

*A Recursive Phonology Interface for WH-F  
Alternative Semantics*

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- (1) he earns more than  $\underbrace{\text{l earn}}_{\phi}$

phonology	[ay] "l" has highest prominence in phonological interval $\phi$ .
semantics	'x <sub>2</sub> earns <i>d</i> much' and 'spkr earns <i>d</i> much' are substitution alternatives, with substitution in the <i>y</i> position of 'y earns <i>d</i> much'.

- (2) an American farmer told a  $\underbrace{\text{CaNADian farmer}}_{\phi}$  a joke

phonology	Second syllable of <i>Canadian</i> has highest prominence in phonological interval $\phi$ .
semantics	$\lambda P \exists x [\text{american}(x) \wedge \text{farmer}(x)]$ $\lambda P \exists x [\text{canadian}(x) \wedge \text{farmer}(x)]$ are substitution alternatives, with substitution in the position <i>Y</i> of $\lambda P \exists x [Y(x) \wedge \text{farmer}(x)]$ .

- (3) ah11a1t — embedded wh-question (focus prosody within the embedded clause)

Naoya still remembers what Mari drank at the bar.

ah11a1t

ah11b1t — embedded yes/no-question (no focus prosody)  
Naoya still remembers whether Mari drank something at the bar.

ah11b1t

*Shin Ishihara*

- (4) Hokenzyo-wa [ syokutyuudoku-kanzya-zen'in-ga  
NA ni-o tabeta-ka ] ma da kakunin-dekinai-no↑?  
health.department-TOP food.poisoning-victim-all-NOM  
what-ACC ate-COMPWh yet confirm-cannot-COMP<sub>Y/N</sub>  
Is the Department of Health yet to be able to confirm [what all of those who suffered from food poisoning ate]?

*Kitagawa (2007)*

- (5) Hokenzyo-wa [ syokutyuudoku-kanzya-zen'in-ga  
NA ni-o tabeta-ka ] kakunin-siyoo-tositeiru-no ↑?  
health.department-TOP food.poisoning-victim-all-NOM  
what-ACC ate-COMPWthr trying.to.confirm-COMPWh

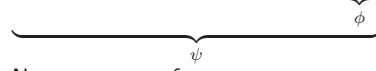
What<sub>1</sub> is such that the Department of Health is trying to confirm [whether all of those who suffered from food poisoning ate it<sub>1</sub> ]?

*Kitagawa (2007)*

### Phonology-Semantics Homomorphy I

The scope of F in English, and the scope of WH-F in Japanese agrees with the phonological domain of prominence.

- (6) You used to earn a little bit more than I did.  
NOW you earn MUCH more than I do.



#### Narrower-scope focus

phonology	[ay] "I" has highest prominence in phonological interval $\phi$ .
semantics	'hearer earns $d$ much' and 'spkr earns $d$ much' are substitution alternatives, with substitution in the $y$ position of 'y earns $d$ much'.

- You used to earn a little bit more than I did.  
NOW you earn MUCH more than I do.



#### Wider-scope focus

phonology	NOW and MUCH have more prominence than anything else in phonological interval $\psi$ .
semantics	'then hearer earned a little bit more than spkr earned' and 'now heard earns much more than spkr earns' are substitution alternatives, with substitution in the $t$ and $x$ positions of 'at $t$ hearer earns $x$ much more than spkr earns'.

- (7) Amy-wa  
[DA re-ga asokode nani-o katta-ka ] sonnani siritagatteiru-no ↑?  
-TOP who-NOM there what-ACC bought-COMPWh  
that.much want.to.know-COMP<sub>wh</sub>  
WHO<sub>1</sub> is such that Amy wants to know so eagerly [ what he<sub>1</sub> bought there ]?

Kitagawa (2005)

### Phonology-Semantics Homomorphy II

In configurations with two F's or two WH-F's with different semantic scopes, relative phonological prominence parallels relative semantic scope.

- (8) Stress F  
Let  $\beta$  be an F-marked phrase with scope  $\phi$ . Then the strongest stress in the phonological realization of  $\phi$  falls within the realization of  $\beta$ .

The core cases of SOF and recursive WH-F fall out of stress F.

(9) **Hypothesis**

1. WH in Japanese is literally focused.
2. WH/WH in Japanese is isomorphic to F/SOF in English  
This is stated explicitly in Ishihara (2006).
3. Pretty good accounts of the recursive effects, either stress F or cyclic spellout.

(10) Syntactic F movement

1. F drives movement
2. F has a phonological interpretation that is sensitive to LF scope. F-marked phrase is spelled out in a cycle later than its scope, with interpretation of greater prominence or specific intonational profile.
3. F+WH and F-WH have semantic interpretations that are sensitive to LF scope, like anything.

Why does WH subclassify F?

(11) UG feature geometry says that WH subclassifies F.

- +F+WH so-called WH
- +F-WH so-called F

Why does WH subclassify F?

