EXPRESSING THE INEXPRESSIBLE: A PHONETIC STUDY OF NONSTANDARD USE OF A DIACRITIC FOR VOICED OBSTRUENTS IN JAPANESE

Keiko Masuda

Chuo University, Tokyo, Japan
masuda@tamacc.chuo-u.ac.jp

ABSTRACT

This paper investigates the phonetic features of vowels with a diacritic for voiced obstruents (*dakuten*) in Japanese, which are phonologically and orthographically nonstandard but often observed recently in informal linguistic media. Recorded data of these vowels was analysed in terms of auditory impression, visual inspection, formant frequencies, phonation type, F0 and acoustic intensity. It was found that the production of /a/ with a *dakuten* exhibited positive spectral tilt in the low frequency range and lowering of F0, both of which are indicative of creaky voice. On the other hand, an increase in acoustic intensity, which has been claimed by some previous work, was not consistently observed in this analysis.

Keywords: nonmodal phonation, creaky voice, expressive speech, sound symbolism.

1. INTRODUCTION

A *dakuten* is a diacritic to mark voicing in the *kana* syllabary ([5]) and looks like two dots on the upper right corner of a *kana* (Figure 1). Properly speaking, a *dakuten* marks a voiced obstruent (/g, z, d, b/) ([2]).

Figure 1: Examples of words formed of *kana* without a *dakuten* and words formed of *kana* with a *dakuten*

か /ka/ (mosquito) が /ga/ (moth)

みそ /miso/ (soybean paste) みぞ /mizo/ (drain)

Because of its function, a *dakuten* should not be added to a vowel-only *kana* (i.e. あ /a/, い /i/, う /u/, え /e/, お /o/). In recent years, however, it has been observed that a *dakuten* is sometimes added to vowel-only *kana* in informal linguistic media particularly for young people, such as comic strips, subtitles used for TV comedy shows, personal websites and email and text messages. Vowels with a *dakuten* do not exist in the Japanese phonological or orthographic systems. Since vowels are already voiced and not obstruents, it is simply impossible for vowels to be altered by a *dakuten*. However, there seem to be some coherent ideas of what these nonexistent vowels should sound like. The aim of this paper is to investigate the phonetic features of vowels marked with a *dakuten*, which do not exist in theory but do seem to exist in some people's minds.

2. NONSTANDARD USE OF THE *DAKUTEN*

According to [4] and [3], the *dakuten* added to vowels is typically used for monosyllabic interjections. A *dakuten* is sometimes added to interjections beginning with a vowel and adds a negative and/or emphatic nuance. For instance, あっ (/aʔ/) is an interjection used to express surprise. あ゛っ (/aʔ/ with a *dakuten*) could therefore denote negative astonishment.

Although vowels with a *dakuten* (D-vowels, henceforth) cannot exist in theory, those who have seen and/or used these vowels in written texts seem to intuitively know what they should sound like. In [4], the informants state that D-vowels have certain phonetic features, typically using words which can be translated as 'loud', 'murmuring', 'faltering', 'groaning', 'shouting' and 'husky-voiced' to describe them. Similarly in [3], of the informants who have seen/used *dakuten* added to vowels, most say that D-vowels are louder and lower-pitched than vowels without a *dakuten* (non-D-vowels), and that they are pronounced 'from deep in the throat' or 'by narrowing the throat', by which they presumably mean laryngealised.

[4] attempted a brief analysis of D-vowels produced by her informant(s). She reported, without detailed data, that compared to non-D-vowels, D-vowels were pronounced more loudly, with strong aspiration and contained aperiodic waveforms.

3. EXPERIMENT

Recordings were made and analysed in order to investigate the phonetic features of D-vowels.

3.1. Subjects

Two of the informants in the survey in [3] who claimed they could actually produce D-vowels agreed to be recorded. They were both male native speakers of Japanese, who were university students aged around 20 at the time of the recording. It may be thought that two subjects are hardly sufficient to examine the general phonetic features of anything. It would indeed have been desirable to have more subjects, at least several more, for the recording, but unfortunately only these two were available this time. Given that the sounds are phonologically and orthographically nonstandard or even nonexistent, the informants might have felt unconfident about producing the sounds 'properly' even though they claimed they could in the survey.

