

EMPIRICAL APPROACHES TO FUKUOKA JAPANESE WH PROSODY

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1 Introduction

The intonation of an utterance often depends on its syntactic structure. In other words, syntax can influence phonology. However, the mechanisms by which this occurs, and the kinds of syntactic information that are available to the phonology, are matters of current debate.

One testing ground for these questions has been the wh prosody/scope correlation in Japanese. In the Tokyo dialect, main-clause wh scope tends to correlate with main-clause wh prosody, while embedded-clause wh scope tends to correlate with embedded-clause wh prosody (see, e.g., Deguchi and Kitagawa 2002; Ishihara 2002, 2007; Hirotsu 2005). A similar finding has also been reported for the Fukuoka dialect (Hayata 1985; Kubo 1989 et seq.), but has been investigated largely through introspective judgments and with older speakers.

This paper describes an empirical investigation of wh prosody in young-adult Fukuoka Japanese speakers, confirming that certain patterns described in previous research do occur in the productions of at least some younger, linguistically naive speakers. An overview of Fukuoka intonation is given in §2. The experimental design and methodology are presented in §3, followed by the results of analyses exploring accent deletion in the wh domain (§4) and the relationship between wh prosody and wh scope (§5). Evidence is found for both accent deletion and a prosody/scope correlation, as predicted by Kubo's descriptions, although the results show a certain amount of variation both within and between speakers.

2 Fukuoka Japanese wh prosody

2.1 Background

The basic description of pitch accent and intonation in Fukuoka Japanese is as follows (Kubo 1989 et seq.; see also Hayata 1985). Aside from wh constructions, the overall system resembles

that of Tokyo, although the accent of individual lexical items often differs between the dialects. In Fukuoka, nouns may be accented or unaccented, while all verbs and adjectives are accented (except in certain deaccenting contexts). Accent is realized as a pitch fall from high to low. A phrase (usually) begins low; a phrase with no accents surfaces with high, gradually falling tone.

According to Kubo's and Hayata's descriptions, a special intonation pattern appears in wh questions and related constructions. A "high flat tone" is initiated by the wh element and lasts until the end of the matrix clause, for matrix wh scope, or until the end of the embedded clause, for embedded wh scope. Kubo (2001, 2005) gives the following phonological analysis of this basic wh pattern: The wh element triggers *accent deletion* on all words inside the wh prosody domain, and the extent of this domain *correlates with the scope* of the wh element; i.e., it begins at the wh element and ends at the associated complementizer (C_[+wh]). If the C_[+wh] is null and sentence-final, the span between the wh element and this C is realized as one single unaccented phrase. Otherwise (as in the case of an embedded C_[+wh]), a default accent is inserted on the penultimate mora of the wh domain, but the wh-C span contains no other accents. In either case, the long stretch with no pitch accents is what creates the characteristic wh "high flat tone."

The surface realization of the wh-prosody domain in Fukuoka is therefore very different from that in Tokyo, which involves a span of *low* pitch, arguably an instance of post-focus pitch reduction (Deguchi & Kitagawa 2002; Ishihara 2002, 2007).

2.2 Testing Kubo's generalizations

Kubo's (1989 et seq.) generalizations about Fukuoka wh prosody are based on introspective judgments, supplemented by consultation with speakers in a similar age range (born in the 1950s or 1960s). However, introspective judgments about sentence-level intonation are notoriously tricky. Moreover, Hayata (1985) discusses a significant change in the phonetics of accent that distinguishes his elderly speakers (born between 1896 and 1926) from his speakers of Kubo's generation. Therefore, it is of interest to determine whether the generalizations about Fukuoka wh prosody laid out in Kubo's work can be replicated in an empirical study with linguistically naive young-adult native speakers, born in the 1980s and 1990s.

In this paper, two of Kubo's crucial basic generalizations are investigated: whether there is accent deletion in lexically accented nouns that intervene between a wh element and its associated complementizer (§4), and whether there is a correlation between wh scope and the domain of wh prosody (§5). It is found that some young-adult speakers do exhibit accent deletion and wh prosody/scope correlations. Another result is that, while some came very close, no speaker in the study produced dialect-typical prosody for every wh utterance; this finding may reflect the effects of exposure to Tokyo or other dialects of Japanese.

3 Experiment design

3.1 Participants

Participants in the study were twelve¹ undergraduate students recruited at the Hakozaki campus of Kyushu University in Fukuoka City, all of whom identified themselves as native Fukuoka-

¹Participant code numbers are not consecutive because two additional speakers, S06 and S13, participated only in a study whose results are not reported here.

dialect speakers who use that dialect frequently at home and among close friends. They each received a nominal payment for their participation. Eleven of the twelve speakers were female; the only male participant was speaker S14.

All twelve speakers were born and raised in the eastern half of Fukuoka Prefecture. Five participants were from Fukuoka City proper: speakers S01, S04, S05, S07, and S12. Four participants were from areas to the north of Fukuoka City, along the coast or slightly inland: S02 (Munakata), S03 (Kasuya District), S10 (Fukutsu), and S11 (Hisayama). Three participants were from areas to the south of Fukuoka City, along the border with Saga Prefecture: S08, S09 (both from Ogoori), and S14 (Ookawa). S14, the only male participant, was also the one whose place of origin was the most distant from central Fukuoka City. As discussed below, S14 was one of the four participants whose results from the accent deletion analysis served to disqualify him from inclusion in the prosody/scope correlation analysis. However, the other three disqualified participants were northern residents S02 and S03 and Fukuoka City resident S04, so there does not seem to be a strong relationship between place of origin and low incidence of accent deletion among the study participants.

3.2 Materials

The experimental stimuli in this study (recorded as part of a larger project with additional experimental conditions) fall into two types, wh sentences and non-wh comparison sentences. The stimuli were presented in Japanese orthography one by one, on separate note cards, in a pseudo-random order that was different for each participant. Each stimulus was preceded by a short description of a conversational context, and participants were asked to produce the stimulus as though they were uttering it in the given context; this was done in an attempt to control for context-dependent factors, such as new versus old information, that are known to affect prosody. Each stimulus was read twice consecutively. An example context and stimulus is shown in (1).

(1) Example context and stimulus (stimulus code w6xa)

Your brother brought his daughter Noriko to a party. Everyone is taking turns looking after Noriko, but you suddenly get confused about whose turn it is, so you ask:

Dare-ga Noriko-ga doko-de asobi-yoo ka waku to Ø?
who-NOM Noriko-NOM where playing-is C_[+wh] know PRT C_[+wh]
 ‘Who knows where Noriko is playing?’

The wh stimuli included seven different syntactic structures (coded w1–w7), each of which was instantiated with two different sets of lexical items (coded x or y; these were instead two different wh-scope interpretations in the case of the scope-ambiguous structure w7). Finally, each sentence occurred in unaccented-noun and accented-noun versions (coded a or u), for a total of 28 wh sentences. The non-wh stimuli included four different syntactic structures (coded n1–n4), matching the first four wh structures; each non-wh structure also had unaccented-noun and accented-noun versions, for a total of eight non-wh sentences. (See the Appendix for all sentences and their stimulus identifier codes, which are used in the data graphics below.)

Participant responses were recorded in a sound-attenuated room on the Hakozaki campus of Kyushu University, using a Marantz PMD 660 digital recorder (sampling rate 44.1 kHz) and a Radio Shack 33-3012 head-mounted microphone. Analysis was carried out in Praat, v. 5.1.11 (Boersma & Weenink 2009).

4 Analysis 1: Accent deletion in the wh domain

A crucial distinctive characteristic of Fukuoka wh prosody, according to Kubo's description, is the deletion of accents in the wh domain. Therefore, the first step in the present study is to see whether accent deletion occurs for the study participants. However, in order to determine whether accents are deleted, a diagnostic for accentedness is needed. §4.1 develops an empirical diagnostic for accentedness in Fukuoka Japanese. Then, §4.2 presents the results for accent deletion in the wh domain.

