to the distinctiveness of the two liquids in his phonological system. But the distinctiveness is unidirectional (Hesekwood & McChrystal, 1999: 59–60) in which the set of realizations for /l/ are properly contained within the set of realizations for /r/ as modelled in the Venn diagram in Figure 8. The non-lateral realizations of /r/ establish that /r/ is distinct from /l/, but the lateral realizations of /r/ mean that we cannot establish that /l/ is similarly distinct from /r/. That is to say, within the data sample, a lateral token could be a realization of either, but a median token can only be a realization of /r/.

Despite the lack of a perceptual distinction between lateral realizations of /r/ and /l/, there is always the possibility of covert contrasts (Hewlett, 1988) where the speaker makes some systematic but subtle phonetic distinction between the realizations of two phonological categories, too subtle for listeners to detect. Acoustic analysis of MT's lateral tokens has failed to discover any systematic difference although it has to be accepted that not finding a difference is not a proof that no difference exists. Frequency values were taken of the four highest-amplitude spectral peaks above the F1 region for lateral realizations of /r/ and /l/ using FFT spectra (LPC spectra are not suited for sounds with anti-formants such as laterals (Johnson, 1997: 87)). In all cases there were peaks in the regions shown in Table IX and no pattern of difference could be observed that would serve to distinguish lateral /r/-tokens from lateral /l/-tokens. Figure 9 presents averaged FFT spectra of the lateral realizations of /l/ and /r/ in the phrase *English and history*. They do not show the kind of differences expected between /r/ and /l/; if anything, they tend in the opposite direction with a higher amplitude peak in the 3kHz region in the /r/-token. However, there is some evidence of differences in the vowel preceding the lateral. MT produces a vowel between the /g/ and /l/ of *English*, and between the /t/ and /r/ (realized as a lateral) of *history*. In *English* the vowel is of a mid-central schwa quality—[ɪŋgəɪ], but in *history* it is more back and rounded and diphthongized—[hɪst:ð̥ɪɪ]; the lengthened [t:] may be a deliberate delay to plan the realization of the /r/ including the epenthetic vowel. Its lower F2 resonance is appropriate for the /r/ target, and the same strategy can be seen in one of his

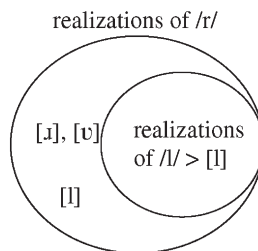


Figure 8. Venn diagram showing that the set of realizations of /r/ properly contains the set of realizations of /l/ and that therefore there is a unidirectional opposition.

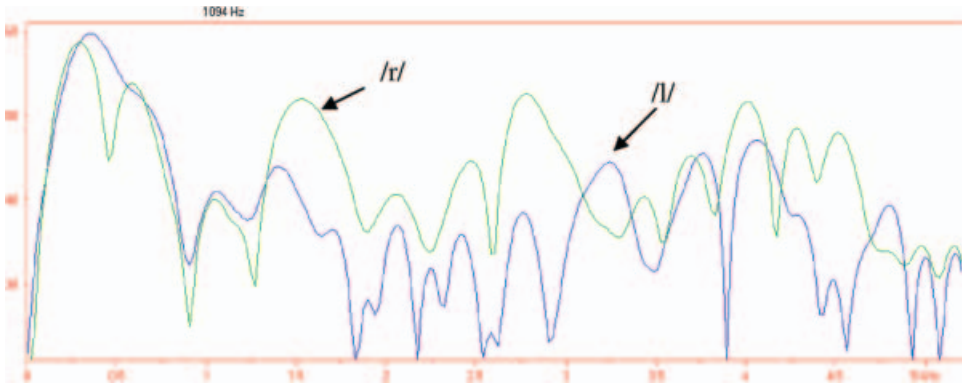


Figure 9. Averaged FFT spectra of lateral realizations of target /r/ and /l/ in *English* and *history*.

pronunciations of *try*—[tʰɔ̃ʊ'lae]. It is not a consistent strategy, however, although we should note that there are no [ɔ̃ʊ]-like vowels associated with realizations of /l/. There are epenthetic vowels in his pronunciations of *British*, *brain*, *friend* and *every* (assuming /'ɛvri/ as the target form) but they are of a schwa-like quality. There is no evidence of lexical vowel qualities being altered, e.g. in *very*. None the less, the “*history*” and “*try*” examples are suggestive that MT is attempting to maintain some kind of phonetic distinction between lateral realizations of /r/ and /l/ even if he more often than not fails to do so.