3.2. Recording procedure

The subjects were left to choose whatever D-vowel(s) they wanted as long as they felt comfortable and confident in producing them and as long as the vowel(s) were one(s) they would use. They both chose /a/, and Subject 2 (S2) also chose to produce /e/ and /o/. They were asked to produce the vowel(s) without a *dakuten* several times first and then with a *dakuten* several times until they were sure that they successfully produced what they believed were the D-vowel(s). The productions were digitally recorded at a sampling rate of 16 kHz onto a Marantz Solid State Recorder PMD671 using an omni-directional condenser microphone in a sound-treated room. As Subject 1 (S1) only produced /a/, S2's productions of /e/ and /o/ were not used for analysis because they could not be compared with S1's productions and common phonetic features could not be examined. Three tokens of /a/ without a *dakuten* (/a/) and three tokens of /a/ with a *dakuten* (D-/a/) from each subject were used.

3.3. Analysis

The recorded data was analysed in terms of (1) auditory impression and visual inspection, (2) phonation type, (3) formant frequencies, (4) F0, and (5) acoustic intensity. The values for (2) to (5) reported below were taken at the midpoint of the duration of the production.

4. RESULTS AND DISCUSSION

4.1. Auditory impression and visual inspection

All three productions of D-/a/ by each subject sound distinctly lower than those of /a/. The productions of D-/a/ also sound laryngealised and give the impression of harshness.

As shown in Figure 2, the spectrograms of the productions of /a/ by S1 have some degree of breathiness. The spectrograms of the productions of D-/a/ by S1, on the other hand, exhibit vertical striations particularly at the beginning of the vowels (Figure 3), which could mean there is creakiness at least at the beginning. There is more energy at higher frequencies in the productions of D-/a/ than those of /a/.

The productions by S2 show less clear contrasts between /a/ and D-/a/ than those by S1. The most clearly visible difference in the productions by S2 is the existence of more energy at higher frequencies (above 5000 Hz) in the productions of D-/a/.

Figure 2: Spectrogram of /a/ produced by S1.

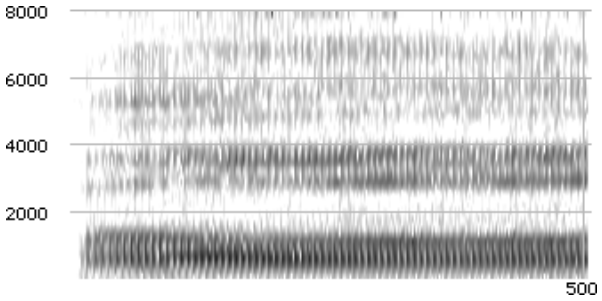
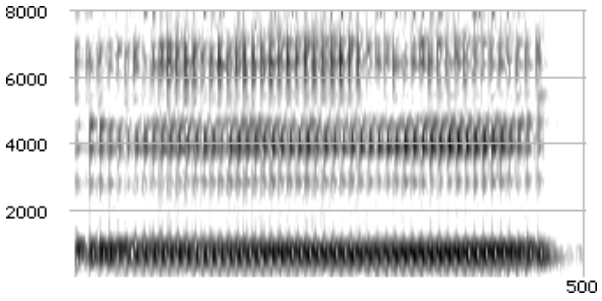


Figure 3: Spectrogram of D-/a/ by S1.