4.1 Identifying accents

As noted above, the accent and intonation system of Fukuoka Japanese is generally very similar to the Tokyo system. An accent is realized as a fall from high to low tone. There is at most one accent per word. Some words have no accent, or surface with no accent as the result of an accent deletion process. In principle, then, to determine whether or not a word bears an accent in a surface representation, all that is needed is to determine whether or not that word has a pitch fall. Unfortunately, this is not as simple as it sounds. As in many languages, Fukuoka Japanese shows declination, that is, a gradual decrease in pitch across an utterance. This means that even an unaccented word may have a lower F0 on later moras than on earlier ones. So the question is not necessarily whether or not the pitch falls within a word, but instead, whether any pitch fall that might be observed is large enough to be the manifestation of a pitch accent.

As it turns out, not even this question necessarily has a straightforward answer. Hayata (1985: 8–9) recounts an anecdote illustrating the problem. He once played a recording of one of his elderly Fukuoka speakers to a number of linguistics students, and found that opinions differed concerning which syllable in the utterance bore the pitch accent. In brief, a pitch fall that was too small to be classified as an accent by himself (a Tokyo speaker), the elderly Fukuoka speakers, or younger speakers from Kitakyushu and Iizuka (in the western part of Fukuoka prefecture) was indeed perceived as an accent by younger speakers from Fukuoka, as well as younger speakers from Saga and Nagasaki to the east. Thus, it is possible that Fukuoka dialect speakers may differ among themselves in the size of the F0 drop that implements a pitch accent.

There is yet another potential complication in identifying whether or not a noun has been accented: Individual speakers may differ in the accentedness status or the accent location of specific lexemes, particularly given that they are exposed to Tokyo-based prescriptive standards (as well as to speakers of other regional dialects).

What is needed is an empirical diagnostic for accentedness that can be established on a speaker-by-speaker basis, and that does not depend on any a priori assumptions about the location of the accent or the size of the F0 fall. The proposed method is based on a measure called the *F0 decrease score*, which is calculated as follows: Demarcate the vowel portion of each mora (μ) of a word, and measure the average F0 in each such vowel interval. Calculate ratios for each pair of adjacent moras (μ_{i+1}/μ_i), and then take the natural log (\ln) of each μ_{i+1}/μ_i ratio. Add together all *negative* $\ln(\mu_{i+1}/\mu_i)$ values for the word; the result is the F0 decrease score.

The F0 ratio μ_{i+1}/μ_i between two consecutive moras shows the amount and direction of F0 change; because it is a ratio and not a difference, it automatically normalizes the magnitude of the F0 change, making the measures comparable across speakers. Taking the natural log of this ratio, $\ln(\mu_{i+1}/\mu_i)$, is useful for two reasons; first, it models the fact that pitch perception is approximately logarithmic, and second, it converts the μ_{i+1}/μ_i ratio into a measure that is centered

around zero. Thus, if there is no change in pitch between μ_i and μ_{i+1} , then the F0 values are equal, so μ_{i+1}/μ_i is 1, and $\ln(\mu_{i+1}/\mu_i)$ is 0. If there is a pitch rise, then the F0 for μ_{i+1} is higher than that for μ_i , the μ_{i+1}/μ_i ratio is greater than 1, and $\ln(\mu_{i+1}/\mu_i)$ is positive. If there is a pitch fall, then the F0 for μ_{i+1} is lower than that for μ_i , the ratio is smaller than 1, and $\ln(\mu_{i+1}/\mu_i)$ is negative.

The final step in calculating the F0 decrease score is to sum all negative values for the word. An accented word, with a phonologically relevant pitch fall, should have a larger F0 decrease score than a word with no accent. (If words of different lengths are to be compared, this would need to be adjusted for, but in the present study, word lengths are approximately equivalent.²)

The discussion in the next section shows that the F0 decrease score does distinguish accented from unaccented nouns for each of the study participants. This same diagnostic is then used to diagnose accent inside a wh span.

4.2 Accent deletion inside the wh domain

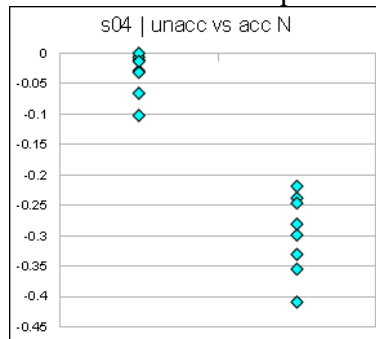
The results of the F0 decrease score defined in the preceding section are now used to answer two questions. First, are accented and unaccented nouns distinguished in non-wh contexts? Second, do lexically accented nouns in wh questions behave like unaccented nouns in non-wh contexts?

For each speaker, the F0 decrease scores were calculated for a set of lexically unaccented nouns and for a set of lexically accented nouns, produced in the non-wh sentences as described in §3.1 (see Appendix; measured nouns are underlined). Nouns were assigned to these sets on the basis of accentedness judgments of the nouns in isolation (with a case suffix) collected from two Fukuoka speakers. In the graphs labeled *unacc vs. acc N* (light dots), nouns that were expected to be lexically unaccented are shown on the left, while those that were expected to be lexically accented are shown on the right. Examples are given in (2).

(2) F0 decrease scores for lexically unaccented and accented nouns in non-wh contexts

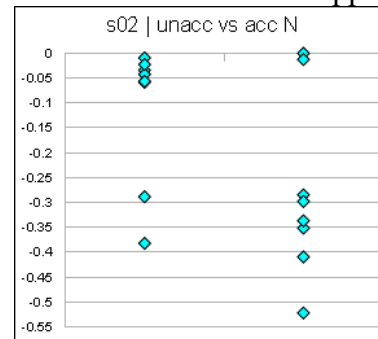
(a) Participant S04

Lexical accents as expected



(b) Participant S02

Four tokens realized in opposite accent class



Some participants produced a few nouns with the opposite of the expected accentedness status, as seen in (2b); such participants presumably either made a speech error, or had a different lexical representation than expected for the noun in question. This is not a significant problem, however, since the question of interest is whether the F0 decrease measure distinguishes between accented and unaccented nouns. As can be seen here and in the subsequent examples, it does—

²All nouns measured here are four moras long, except for the proper names in the w6 sentences, which are three. This difference should not matter, however, since all accented words are accented three moras from the end: $(\mu)\mu\mu\mu$. Moras that precede the accented one should show a pitch *rise*, which would not affect the F0 decrease score.

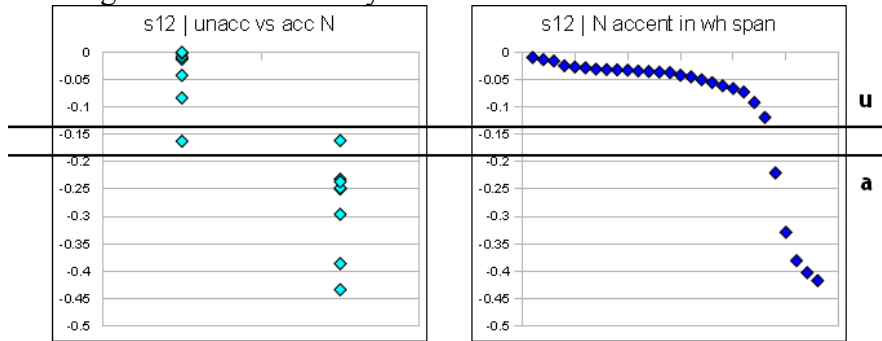
there is a vertical separation between tokens with a small F0 decrease measure (phonetically unaccented) and tokens with a larger F0 decrease measure (phonetically accented).

The comparison of interest is, for each speaker, whether lexically accented nouns in the wh-C span are realized with an F0 decrease score more similar to that for accented or unaccented nouns. Nouns in the wh context (wh-N) with F0 decrease scores equivalent to unaccented nouns can be said to have undergone accent deletion, in accordance with Kubo's generalization. In (3)–(6), F0 decrease scores for nouns in non-wh contexts are shown in the left graph (light dots), with lexically accented nouns in the left half and lexically accented nouns in the right half. F0 decrease scores for lexically accented wh-N tokens (see (A3) in the Appendix for the stimuli) are shown in the right graph (dark dots), arranged by increasing magnitude of F0 decrease score.