(12) F and WH both use alternative semantics—they have a common meaning component, an 'alternative semantic value'.

The phonology interface that is relevant for F and F+WH is the recursive phonology interface for alternative semantic values.

**Alternative semantics architecture**

(13) Hamblin

- [<sub>VP</sub>Mary-o aisiteiru] { $\lambda x.\text{love}(x, \mathbf{m})$ }
- [<sub>VP</sub>dare-o aisiteiru] { $\lambda x.\text{love}(x, y)|\text{person}(y)$ }
- [<sub>VP</sub>Mary-o<sub>F</sub>aisiteiru] not analyzed

(14) Rooth

- [<sub>VP</sub>Mary-o aisiteiru] ordinary  $\lambda x.\text{love}(x, \mathbf{m})$   
focus { $\lambda x.\text{love}(x, \mathbf{m})$ }
- [<sub>VP</sub>dare-o aisiteiru] ordinary { $\lambda x.\text{love}(x, y)|\text{person}(y)$ }
- focus {{{ $\lambda x.\text{love}(x, \mathbf{m})|\text{person}(x)$ }}}
- [<sub>VP</sub>Mary-o<sub>F</sub>aisiteiru] ordinary  $\lambda x.\text{love}(x, \mathbf{m})$   
focus { $\lambda x.\text{love}(x, y)|y \in D$ }

(15) Beck

$[\text{VP} \text{Mary-o aiseiteiru}]$	ordinary	$\lambda x. \mathbf{love}(x, \mathbf{m})$
	focus	$\lambda x. \mathbf{love}(x, \mathbf{m})$
$[\text{VP} \text{dare-o aiseiteiru}]$	ordinary	undefined
	focus	$\lambda x. \mathbf{love}(x, y)$
$[\text{VP} \text{Mary-o}_F \text{ aiseiteiru}]$	ordinary	$\lambda x. \mathbf{love}(x, \mathbf{m})$
	focus	$\lambda x. \mathbf{love}(x, y)$

In the focus semantic values,  $y$  is a distinguished focus variable. Or really, meanings are functions from assignments to semantic values, with a focus variables distinguished in the domain of assignment functions (Wold 1996).

$\lambda g \lambda x. \text{if } \mathbf{person}(g(y)) \text{ then } \mathbf{love}(x, g(y)) \text{ else undefined}$

(16) Same, but with alternatives at recursive levels.

$[\text{VP} \text{Mary-o aiseiteiru}]$	ordinary	$\lambda x. \mathbf{love}(x, \mathbf{m})$
	focus	$\{\lambda x. \mathbf{love}(x, \mathbf{m})\}$
$[\text{VP} \text{dare-o aiseiteiru}]$	ordinary	undefined
	focus	$\{\lambda x. \mathbf{love}(x, y)   \mathbf{person}(y)\}$
$[\text{VP} \text{Mary-o}_F \text{ aiseiteiru}]$	ordinary	$\lambda x. \mathbf{love}(x, \mathbf{m})$
	focus	$\{\lambda x. \mathbf{love}(x, y)   y \in D\}$

(17) Plan

1.  $[\text{VP} \text{dare-o aiseiteiru}]$  and  $[\text{VP} \text{Mary-o}_F \text{ aiseiteiru}]$  have an identical meaning component, the focus semantic value.
2. That meaning component is obtained by recursively projecting alternatives.
3. The alternatives can project from the left in  $[\alpha\beta]$  only if  $\alpha$  is phonologically stronger than  $\beta$ .
4. Factor both the semantics and the phonology locally
  - 4.1 Semantics: recursive projection of alternatives
  - 4.2 Phonology: local comparison of prominence in binary tree

(18) Standardly, alternatives are projected automatically, using an image construction. The alternative set for a complex phrase  $[\alpha\beta]$  is the image of the normal semantic-combination function acting on the alternative sets for  $\alpha$  and  $\beta$ .

$[[\text{dare-o}]^f]$	$\{x   \mathbf{person}(y)\}$
$[[\text{aiseiteiru}]^f]$	$\{\mathbf{love}\}$
semantic op	$\lambda ab. b(a)$ (leftward function application)
$[[\text{dare-o aiseiteiru}]^f]$	$\{b(a)   a \in [[\text{dare-o}]^f] \wedge b \in [[\text{aiseiteiru}]^f]\}$
	$= \{\mathbf{love}(y)   \mathbf{person}(y)\}$

(19) Four local operators that project alternatives differently.

- 10 project alternatives from left child
- 01 project alternatives from right child
- 11 project alternatives from both
- 00 don't project alternatives

Let  $h$  be the ordinary semantic operation, e.g. leftward function application or rightward function application.