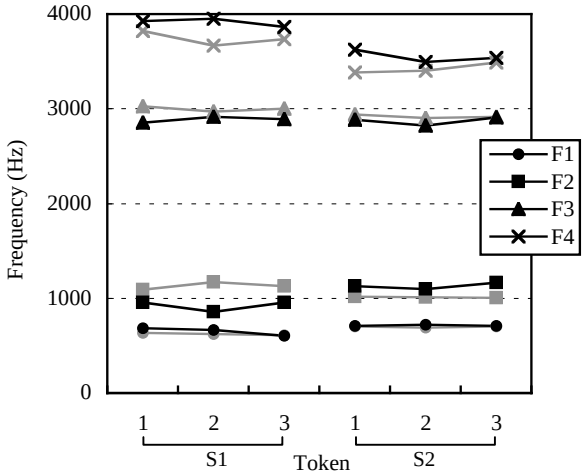


4.2. Formant frequencies

Measuring formants does not reveal any common tendencies in the productions by the two subjects (Figure 4). Comparing the productions of /a/ and D-/a/ made by the same subject, the productions of D-/a/ by S1 have lower F2 and F3 and higher F4 than those of /a/. On the other hand, the

productions of D-/a/ by S2 have higher F2 and F4 than those of /a/.

Figure 4: Formants of /a/ (in grey) and D-/a/ (in black) produced by S1 (left) and S2 (right).



4.3. Phonation type

According to [1], one major acoustic parameter to differentiate phonation types is spectral tilt, the value of which can be defined by subtracting the amplitude of the fundamental frequency (F0) from that of higher harmonics such as the second harmonic (H2) or the harmonic closest to the first formant (f1, as indicated in Figure 5 and Figure 6). Spectral tilt values are the greatest for creaky vowels, the smallest for breathy vowels, and intermediate for modal vowels.

Figure 5: FFT spectra of /a/ produced by S1.

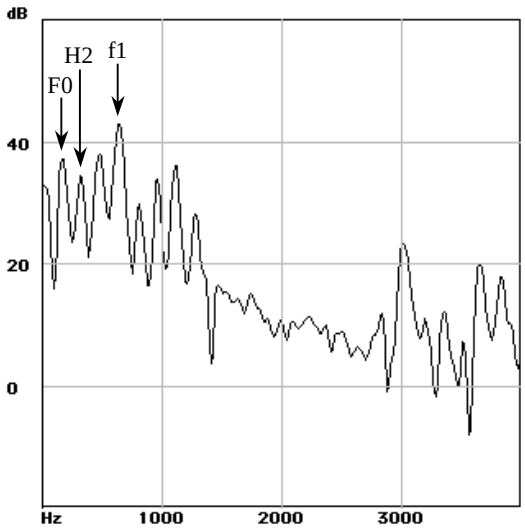
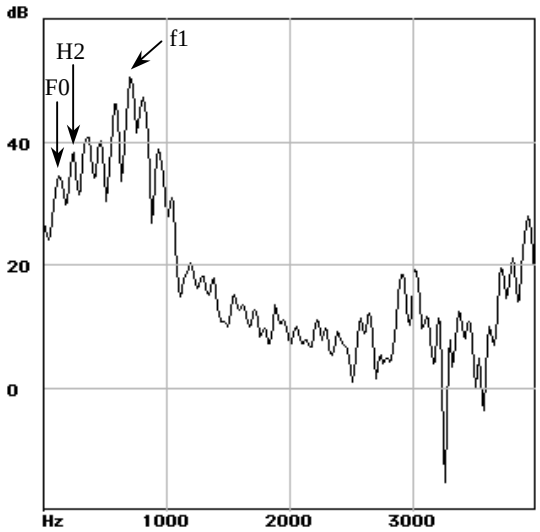


Figure 6: FFT spectra of D-/a/ produced by S1.

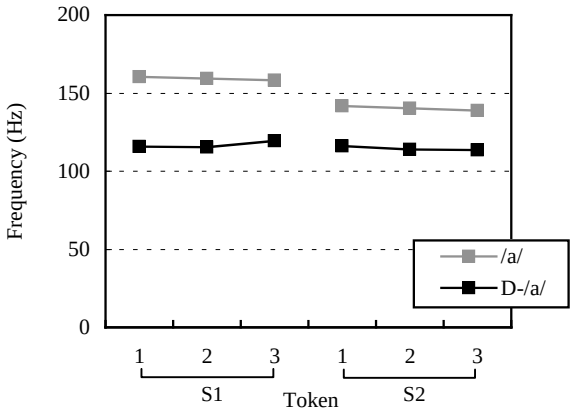


While the production of /a/ by S1 exhibits negative spectral tilt for H2-F0 and positive tilt for f1-F0 (Figure 5), the production of D-/a/ shows positive spectral tilt for both H2-F0 and f1-F0 (Figure 6), which could indicate that the production of D-/a/ has more creakiness than that of /a/. This observation holds true for the other productions by S1 and the productions by S2 although the difference is less clear in the case of S2.

