Second Occurrence Focus and Relativized Stress $F$

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1 Semantic and phonological scope of focus

In “anaphoric” or “givenness” theories of the semantics and pragmatics of intonational focus, the first sentence in (1) is in a certain sense the antecedent for the focus in the second sentence. The representation (2) makes the anaphora explicit using an operator “~” which marks the scope and the antecedent of the focus. The focused phrase is marked with the feature $F$.

(1) You boil your vegetables?
    I microwave my vegetables.

(2) \[
\begin{array}{l}
\text{[You boil your vegetables]}_s \\
\text{[I microwave}_{F}\text{ my vegetables]} \sim 8 \\
\end{array}
\]

The semantic part of anaphoric theories jointly constrains the denotation of the antecedent (here the proposition ‘John boils John’s vegetables’, assuming the second speaker is John) and the focus semantic value of the scope of the focus (here the set of propositions of the form ‘John $R$’s John’s vegetables’, where $R$ is an alternative to ‘boil’). A couple of versions of the constraint have been given (Rooth 1992, Rooth 1996, Schwarzschild 1999). Two options are stated in (3), restricting attention to the clauses which apply to (2).\footnote{The constraints include several subclauses or type accommodation principles which are conditioned by semantic type.} In order for the structure to be licensed, the focus constraint has to be satisfied. In this case, the first one is satisfied because the antecedent ‘John boils John’s vegetables’ is an element of the focus semantic value of the scope of the focus. The second version is satisfied because the union of the focus semantic value is a disjunction of propositions, and in this case one of them is the antecedent ‘John boils John’s vegetables’. Since a proposition $p_i$ entails
the disjunction \( p_1 \lor \ldots \lor p_i \lor \ldots \), the antecedent entails the union of the focus semantic value.

(3) a. Where \( \phi \) is the scope of the focus, the denotation of the antecedent is an element of \( \llbracket \phi \rrbracket^f \). (Rooth 1992)

b. Where \( \phi \) is the scope of the focus, the denotation of the antecedent entails the union of \( \llbracket \phi \rrbracket^f \). (Schwarzschild 1999)

In combination, the notation (2) and its interpretation (3) define a semantic notion of the scope of a focus.\(^2\) Truckenbrodt (1995) argued that this agrees with a phonological notion of the scope of focus, namely the domain of prominence of the focus. To capture the correlation, he advocated a Stress F constraint which in my discussion will be formulated as (4).\(^3\)

(4) 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 \( \beta \).

Suppose stress is represented in the metrical grid formalism (Prince 1983), and that the grid representation of (2) is along the lines of (5). Then Stress F is satisfied, because the strongest stress in the phonology of the whole sentence, namely the stress on the first syllable of \( \text{micro} \), falls within the phonological interval corresponding to the F-marked element \( \text{microwave} \). Stress F would not be satisfied if the first syllable of \( \text{vegetables} \) had greater grid prominence than the first syllable of \( \text{micro} \).

\[
\begin{array}{cccccccc}
\text{x} & \text{x} & \text{x} & \text{x} & \text{x} & \text{x} & \text{x} \\
\text{x} & \text{x} & \text{x} & \text{x} & \text{x} & \text{x} & \text{x} \\
\hline
\text{I} & \underline{\text{mi} \text{cro} \text{wave}} & \text{my} & \text{vege} & \text{ta} & \text{bles} \\
\end{array}
\]

Truckenbrodt’s argument for Stress F is based on examples like (6), where there is arguably a focus on \( \text{American} \) whose scope is the nominal \( \text{[an American farmer]} \), rather than the whole sentence.

(6) \( [s_{\text{sp}} \text{[an American}_{F} \text{ farmer]}_{1} \sim 2 \text{ told a } [s_{\text{sp}} \text{[a Canadian}_{F} \text{ farmer]}_{2} \sim 1] \text{ a joke}] \)

In the anaphoric theory, the scope of the foci on \( \text{American} \) and \( \text{Canadian} \) can not be the whole sentence, because the sentence can be used in discourse contexts where there is no available antecedent which has the form ‘a \( P \) farmer told a \( Q \) farmer a joke’, or which entails that a farmer of some nationality told a farmer of some na-

\(^2\)In Schwarzschild (1999), the scope of an F is marked by the next F up, rather than the \( \sim \) operator.