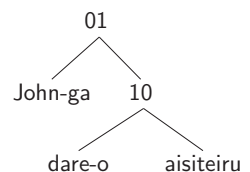
$$[[_{10}\alpha\beta]]^f = \{h(a, [[\beta]^o]) | a \in [[\alpha]^f]\}$$

$$[[_{01}\alpha\beta]]^f = \{h([[ \alpha]^o], b) | b \in [[\beta]^f]\}$$

$$[[_{11}\alpha\beta]]^f = \{h(a, b) | a \in [[\alpha]^f] \wedge b \in [[\beta]^f]\}$$

$$[[_{00}\alpha\beta]]^f = \{h([[ \alpha]^o], [[\beta]^o])\}$$

(20) A binary node embedding WH on the left has to be labeled 1x if the alternative-scope is to project. A binary node embedding WH on the right has to be labeled x1 if the alternative-scope is to project. Since  $[[\text{dare}]^o]$  is undefined, if this condition is not met  $[[.]^o]$  and  $[[.]^f]$  are both undefined.



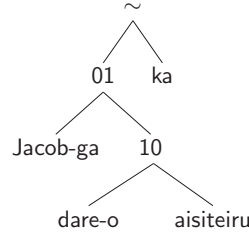
(21) Phonology (constraint version)

Given a node  $[\alpha\beta]$ , there is a grid column in the phonological interval corresponding to  $\alpha$  that is higher than every grid column in the phonological interval corresponding to  $\beta$ .

Given a node  $[\alpha\beta]$ , there is a grid column in the phonological interval corresponding to  $\beta$  that is higher than every grid column in the phonological interval corresponding to  $\alpha$ .

- 00 no constraint
- 11 maximal heights are equal, or no constraint?

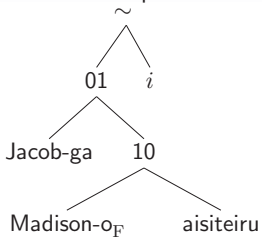
Termination operator for questions



$[[\phi]]^o$  set of propositions of the form  $\lambda w \mathbf{love}(w, j, y)$   
 $[[\phi]]^f$   $\{[[\phi]]^o\}$

$[[\sim\psi \text{ ka}]]^o = [[\psi]]^f$   
 $[[\sim\psi \text{ ka}]]^f = \{[[\sim\psi \text{ ka}]]^o\}$

Termination operator for ordinary F.



$[[\phi]]^o$   $\mathbf{love}(w, j, m)$ , with presupposition that  $g(i)$  entails that Jacob loves some entity.

$[[\phi]]^f$   $\{[[\phi]]^o\}$

$[[\sim\psi \ i]]^o = \partial[g(i) \rightarrow \cup[[\psi]]^f] \wedge [[\psi]]^o$

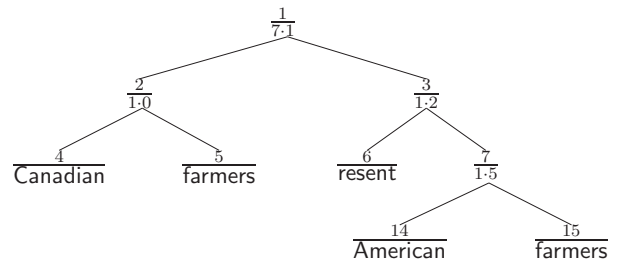
Type generalization of the licensing condition, as in givenness semantics for focus. (But with no interpretation of F at intermediate scopes.)

Two farmers in “farmer example” have a different phonological/phonetic status—first observed by Craige Roberts.

(22) [an AMERICAN farmer]<sub>3</sub>~ 4 was talking to [a CANADIAN farmer]<sub>4</sub>~ 3

Fery and Ishihara (2010) and Katz and Selkirk (in press) propose theories where an F can have a given scope (resulting in de-stressing of the scope) or a non-given scope. Selkirk represents this with FOC and F, or F and f.

This way of combining alternative semantics and givenness semantics is wrong, because givenness semantics is a generalization of alternative semantics.



### Advantages of stress-first architecture

Pitch is not the only correlate of F

Howell and Rooth (2009a, 2009b): web-derived corpus of comparatives with *than I did* in the than-clause.

- (23)a. She did more than I<sub>F</sub> did.  
 b. I wish I had done more than I did<sub>F</sub>.  
 c. I did more than I did before<sub>F</sub>.

The features that are useful an SVM binary classifier for focusing of subject "I" include pitch, but also vowel duration and vowel-quality.

(24) Classification experiment (Howell and Rooth 2009)

1. Sample of 91, 40 with subject focus and 51 with focus on *did* or later.
2. Hand labeling of intervals in signal.
3. Extract 308 acoustic parameters, including values for duration, intensity, energy, amplitude, f0, vowel formants, measures of spectral tilt or balance.
4. One-held out crossvalidation—in each run use 90 items for training, one for testing.
5. Train SVM binary classifier, and use it to classify the test item; pool classifications of test items.

Models without pitch do about as well as models with pitch.

- 89.0% just duration of V1  
 92.3% duration of V1, distance between F1 and F2 40% into V1,  
 duration of [d] closure