4.4. F0

A consistent difference common to both subjects can be observed in the fundamental frequency. In both subjects' productions, D-/a/ has lower F0 than /a/ (Figure 7).

Figure 7: F0 of /a/ (in grey) and D-/a/ (in black) produced by S1 (left) and S2 (right).



The difference is greater in the productions by S1 than in those by S2, the latter also showing less clear difference between /a/ and D-/a/ in other

parameters. A lowering of F0 commonly happens in nonmodal phonation types such as breathy voice and creaky voice in many of the languages where there is a phonological contrast between modal and nonmodal, although it is less common in creaky voice ([1]).

4.5. Acoustic intensity

[4] reports that D-vowels were pronounced with greater acoustic intensity than non-D-vowels, and in [3] some informants claimed that they believed D-vowels were higher in amplitude. However, the productions of neither subject in this experiment exhibit a clear and consistent difference in acoustic intensity (Table 1), which could have been affected by the distance between the subjects and the microphone. The average values may give the impression that the productions of D-/a/ have greater intensity in the case of both subjects. However, the average may not be a representative value in this case because the average value of the productions of D-/a/ by S2 seems heavily affected by Token 1, which has much greater acoustic intensity than the other two productions.

Table 1: Acoustic intensity of the productions of /a/ and D-/a/ in decibels (dB) produced by S1 and S2.

		/a/	D-/a/
S1	Token 1	42.2	48.4
	Token 2	46.3	51.2
	Token 3	49.2	42.9
	Average	**45.9**	**47.5**
S2	Token 1	42.7	79.0
	Token 2	48.9	44.6
	Token 3	46.7	39.0
	Average	**46.1**	**54.2**

[1] points out that creakiness 'triggers a reduction in acoustic intensity (relative to modal phonation)'. If this result suggests the productions of /a/ and those of D-/a/ were not very different in terms of acoustic intensity, it could be hypothesised that D-/a/ may indeed have been produced louder. The productions of D-/a/ were not consistently louder than those of /a/, but they could have been louder than simple creaky-voiced /a/ would have been. This may suggest that a *dakuten* adds extra semantic information which helps increase acoustic intensity.

It should be mentioned that the result might have been different if the subjects had produced /a/ and D-/a/ alternately, which would probably have led them to contrast the vowels more clearly. As noted in 3.2, they first produced /a/ several times, and then D-/a/ several times. This might have made it difficult for them to contrast the two vowels.

5. CONCLUSION

This analysis of recorded productions of /a/ with a *dakuten*, a phonologically and orthographically nonstandard sound, by two subjects reveals that the common phonetic features of the sound in both subjects' productions are positive spectral tilt in the low frequency range and lowering of F0. These features, together with the visual inspection, suggest that the productions may be creaky-voiced. This supports the results of the survey by [3], in which the informants claimed that they believed vowels with a *dakuten* were lower-pitched than those without, and that they were pronounced 'from deep in the throat' or 'by narrowing the throat' (probably laryngealised).

On the other hand, an increase in acoustic intensity, as reported by [4] and claimed by some informants in [3], was not consistently observed in this experiment. Perhaps /a/ with a *dakuten* is not particularly great in acoustic intensity or possibly a different recording method might have produced a result more in line with the previous findings.

Although the number of subjects used for analysis was very limited, the analysis demonstrated the possibility that vowels with a *dakuten* may be produced in a low-pitched creaky voice.

6. REFERENCES

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