

A quantitative study of the wh prosody/scope correlation in Fukuoka Japanese

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1 Introduction

- (1) How does syntax influence phonology?
- (2) Evidence from wh prosody/scope correlation in Tokyo Japanese (see, e.g., Deguchi and Kitagawa 2002; Ishihara 2002, 2003, 2007; Hirotsu 2005, to appear)
 - (a) main-clause wh scope tends to correlate with main-clause wh prosody
 - (b) embedded-clause wh scope tends to correlate with embedded-clause wh prosody
- (3) A similar finding has also been reported for the Fukuoka dialect (Hayata 1985; Kubo 1989 et seq.), but has been investigated largely:
 - (a) through introspective judgments
 - (b) with older speakers
- (4) Today's goal: Describe an empirical investigation of wh prosody in twelve young-adult, linguistically naive Fukuoka speakers
- (5) Outline of talk
 - §2 Overview of Fukuoka intonation
 - §3 Experimental design and methodology
 - §4 Results: Accent deletion in the wh domain
 - §5 Results: Relationship between wh prosody and wh scope
 - §6 Preliminary results: Prosody/scope correlation in production vs. perception
- (6) Preview of results
 - (a) Evidence is found for both accent deletion and a prosody/scope correlation, as predicted by Kubo's descriptions
 - (b) However, the results show a certain amount of variation both within and between speakers
 - (c) The results of the production task and the (pilot) perception task suggest that speakers do not show the same prosody/scope correlations in both tasks

2 Fukuoka Japanese wh prosody

2.1 Background

- (7) The basic description of pitch accent and intonation in Fukuoka Japanese from Kubo (1989 et seq.; see also Hayata 1985)
 - Overall system resembles Tokyo (aside from wh constructions), but accent of individual lexical items often differs between the dialects
 - (a) Nouns may be accented or unaccented
 - (b) All verbs and adjectives are accented (except in certain deaccenting contexts)
 - (c) Accent is realized as a pitch fall from high to low
 - (d) A phrase (usually) begins low
 - (e) A phrase with no accents surfaces with high, gradually falling tone
- (8) Intonation in wh questions & related constructions (Kubo 1989 et seq.; Hayata 1985): A “high flat tone” is initiated by the wh element
 - Lasts until the end of the matrix clause, for matrix wh scope
 - Lasts until the end of the embedded clause, for embedded wh scope
- (9) Phonological analysis (Kubo 2001, 2005)
 - (a) The wh element triggers accent deletion on all words inside wh prosody domain
 - (b) Extent of this domain correlates with the scope of the wh element
 - Begins at the wh element and ends at associated complementizer (C[+wh])
 - If C[+wh] is null and sentence-final, the span between wh element and C is realized as one single unaccented phrase
 - Otherwise (e.g., 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
 - (c) Long stretch with no pitch accents is what creates the characteristic wh “high flat tone”
- (10) 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, 2003, 2007)

2.2 Testing Kubo’s generalizations

- (11) Basis of Kubo’s (1989 et seq.) generalizations about Fukuoka wh prosody
 - (a) introspective judgments
 - (b) supplemented by consultation with speakers in similar age range (born 1950s-60s)

- (12) Motivation for an empirical examination of the generalizations
- (a) introspective judgments about sentence-level intonation are notoriously tricky
 - Are additional patterns grammatical? Are some patterns optional?
 - (b) Hayata (1985) discusses a change in the phonetics of accent that distinguishes his elderly speakers (born 1896-1926) from his speakers of Kubo's generation
 - Has there been further diachronic change?
- (13) Today's talk investigates two of Kubo's crucial basic generalizations:
- (a) whether there is accent deletion in lexically accented nouns that intervene between a wh element and its associated complementizer (§4)
 - (b) whether there is a relationship between wh scope and wh prosody (§5, §6)

3 Experiment design

3.1 Participants

- (14) Basic demographic information
- (a) Twelve undergraduate students recruited at the Hakozaki campus of Kyushu University in Fukuoka City (*subject codes not consecutive*)
 - (b) All self-identified as native Fukuoka speakers who use the dialect frequently
 - (c) Received a nominal payment for participation
 - (d) Eleven of the twelve speakers were female; S14 was male
- (15) Place of origin (speakers in gray did not show expected accent deletion)

Northeast of Fukuoka City

- M S02 (Munakata)
- F S10 (Fukutsu)
- H S11 (Hisayama)
- K S03 (Kasuya District)

Fukuoka City proper

- F* S04, S05, S07, S12 (ward not specified)
- FS S01 (Sawara ward)

Southwest of Fukuoka City

- G S08, S09 (Ogoori)
- O S14 (Ookawa)



3.2 Materials

- (16) Trade-off between controlled experimental conditions and naturalistic productions
 >> two production tasks
- (a) Controlled production task (§4, 5)
 - (b) Conversation task (next stage of project)

3.2.1 Controlled production experiment

- (17) Procedure
- (a) Two sentence types:
 - wh sentences
 - non-wh comparison sentences
 - (b) Stimuli presented on note cards (Japanese orthography), in pseudo-random order
 - (c) 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
 - intended to control for context-dependent factors, such as new versus old information, that are known to affect prosody
 - (d) Each stimulus was read twice consecutively
- (18) Factors in design: wh stimuli (28 sentences * 2 repetitions)
- (a) seven different syntactic structures (coded *w1-w7*)
 - (b) each structure used with two different sets of lexical items (coded *x* or *y*)
 - or, two different scope interpretations for the scope-ambiguous structure *w7*
 - (c) each sentence then had unaccented- and accented-noun versions (coded *a* or *u*)
- (19) Factors in design: non-wh stimuli (8 sentences * 2 repetitions)
- (a) four different syntactic structures (coded *n1-n4*; match *w1-w4*)
 - (b) each non-wh structure also had unaccented- and accented-noun versions (*a* or *u*)
- (20) See the Appendix for all sentences and identifier codes (used in data graphics)
- (21) Example context (translated) and stimulus (*code w6xa; nested wh-C pairs*)

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	wakaru	to	Ø?
<i>who-NOM</i>	<i>Noriko-NOM</i>	<i>where</i>	<i>playing-is</i>	<i>C_[+wh]</i>	<i>know</i>	<i>PRT</i>	<i>C_[+wh]</i>

‘Who knows where Noriko is playing?’

