

The Prosodic Features of the Mandarin Discourse Marker *Nibuzhidao* under Different Functions

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Keywords: *nibuzhidao*, prosody, function

Abstract: This study examines the prosodic features of a Mandarin discourse marker *nibuzhidao* under different functions. The result reveals that four types of *nibuzhidao* have differences in acoustic features, including pause, pitch accent, speed and mean pitch. It could be concluded that there is close correspondence between functions and prosody.

1. Introduction

With the development of speech technology, more and more researchers study prosody using phonetic experiments. Especially in the age of rapid progress of artificial intelligence, prosody study has gained an important practical significance, that is, to provide prosodic guidance for speech synthesis.

In the area of prosody study, the relationship between functions and prosody is a hot research topic. Studies have shown that the prosodic features of discourse are restricted by their functions and the functions can be realized by their prosodic features to some extent [1]. However, within the field of discourse markers, such studies are lacking, although discourse markers have been proved to be multifunctional [2]. This study will take the discourse marker *nibuzhidao* ‘you don’t know’ as an object to examine its prosodic features under different functions.

2. Object

In this study, we aim to explore correspondence between the prosody of *nibuzhidao* and its functions. The functions of a discourse marker can be generally divided into two categories which are lexical functions and discourse functions [2], and *nibuzhidao* is no exception. We remark the former as *nibuzhidao1* and the latter as *nibuzhidao2*. By further dividing, *nibuzhidao1* can be classified into two subtypes, remarked as *nibuzhidao1.1* and *nibuzhidao1.2* respectively. Similarly, *nibuzhidao2* can also be categorized into two subclasses, called *nibuzhidao2.1* and *nibuzhidao2.2* respectively.

2.1 *Nibuzhidao1*

2.1.1 *Nibuzhidao1.1*

Nibuzhidao1.1 is a subject-predicate phrase composed of a second personal pronoun *ni* ‘you’, a negative word *bu* ‘don’t’ and a verb *zhidao* ‘know’. It can be located before or after an object, or exist even without an object. For example,

(1) Ni bu zhi dao ta lai le.

You don’t know he is coming.

2.1.2 *Nibuzhidao1.2*

Nibuzhidao1.2 has strong subjective atmosphere, so it is mainly used to express exclamation. It is usually located at the beginning of a sentence. For example,

(2) Ni bu zhi dao WO you duo kai xin!

You don’t know how happy I am!

2.2 Nibuzhidao2

2.2.1 Nibuzhidao2.1

Nibuzhidao2.1 is placed at the initial position of a discourse turn. It possesses the turn-opening function. For example,

(1) Ni bu zhi dao, bei jing de dong tian ke leng le.

*You don't know, the winter in Beijing is so cold.

2.2.2 Nibuzhidao2.2

Nibuzhidao2.2 is situated at the middle of a turn, functioning as a turn-holding marker. For example,

(2) Wo zuo tian jian dao xiao hong le, ni bu zhi dao, ta xian zai ke piao liang la!

*I met Hong yesterday, you don't know, she is so pretty now!

3. Methods

3.1 Corpus

The corpus we use is *Media Language Corpus* established by Communication University of China [3]. The retrieval ranges are three TV programs called *A Date with Lu Yu* (hereinafter referred to as *ADLY*), *Behind the Headlines with Wen Tao* (*BHWT*) and *Xiang Yue* (*XY*), respectively. Totally, we find 314 *nibuzhidao* in 264 texts. The specific data are shown in Table 1, where M stands for male, and F for female.

Due to the lack of data on female speech, we only study male speech data. For *nibuzhidao1.1*, we randomly select 30 tokens as experimental samples. For *nibuzhidao1.2*, *nibuzhidao2.1* and *nibuzhidao2.2*, whose tokens are less than 30, we select all of their tokens. In all, the total experimental samples in this study are 30 *nibuzhidao1.1*, 7 *nibuzhidao1.2*, 9 *nibuzhidao2.1* and 11 *nibuzhidao2.2*.