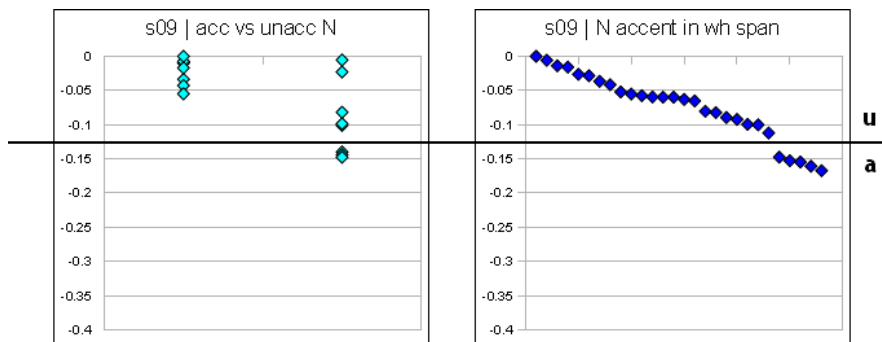
For some of the participants, it is easy to classify wh-N tokens as deaccented or not based on an F0 decrease score comparison with the non-wh nouns (3). These are cases where there is a clear discontinuity in the F0 decrease scores for wh-N that matches the discontinuity between scores for phonetically accented and unaccented non-wh nouns. Tokens with F0 decrease scores above the horizontal line are classified as unaccented, labeled 'u' at the right side of the plots, while those below the line are accented, 'a'.

(3) wh-N that are straightforward to classify

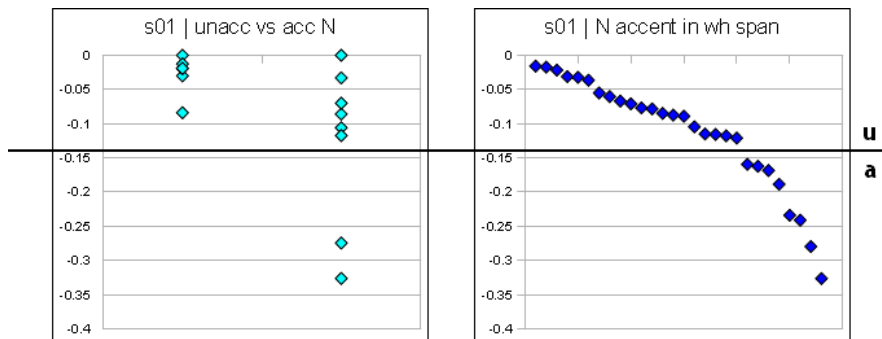
(a) S12



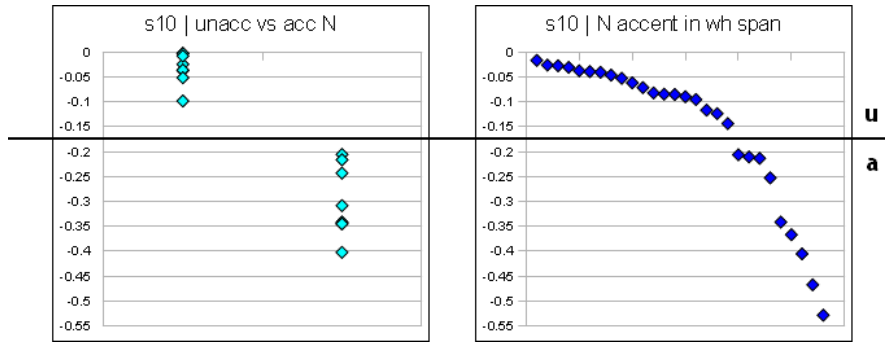
(b) S09



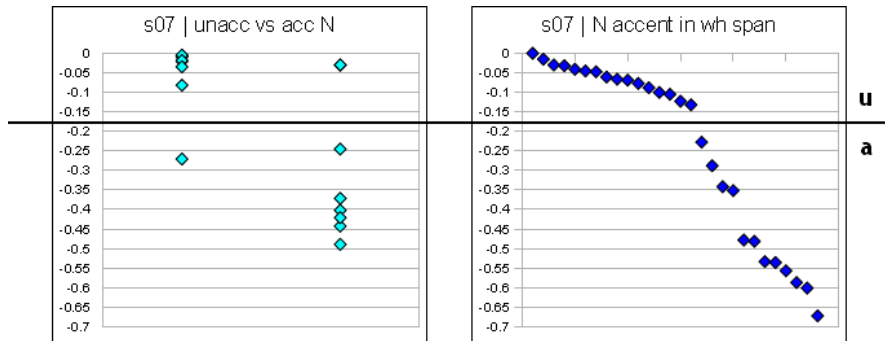
(c) S01



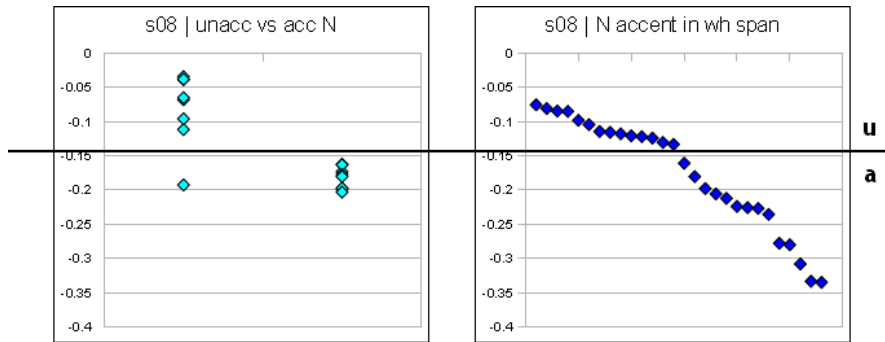
(d) S10



(e) S07



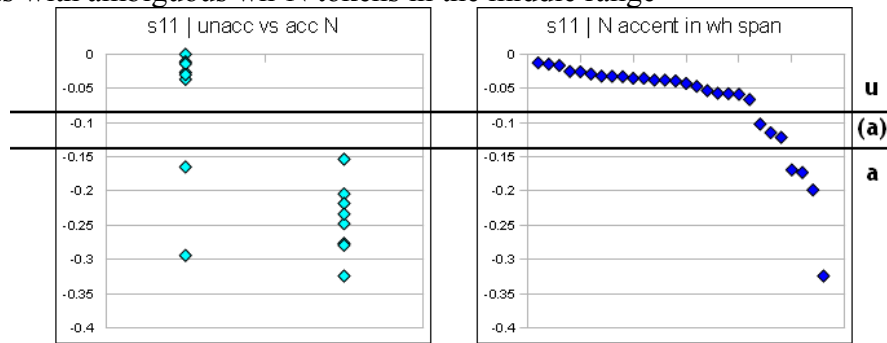
(f) S08



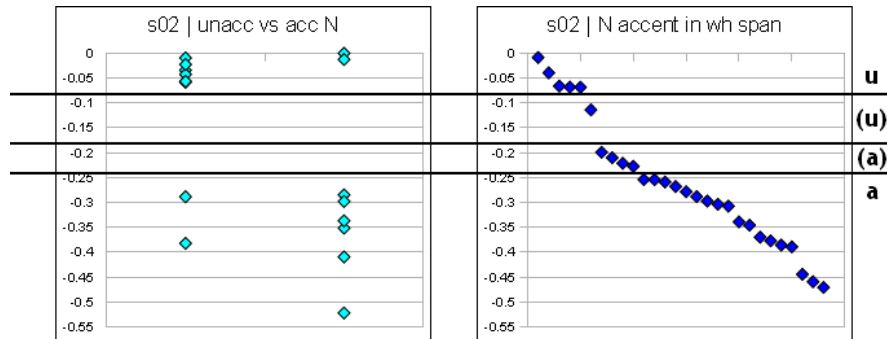
In other cases, however, it is less clear exactly how to classify the wh-N tokens. For the participants shown in (4), there are multiple discontinuities in the F0 decrease scores for the wh-N items, some of which fall between the clearly unaccented and accented values for the non-wh comparison cases. For these, the wh points outside the ambiguous range are classified as unaccented, 'u', or accented, 'a', as appropriate. Inside the ambiguous range, the dividing line is considered to be either the uppermost sharp discontinuity, or a match with the unaccented/accented non-wh noun division. Items in the ambiguous range above this dividing line are coded as probably unaccented, '(u)', and are treated as unaccented in the summary analysis to follow. Likewise, items in the ambiguous range that fall below the dividing line are coded as probably accented, '(a)', and are treated as accented in the summary analysis.