- (22) Recording and analysis
 - (a) Recorded in sound-attenuated room, Kyushu University, Hakozaki campus
 - (b) Marantz PMD 660 digital recorder (sampling rate 44.1 kHz); Radio Shack 33-3012 head-mounted microphone
 - (c) Analysis in Praat, v. 5.1.11 (Boersma & Weenink 2009)

3.2.2 *Perception experiment*

- (23) Only speakers S08, S09, S10, S11, S12, and S14 took part in the perception task
- (24) Stimuli were of three types
 - (a) Ambiguous: compatible with matrix or embedded scope
 - (b) Unambiguous with expected embedded scope
 - (c) Unambiguous with expected matrix scope
- (25) All three types of stimuli were recorded with two types of prosody, one appropriate for embedded scope and one appropriate for matrix scope
 - The unambiguous sentences therefore each had one version where semantic information and prosody were in conflict
- (26) The experimental task
 - (a) Sound files were presented to each participant individually over headphones
 - (b) Participants responded to each stimulus by selecting an answer to the question
 - answer choices included one for a matrix scope interpretation, one for an embedded scope interpretation, and one that said 'neither'
 - (c) Distractor items: simple matrix wh questions, and matrix yes/no questions containing wh+ka indefinites

4 Accent deletion in the wh domain

- (27) Main diagnostic of the wh domain, according to Kubo (1989 et seq.):
Deletion (absence) of pitch accents on otherwise accented words
- (28) First step in current study:
Determine the extent to which accent deletion (absence) is observed
 - (a) Goal: Examine wh questions containing lexically accented nouns and determine whether or not the nouns are accented (§4.2)
 - (b) But – there needs to be a diagnostic for accentedness (§4.1)

4.1 Diagnosing accent: The F0 decrease score

(29) Phonetics of accent in Fukuoka Japanese (similar to Tokyo)

- (a) An accent is realized as a fall from high to low tone
- (b) There is at most one accent per word; some words have no accent

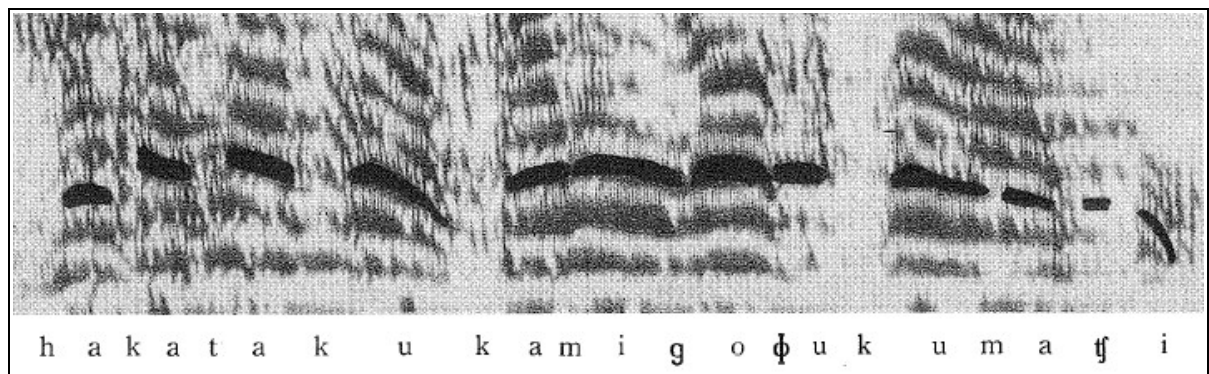
(30) In principle: Is a word accented? = Does the word have a pitch fall?

(31) Complication #1: Declination

- (a) Pitch decreases gradually across an utterance (in FJ as in many languages)
- (b) So, even an unaccented word may have a lower F0 on later moras
- (c) The crucial question is not whether there is a pitch fall...
- (d) ...but whether any observed pitch fall is **large enough** to be an accent

(32) Complication #2: Potential interspeaker differences in “large enough”

Hayata (1985: 8) – spectrogram from elderly FJ speaker; 3rd glottal harmonic is highlighted



- (a) ...ka.mi-go.hu.ku.má.ti
 - elderly Fukuoka speakers
 - ‘young’ Kitakyushu, Izuka
 - Hayata himself (Tokyo)
- (b) ...ka.mi-go.hu.kú.ma.ti
 - ‘young’ FJ speakers
 - ‘young’ Saga, Nagasaki

(33) Complication #3: Inter-speaker accent(edness) differences in lexical entries

- (a) Speakers are exposed to Tokyo prescriptive norms and other regional dialects
- (b) Different speakers may have lexicalized the same “accented” Fukuoka words with accent on different moras, or no accent at all

(34) Goal—Develop an empirical diagnostic for accent that

- (a) can be established on a speaker-by-speaker basis
- (b) does not depend on any a priori assumptions about the location of the accent or the size of the F0 fall

- (35) Proposed method: Compute **F0 decrease score**
- (a) Mark the vowel portion of each mora of a word
 - (b) Measure the average F0 in each interval
 - (c) Calculate ratios for each pair of adjacent moras
 - (d) Ratio shows amount and direction of change:
 - $\mu_2/\mu_1 = 1$ no change
 - $\mu_2/\mu_1 > 1$ F0 rise
 - $\mu_2/\mu_1 < 1$ F0 fall
 - (e) Take ln of μ -to- μ F0 ratios (Models F0 perception – proportional to semitones)
 - $\ln(\mu_2/\mu_1) = 0$ no change
 - $\ln(\mu_2/\mu_1) > 0$ F0 rise
 - $\ln(\mu_2/\mu_1) < 0$ F0 fall
 - (f) Add together all negative values for the word
>> Result is **F0 decrease score**

(36) Predictions

- (a) Accented words (phonologically relevant pitch fall) should have a larger F0 decrease score than unaccented words (no phonologically relevant pitch fall)
- (b) This measure can also diagnose accent inside a wh span