\(^3\)See also Jackendoff (1977), Rooth (1996), Büring (2006), Selkirk (2006).
tionality a joke. If the representation is as in (6) with a narrower scope for the focus on *American*, the constraint (3a) is satisfied for the focus on *American*, because as long as being Canadian is an alternative to being American, the denotation of the antecedent [a Canadian farmer] is an element of the focus semantic value for the scope of the focus.4

The point now is that the semantically-motivated scope of focus in (6) agrees with the phonological domain of prominence. (7) is a plausible grid representation. The syllable second syllable in *American* has greater stress than anything else in the phonological interval corresponding to [an American farmer], but it does not have greater stress than *joke* or the second syllable in *Canadian*.5

But stress F is obeyed, because the semantic scope of the F on *American* (the \( \phi \) in the constraint) is the nominal [an American farmer], rather than the whole sentence.

\[
\text{(7)} \quad \text{an A me ri can far mer told a Ca na di an far mer a joke}
\]

The argument supports the hypothesis that the semantic scope of focus matches phonological domain of focus prominence, as captured in (4).

## 2 Second occurrence focus

*Second occurrence focus* is an intonational pattern found in certain examples with multiple motivations for focus;6

(8) a. Eva only gave xerox copies to the [GRADUATE] \( F \) students.
   No, PETR \( F \) only gave xerox copies to the GRADUATE \( SOF \) students.

4The semantic side of the story about the focus on *Canadian* is symmetric. However, Fery and Samek-Lodovici (2006) point out that there is an asymmetry on the phonological side. In their example (i), each occurrence of *Chevrolet* can be within the scope of the focus on the occurrence of *farmer* to the left. But the first occurrence of *Chevrolet* is realized with an accent.

(i) An American farmer with a purple Chevrolet was talking to a Canadian farmer with a purple Chevrolet.

5Evidence for this is that the nuclear accent falls on *joke*. Truckenbrodt notes “If the phonological domain of a focus would be the clause, regardless of the semantic domain the clause-final default-stress in these examples would not be derived. Instead, one of the foci in each of these examples would attract the nuclear stress of the clause.”

6These examples are from Partee (1991), Rooth (1993), and Krifka (2004).
b. We only introduced Marilyn to [JOHN]_F Kennedy.  
   (i.e. not to Bobby and Edward Kennedy)  
We also only introduced [Sue]_F to [JOHN]_SOF Kennedy.  
c. Mary only [STEAMS] vegetables, and even [JOHN]_F only [steams]_SOF vegetables.

The notation SOF marks a phrase where on semantic grounds one might expect there to be a focus, but where apparently there is no focus marked by a pitch movement. In early literature, there was disagreement about phonetic/phonological status of SOF. Either SOF is not phonetically marked at all (Partee 1991, Krifka 1997/2004) or SOF is phonologically prominent, though not marked with a pitch accent (Rooth 1996, 1997/2004, von Fintel 1994). Recent experimental studies are interpreted as supporting the second position, though the magnitude of the phonetic reflexes is small and not consistent at the token level (Beaver et. al. 2007, Howell 2007). There is additional evidence from weak pronouns (von Fintel 1994; Rooth 1996; Beaver and Clark 2003). English pronouns can be reduced to various degrees; at the extreme, they can lose their onset and be prosodically incorporated into the preceding word as in (9). This process is blocked in SOF configurations, as illustrated in (10).

(9) a. I likim (= him).  
   b. He likser (= her).

(10) Mary’s boyfriend only likes HER.  
    #Even her BOSS only likser.

The SOF data have been interpreted as indicating that the phonological correlate of F is metrical prominence, as in Stress F theories, rather than pitch accent (Rooth 1996, Selkirk 2006, Beaver et. al. 2007). Some prominences derived from F surface with pitch accents; these are the ordinary F’s. Others do not; these are the SOF’s. Apparently, all examples of SOF in the literature have a special configuration of relative scope of focus, with the scope of the SOF embedded in the scope of the primary F (Rooth 1996, Büring 2006, Selkirk 2006). The configuration is schematized in (11).