(4) Participants with ambiguous wh-N tokens in the middle range

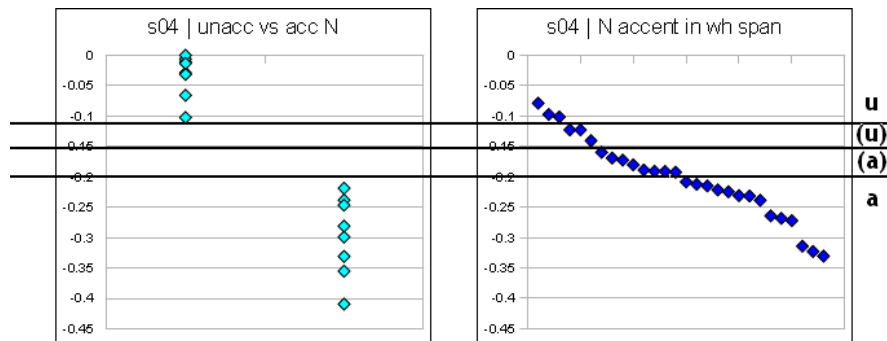
(a) S11



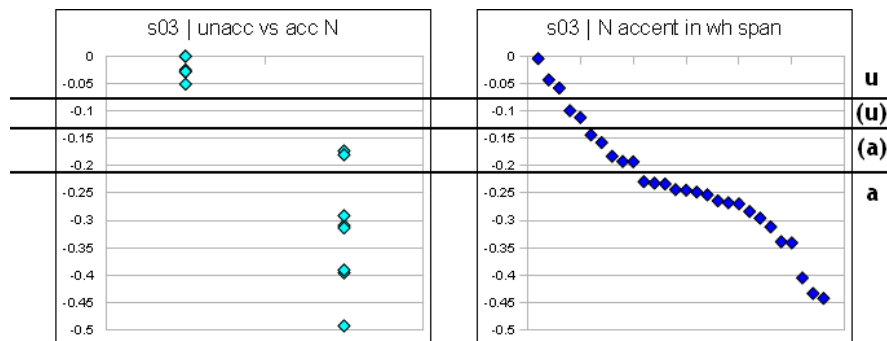
(b) S02



(c) S04

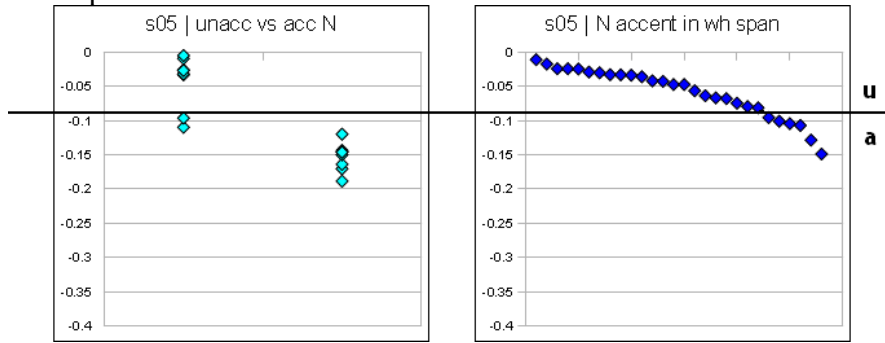


(d) S03



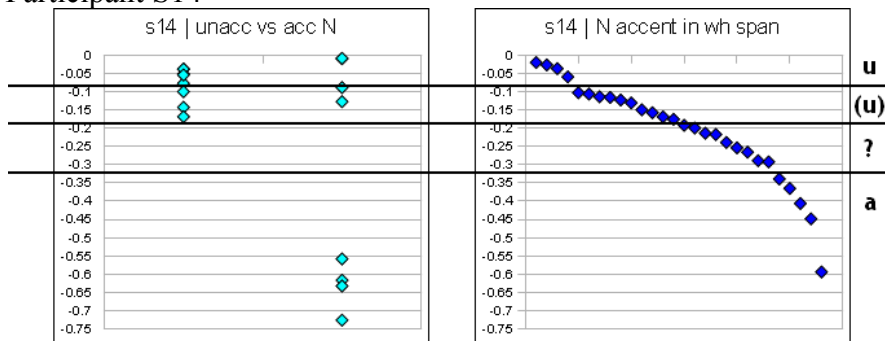
For the remaining two participants, the patterns are slightly different. Participant S05 has a subtle discontinuity in the wh-N values that is a good match for highest accented point among the non-wh control nouns, so the division is made at this point.

(5) Participant S05



For participant S14, the situation is quite complicated. The sharpest discontinuities among the F0 decrease scores for wh-N points seem to be at a value too high (above -0.1) or too low (below -0.45) to be a plausible division between accented and unaccented tokens. The lowest unaccented value in the non-wh comparison cases does not correspond with any discontinuity in the wh-N values at all. Moreover, as noted above, this speaker is the only male participant, and his place of origin is the furthest from central Fukuoka City. It is also the case that, impressionistically, S14 does not ‘sound like’ a FJ speaker in terms of his intonational patterns. For the present study, this participant will be excluded from further analysis.

(6) Participant S14



The chart in (7) summarizes the results of the accent deletion analysis for the wh-N tokens. The column headers are stimulus identifier codes; see Appendix for the full sentences. Two repetitions were recorded for each sentence, so each cell contains two symbols from among the following: ‘.’ for *unaccented*, ‘|’ for *probably unaccented*, ‘a’ for *probably accented*, and ‘A’ for *accented*, as well as ‘?’ for the questionable tokens from speaker S14. Row headers identify the participant and indicate how many tokens were accented. Participants are ordered by increasing numbers of accented (including probably accented) tokens, out of a total of 28 tokens. Stimulus items are ordered left to right from most frequently to least frequently deaccented, based on the productions of the first eight (i.e., most productively deaccenting) speakers.

(7) Noun accents in wh domain, by participant and item

	w3 ya	w5 ya	w3 xa	w2 ya	w1 xa	w6 xa	w4 ya	w6 ya	w1 ya	w2 xa	w5 xa	w7 xa	w7 ya	w4 xa
S12 5	..	..	..	..	..	..	..	..	..	AA	A.	..	..	AA
S09 5	..	..	..	..	..	..	A.	..	..	..	..	..	AA	AA
S05 6	..	..	A.	..	A.	..	A.	..	AA	..	..	..	..	A.
S11 7	..	..	..	..	..	..	..	..	aa	a.	..	AA	AA	..
S01 8	..	..	..	..	..	A.	..	AA	..	..	AA	..	A.	AA
S10 9	..	..	..	..	AA	..	..	..	..	AA	A.	AA	..	AA
S07 12	..	..	..	AA	..	..	..	AA	AA	..	AA	AA	AA	..
S08 14	..	..	..	..	..	AA	AA	AA	A.	AA	A.	AA	A.	A.
S14 14?	?|	?|	||	A?	??	||	A?	?.	|.	..	A|	AA	??	||
S02 22	AA	..	Aa	AA	AA	AA	AA	|.	Aa	AA	AA	..	Aa	Aa
S04 22	aa	a|	a|	Aa	|.	AA	AA	AA	..	aa	Aa	AA	AA	AA
S03 23	..	Aa	aa	|.	AA	AA	Aa	AA	AA	AA	Aa	AA	AA	A|

There are six participants (S01, S05, S09, S10, S11, and S12) with fewer than ten tokens that failed to undergo accent deletion, and two additional participants (S07 and S08) with accents retained in no more than half of the tokens. Three more speakers (S02, S03, and S04) showed very little accent deletion, so their productions are excluded from further analysis in §5. As noted above, participant S14 is also excluded from further analysis, because accentedness was difficult to determine for his wh-N items.