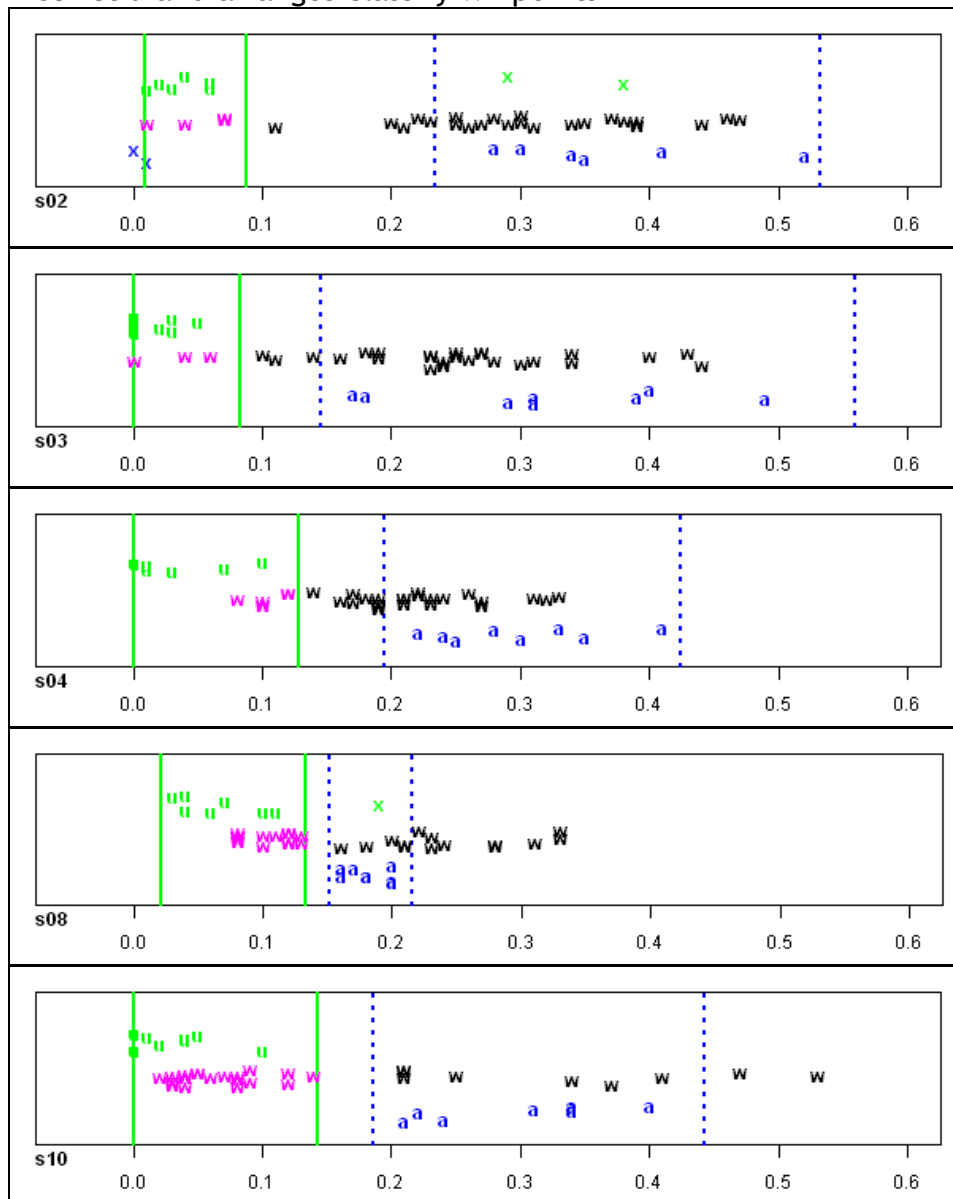
4.2 Accent deletion inside the wh domain

- (37) F0 decrease score can be used to answer these questions:
- (a) Are accented and unaccented nouns distinguished in non-wh contexts?
 - (b) Do lexically accented nouns in wh questions behave like unaccented nouns in non-wh contexts?
- (38) 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 based on accentedness judgments of the nouns in isolation (with a case suffix) collected from two Fukuoka speakers
- (39) In the graphs shown below:
- (a) Unaccented nouns from non-wh contexts are in the top third of the plot (**u**)
 - (b) Accented nouns from non-wh contexts are in the bottom third of the plot (**a**)
 - (c) Lexically accented nouns from wh contexts are in the middle third of the plot (**w**)
- (40) Category-change u/a items: Any **u** or **a** point that lies in the *middle* of the ‘cloud’ of the other category (not the *near edge*) is considered to belong to the other category for that speaker, and is replaced with **x** in the plot

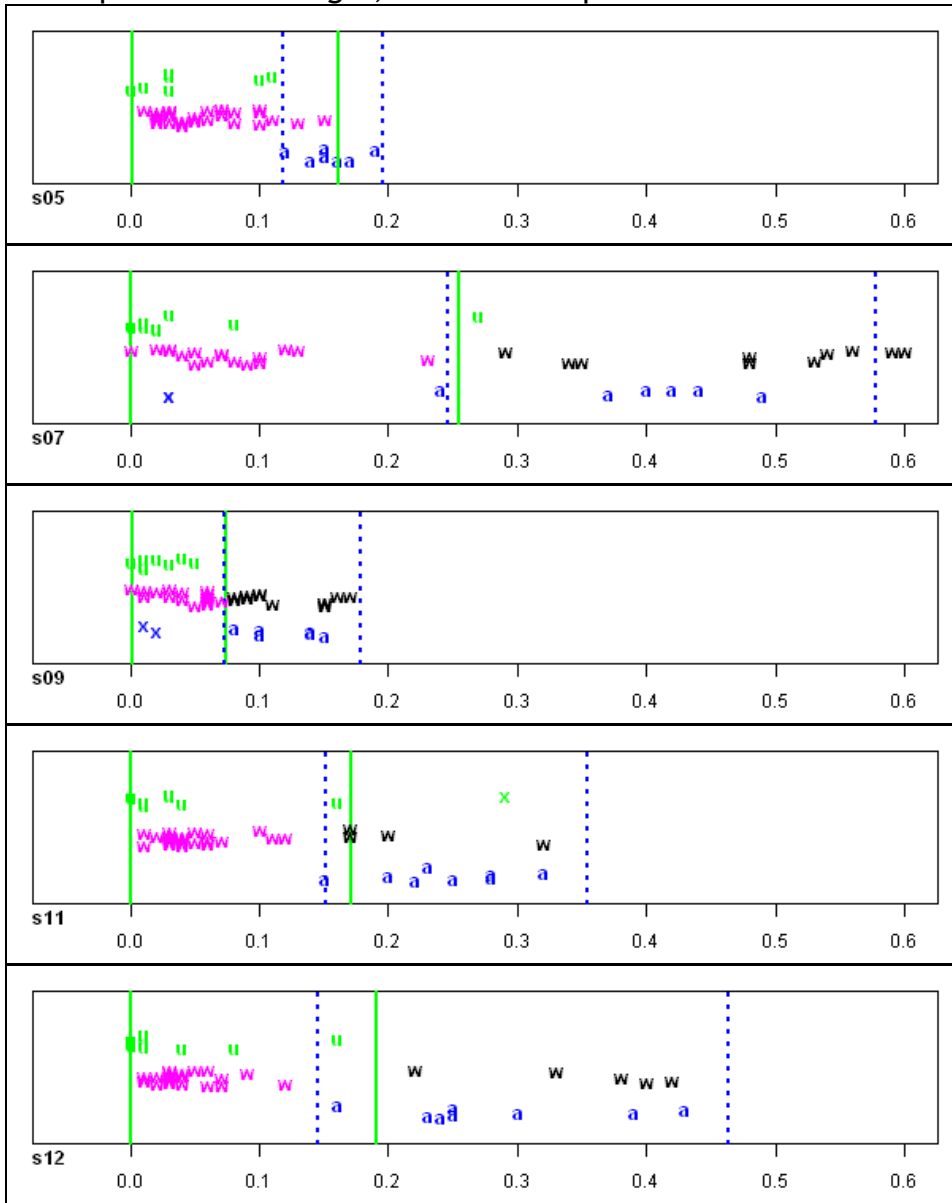
(41) Classifying wh points

- (a) For each speaker, the u and a points (not x) were used to estimate u and a gamma distributions
- (b) The F0 decrease score range representing the 95% probability range – the range in which 95% of points belonging to that distribution would theoretically fall – is marked for each u and a distribution (solid line=u; dotted line=a)
- (c) If a wh point (w) falls inside the 95% range for the u distribution (or is even smaller), but does not fall inside the 95% range for the a distribution, it is classified as showing accent deletion