An interesting observation with theoretical implications is MT’s use of a lateral realization of /r/ for all four instances of so-called “linking /r/” as well as for twelve realizations of “lexical” /r/ (see Table IX). This supports the view argued in Heselwood (2006) that linking (and intrusive) /r/ in non-rhotic English is phonologically no different from word-internal /r/ and is in fact part of the phonological form of the word. If linking /r/ were merely a hiatus-breaker, as argued by a number of phonologists (e.g. Broadbent, 1991; Uffmann, 2003; Krämer, 2005), then it is difficult to explain why speakers use the same /r/-variant for linking /r/ as they use for word-internal /r/, especially when the variant in question is a highly unusual one as is the case with MT. The example reported in Ball, Lowry, and McInnis (2006) of a child from Louisiana having mostly non-rhotic speech but a linking /r/ of the same phonetic quality as his word-internal intervocalic /r/ provides further evidence for this argument.

Table IX. Realizations of /r/ and /l/: contexts, frequency of types, and spectral characteristics.

	/r/	/l/
	median n=7	lateral n=25
	[ɹ] 2, #_V (“ <i>rush</i> ”, “ <i>reading</i> ”)	[l] 24, all contexts
	[ɹ̥] 1, V_V (“ <i>century</i> ”, “ <i>haemorrhage</i> ”)	[l̥] 1, V_#
	[v] 2, 't_V (“ <i>Australian</i> ”, “ <i>try</i> ”)	
	[w] 1, 'g_V (“ <i>graduate</i> ” (v.))	
	[d] 1, 'V_V (“ <i>American</i> ”)	
		lateral n=16
		[l] 12 lexical /r/: 7, 'C_V (“ <i>British</i> ”, “ <i>brain</i> ”, “ <i>friend</i> ”, “ <i>try</i> ”, “ <i>every</i> ” × 3)
		3, 'V_V (“ <i>very</i> ” × 3)
		2, V_V (“ <i>history</i> ”, “ <i>Dewsbury</i> ”)
		4 linking /r/: 1, 'V_#V (“ <i>there as well</i> ”)
		3, V_#V (“ <i>for asking</i> ”, “ <i>for ages</i> ”, “ <i>or is it</i> ”)
peak c. 11–13kHz	yes	no
peak c. 14–16kHz	no	yes
peak c. 20–30kHz	no	yes
peak c. 30–40kHz	no	yes

Conclusion

The case presented is of a subject whose speech is quite severely unintelligible and dysfluent. The dysfluency is largely due to a slow speech rate resulting from frequent breath-pauses, slow articulator velocity and full-vowelling. The occurrence of breath-pauses not only at intonation-group boundaries but also within intonation-groups and within rhythm-groups adds considerably to the listener's overall impression of dysfluency. There are also problems with velic action and the accuracy of certain articulatory gestures such as those required for /r/. Rather than his disruptive breathing pattern being due to wastage of air through laryngeal hypovalving, the evidence from his phonatory behaviour and from his observed expirations is that he can only take in a relatively limited amount of air when breathing for speech, an amount which is simply not sufficient for sustaining talk longer than a few syllables.

Careful auditory and acoustic analysis suggest that MT has developed a range of strategies for managing at least some aspects of the problems his shallow breathing causes so as to minimize their deleterious effects on communication. They indicate that his speech planning is competent and that he tries to:

1. plan his breath intakes at rhythm-group boundaries;
2. suppress F₀ rises on intrusive stresses;
3. conserve air by using falsetto phonation to reduce volume velocity airflow;
4. breathe in quickly so as to continue speaking as soon as possible;
5. avoid breath-pauses in the domain of a nuclear tone;
6. preserve overall intonational contours across breath-pauses;
7. avoid breath-pauses within syllables and word-forms;
8. maintain the /l/-r/ contrast even when /r/ is realized as a lateral.