3.2 Acoustic Analysis

The audio files are saved in WAV format using 16 kHz sampling rate. The acoustic features we measure are pause, pitch accent, speed and mean pitch, using Praat, a speech analysis software. Pause is the silent part of speech [4]. It appears as a blank in a sound wave. The pause we measure here is the time duration of the blank between *nibuzhidao* and the units after it. Pitch accent is the prominence of a syllable by pitch change [5]. It is reflected in the fundamental frequency contour as a sudden pitch change in a short time. Speed is the number of syllables spoken per unit time. Mean pitch is the average value of the pitch of each syllable in a unit.

After acoustic analysis, we draw the figures showing the acoustic features using Praat. Each figure contains five types of information, which are, from top to bottom, a fundamental frequency curve, a sound wave, a sentence, mean pitch and sound length. When labeling units of a sentence, we label *nibuzhidao* as *nbzd* because of the lack of adequate space. The figures are shown in the following section.

4. Results

4.1 The Prosodic Features of Nibuzhidao1

4.1.1 The prosodic features of nibuzhidao1.1

We use the following examples to illustrate the prosody of *nibuzhidao1.1*.

(1) Ni bu zhi dao ren jia zhen you hai shi mei you a. (*BHWT*, 20090922)

You don't know if he really has.

(2) Ni bu zhi dao yi ge shen me xing xiang, "guang dang" jiu huo le. (*BHWT*, 20090313)

Someone you don't know becomes famous suddenly.

Table 1. The Appearing Times of Four Kinds of Nibuzhidao

	Nibu zhidao1				Nibu zhidao2			
	<i>Nibu zhidao1.1</i>		<i>Nibu zhidao1.2</i>		<i>Nibu zhidao2.1</i>		<i>Nibu zhidao2.2</i>	
	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>
times	240	44	7	0	9	2	11	1

(3) Ni bu zhi dao ni shi shei. (ADLY, 20121214)

You don't know who you are.

First, the pitch accent is often on *bu* or *zhidao*. We can clearly see this phenomenon from Fig.1 in which the pitch range of *zhidao* is wider than the other units'. In 30 samples with this function, 16 samples have pitch accents, among which 13 samples' accents are on *bu* or *zhidao*, occupying 81.3%.

Second, there is usually no pause between *nibuzhidao1.1* and the object after it. In 22 samples with objects, there is no pause except for 1 sample, accounting for 95.5%.

Next, the relationship of speed shows no inclination between *nibuzhidao1.1* and the object after it. There are 19 samples (63.3%) whose speed of *nibuzhidao1.1* is faster and the other 11 samples (36.7%) own the opposite results. We can see this difference in example 6 and example 7. In example 6 shown in Fig.2, the speed of *nibuzhidao1.1* is 5.33 syllables per second, slower than that of the other units, which is 6.18 syllables per second. But in example 7 shown in Fig.3, the speed of *nibuzhidao1.1* is 8.16 syllables per second, faster than that of the other units, which is 5.56 syllables per second.

What's more, the mean pitch of *nibuzhidao1.1* is prone to be higher than the other units', except in only 2 samples. For example, the mean pitch of *nibuzhidao1.1* in example 6 is 271Hz, significantly higher than the other units' which is 191Hz.