(42) Distinct u and a ranges classify wh points

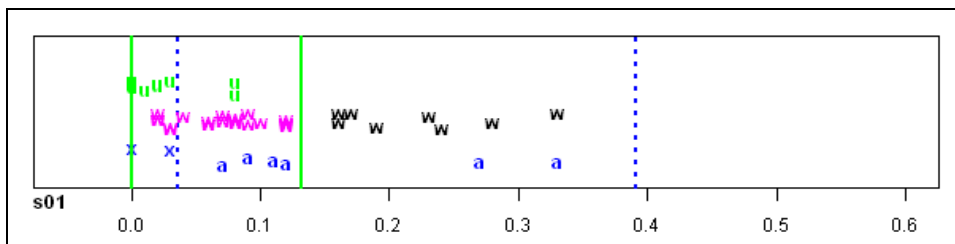


(43) Overlap in u and a ranges, but most wh points classifiable

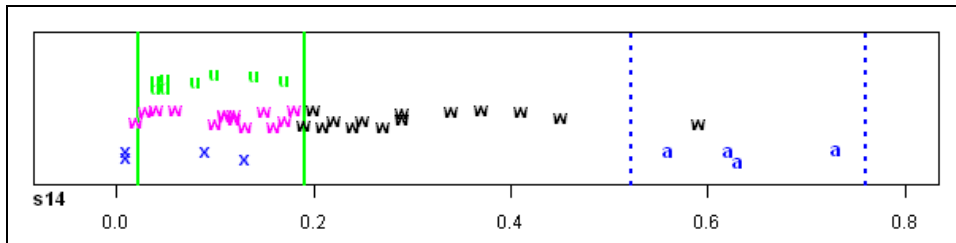


(44) Complicated cases – not included in prosody/scope analysis in §5 below

(a) S01 – If only two non-wh nouns are actually unaccented for this speaker, a lot more wh tokens would be classified as unaccented



(b) S14 – The wh points form a continuous cloud that is outside the accented 95% range, but are they truly all unaccented? (Impressionistically, this speaker doesn't sound too typical for Fukuoka; he is the only male speaker; he is furthest from F. city...)



(45) Noun accents in wh domain, by participant
(see Appendix for stimulus codes and full sentences)

	w1	w1	w2	w2	w3	w3	w4	w4	w5	w5	w6	w6	w7	w7
	xa	ya	xa	ya	xa	ya	xa	ya	xa	ya	xa	ya	xa	ya
S05 2	..	..	..	..	|.	..	..	|.	..	..	..	..	..	..
S11 4	..	..	..	..	..	..	..	..	..	..	..	..	A|	A|
S12 5	..	..	AA	..	..	..	AA	..	A.	..	..	..	..	..
S10 9	AA	..	AA	..	..	..	AA	..	A.	..	..	..	AA	..
S07 11	..	.A	..	AA	..	..	..	..	Aa	..	..	AA	AA	AA
S09 12	AA	..	..	..	A.	..	AA	AA	..	..	AA	A.	..	AA
S08 14	..	A.	AA	..	..	..	A.	AA	A.	..	AA	AA	AA	A.
S14 14?	aa	..	a.	aa	..	..	..	Aa	a.	a.	..	a.	aa	aa
S01 23?	||	||	|.	..	|.	||	AA	||	AA	|.	A|	AA	||	A|
S02 23	AA	Aa	AA	AA	Aa	AA	Aa	AA	AA	..	AA	a.	..	Aa
S04 23	..	..	aa	Aa	aa	aa	AA	AA	Aa	a.	AA	AA	AA	AA
S03 25	AA	AA	AA	a.	AA	..	Aa	AA	AA	Aa	AA	AA	AA	AA

KEY . = unacc 95% range (or above) a = between 95% ranges
 | = in both 95% ranges A = acc 95% range (or below)

(46) Summary of results by participant

- (a) Three participants (S05, S11, S12) have fewer than seven tokens (<25%) that failed to undergo accent deletion
- (b) Four participants (S07, S08, S09, S10) have no more than 14 tokens (≤50%) that failed to undergo accent deletion
- (c) Three more speakers (S02, S03, S04) showed very little accent deletion – excluded from wh prosody/scope analysis in §5
- (d) As noted above, S01 and S14 are also excluded from prosody/scope analysis

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

	w3 ya	w5 ya	w1 ya	w2 ya	w3 xa	w1 xa	w6 xa	w4 ya	w5 xa	w6 ya	w2 xa	w4 xa	w7 ya	w7 xa
S05 2	..	..	..	..	|.	..	..	|.	..	..	..	..	..	..
S11 4	..	..	..	..	..	..	..	..	..	..	..	..	A|	A|
S12 5	..	..	..	..	..	..	..	..	A.	..	AA	AA	..	..
S10 9	..	..	..	..	..	AA	..	..	A.	..	AA	AA	..	AA
S07 11	..	..	.A	AA	..	..	..	..	Aa	AA	..	..	AA	AA
S09 12	..	..	..	..	A.	AA	AA	AA	..	A.	..	AA	AA	..
S08 14	..	..	A.	..	..	..	AA	AA	A.	AA	AA	A.	A.	AA
S14 14?	..	a.	..	aa	..	aa	..	Aa	a.	a.	a.	..	aa	aa
S01 23?	||	|.	||	..	|.	||	A|	||	AA	AA	|.	AA	A|	||
S02 23	AA	..	Aa	AA	Aa	AA	AA	AA	AA	a.	AA	Aa	Aa	..
S04 23	aa	a.	..	Aa	aa	..	AA	AA	Aa	AA	aa	AA	AA	AA
S03 25	..	Aa	AA	a.	AA	AA	AA	AA	AA	AA	AA	Aa	AA	AA

(48) Summary of results by participant and item

(a) In general, no syntactic structure consistently impeded accent deletion

- Same syntactic structure → same first two symbols in identifier code
- The exception is the scope-ambiguous w7 structure, a special case (see §5.1)

(b) One lexical item may have impeded accent deletion: onígrí ‘rice ball’, in w4xa

(49) For seven 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 prosody/scope analysis will examine these seven speakers only

5. The relationship between wh prosody and wh scope

(50) For the seven Fukuoka speakers with 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

(51) Crucial comparison is between:

- sentences where the wh scope ends at an embedded C
- sentences where the wh scope extends to the end of the matrix clause

- (52) Kubo's generalizations predict:
- (a) accent near the end of the embedded clause in the first case (embedded scope)
 - (b) but no accent at that position in the second case (matrix scope)

5.1 Ambiguous structures

- (53) 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

- (54) Problem: Embedded question complementizers in the Fukuoka dialect are generally specified as [+wh] or [-wh] – disambiguate the intended wh scope

Solution: Use [wh V-*te mo*] structure, meaning 'no matter wh Vs' (in the case of embedded wh scope)

- (55) Sentences with ambiguous wh scope (structure w7; see Appendix)

- (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?'