How far such strategies are successful is a matter for listeners to judge and is beyond the scope of this study, but they can be seen to be underpinned by a kind of phonetic "logic" or rationale motivated by the goal of successful communication. That is to say, the motivation behind MT's strategies is exactly that which may be behind all speech behaviour—to successfully transmit language in the face of the limitations of the speech production system, i.e. in non-optimal channel conditions. The difference in MT's case, and in the case generally of speakers with disorders, is that normal channel limitations are augmented by ones which are more severe and of a kind not faced by other members of the speech community. In the absence of collective solutions transmitted from generation to generation, such speakers have to come up with their own. The ability to do so is evidence of a kind of linguistic innovation not essentially different from Chomsky's "limitationist" notion of creativity (D'Agostino, 1986: 155–205) except that it is situated in the speaker's relationship with the constraints of the peripheral systems of speech production rather than the constraints of the cognitive structures responsible for the more abstract language system. It is a kind of creativity that perhaps deserves more attention from linguists than it has so far received, and may have played a key role in children's phonological development and the course of historical phonological change since spoken language first arose.

References

- Abercrombie, D. (1967). *Elements of general phonetics*. Edinburgh: Edinburgh University Press.
- Ackermann, H., & Hertrich, I. (1993). Dysarthria in Friedreich's ataxia: timing of speech segments. *Clinical Linguistics and Phonetics*, 7, 75–91.

- Auzou, P., Özsancak, C., Morris, R. J., Jan, M., Eustache, F., & Hannequin, D. (2000). Voice onset time in aphasia, apraxia of speech and dysarthria: a review. *Clinical Linguistics and Phonetics*, 14, 131–150.
- Ball, M. J., & Rahilly, J. (1999). *Phonetics, the science of speech*. London: Arnold.
- Ball, M. J., Code, C., Rahilly, J., & Hazlett, D. (1994). Non-segmental aspects of disordered speech: developments in transcription. *Clinical Linguistics and Phonetics*, 8, 67–83.
- Ball, M. J., Lowry, O., & McInnis, L. (2006). Distributional and stylistic variation in /r/-misarticulations: a case study. *Clinical Linguistics and Phonetics*, 20, 119–124.
- Bernhardt, B., & Ball, M. J. (1993). Characteristics of atypical speech currently not included in the Extensions to the IPA. *Journal of the International Phonetic Association*, 23, 35–38.
- Borden, G. J., Harris, K. S., & Raphael, L. (1994). *Speech science primer* (third edition). Philadelphia, PA: Williams & Wilkins.
- Broadbent, J. (1991). Linking and intrusive r in English. *Working Papers in Linguistics*, 3, 281–302. Department of Phonetics and Linguistics, University College, London.
- Browman, C. P., & Goldstein, L. (1989). Articulatory gestures as phonological units. *Phonology*, 6, 201–251.
- Browman, C. P., & Goldstein, L. (1992). Articulatory phonology: an overview. *Phonetica*, 49, 155–180.
- Catford, J. C. (1977). *Fundamental problems in phonetics*. Edinburgh: Edinburgh University Press.
- Cruttenden, A. (1997). *Intonation*. Cambridge: Cambridge University Press.
- D'Agostino, F. (1986). *Chomsky's system of ideas*. Oxford: Clarendon Press.