(11)  

[[.... α_F ...][[.... β_F ...] ~ j][... ~ k]]  

ordinary F SOF  
phonology phonology

An additional line of evidence is provided in Fery and Ishihara (2005). They look at examples in German where the narrower-scope focus precedes the wider-scope focus. They find that in such configurations the narrower-scope focus is realized with a pitch accent, but one which has a compressed pitch range relative to the

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7There is discussion of possible counterexamples in Section 5.
wider-scope focus.

We are left with the following picture. In a configuration with two F’s whose scopes are nested, the narrower scope focus is phonologically realized with less grid prominence than the wide scope focus. This provides the interface between semantics and phonology/phonetics. The prominence relation results in different realizations, depending on linear order. The narrower-scope focus, if it follows the wider-scope one, is realized with SOF phonology and phonetics, without a pitch movement. If the narrower-scope focus precedes the wider-scope one, it is realized with a compressed pitch range.

The core of this hypothesis about SOF is that the semantic scope of F’s correlates with relative prominence at the grid level. The next section investigates whether this is a consequence of Stress F, or calls for a revision of it.

3 Relativized Stress-F

Consider example (12), where on the assumptions of Section 2 there is an F on Ashley with ordinary realization, and and F on Bobby with SOF realization. Example (13) is similar, with F on Gouda and caviar, and SOF on New Jersey.

(12) You know what? You only introduced Mona to BobbyF yesterday.
    You also only introduced AshleyF to BobbySOF yesterday.
(13) What foods did you only find in New Jersey last year?
    I only found Gouda and CaviarF in NewJerseySOF last year.

Figure 1 represents the scopes of focus features in (12). The indexing on F is informal notation for the scope of focus: F1 takes scope at the first c-commanding ~, while F2 takes scope at the second c-commanding ~. Let’s apply Stress-F to F1, with Bobby as the focused element β1, and [you introduced Ashley to Bobby] as the scope φ1 of the focus. Stress F tells us that the highest stress in φ1 falls within β1. Second, let’s apply Stress-F to F2, with Ashley as the focused element β2, and [you only introduced Ashley to Bobby] as the scope φ2 of the focus. Stress-F tells us that the highest stresses within φ2 must fall within β2. These constraints are inconsistent, because β1 and β2 are disjoint subintervals of φ1, while φ1 is a subinterval of φ2. Under these circumstances, β1 can not contain the greatest prominence in φ1 while β2 contains the greatest prominence in φ2.8

Because of this logic, which is pointed out in Büring (2005), Stress-F has to be modified.9 Note that empirically, the strongest stress in φ1 is within the wider-scope focus Ashley, rather than the more local focus on Bobby whose scope is φ1. This

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8This would be comparable to the tallest mountain in North America being in Alaska, while the tallest mountain in the Americas is in Colorado.

9However, Büring (2005) has it that examples isomorphic to (12) and (13) are bad, so that they support ordinary stress F. See section 4.
suggests that wider-scope F’s should be ignored in checking Stress F. This results in the constraint (14).

(14) Relativized Stress-F

Let $\beta$ be an F-marked phrase with scope $\phi$. Then the strongest stress in the phonological interval corresponding to $\beta$ is strictly stronger than any stress in the phonological interval corresponding to $\phi$ which is not contained in the phonological interval corresponding to an F-marked subconstituent of $\phi$ whose scope is at least $\phi$.

In Figure 1, Relativized Stress-F as applied to F1 says that we should ignore prominences within $\beta_2$ (which is [Ashley]$_{F2}$) while checking whether the greatest prominence within $\phi_1$ falls within $\beta_1$ (which is [Bobby]$_{F1}$). Suppose the grid structure for $\phi_1$ is along the lines of (15). The first syllable of Ashley has the greatest prominence. But in checking relativized Stress F for the focus on Bobby, any prominences within Ashley are ignored, because Ashley is contained in a wider-scope focus. Relativized Stress F applied to F2 on Ashley requires that the first syllable
on Ashley have greater prominence than the first syllable on Bobby, which it does in this representation. So the contradiction is removed. In general, relativization allows two F’s to take different scopes out of the same constituent, something which is not possible under Stress F. At the same time, it requires that the wider scope focus have greater stress prominence.