- (56) Measurement method (measured vowels in **gray**)

Dare-ga norimaki-o **ut-te mo**] ii to Ø?
who-NOM norimaki-ACC sell-TE C ok PRT C

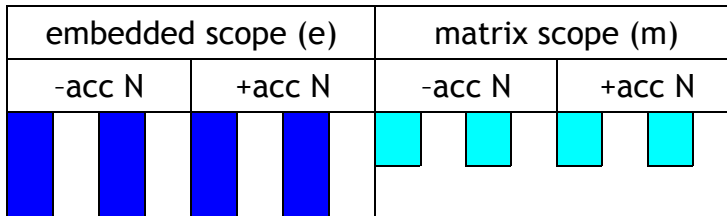
- (a) Measure vowel portion of antepenult μ in V (at or before any accented μ)
- (b) Measure vowel portion of embedded C
- (c) Compute ratio: μ_C/μ_V

- (d) Take ln of ratio • $\ln(\mu_C/\mu_V) = 0$ | no change → no accent at emb C
- $\ln(\mu_C/\mu_V) > 0$ | F0 rise → no accent at emb C
- $\ln(\mu_C/\mu_V) < 0$ | F0 fall → accent at emb C (if enough fall)

(57) Prediction:

- Items in the embedded-scope context should have a larger negative change than items in the matrix-scope context

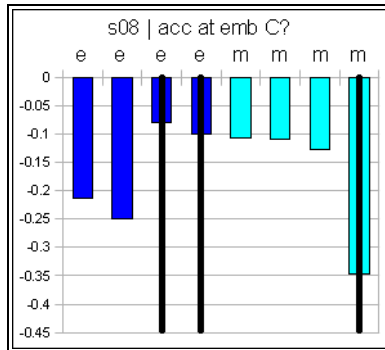
(58) Predicted F0 difference pattern



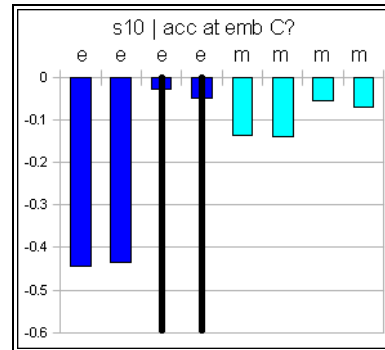
(59) Speakers who show a consistent wh-prosody/scope correlation

- Dark bars = embedded scope; light bars = matrix scope; thin black lines = item excluded because deaccenting did not occur

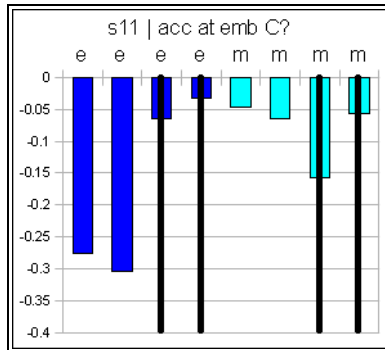
S08



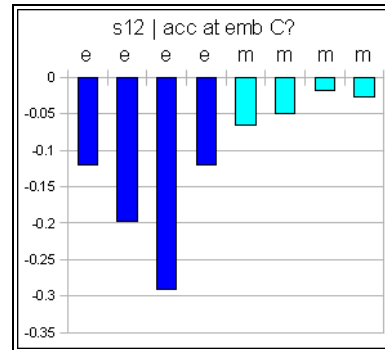
S10



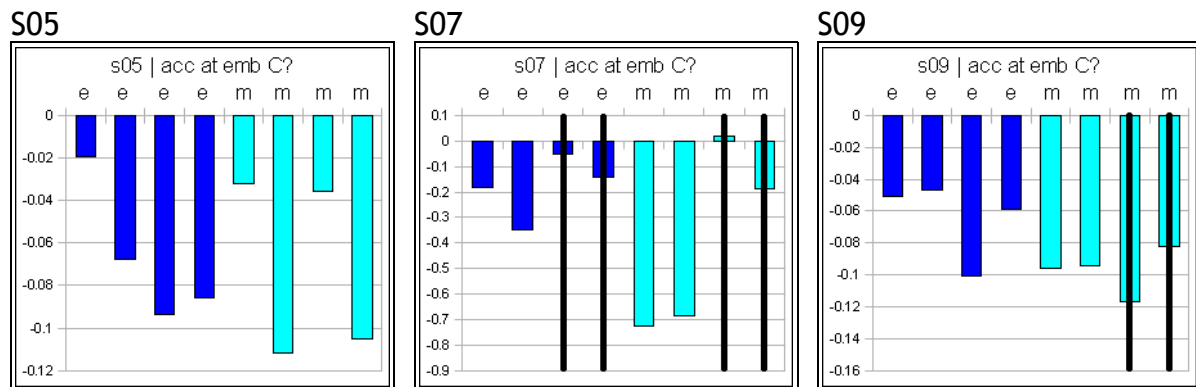
S11



S12



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



(61) As seen in §4.2, these sentences were particularly likely to resist accent deletion

- (a) Background contexts needed to disambiguate these sentences may have been less natural?
- (b) Background context, or the fact that these were ambiguous, may have encouraged productions with (contrastive) focus?
- More research is needed on the interaction of focus with wh prosody in Fukuoka (see Kubo 2005, 2009 for preliminary examples and discussion)

5.2 Unambiguous structures

(62) Question: Does wh domain match wh scope when segmental string is **unambiguous**?

- Same measurement method as for ambiguous cases (measured vowels in **gray**)

(63) Test structures ([...] indicates syntactic clause structure)

(a) 1 wh in embedded clause, embedded scope (**1wh-e**; code w2 in Appendix)

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

(b) wh in relative clause, matrix scope (**1wh-m**; code w3 in Appendix)

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

(c) 2 wh in embedded clause, embedded scope (**2wh-e**; code w5) — 'wh-wh-C'

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

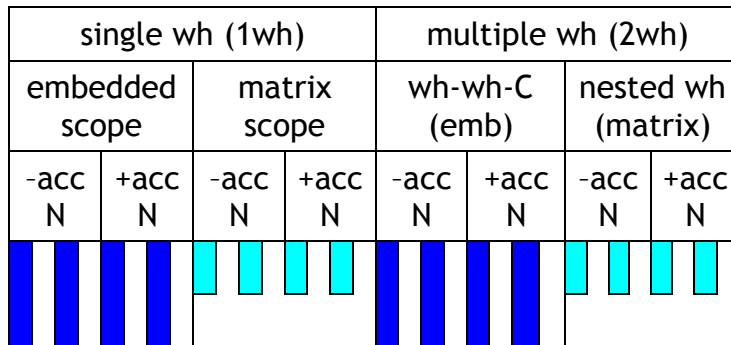
(d) 2 nested wh/C pairs, outer wh = matrix scope (**2wh-m**; code w6)

dare-ga [Noriko-ga doko de asobi-yoo ka] waku to Ø?
 who-NOM Noriko-NOM where at is-playing C know PRT C
 'Who knows where Noriko is playing?'