- Docherty, G. J. (1992). *The timing of obstruents in British English*. Berlin: Foris Publications.
- Duckworth, M., Allen, G., Hardcastle, W., & Ball, M. J. (1990). Extensions to the International Phonetic Alphabet for the transcription of atypical speech. *Clinical Linguistics and Phonetics*, 4, 273–280.
- Fuller, M. (1990). Pulmonic ingressive fricatives in Tsou. *Journal of the International Phonetic Association*, 20, 9–14.
- Garman, M. (1990). *Psycholinguistics*. Cambridge: Cambridge University Press.
- Gierut, J. A., & Champion, A. H. (2000). Ingressive substitutions: typical or atypical phonological pattern? *Clinical Linguistics and Phonetics*, 14, 603–617.
- Gimson, A. C. (1980). *An introduction to the pronunciation of English*, third edition. London: Arnold.
- Goldman-Eisler, F. (1968). *Psycholinguistics: experiments in spontaneous speech*. London: Academic Press.
- Gordon, M., & Ladefoged, P. (2001). Phonation types: a cross-linguistic overview. *Journal of Phonetics*, 29, 383–406.
- Grosjean, F., & Collins, M. (1979). Breathing, pausing and reading. *Phonetica*, 36, 98–114.
- Grunwell, P. (1987). *Clinical phonology*, second edition. London: Croom Helm.
- Hallidie-Smith, K. (1985). The heart. In D. Lane, & B. Stratford (Eds.), *Current approaches to Down's syndrome*. New York: Holt, Rinehart & Winston.
- Hardcastle, W. J., Barry, R. A. M., & Clark, C. J. (1985). Articulatory and voicing characteristics of adult dysarthric and verbal dyspraxic speakers: an instrumental study. *British Journal of Disorders of Communication*, 20, 249–270.
- Hayward, K. (2000). *Experimental phonetics*. London: Longman.
- Heselwood, B. (2006). Final schwa and R-sandhi in RP English. *Leeds Working Papers in Linguistics and Phonetics*, 11, 78–95.
- Heselwood, B. & Howard, S. (2002). The realisation of English liquids in impaired speech: A perceptual and instrumental study. In F. Windsor, L. M. Kelly, & N. Hewlett (Eds.), *Investigations in clinical linguistics and phonetics* (pp. 225–241). Mahwah, NJ: Lawrence Erlbaum Associates.
- Heselwood, B., & Howard, S. (forthcoming). Clinical phonetic transcription. In M. J. Ball, M. R. Perkins, N. Müller, & S. Howard (Eds.), *Handbook of clinical linguistics*. Oxford: Blackwell.
- Heselwood, B., & McCrystal, L. (1999). The effect of age-group and place of L1 acquisition on the realisation of Punjabi stop consonants in Bradford: an acoustic sociophonetic study. *Leeds Working Papers in Linguistics and Phonetics*, 7, 49–68.
- Heselwood, B., Bray, M., & Crookston, I. (1995). Juncture, rhythm and planning in the speech of an adult with Down's syndrome. *Clinical Linguistics and Phonetics*, 9, 121–137.
- Hewlett, N. (1988). Acoustic properties of /k/ and /t/ in normal and phonologically disordered speech. *Clinical Linguistics and Phonetics*, 2, 29–45.
- Hiot, J. D., Solomon, N. P., & Hixon, T. J. (1993). Effect of lung volume on voice onset time (VOT). *Journal of Speech and Hearing Research*, 36, 516–521.
- Hollien, H., & Michel, J. F. (1968). Vocal fry as a phonational register. *Journal of Speech and Hearing Research*, 11, 600–604.
- Huot, D., Ryalls, J., & Le Dorze, G. (1999). Production and perception of speech prosody in left- and right-brain-damaged adults. In B. Maassen, & P. Groenen (Eds.), *Pathologies of speech and language* (pp. 215–220). London: Whurr.