(15)  

Clearly, (14) is a complicated and non-local statement. It refers to information about the scope of F’s which is scattered in the tree. To an extent, this is also a problem with the original Stress-F. Normally, constraints relating linguistic levels—such as compositional semantic rules—refer to local pieces of representation. One would like to have an account where a local configuration of operators has both a semantic effect on the relative scope of F’s and a phonological effect on relative prominence. Stating it differently, the Stress F constraints describe the results of a homomorphic relation between phonology and semantics, without articulating the operators which figure in the homomorphism. Improving on this is the topic of the next section.

4 Stress F via local operators

Here is an exercise in labeling trees. Starting with the tree in Figure 1, mechanically percolate the F-indices 1 and 2 to the level of their scopes. The indices are written in descending order at each node. This produces the tree on the left in Figure 2. Next, mechanically add an additional annotation which indicates whether each index came from the left or the right in the binary tree. In the sequence 2,1 which labels \[v_p \text{ introduced Ashley to Bobby}\], the index 2 came the left child (from \[v_p \text{ introduced Ashley}\]), while the 1 came from the right child (from \[v_p \text{ to Bobby}\]). This results in the label “lr”, with “l” indicating a source on the left, “r” indicating a source on the right, and the linear order in “lr” corresponding to the linear order in “2,1”. In the right tree in Figure 2, all nodes are labeled according to this principle. It can be observed that the l’s and r’s capture all the information about the scope of the F’s, so that if we include l and r in the representation, the F indices (here 1 and 2) are no longer required.

The move now is to treat l and r as operators which have both a phonological interpretation and a semantic one.\(^{10}\) Semantically, a sequence lr indicates that

\(^{10}\)This is somehow similar to Wagner (2006)’s local alternative semantics, which uses a local operator on a pair of sisters pair of sisters which has a semantic and a phonological interpretation.
there is a widest-scope focus in the left child, and an additional focus in the right child. A sequence \( rr \) indicates that there is a widest-scope F in the right child, and an additional F also in the right child. And so forth. Turning to phonology, the phonological interpretation of any sequence \( l\alpha \) which begins with an \( l \) is that the left child of the labeled node must be metrically stronger than the right child. The phonological interpretation of a sequence \( r\alpha \) which begins with \( r \) is that the right child must be metrically stronger than the left one.

A starting point for implementing this design is the compositional structured-meaning analysis of Krifka (1991).\(^{11}\) As in all structured meaning approaches to focus, the idea is that focus has the effect of structuring the semantic value into a tuple (von Stechow 1989).\(^{12}\) The denotation of (16a) is normally (16b).\(^{13}\) It is struc-

\(^{11}\)I don’t contemplate using structured meanings as a semantics for focus in place of anaphoric/givenness semantics, just as a compositional device.

\(^{12}\)An option closer to Wold (1996) would be to use a pair of denotations, one of which is a focus skeleton with lambda-bound variables in the position of focused phrases. As in alternative semantics, in a phrase with one focus the other denotation is the ordinary semantic value. In the focus skeleton, the argument order corresponds to the scope of focus. I believe the technical development would be similar to the one in the text.

\(^{13}\)In this notation a function application term is written \( f a \) or \( (f) a \) rather than \( f(a) \). Application terms are interpreted left-associatively, so that \( fxy \) is \( ((fx)y) \).
tured into the tuple (16c). The first element is a version of the normal denotation with a bound variable in the position of the focused phrase, and the second element is the denotation of the focused phrase. I will call the first elements in structured meanings “focus skeletons”. For another example, the structured interpretation of the focused phrase (16d) is (16e), where the skeleton is the identity function. As in Krifka’s compositional approach, structuring happens also at compositional levels, not just at the level of the scope of the focus.

\[(16)\begin{align*}
& \text{a. } [v, \text{introduce Ashley}_F] \\
& \text{b. } (\text{introduce ashley}) \\
& \text{c. } \langle \lambda z (\text{introduce} z), \text{ashley} \rangle \\
& \text{d. } \text{Ashley}_F \\
& \text{e. } \langle \lambda y, y, \text{Ashley} \rangle
\end{align*}\]