(64) Predictions

- Embedded scope items should have larger neg. change than matrix scope items
- Nested wh structure (2wh-m) should not show accent at embedded C because scope of first wh element extends beyond embedded clause to matrix clause

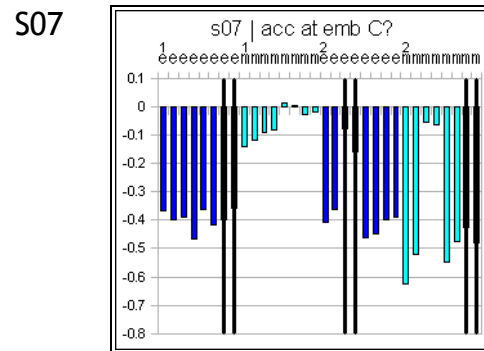
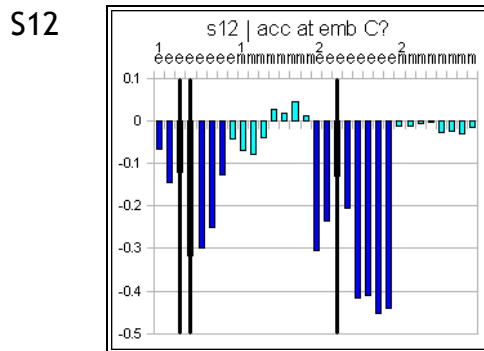
(65) Predicted F0 difference pattern (note: two repetitions of each item)



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

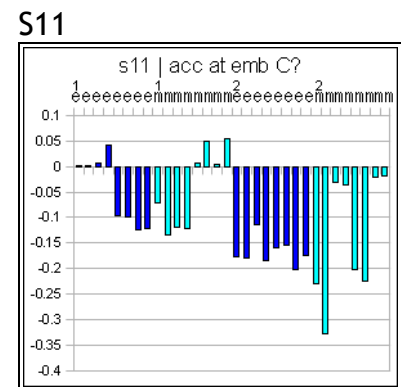
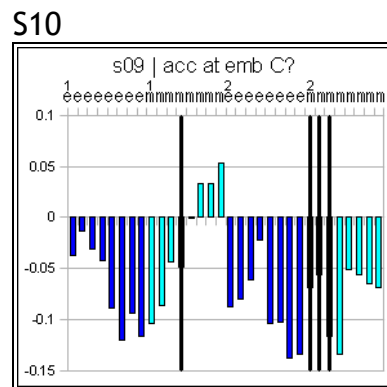
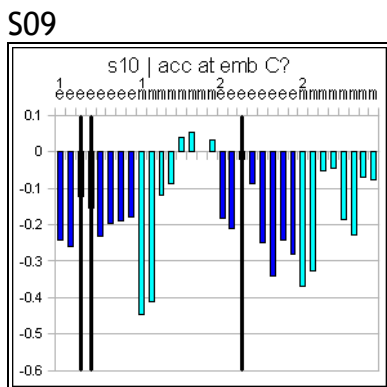
(a) For all conditions (single (1wh)/ multiple (2wh), embedded (e)/ matrix (m))

(b) For single wh (1wh-e, 1wh-m) and wh-wh-C (2wh-e), but not for nested wh (2wh-m)

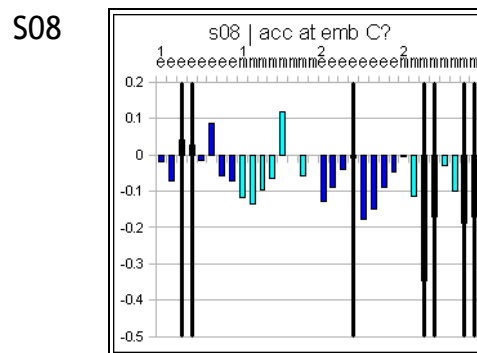
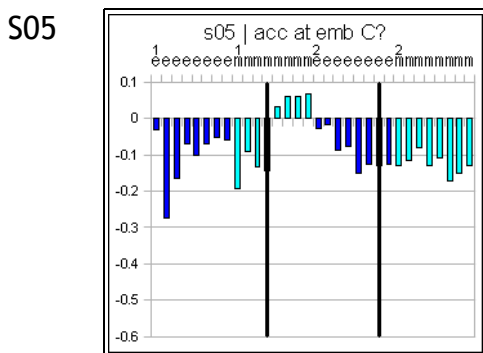


(67) Speakers with no consistent wh-domain/scope correlation

(a) Some evidence of correlation, but notable exceptions



(b) Results seem quite random



5.3 Discussion: wh prosody and scope

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

structure:	single wh		multiple wh		ambiguous	
	<i>embedded</i>	<i>matrix</i>	<i>embedded (wh-wh-C)</i>	<i>matrix (nested wh)</i>	<i>embedded</i>	<i>matrix</i>
S12	○	○	○	○	○	○
S10	○	△	△	△	○	○
S11	△	△	△	△	○	○
S07	○	○	○	△	×	×
S09	△	△	△	△	×	×
S05	△	△	△	×	△	×
S08	×	×	×	×	○	○

(a) Three participants (S12, S10, S11) show good or medium prosody/scope match

(b) Two more participants (S07 and S09) show good or medium match if ambiguous (*V-te mo*) items are excluded

(c) The remaining two participants (S05, S08) show little or no correlation (except in the ambiguous cases, for S08)

(69) Discussion

(a) Some speakers (S08, S10, S11): better prosody/scope match in ambiguous cases

- Compare Hirotani's (2005) finding: Tokyo speakers do not necessarily use wh prosody/scope correlations in production unless deliberately *disambiguating*

(b) But, other speakers (S07, S09) show stronger correlation in unambiguous cases

(c) The nested-wh structure (2w-m) shows less prosody/scope correlation than other unambiguous structures for some speakers (s05, s07)

- Somewhat complex to interpret; did speakers have a different interpretation in mind from the intended one (despite the background context)?

6. Preliminary results: Prosody/scope correlation in production vs. perception

6.1 Materials and design

(70) Three sentence types (plus distractor items) were used

(71) **Ambiguous** structure (compatible with either matrix or embedded prosody)

Ziroo-ga nan-no hi ni dare to atta ka wakaran to Ø?
JiROO-NOM what-GEN day on who with met C don't.know PRT C

(embedded wh scope) 'Do (you) not know [_{CP} who Jiro met when]?'
 (matrix wh scope) 'What day is it that (you) don't know who Jiro met (then)?'