- Johnson, K. (1997). *Acoustic and auditory phonetics*. Cambridge, MA: Blackwell.
- Jones, D. (1972). *An outline of English phonetics*, ninth edition. Cambridge: Cambridge University Press.
- Jones, M. (2007). The initial voicing contrast in Barnsley English: a case study. Accessed 7 April 2007, available at: <http://kiri.ling.cam.ac.uk/Mark/Barnsley%20VOT.pdf>.
- Kelly, J., & Local, J. (1989). *Doing phonology*. Manchester: Manchester University Press.
- Krämer, M. (2005). English schwa insertion before liquids and phonological opacity. Accessed 9 November 2006, available at: <http://www.hum.uit.no/a/kraemer/mk%20cls41.pdf>.
- Ladefoged, P. (2003). *Phonetic data analysis*. Oxford: Blackwell.
- Ladefoged, P., & Zeitoun, E. (1993). Pulmonic ingressive phones do not occur in Tsou. *Journal of the International Phonetic Association*, 23, 13–15.
- Laver, J. (1980). *The phonetic description of voice quality*. Cambridge: Cambridge University Press.
- Laver, J. (1994). *Principles of phonetics*. Cambridge: Cambridge University Press.
- Li, Y. K. N., & Yiu, E. M.-L. (2006). Acoustic and perceptual analysis of modal and falsetto registers in females with dysphonia. *Clinical Phonetics and Linguistics*, 20, 463–481.
- Mowrer, D. E., & Fairbank, C. (1991). A case report of within-vowel glottal stop insertion in the speech of an adult male. *Journal of Fluency Disorders*, 16, 55–69.
- Mueller, P. B. (1971). Parkinson's disease: motor speech behaviour in a selected group of patients. *Folia Phoniatrica*, 23, 333–346.
- Müller, N., Damico, J. S., & Guendouzi, J. A. (2006). What is transcription, and why should we do it? In N. Müller (Ed.), *Multilayered transcription* (pp. 1–18). San Diego, CA: Plural Publishing.
- Nickerson, R. S. (1975). Characteristics of the speech of deaf persons. *Volta Review*, 77, 342–362.
- Nishio, M., & Niimi, S. (2001). Speaking rate and its components in dysarthric speakers. *Clinical Linguistics and Phonetics*, 15, 309–317.
- Proctor, D. F. (1980). *Breathing, speech, and song*. Vienna: Springer-Verlag.
- Putnam, A. H. B., & Hixon, T. J. (1984). Respiratory kinematics in speakers in motor neuron disease. In M. R. McNeil, J. C. Rosenbek, & A. Aronson (Eds.), *The dysarthrias: physiology-acoustics-perception-management* (pp. 37–67). San Diego, CA: College Hill Press.
- Robb, M. P., Maclagan, M. A., & Chen, Y. (2004). Speaking rates of American and New Zealand varieties of English. *Clinical Linguistics and Phonetics*, 18, 1–15.
- Shockey, L. (2003). *Sound patterns of spoken English*. Oxford: Blackwell.
- Tench, P. (1996). *The intonation systems of English*. London: Cassell.
- Till, J. A., & Alp, L. A. (1991). Aerodynamic and temporal measures of continuous speech in dysarthric speakers. In C. A. Moore, K. M. Yorkston, & D. R. Beukelman (Eds.), *Dysarthria and apraxia of speech: perspectives on management* (pp. 185–203). Baltimore: Paul H. Brooks.
- Uffmann, C. (2003). Intrusive [r] and optimal epenthetic consonants. Ms. University of Marburg. Accessed 9 November 2006, available at: <http://www.staff.uni-marburg.de/~uffmann/language-science.pdf>.
- Van Lancker, D., & Sidtis, J. (1992). The identification of affective-prosodic stimuli by left- and right-hemisphere-damaged subjects. *Journal of Speech and Hearing Research*, 35, 963–970.
- Volaitis, L. E., & Miller, J. L. (1992). Phonetic prototypes: influence of place of articulation and speaking rate on the internal structure of voicing categories. *Journal of the Acoustical Society of America*, 92, 723–735.
- Weismer, G. (1997). Motor speech disorders. In W. J. Hardcastle, & J. Laver (Eds.), *The Handbook of Phonetic Sciences* (pp. 191–219). Oxford: Blackwell.
- Weismer, G. (2006). Philosophy of research in motor speech disorders. *Clinical Linguistics and Phonetics*, 20, 315–549.
- Wells, J. C. (1982). *Accents of English*. Cambridge: Cambridge University Press.
- West, J. B. (2005). *Respiratory physiology*. Philadelphia, PA: Lippincott Williams & Wilkins.
- Ziegler, W. (2002). Task-related factors in oral motor control: speech and oral diadochokinesis in dysarthria and apraxia of speech. *Brain and Language*, 80, 556–575.