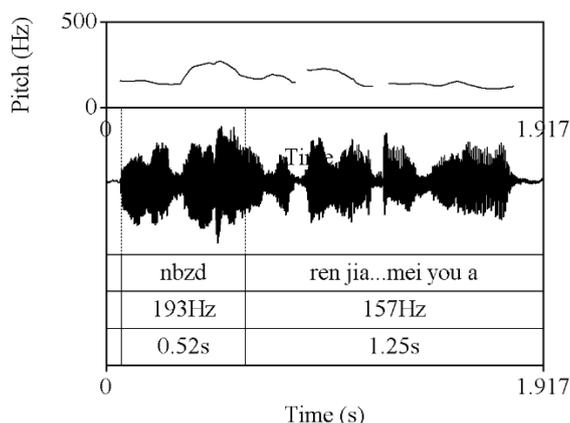


Figure 1. The prosodic features of example 5

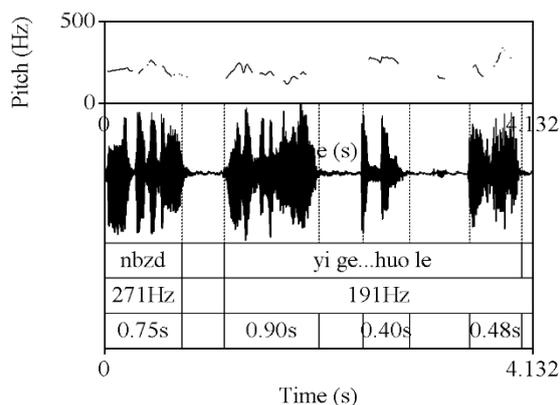


Figure 2. The prosodic features of example 6

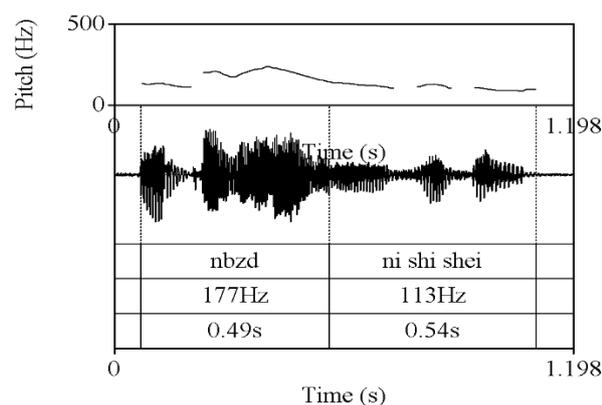


Figure 3. The prosodic features of example 7

4.1.2 The prosodic features of *nibuzhidao1.2*

We use the following examples to illustrate the prosody of *nibuzhidao1.2*.

(1) Ni bu zhi dao zhe ge dian hua dui ta you duo zhong yao! (BHWT, 20090818)

You don't know how important the call is to him!

(2) Ni bu zhi dao na dui yi ge nv ren lai shuo shi duo me de e xin, duo me de nan shou! (BHWT, 20090508)

You don't know how nasty the affair is to a woman.

According to the data we analyse, all 7 samples show strong tendencies in pause, pitch accent and speed.

Firstly, like *nibuzhidao1.1*, there is no pause between *nibuzhidao1.2* and the clause attached to it for the reason that *nibuzhidao1* owns lexical meaning, although the meaning of *nibuzhidao1.2* has been weakened. We can see this characteristic from Fig.4 in which the *nibuzhidao1.2* in example 8 is closely connected with neighboring utterances.

Secondly, the pitch accent of a sentence is on the unit of the clause behind *nibuzhidao1.2*. For instance, the pitch accent of example 8 is obviously not on *nibuzhidao1.2*.

What's more, the speed of *nibuzhidao1.2* is faster than the other units'. Just like the data displayed in Fig.5, the speed of *nibuzhidao1.2* (7.14 syllables per second) is faster than that of the other units (5.35 syllables per second) in example 9.