(a) Right. (I) don't know. (indicates embedded wh interpretation)
 (b) The day of the wedding. (indicates matrix wh interpretation)

(72) **Unambiguous structure – embedded scope** expected

Naoya-wa Mariko-ga nani-o katta ka wakaran to Ø?
Naoya-TOP Mariko-NOM what-ACC bought C doesn't.know PRT C

(embedded wh scope) 'Does Naoya not know what Mariko bought?'
 (forced matrix interpretation?) 'What doesn't Naoya know whether Mariko bought?'

(a) Right. (He) doesn't know. (indicates embedded wh interpretation)
 (b) A coat. (indicates matrix wh interpretation)

(73) **Unambiguous structure – matrix scope** expected

Yoohei-wa Emiko-ga nani-o nonda ka.doo.ka wakaran to Ø?
Yoohei-TOP Emiko-NOM what-ACC drank C doesn't.know PRT C

(matrix wh scope) 'What doesn't Yoohei know whether Emiko drank?'
 (forced emb interpretation?) 'Does Yoohei not know what Emiko drank?'

(a) Wine. (indicates matrix wh interpretation)
 (b) Right. (He) doesn't know. (indicates embedded wh interpretation)

6.2 Results and discussion

(74) Perception results: Ambiguous items • Disambiguated by prosody?

	<i>matrix</i> prosody				<i>embedded</i> prosody			
	1 wh; V-te-mo		2 wh		1 wh; V-te-mo		2 wh	
	(1a)	(2a)	(3a)	(4a)	(1b)	(2b)	(3b)	(4b)
S08	<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	<u><i>e</i></u>	<u><i>e</i></u>	<u><i>e</i></u>	<u><i>e</i></u>
S09	<i>e</i>	<i>e</i>	*	<i>e</i>	<u><i>e</i></u>	<u><i>e</i></u>	*	*
S10	<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	<u><i>e</i></u>	<u><i>e</i></u>	<i>m</i>	<u><i>e</i></u>
S11	<u><i>m</i></u>	<u><i>m</i></u>	<u><i>m</i></u>	<u><i>m</i></u>	<i>m</i>	<i>m</i>	<u><i>e</i></u>	<u><i>e</i></u>
S12	<u><i>m</i></u>	<u><i>m</i></u>	<i>e</i>	<i>e</i>	<u><i>e</i></u>	<u><i>e</i></u>	<u><i>e</i></u>	<u><i>e</i></u>

KEY *m* = matrix interpretation *e* = embedded interpretation * = rejected
m,e = predicted response *m,e* = not predicted response

(75) Perception results: Unambiguous items (only one scope interpretation expected)
 • Is (expected) scope/prosody mismatch ungrammatical? If not, what prevails?
 • Does (expected) scope/prosody match lead to high matching response rate?

	only <i>matrix</i> interpretation expected				only <i>embedded</i> interpretation expected			
	matrix prosody		embedded prosody		matrix prosody		embedded prosody	
	(7a)	(7b)	(8a)	(8b)	(5a)	(6a)	(5b)	(6b)
S08	*	<u><i>m</i></u>	* _	<u><i>e</i></u>	<i>e</i>	<i>e</i>	<i>m</i>	<i>m</i>
S09	<i>e</i>	<i>e</i>	* _	<u><i>e</i></u>	<i>e</i>	* _	<u><i>e</i></u>	<u><i>e</i></u>
S10	<i>e</i>	<i>e</i>	<u><i>e</i></u>	<i>m</i>	<i>e</i>	<u><i>m</i></u>	<u><i>e</i></u>	<u><i>e</i></u>
S11	<u><i>m</i></u>	<u><i>m</i></u>	<i>m</i>	<i>m</i>	<u><i>m</i></u>	<u><i>m</i></u>	<u><i>e</i></u>	<u><i>e</i></u>
S12	<i>e</i>	<i>e</i>	<u><i>e</i></u>	<u><i>e</i></u>	<u><i>m</i></u>	<i>e</i>	<u><i>e</i></u>	<u><i>e</i></u>

(76) Perception results: Summary by participant / comparison with production results

	Perception results			Production results	
	<i>Ambiguous</i>	<i>Unambiguous, prosody match</i>	<i>Unambiguous, prosody mismatch</i>	<i>Ambiguous</i>	<i>Unambiguous</i>
S08	'e' bias	'm' bias	'e' bias	○	×
S09	'e' bias / *	'e' bias	'e' bias	×	△
S10	'e' bias	'e' bias	at chance?	○	△
S11	△	○	'm' bias	○	△
S12	△	'e' bias	'e' bias	○	○

(77) Summary of results

- (a) Prosody/scope match behavior in production task does not necessarily predict that prosody will determine interpretation in perception task
- (b) Many participants appear to have particular response biases, for embedded (or sometimes matrix) interpretations
- (c) Could some of these patterns be task effects?
 - Small number of participants and small number of items
 - Distractor items were still questions/choose answers; too similar to stimuli?
 - There was an error in stimulus randomization, such that most of the expected 'm' and 'e' responses were accidentally presented in blocks (though this does not predict the consistent 'e' or 'm' response biases across conditions)
 - Questions complex and hard to process on one hearing only?

7. Conclusions

(78) Some, but not all, speakers showed a strong tendency to deaccent in the wh domain

- No speaker deaccented in every case
- Compare Igarashi (2007), Igarashi & Kitagawa (2007)

(79) Several speakers showed evidence of a wh prosody/scope correlation

Planned follow-ups:

- Use data from the more “reliable” speakers to examine further generalizations from Kubo’s work
- Look for regularities in the behavior of the less “reliable” speakers
- Pursue perception experiments with FJ speakers

(80) Possible reasons for behavior that diverges from Kubo’s descriptions

(a) Speakers’ grammar may differ from Kubo’s

- younger generation – dialect change in progress?
- different speakers may show different degrees of convergence with non-FJ dialects

(b) Kubo’s introspective judgments may not capture the whole range of grammatical intonation behavior

(c) Experimental situation?

- speakers may not have had the intended semantic representation in mind
- the laboratory situation may have contributed to less-natural production

Acknowledgments

- Many thanks to all experiment participants
- Thanks to Tomoyuki Kubo, Randall Hendrick, and FAJL 5 for discussion and comments
- Thanks to Noriyuki Ikeda, Yui Izumo, Tomoyuki Kubo, Naomi Matsunaga, Reiko Mazuka, Go Mizumoto, Elliott Moreton, Tsutomu Sakamoto, Kumiko Sato, Maki Takahashi, and Daichi Yasunaga for assistance with experiment design and preparation
- Thanks to Chris Wiesen for statistics consultation and support
- Thanks to Shigeto Kawahara for his list of Japanese words with sonorant consonants
- Thanks to Mietta Lennes for Praat scripts
- Additional research support was provided by the Kyushu University Linguistics Department and a Carolina Asia Center Faculty Travel Grant

Appendix: Materials

(See §3.2.1 for an explanation of the *n*– and *w*– codes for the production stimuli)

(A1) Production stimuli: Unaccented nouns (in non-wh structures)

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

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

(A2) Production stimuli: Accented nouns (in non-wh structures)

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

- n1a Imanisi-ga doyoobi aómusi 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 siran’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 onígiri-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) Production stimuli: wh questions with lexically accented nouns

- Nouns measured for Analysis 1 (F0 decrease score, §4) are underlined
- Measurement points for Analysis 2 (prosody and scope, §5; see also (A4)) in w2, w3, w5, w6, and w7 are underlined and italicized; expected default penultimate accents are marked

- w1xa nan.de kyoo imómusi-ga ooi to Ø?
why today hornworm-NOM numerous PRT C
 ‘Why are there so many hornworms today?’