Appendix

Orthographic transcript of MT's utterances analysed into intonation-groups, rhythm-groups and breath-groups.

Key

↓ =intake of breath

↑ =audible exhalation

*=holding of breath

(. .)=pause without a breath intake

| =perceived rhythm group boundary

|| =intonation group boundary

{ } =a conversational turn

Underline=tonic syllable

...=uncompleted intonation group

?=uncertain item

Line No	Intonation group	No of syllables
01	{ Thanks for <u>asking</u> me }	5
02	{ I ↓ am a ↓ <u>work-</u> ↓ shy * <u>bum</u> }	6
03	↓ and I spend ↓ <u>most</u> of my time }	7
04	↓ lying <u>about</u> }	4
05	↓ doing <u>nothing</u> }	4
06	{ I ↓ used to be ↓ very keen ↓ on ↓ <u>music</u> }	10
07	↓ but ↓ since ↓ my ↓ <u>acci</u> dent }	6
08	↓ I - I can't ↓ play things like gui tar <u>play?</u> no more }	11
09	{ I ↓ used to ↓ be <u>very</u> keen }	7
10	↓ on ↓ an ↓ Aus <u>tralian</u> band }	7
11	↓ called ↓ the <u>Go-Be</u> tweens ↑ }	5
12	↓ But ↓ they're very ↓ ob <u>scure</u> }	7
13	{ the <u>Beatles</u> }	3
14	{ I haven't ↓ heard 'em for <u>ages</u> }	8
15	↓ but ↓ I would quite like to hear them a <u>gain</u> }	10
16	{ No I don't think so <u>no</u> }	6
17	{ I used to be ↓ <u>quite</u> keen }	6
18	on ↓ reading ↓ as <u>well</u> }	5
19	↓ but er that is something <u>else</u> }	7
20	↓ that is very difficult <u>now</u> }	8
21	{ Yes I sup <u>pose</u> so }	5
22	I was sup posed to be <u>doing</u> (.)	8
23	↓ English ↓ and ↓ <u>Histo</u> ry }	7
24	↓ but I didn't do a lot of <u>work</u> }	9
25	{ I think ↓ mainly ↓ the ↓ nineteenth ↓ and ↓ twentieth * <u>centuries</u> }	14
26	{ just british and a <u>merican</u> }	8
27	{ No I didn't <u>graduate</u> }	7
28	{ A lot of ↓ dead-end ↓ <u>jobs</u> }	6
29	{ Dead-end <u>jobs</u> }	3
30	{ <u>Dewsbu</u> ry }	3
31	{ I ↓ also lived in ↓ <u>Liverpool</u> for a long while }	12
32	{ Not having ↓ any <u>money</u> }	7
33	{ I <u>went</u> ↓ there }	3
34	↓ be cause my <u>friend</u> }	4

Line No	Intonation group	No of syllables
35	↓ was at ↓ uni <u>versity</u> there	8
36	↓ and we <u>went</u> there	4
37	↓ to be come ↓ <u>famous</u>	5
38	↓ but it didn't work <u>out</u> }	6
39	{ I ↓ speak ↓ like <u>this</u>	4
40	↓ be cause ↓ I ↓ had ↓ a <u>brain</u> ↓ haemorrhage	10
41	↓ a bout ↓ eighteen <u>months</u> a go }	7
42	{ Yes I <u>am</u>	3
43	now and a <u>gain</u> }	4
44	{ *I think ↓ it is ↓ every ...	7
45	↓ is it ↓ every two <u>week</u>	7
46	↓ or is it ↓ every <u>month</u> }	7
47	{ She ↓ told me ↓ to ↓ take my <u>time</u>	7
48	↓ and ↓ not ↓ <u>rush</u> ↑ things }	4
49	{ and ↓ try to <u>think</u> about	6
50	↓ what I want to <u>say</u> }	5
51	{ I t <u>ry</u> }	3
52	{ That is a good <u>question</u>	6
53	↓ I sup pose ...	3
54	↓ I sup pose ↓ the <u>main</u> ↓ difficulty is	9
55	↓ not ↓ being ↓ able to speak ↓ as clearly ↓ as I would <u>like</u> }	13
56	{ I don't think so <u>no</u> }	5
57	{ I'm ↓ quite ↓ keen on * <u>writing</u>	6
58	↓ so I do a lot of <u>that</u> }	7
59	{ I'm writing a <u>diary</u>	6
60	↓ and ↓ I'm also ↓ doing ↓ a course ↓ in ↓ <u>journalism</u> }	12
61	{ it is a corre <u>spondence</u> course }	8
62	{ quite a <u>lot</u> really }	5
63	{ but I'm a bit ↓ <u>lazy</u> }	6
64	{ Yes I <u>do</u>	3
65	↓ I quite ↓ like to go to the * <u>pub</u> }	8
66	{ And ↓ we ↓ go ↓ swimming ↓ every <u>week</u> }	9
67	{ Yes I do go there as <u>well</u> }	7
68	{ it is ↓ al <u>right</u> }	4
69	{ it is (.) ↓ just a local ↓ arts <u>group</u>	8
70	↓ but ↓ they are very <u>good</u>	6
71	↓ and quite am <u>bitious</u> }	5
72	{ Yes we <u>do</u> }	3
73	{ we ↓ also ↓ have been to ↓ Newcastle ↓ under <u>Lyme</u>	12
74	↓ a couple of <u>times</u> }	5
75	{ Yes we <u>do</u> }	3
76	{ what are you going to <u>see</u> }	6
77	{ I think I know ↓ the <u>film</u>	6
78	↓ is it (.) who's <u>in</u> it	5
79	↓ is it ↓ Kenneth <u>Moore</u> }	5
80	{ I've en <u>joyed</u> it }	4
81	{ Thank <u>you</u> }	2
	Mean	6.3