On the approach to be developed here, a phrase containing several unbound foci denotes a tuple whose first element is a focus skeleton with the focus positions bound by lambda, whose second element is the denotation of the widest-scope focus, whose third element is the denotation of the next-widest scope focus, and so forth. \(l\) and \(r\) are construed as operators which manipulate structured meanings of this kind, determining the scope of \(F\)’s, while also having their phonological effect. Consider the following scheme. All syntactic branching is binary. Each non-terminal node is annotated with a type-raised version of the ordinary semantic operation for the node, which is usually function application (either in the right or left direction). (17) is the semantic derivation tree for [introduced Ashley] with no focus. At terminal nodes, a type-raising operator \(u\) introduces a unit list, to initialize structured meanings. The operator \(a\) is a type-raised version of the rightward function application operator \(\lambda f \lambda a. fa\), and \(c\) is an additional operator involved in propagating structured meanings. To obtain the interpretation of the phrase, the lambda term annotating the parent is applied to the lambda terms coming from the two children, in their linear order. In this example, the propagation of structured meanings in the resulting term \(ca (u \text{ introduce})(u \text{ Ashley})\) is trivial, producing the unit set of the ordinary semantic value \((\text{introduce Ashley})\).

\[(17)\]

\[
\begin{array}{c}
\text{ca} \\
(u \text{ introduce}) & (u \text{ Ashley})
\end{array}
\]

The operators \(l\) and \(r\) are treated as type-raising operators modifying the semantic operation. They provide for the appropriate projection of structured meanings, in accord with the constraint that \(l\) projects a widest-scope focus from the left, while \(r\) projects a widest-scope focus from the right. (18) is the compositional structure for (16a), which has a focus on the right. The operator \(c(\text{ra})\) which annotates the parent is a type-raised version of the rightward function application operator which propagates a focus from the right. \(f\) is the semantic focusing operator. The denotation of the whole phrase, which can be written \(c(\text{ra})(u \text{ introduce})(f(u \text{ Ashley}))\),
Figure 3: Compositional structure with wider scope for the focus on Ashley is the non-trivial structured meaning (16c).

(18) $c(ra)$

In Figure 3, the scheme is applied to the tree on the right in Figure 2, restricting attention to the part below the focus interpretation operators. The scope of the F’s is fixed by the operator $l(ra)$, which propagates the widest-scope focus from the left child [introduce Ashley_F], and the narrower-scope focus from the right child [to Bobby_F]. Figure 4 is the version with the wider-scope focus on [NP Bobby]. Everything is the same, except that $r(la)$ replaces $l(ra)$ in the semantic operation for the phrase [introduce Ashley_F to Bobby_F]. $r(la)$ propagates the widest-scope focus from the right child [to Bobby_F], and the other focus from the left child [introduced Ashley_F]. The difference in focus scope is localized at the point where the denotation of [introduce Ashley_F] combines with the denotation of [to Bobby_F]. Here it has a local phonological effect (on the relative prominence of the two phrases) and a local semantic one (on the scopes of the two F’s).

Structured meanings are formalized as lists. To be systematic, even phrases without any F’s have list denotations. This illustrated by (17), where each phrase denotes the unit set of its standard semantics. Semantic operations have to manipulate lists, and also, it will turn out, ordered pairs. This is done with the lambda calculus encodings of list and pairing operations stated in Figure 5.14 Using these definitions, the list denoted by [NP Ashley] is obtained as \(\text{cns} \, (\lambda z.z)(u \text{Ashley})\). Where \(L\) is that list, the first element can be extracted as \(\text{hd} \, L\), and the second element as \(\text{hd} \,(\text{tl} \, L)\). The non-focused verb introduced denotes a unit list, which can be written as \(\text{cns} \, \text{introduce} \, \text{nil}\). To interpret the complex phrase [introduced Ashley_F], the two structured meanings have to be combined. If there was no focus

\[c(ll(b))\]
\[c(r(ra)) \quad (u \text{ yesterday})\]
\[c(l(ra)) \quad (u \text{ addressee})\]
\[c(l(ra)) \quad (u \text{ introduce} \quad f(u \text{ Ashley}) \quad (u \lambda y.y) \quad f(u \text{ Bobby})\]

\[c(ra) \quad (u \text{ introduce}) \quad f(u \text{ Ashley})\]
or structuring, the denotations of introduce and Ashley would be combined with the rightward function application operator \( \lambda f.\lambda a.f a \). In the structured-meaning scheme, they are instead combined using \( cr a \). This is a type-raised rightward function application operator, modified by an operator \( r \) which projects a focus from the second (right) argument.