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- w1ya dare-ga doyoobi aómusi-ni yarareta to Ø?
 who-NOM Saturday caterpillar-by done PRT C
 ‘Who was hit by caterpillars on Saturday?’
- w2xa [dare-ga doyoobi aníyome-o yondá k̄a] siran’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 k̄a] siran’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 [itu 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] 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.?’
- w4xa dare-ga omise-de dare-ni onígiri-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 k̄a] 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 k̄a] 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 Noriko-ga [doko de asobi-yoo k̄a] wakaru to Ø?
 who-NOM Noriko-NOM where at playing-is C knows PRT C
 ‘Who knows where Noriko is playing?’
- w6ya dare-ga Naoya-ga [itu arawareru k̄a] 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 norímaki-o ut-té mo] 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 [norímaki-o ut-te mo] 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, §5)

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

(a) single wh in embedded clause, embedded scope (1wh-e)

w2xa (see A3)

w2xu [dare-ga doyoobi Murayama-o yondá k̄a] siran’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 takusan arú k̄a] siran’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 (1wh-m)

w3xa (see A3)

- w3xu kyoo-wa [itu moratte.kita] y_gmaimo-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] hito 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 M.?’

(c) multiple wh in embedded clause, both with embedded scope (2wh-e)

- w5xa (see A3)
- w5xu [dare-ga doyoobi doko de yamaimo-o yaita ka] 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-yoo ka] 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 (2wh-m)

- w6xa (see A3)
- w6xu dare-ga Naomi-ga [doko de asobi-yoo ka] 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 [itu arawareru ka] 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-te mo] 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 mo] 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)

(A5) Perception stimuli (§6): Structures with ambiguous wh scope

- 1a matrix wh prosody
 Dare-ga kudamono-o ut-te mo ii to Ø?
who-NOM fruit-ACC sell-TE C good PRT C
 ‘For whom is it okay, even if they sell fruit?’
- 1b embedded wh prosody
 [Dare-ga kudamono-o ut-te mo] ii to Ø?
who-NOM fruit-ACC sell-TE C good PRT C
 ‘Is it okay, no matter who sells fruit?’
- 2a matrix wh prosody
 Nani-o torakku de hakon-de mo ii to Ø?
what-ACC truck by transport-TE C good PRT C
 ‘For what is it okay, even if (I) transport it by truck?’
- 2b embedded wh prosody
 [Nani-o torakku de hakon-de mo] ii to Ø?
what-ACC truck by transport-TE C good PRT C
 ‘Is it okay, no matter what (I) transport by truck?’

- 3a matrix wh prosody
 Ziroo-ga nan-no hi ni dare to atta ka wakaran to Ø?
Jiroo-NOM what-GEN day on who with met C don't.know PRT C
 'What day is it that (you) don't know who Jiro met (on that day)?'
- 3b embedded wh prosody
 [Ziroo-ga nan-no hi ni dare to atta ka] wakaran to Ø?
Jiroo-NOM what-GEN day on who with met C don't.know PRT C
 'Do (you) not know [CP who Jiro met when]?'
- 4a matrix wh prosody
 Ayako-ga doko de nani-o wasureta ka wakaran to Ø?
Ayako-NOM where at what-ACC forgot C don't.know PRT C
 'Where is it that (you) don't know what Ayako forgot (there)?'
- 4b embedded wh prosody
 [Ayako-ga doko de nani-o wasureta ka] wakaran to Ø?
Ayako-NOM where at what-ACC forgot C don't.know PRT C
 'Do (you) not know [CP where Ayako forgot what]?'

(A6) Perception stimuli (§6): Structures with expected embedded scope

- 5a matrix wh prosody (ungrammatical-?)
 Naoya-wa Mariko-ga nani-o katta ka wakaran to Ø?
Naoya-TOP Mariko-NOM what-ACC bought C doesn't.know PRT C
 (prosody-compatible interpretation:) 'What doesn't Naoya know whether M. bought?'
- 5b embedded wh prosody
 Naoya-wa [Mariko-ga nani-o katta ka] wakaran to Ø?
Naoya-TOP Mariko-NOM what-ACC bought C doesn't.know PRT C
 'Does Naoya not know what Mariko bought?'
- 6a matrix wh prosody (ungrammatical-?)
 Tiekō-wa Kenzi-ga dare to odotta ka wakaran to Ø?
Chieko-TOP Kenji-NOM who with danced C doesn't.know PRT C
 (prosody-compatible interpretation:) 'Who doesn't C. know whether K. danced with?'
- 6b embedded wh prosody
 Tiekō-wa [Kenzi-ga dare to odotta ka] wakaran to Ø?
Chieko-TOP Kenji-NOM who with danced C doesn't.know PRT C
 'Does Chieko not know who Kenji danced with?'

(A7) Perception stimuli (§6): Structures with expected matrix scope

- 7a matrix wh prosody
 Yoohei-wa Emiko-ga nani-o nonda ka.doo.ka wakaran to Ø?
Yoohei-TOP Emiko-NOM what-ACC drank C doesn't.know PRT C
 'What doesn't Yoohei know whether Emiko drank?'
- 7b embedded wh prosody (ungrammatical-?)
 Yoohei-wa [Emiko-ga nani-o nonda ka.doo.ka] wakaran to Ø?
Yoohei-TOP Emiko-NOM what-ACC drank C doesn't.know PRT C
 (prosody-compatible interpretation:) 'Does Yoohei not know what Emiko drank?'
- 8a matrix wh prosody
 Minako-wa Yuuta-ga dare to kenka.sita ka.doo.ka wakaran to Ø?
Minako-TOP Yuuta-NOM who with quarreled C doesn't.know PRT C
 'Who doesn't Minako know whether Yuuta quarreled with?'
- 8b embedded wh prosody (ungrammatical-?)
 Minako-wa [Yuuta-ga dare to kenka.sita ka.doo.ka] wakaran to Ø?
Minako-TOP Yuuta-NOM who with quarreled C doesn't.know PRT C
 (prosody-compatible interpretation:) 'Does Minako not know who Y. quarreled with?'

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