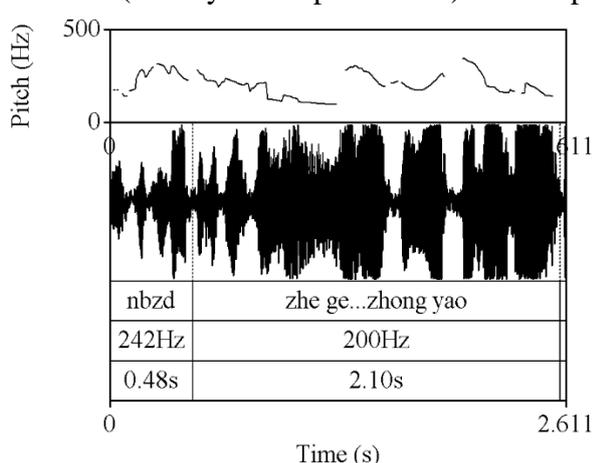


Figure 4. The prosodic features of example 8

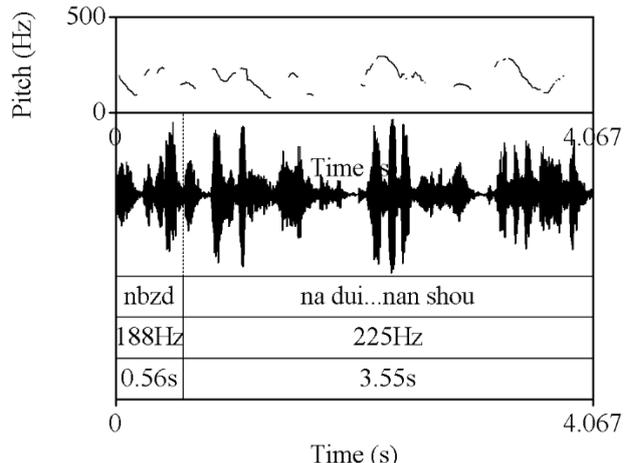


Figure 5. The prosodic features of example 9

In terms of the relative relationship of mean pitch between *nibuzhidao1.2* and the other units, there is no significant tendency on whose mean pitch is higher or lower. In 4 samples, the mean pitch of *nibuzhidao1.2* is higher, accounting for 57.1%. For instance, in example 8, the mean pitch of *nibuzhidao1.2* is 242Hz, higher than that of the other units which is 200Hz. However, in other 3 samples, the results are opposite. Take example 9 as an instance where we can see that the mean pitch of *nibuzhidao1.2* which is 188Hz is lower than the other units' which is 225Hz.

4.2 The Prosodic Features of *Nibuzhidao2*

4.2.1 The prosodic features of *nibuzhidao2.1*

We use the following examples to illustrate the prosody of *nibuzhidao2.1*.

(1) Ni bu zhi dao, wo shi tie tou gong. (XY, 20120302)

*You don't know, I have headbutt.

Firstly, the speed of *nibuzhidao2.1* is faster than the other units'. As is shown in Fig.6, the speed of *nibuzhidao2.1* (6.06 syllables per second) in example 10 is faster than that of the other units (2.63 syllables per second).

In the second place, there tends to be a pause between *nibuzhidao2.1* and the other units behind it. In 9 samples of *nibuzhidao2.1*, 8 samples accord with this tendency, occupying 88.9%.

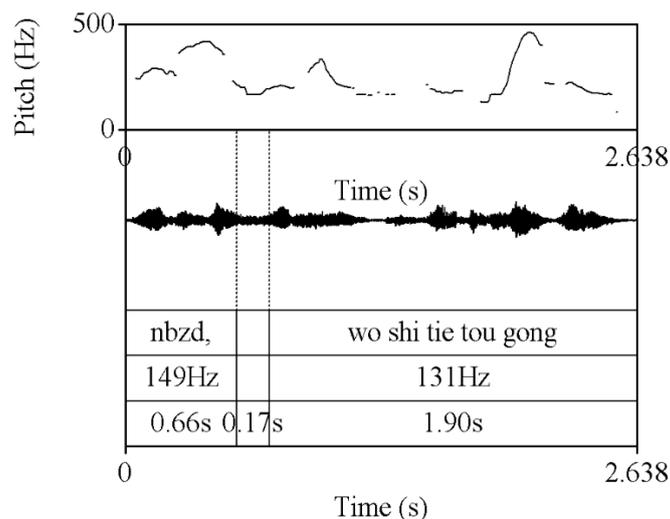


Figure 6. The prosodic features of example 10

In the next place, the pitch accent is not on *nibuzhidao2.1*. For instance, the pitch accent of example 10 is on the noun ‘head’.

What’s more, the mean pitch of *nibuzhidao2.1* tends to be higher than that of the other units. In 9 samples, 6 samples are consistent with this tendency. We can also see it from example 10 where the mean pitch of *nibuzhidao2.1* is 149Hz, higher than that of the other units, which is 131Hz.

4.2.2 The prosodic features of *nibuzhidao2.2*

We use the following example to illustrate the prosody of *nibuzhidao2.2*.

(1) Qi shi hen jian dan, ni bu zhi dao shi wu shi nian dai na shi hou qiang bi di zhu, tai shang xuan bu zui xing ma shang zhi xing, tong chang zai yi ge xiao shi zhi nei jiu beng le. (BHWT, 20090425)

*In fact, it’s so easy. You don’t know in the 50s, the shooting would be executed rapidly within one hour after the landlord’s crime is sentenced and announced.