Stimuli with the same syntactic structure share the first two symbols of their identifier code (see §3.1). The chart in (7) shows that, with one exception, no syntactic structure consistently impeded accent deletion. That exception is the scope-ambiguous w7 structure, a special case (see §5.1). All other sentences (considering the top eight speakers only) with more than four tokens that failed to undergo accent deletion, or for which more than three speakers failed to apply accent deletion, turn out to be only one of a pair; their structurally matched counterparts do undergo reasonably systematic accent deletion. The other point to note in (7) is that sentence w4xa had very little accent deletion, especially among the top eight typically deaccenting speakers, even though its structural counterpart, w4ya, is unremarkable. The crucial accented noun in w4xa is *onigiri* ‘rice ball’, and it may be that this lexical item resists accent deletion.³

Thus, we can conclude that for eight out of the twelve young-adult speakers of Fukuoka Japanese who participated in the study, lexically accented nouns generally appear phonetically unaccented when they occur soon after a wh element. The next analysis, which looks for evidence of a wh prosody/scope correlation, will examine these eight speakers only.

³For example, although no experimental participant made any direct mention of this, it is conceivable that the lexical item *onigiri* is strongly associated with the Tokyo or standard dialect of Japanese and as a result impedes the application of Fukuoka-specific intonational phonology.

5. Analysis 2: wh prosody and scope

For the eight Fukuoka speakers who show reasonably productive accent deletion in a wh context, it is possible to investigate whether the extent of the deaccenting correlates with the scope of the wh element. The crucial comparison is between sentences where the wh scope ends at an embedded complementizer, and sentences where the wh scope extends to the end of the matrix clause. According to Kubo's generalizations, we would expect to see an accent near the end of the embedded clause in the first case, but no accent at that position in the second case.

This section presents two comparisons of this sort: one comparison in which the same surface string has ambiguous wh scope (to be disambiguated according to the background context provided for the sentence), and one comparison in which unambiguous sentences with embedded versus matrix wh scope are compared to each other.

5.1 Ambiguous structures

The most straightforward way to test whether wh prosody correlates with wh scope in Fukuoka Japanese would be to examine ambiguous cases: if the same string of words can have either matrix or embedded wh scope, then we can see whether the wh scope correlates with prosody. It is difficult to construct such ambiguous strings, however. Embedded complementizers in the Fukuoka dialect are generally specified as [+wh] or [-wh], and so necessarily disambiguate the intended wh scope.

Another construction in which wh prosody has been attested (Kubo 1989) is in the [wh V-*te mo*] structure, meaning 'no matter wh Vs' (in the case of embedded wh scope). Unlike an embedded question with a finite verb, this construction is ambiguous—it is consistent with a matrix-scope reading for the wh element as well, given an appropriate background context. The w7 sentences (see Appendix) instantiate this structure. These sentences were presented to participants with two different background contexts, as shown in (8).

(8) Sentences with ambiguous wh scope (structure w7)

(a) Context that facilitates embedded scope

At the store where you work part time, only designated people are allowed to sell things like nigiri sushi and alcohol. It seems that this is not the case for sushi rolls, but in order to make sure, you ask:

[**Dare**-ga norimaki-o ut-te **mo**] ii to Ø?
who-NOM sushi.roll-ACC sell-TE C_[+wh] okay PRT C_[-wh]
 'Is it okay, no matter who sells sushi rolls?'

(b) Context that facilitates matrix scope

The only people at work are Hanako, Yôko, and Junko. One of them has to sell sushi rolls. But when you ask the manager who will do it, you get these answers: "Not Hanako." "Not Yôko either." "Not Junko either." Even though one of the three has to do it! You're a little annoyed, so you say to the manager:

Dare-ga [norimaki-o ut-te mo] ii to **Ø**?
who-NOM sushi.roll-ACC sell-TE C_[-wh] okay PRT C_[+wh]
 'For whom is it okay, even if they sell sushi rolls?'

As suggested by the contexts in (8), the embedded-scope version may be more natural or less marked than the matrix-scope version; see below for further discussion of this point.

Measurements for this analysis were carried out in a way similar to the computation of the F0 decrease score in §4: F0 measures of the vocalic portions of moras were used to compute the natural log of a ratio. The values compared were the maximum F0 value in the antepenultimate mora of the embedded verb (μ_V), and the minimum F0 value of the (single) mora of the embedded complementizer (μ_C); these points should fall before and after any accent, if there is one, because embedded wh prosody is realized with a default accent on the penultimate mora of the embedded clause (Kubo 2001, 2005; cf. 2009). See (A3) and (A4) in the Appendix for more information; the vowels that were measured are shown with italics and underline.

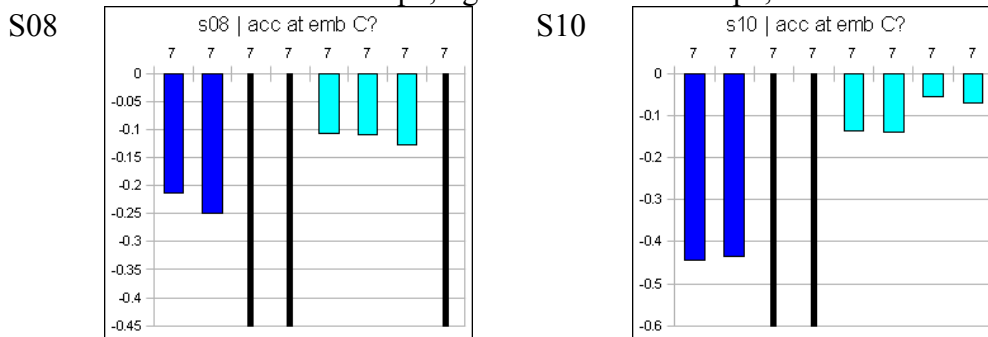
If there is an accent just before the embedded complementizer, there should be a large pitch fall between μ_V and μ_C . This would make the μ_C F0 value smaller than that for μ_V , giving a μ_C/μ_V ratio of less than 1, and a value for $\ln(\mu_C/\mu_V)$ that is negative. If the computed value $\ln(\mu_C/\mu_V)$ is close to zero, or even positive, this indicates the absence of an accent in the span between the two crucial moras. If there is a correlation between wh scope and wh prosody, embedded scope should correlate with the presence of an accent between μ_V and μ_C , and matrix scope should not. Therefore, the value for $\ln(\mu_C/\mu_V)$ is predicted to be a negative number of larger amplitude in embedded-scope cases than in matrix-scope cases, which should show a small negative value (because of declination) or possibly even a zero or small positive value.

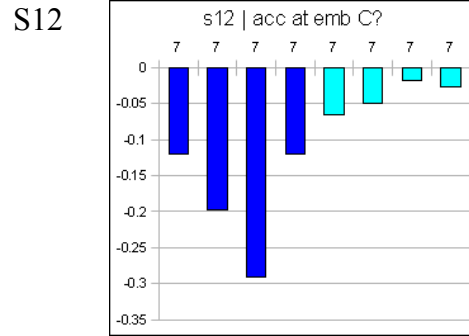
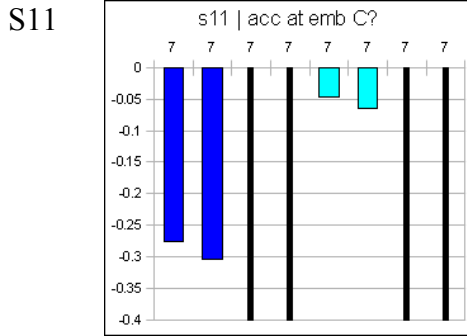
Results for the ambiguous sentences are shown in (9) and (10). The first four tokens (dark bars), two repetitions each of sentences w7xa and w7xu (see Appendix), have embedded wh scope, while the last four tokens (light bars), two repetitions each of w7ya and w7yu, have matrix wh scope. If there is a prosody/scope correlation, the dark bars should be longer.

Note that if a noun earlier in the sentence has failed to undergo accent deletion, then there could not be much of a pitch drop between μ_V and μ_C even if an accent were phonologically present, since the pitch range would likely already be compressed. Therefore, any sentences in which noun deaccenting has not taken place (identified in (7) above) have been disregarded in the present analysis. Such cases are indicated with a thin black line here and in subsequent graphs, in order to distinguish a discarded value from a legitimate value near zero.

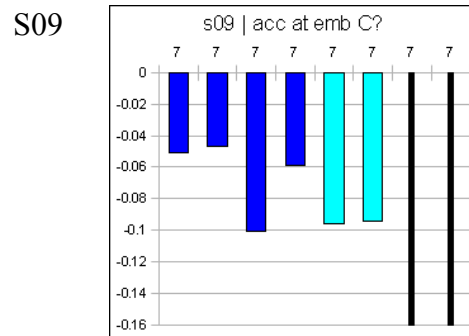
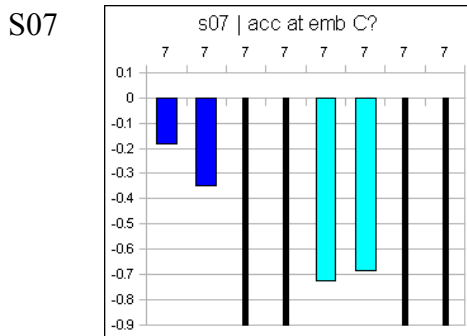
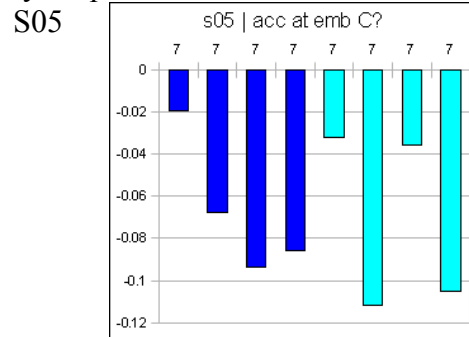
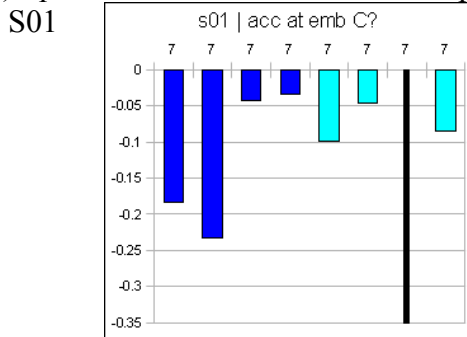
(9) Speakers who show a consistent wh-prosody/scope correlation

- Dark bars = embedded scope; light bars = matrix scope; black lines = not measured





(10) Speakers without a consistent wh-prosody/scope correlation



As noted in §4.2, these sentences (structure w7) were particularly likely to resist accent deletion. This may be related to the fact that the background contexts that were necessary to disambiguate these sentences, especially for the matrix scope version, are somewhat contrived. Moreover, either the slightly contrived nature of the matrix context, or the fact that these examples were ambiguous, may have encouraged productions with (contrastive) focus; more research is needed on the interaction of focus with wh prosody in Fukuoka Japanese (though see Kubo 2005, 2009 for preliminary examples and discussion).

5.2 Unambiguous structures

To further explore whether there is a correlation between wh prosody and wh scope, the prosody of wh questions with unambiguous scope was also examined. Four unambiguous structures were investigated, with four experimental items representing each structure (see (A3) and (A4) in the Appendix). Structures w2 and w3 each have a single wh element contained in an embedded clause (11), but that wh element has embedded scope in the w2 sentences, which are embedded

questions, and matrix scope in the w3 sentences, in which the wh element is contained in a relative clause. If wh scope correlates with wh prosody, we should expect to see an accent at the end of the embedded question in (11a), but not at the end of the relative clause in (11b).

(11) Single wh element in embedded clause

(a) wh element in embedded question; embedded scope (structure w2)

[**dare**-ga doyoobi aniyome-o yondá **ka**] shiran'yatta.
who-NOM Saturday sister-in-law-ACC called C didn't.know
 '(I) didn't know who called (my) sister-in-law on Saturday.'

(b) wh element in relative clause; matrix scope (structure w3)

nomiya-de [**nan.de** Morioka-ni mukau] hito-to nomi-yotta to **Ø**?
bar-at why Morioka-to heading person-with drinking-were PRT C
 'At the bar, who were you drinking with, identified by why they were going to M.?'

The other two structures examined have multiple wh elements. Structure w5 has two wh elements in the embedded clause, both with embedded scope (12a). Structure w6 has two wh-element/complementizer pairs, one nested inside the other (12b). According to Kubo's generalizations, we should see an accent at the end of the embedded clause in w5, where all wh elements come to the end of their scope domain, but not in w6, where the scope of the first wh element extends beyond the embedded clause to the matrix clause.

(12) Multiple wh elements

(a) 'wh-wh-C' structure: Two wh elements with embedded scope (structure w5)

[**dare**₁-ga doyoobi **doko**₁-de amaguri-o yaitá **ka**₁] wakaran.
who-NOM Saturday where-at chestnuts-ACC roasted C don't.know
 '(I) don't know who roasted chestnuts where on Saturday.'

(b) Two nested wh/C pairs, outer wh = matrix scope (structure w6)

dare₁-ga [Noriko-ga **doko**₂-de asobi-yoo **ka**₂] wakaru to **Ø**₁?
who-NOM Noriko-NOM where-at playing-is C know PRT C
 'Who knows where Noriko is playing?'

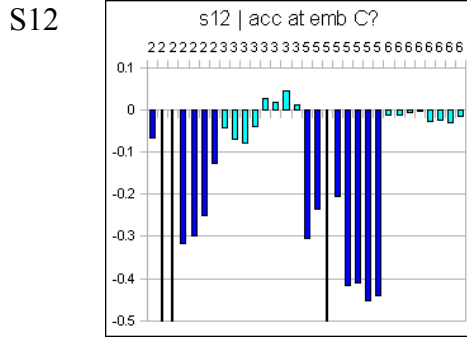
The same measurement method was used as for the ambiguous cases described in §5.1 above: for structures w2, w5, and w6, the natural log of the ratio between the (single) complementizer mora and the penultimate verb mora, $\ln(\mu_C/\mu_V)$, was calculated. The relative-clause structure w3 has no complementizer, so in this case, the final mora of the head noun ([to] of *hito* 'person' in (11b)) stood in for μ_C , and a mora in the verb that was three moras before ([ka] of *mukau* 'head (toward)' in (11b)) stood in for μ_V .

In the graphs that follow, the single-wh cases (w2, w3) are shown at the left, and the multiple-wh cases (w5, w6) are shown at the right. According to Kubo's generalizations, then, the embedded-scope structures w2 and w5 (dark bars) should show a larger negative change than the matrix-scope structures w3 and w6 (light bars). As in §5.1, items in which accent deletion failed to apply (see (7)) were excluded from analysis, and are indicated with a thin black line.