Nibuzhidao2.2 owns the same prosodic features with *nibuzhidao2.1* in speed and pitch accent which are determined by the essential characteristic of discourse markers that they lack truth value meaning.

But as for pause and mean pitch, *nibuzhidao2.2* shows differences from *nibuzhidao2.1*.

First of all, there is no obvious tendency in pause. In 11 samples, there are 5 samples having a pause and the other 6 do not have, such as example 11 which is shown in Fig.7. This finding challenges the traditional opinion that discourse markers are usually independent of neighboring discourse components [6]. In fact, this phonetic experiment tells us that discourse markers can also be grouped with the following units.

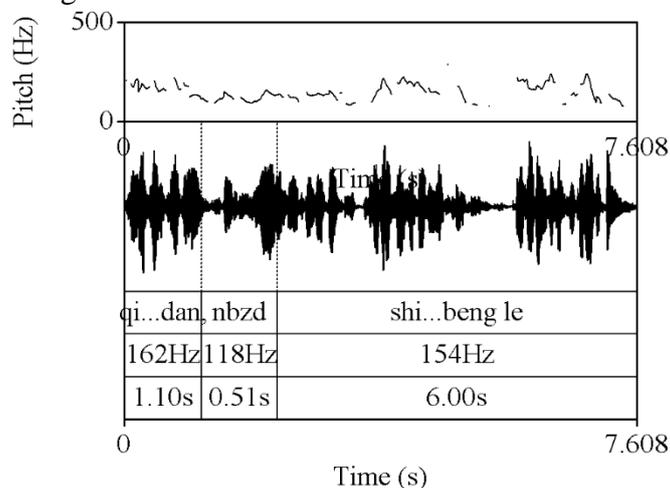


Figure 7. The prosodic features of example 11

Moreover, the mean pitch of *nibuzhidao2.2* tends to be lower than that of the other units. In 7 samples of all 11 samples, the mean pitch of *nibuzhidao2.2* are in line with this tendentiousness. We can also observe it from example 11 that the mean pitch of the *nibuzhidao2.2* is 118Hz, lower than that of the other units, which is 158Hz.

5. Conclusion

It could be concluded from above results that there is close correspondence between prosody and functions of the discourse marker *nibuzhidao*. In regard to pause, there tends to be no pause between *nibuzhidao* and the units behind it when it comes to *nibuzhidao1*. But behind *nibuzhidao2.1*, there tends to be a pause, while there is no obvious tendentiousness when it comes to *nibuzhidao2.2*. In terms of pitch accent, the pitch accent of *nibuzhidao1.1* is always on *bu* or *zhidao*, while that of *nibuzhidao1.2* and *nibuzhidao2* is on the other units. With respect to speed, the speed of *nibuzhidao1.2* and *nibuzhidao2* tends to be faster than the other units'. But the relationship of speed between *nibuzhidao1.1* and the other units has no apparent tendency on whose speed is faster or slower. Finally, the mean pitch of *nibuzhidao1.1* tends to be higher than the other units', whereas *nibuzhidao1.2* and *nibuzhidao2* can choose their pitch relative to the other components in an utterance according to different needs.

6. Discussion

At present, one important issue for artificial intelligence, especially its speech interface, is how to make the robot speech more natural, emotional and humanlike, whose key is to grasp the rules of prosody. However, most of speech synthesis systems today integrate prosody inadequately. One of the reasons is that they avoid discourse prosody which is significant to the naturalness of speech [7]. Na Hu et al. [7] proved that discourse prosody in relation to discourse structure can improve the naturalness of synthesis speech by modifying the conventional HMM-based speech synthesis with two discourse prosodic measures. Studies showing the correspondent patterns between prosody and functions on discourse markers provide another direction for the integration of discourse prosody into speech synthesis.

The research we carry out is a preliminary study on the relationship between functions and prosody. More in-depth research is required. Furthermore, the question that whether the reference to discourse functions in synthesized prosody would make speech more natural should be examined in the next step.

Acknowledgements

This paper is sponsored by the youth program of social science foundation of Ministry of Education of China (16YJC740065).

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