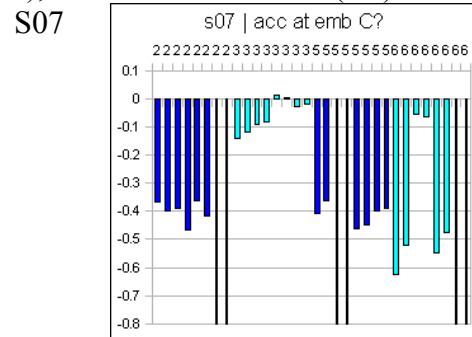
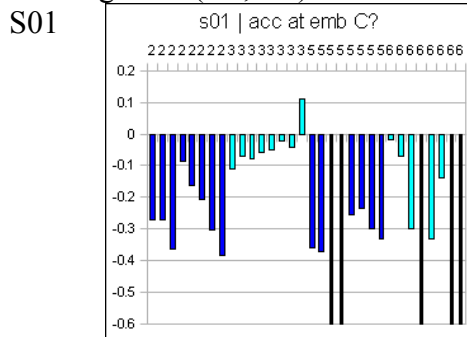
Participants fell into two main groups: those who showed a wh prosody/scope correlation for the unambiguous sentences (13), and those who did not (14).

(13) Speakers with a wh-domain/scope correlation

(a) For both single and multiple wh structures

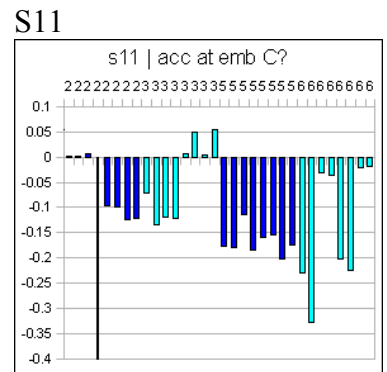
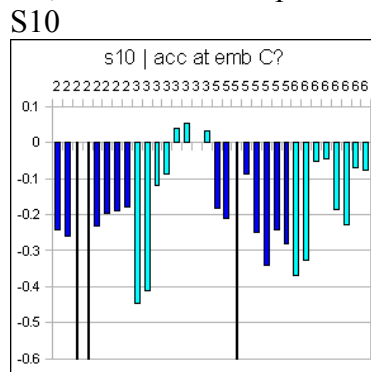
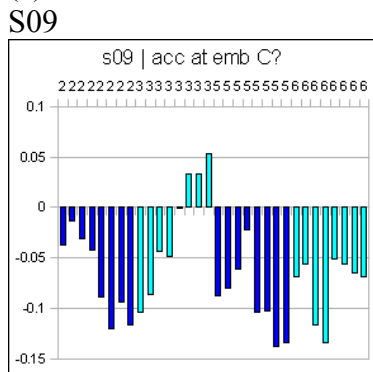


(b) For single wh (w2, w3) and wh-wh-C (w5), but not for nested wh (w6)

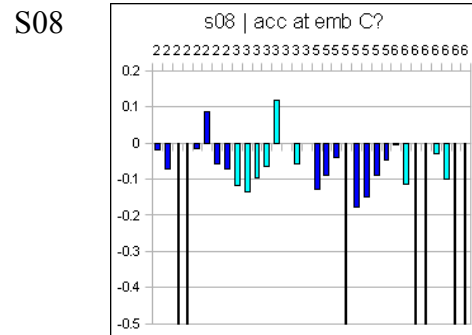
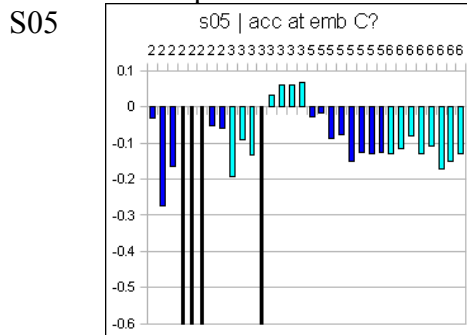


(14) Speakers with no consistent wh-domain/scope correlation

(a) Some evidence of correlation, but notable exceptions



(b) Results seem quite random



5.3 Discussion: wh prosody and scope

Some participants showed a correlation between wh scope and wh prosody only in the ambiguous cases, while others showed such a correlation only in the unambiguous cases. Participant patterns are summarized in (15).

(15) Summary by speaker: wh domain/scope correlation? ○=good; △=medium; ×=no

structure:	single wh		wh-wh-C	nested	ambiguous	
wh scope:	embedded (w2)	matrix (w3)	embedded (w5)	matrix (w6)	embedded (w7x)	matrix (w7y)
S12	○	○	○	○	○	○
S01	○	○	○	△	△	○
S10	○	△	△	△	○	○
S11	△	△	△	△	○	○
S07	○	○	○	△	×	×
S09	△	△	△	△	×	×
S05	△	△	△	×	△	×
S08	×	×	×	×	○	○

Four participants (S12, S01, S10, and S11) show good or medium correlation between wh prosody and wh scope. Two more participants (S07 and S09) show good or medium correlation if the ambiguous w7 (*V-te mo*) items are excluded. The remaining two participants (S05, S08) show little or no correlation (except in the ambiguous cases, for S08). The fact that some speakers, especially S11 and S08, show a better prosody/scope correlation in the ambiguous cases is reminiscent of Hirotsu's (2005) finding that Tokyo speakers do not necessarily use wh prosody/scope correlations in production unless deliberately disambiguating. In this light, it is interesting to note the pattern shown by speakers S07 and S09, where the correlation was stronger in the *unambiguous* cases.

Three participants (S01, S07, and S05) show less prosody/scope correlation in the structure with two nested wh-C pairs (w6) than in the other unambiguous structures. These sentences are somewhat complex; as in all cases, a background context was supplied to facilitate the intended semantic interpretation of the stimulus sentence (see (1) for an example of a w6 sentence with its background context), but it is possible that some speakers nevertheless had in mind an interpretation different from the intended one. Further investigation of this structure is needed.

6. Conclusions

Kubo's basic generalizations about wh prosody in Fukuoka Japanese are borne out for the young-adult participants in this study. First, eight of twelve speakers showed a strong tendency to delete accents in the wh domain. No speaker had accent deletion in every case, a result that is consistent with Igarashi (2007), Igarashi & Kitagawa (2007), and Smith (2007). However, for these eight speakers, accent deletion appears to be productive.

Among the eight speakers with productive accent deletion, there was also some evidence of a correlation between wh prosody and wh scope. Points of interest include the fact that some speakers showed more prosody/scope correlation for ambiguous sentences, while others showed more for unambiguous sentences. Further investigation is needed concerning the nested wh/C structure (w6), where only one participant clearly showed the pattern that was expected according to Kubo's description.

To the extent that the study participants do not match Kubo's generalizations, there are various reasons why this might be the case. Some speakers' grammar may differ from Kubo's; participants in this study fall in a younger age range, so there may be dialect change in progress. Or, different speakers may show different degrees of convergence with non-Fukuoka dialects. It is also possible that Kubo's introspective judgments may not capture the whole range of grammatical naturalistic intonation patterns. Finally, there may be artifacts of the experimental situation. Despite the background contexts that were provided along with the stimuli, speakers may not have had the intended semantic representation in mind when they produced their sentences. Or, more generally, the laboratory situation may have contributed to less-natural productions. Production data that has been collected from some of the same participants in a more naturalistic paired-conversation task may bear on some of these questions, as might future work with different experimental tasks or Fukuoka speakers of different age ranges.

Acknowledgments

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Appendix: Materials

See §3.1 for an explanation of the stimulus identifier codes.

(A1) Unaccented nouns (in non-wh structures)

- Moras in underlined nouns were measured to compute F0 decrease score (see §4)

n1u	Imanishi-ga	doyoobi	<u>marariya-ni</u>	yarareta	to.	
	<i>Imanishi-NOM</i>	<i>Saturday</i>	<i>malaria-by</i>	<i>done</i>	<i>PRT</i>	
	'Imanishi was hit by malaria on Saturday.'					
n2u	Yoneyama-ga	doyoobi	<u>Muraoka-o</u>	yonda	tte	shiran'yatta.
	<i>Yoneyama-NOM</i>	<i>Saturday</i>	<i>Muraoka-ACC</i>	<i>called</i>	<i>C</i>	<i>didn't.know</i>
	'(I) didn't know Yoneyama called Muraoka on Saturday.'					
n3u	Kyoo-wa	kinoo	moratte.kita	<u>yamaimo-o</u>	yaki-yotta	to.
	<i>today-TOP</i>	<i>yesterday</i>	<i>received</i>	<i>yams-ACC</i>	<i>roasting-were</i>	<i>PRT</i>
	'Today, we were roasting the yams we got yesterday.'					
n4u	Naomi-ga	omise-de	Minoru-ni	<u>yamamori-o</u>	moratta	to.
	<i>Naomi-NOM</i>	<i>shop-at</i>	<i>Minoru-DAT</i>	<i>full.plate-ACC</i>	<i>received</i>	<i>PRT</i>
	'Naomi got a full plate from Minoru at the shop.'					

(A2) Accented nouns (in non-wh structures)

- Moras in underlined nouns were measured to compute F0 decrease score (see §4)
- n1a Imanishi-ga doyoobi aómushi-ni yarareta to.
Imanishi-NOM Saturday caterpillar-by done PRT
 ‘Imanishi was hit by caterpillars on Saturday.’
- n2a Yoneyama-ga doyoobi aniyome-o yonda tte shiran’yatta.
Yoneyama-NOM Saturday sister.in.law-ACC called C didn’t.know
 ‘(I) didn’t know Yoneyama called (my) sister.in.law on Saturday.’
- n3a Kyoo-wa kinoo moratte.kita amáguri-o yaki-yotta to.
today-TOP yesterday received chestnuts-ACC roasting-were PRT
 ‘Today, we were roasting the chestnuts we got yesterday.’
- n4a Naomi-ga omise-de Minoru-ni onigiri-o moratta to.
Naomi-NOM shop-at Minoru-DAT rice.ball-ACC received PRT
 ‘Naomi got a rice ball from Minoru at the shop.’

(A3) wh questions with lexically accented nouns

- Nouns measured for Analysis 1 (F0 decrease score) are underlined; measurement points for Analysis 2 (prosody and scope; see also (A4)) in w2, w3, w5, w6, and w7 are underlined and italicized
- w1xa nan.de kyoo imómushi-ga ooi to Ø?
why today hornworm-NOM numerous PRT C
 ‘Why are there so many hornworms today?’
- w1ya dare-ga doyoobi aómushi-ni yarareta to Ø?
who-NOM Saturday caterpillar-by done PRT C
 ‘Who was hit by caterpillars on Saturday?’
- w2xa [dare-ga doyoobi aniyome-o *yondá* *ká*] shiran’yatta.
who-NOM Saturday sister.in.law-ACC called C didn’t.know
 ‘(I) didn’t know who called (my) sister-in-law on Saturday.’
- w2ya [nan.de kyoo norímaki-ga *takusan* *arú* *ká*] shiran’yatta.
why today sushi.roll-NOM many exist C didn’t.know
 ‘(I) didn’t know why there were so many sushi rolls today.’
- w3xa kyoo-wa [*itsu* *moratte*.kita] amáguri-o yaki-yotta to Ø?
today-TOP when received chestnuts-ACC roasting-were PRT C
 ‘Today, which chestnuts were (you) roasting, identified by when you received them?’
- w3ya nomiya-de [nan.de Morioka-ni *mukau*] *hitó*-to nomi-yotta to Ø?
bar-at why Morioka-to heading person-with drinking-were PRT C
 ‘At the bar, who were you drinking with, identified by why they were going to Morioka?’
- w4xa dare-ga omise-de dare-ni onigiri-o moratta to Ø?
who-NOM shop-at who-DAT rice.ball-ACC received PRT C
 ‘Who received a full plate from whom at the shop?’
- w4ya dare-ga kyoo doko-de omáwari-o kowagari-yotta to Ø?
who-NOM today where-at policeman-ACC seem.afraid-were PRT C
 ‘Who was acting afraid of a policeman where today?’
- w5xa [dare-ga doyoobi doko-de amáguri-o *yaitá* *ká*] wakaran.
who-NOM Saturday where-at chestnut-ACC roasted C don’t.know
 ‘I don’t know who roasted chestnuts where on Saturday.’
- w5ya [dare-ga kyoo nan.de yamádera-de *moriagari-yóo* *ká*] wakaran.
who-NOM today why mountain temple-at having.fun-are C don’t.know
 ‘I don’t know who is having fun why at the mountain temple today.’
- w6xa dare-ga [Nóriko-ga doko-de *asobi-yoo* *ká*] wakaran to Ø?
who-NOM Noriko-NOM where-at playing-is C knows PRT C
 ‘Who knows where Noriko is playing?’
- w6ya dare-ga [Náoya-ga *itsu* *arawareru* *ká*] wakaran to Ø?
who-NOM Naoya-NOM when appear C doesn’t.know PRT C
 ‘Who doesn’t know when Naoya will show up?’

- w7xa [dare-ga norimaki-o ut-té m_Q] ii to Ø?
who-NOM sushi.roll-ACC sell-TE C good PRT C
 ‘Is it okay, no matter who sells sushi rolls?’ (embedded wh scope)
- w7ya dare-ga [norimaki-o ut-te m_Q] ii to Ø?
who-NOM sushi.roll-ACC sell-TE C good PRT C
 ‘For whom is it okay, even if they sell sushi rolls?’ (matrix wh scope)

(A4) wh questions for Analysis 2 (prosody and scope)

- Measurement points are underlined and italicized; expected default penultimate accents are marked

(a) single wh in embedded clause, embedded scope

- w2xa (see A3)
- w2xu [dare-ga doyoobi Murayama-o yondá ká] shiran’yatta.
who-NOM Saturday Murayama-ACC called C didn’t.know
 ‘(I) didn’t know who called Murayama on Saturday.’
- w2ya (see A3)
- w2yu [nan.de kyòo waremono-ga takusau arú ká] shiran’yatta.
why today breakables-NOM many exist C didn’t.know
 ‘(I) didn’t know why there were so many breakables today.’

(b) single wh in embedded clause, matrix scope

- w3xa (see A3)
- w3xu kyoo-wa [itsu moratte.kita] yamaimo-o yaki-yotta to Ø?
today-TOP when received yams-ACC roasting-were PRT C
 ‘Today, which yams were (you) roasting, identified by when you received them?’
- w3ya (see A3)
- w3yu nomiya-de [nan-de Momoyama-ni mukau] hit_Q-to nomi-yotta to Ø?
bar-at why Momoyama-to heading person-with drinking-were PRT C
 ‘At the bar, who were you drinking with, identified by why they were going to Momoyama?’

(c) multiple wh in embedded clause, both with embedded scope

- w5xa (see A3)
- w5xu [dare-ga doyoobi doko-de yamaimo-o yaitá ká] wakaran.
who-NOM Saturday where-at yam-ACC roasted C don’t.know
 ‘I don’t know who roasted yams where on Saturday.’
- w5ya (see A3)
- w5yu [dare-ga kyoo nan.de yamagoya-de moriagari-yóo ká] wakaran.
who-NOM today why cabin-at having.fun-are C don’t.know
 ‘I don’t know who is having fun why at the mountain cabin today.’

(d) nested wh–C pairs

- w6xa (see A3)
- w6xu dare-ga Naomi-ga [doko-de asobi-yoo ká] wakaran to Ø?
who-NOM Naomi-NOM where-at playing-is C knows PRT C
 ‘Who knows where Naomi is playing?’
- w6ya (see A3)
- w6yu dare-ga Minoru-ga [itsu arawareru ká] wakaran to Ø?
who-NOM Minoru-NOM when appear C doesn’t.know PRT C
 ‘Who doesn’t know when Minoru will show up?’

(e) structures with ambiguous wh scope

- w7xa (see A3)
- w7xu [dare-ga omamori-o ut-té m_Q] ii to Ø?
who-NOM amulet-ACC sell-TE C good PRT C
 ‘Is it okay, no matter who sells amulets?’ (embedded wh scope)
- w7ya (see A3)
- w7yu dare-ga [omamori-o ut-te m_Q] ii to Ø?
who-NOM amulet-ACC sell-TE C good PRT C
 ‘For whom is it okay, even if they sell amulets?’ (matrix wh scope)

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