Operators which project structured meanings are defined in two parts. First, there are operators \( l_1 \) and \( r_1 \) which modify the semantic operation which applies to the focus skeletons. Where \( o_1 \) is such an operation, \( l_1(o_1) \) accommodates an additional focus coming from the left child, and \( r_1(o_1) \) accommodates an additional focus coming from the right child.

Second, there are operators \( l_2 \) and \( r_2 \) which manipulate the additional meaning components corresponding to focused phrases. Lists of focused-phrase denotations have to be merged together, observing the constraint that \( l \) projects the widest-scope focus from the left argument, and \( r \) from the right argument. Where \( o_2 \) is an operator which manipulates focus lists, \( l_2(o_2) \) accommodates an additional focus coming from the left child (corresponding to the first argument of the operator) and \( r_2(o_2) \) accommodates an additional focus coming from the right child (corresponding to the second argument of the operator.)

Operators such as \( a \), \( la \), \( r(la) \), and \( b \) (which is the type-raised backward function application operator) have the type of ordered pairs. \( l \) is defined in terms of \( l_1 \) and \( l_2 \) to map an ordered pair of this kind to another ordered pair. \( c \) acts as an application operator which combines an operator like \( r(l(a)) \) with the two structured meanings denoted by the child phrases.

The operators \( l \), \( r \) and \( c \) are defined in Figure 6, using the list operations of Figure 5. Figure 7 defines type-raised function application operators. It remains to define the focusing operator. As already exemplified above, this has a simple definition which adds the identify function to the front of the list denoted by the argument. This operation is defined in (19).

\[
(19) \quad f = \lambda y.\text{cns}(\lambda x.x)y
\]
\[ \text{pr} = \lambda x. \lambda y. \lambda s.sxy \] is the ordered pair of \( x \) and \( y \)

\[ \text{fst} = \lambda p.p(\lambda x. \lambda y.x) \] \( \text{fst}p \) is the first element of the ordered pair \( p \)

\[ \text{snd} = \lambda p.p(\lambda x. \lambda y.y) \] \( \text{snd}p \) is the second element of the ordered pair \( p \)

\[ \text{nil} = \lambda x.x \] empty list

\[ \text{hd} = \lambda x. \text{fst}(\text{snd}x) \] \( \text{hd} \) \( x \) is the head (first element)

\[ \text{tl} = \lambda x. \text{snd}(\text{snd}x) \] \( \text{tl} \) \( x \) is the tail (list of remaining elements)

\[ \text{cns} = \lambda x. \lambda y. \text{pr}(\lambda x. \lambda y.y)(\text{pr}xy) \] \( \text{cns}yx \) is the list with head \( y \) and tail \( x \)

\[ \text{u} = \lambda x. \text{cns}x\text{nil} \] \( u \) \( x \) is the unit list with element \( x \)

Figure 5: Pairing and list operators.

\[ l_1 = \lambda f\lambda a\lambda b\lambda x.f(ax)b \]
\[ r_1 = \lambda f\lambda a\lambda b\lambda x.f(a(bx)) \]
\[ l_2 = \lambda f\lambda a\lambda b.\text{cns}(\lambda d.a)(f(tl)a)b \]
\[ r_2 = \lambda f\lambda a\lambda b.\text{cns}(\lambda d.b)(fa(tl)b) \]
\[ r = \lambda o.(r_1(\text{fst}o))(r_2(\text{snd}o)) \]
\[ l = \lambda o.(l_1(\text{fst}o))(l_2(\text{snd}o)) \]
\[ c = \lambda o.\lambda a.\lambda b.\text{cns}((\text{fst}o)(\lambda d.a)(\lambda d.b))((\text{snd}o)(\lambda l.a)(\lambda l.b)) \]

Figure 6: Operators projecting structured meanings. \( ro \) applies the semantic operation \( o \), while projecting an additional focus from the second (right) argument. \( lo \) applies the semantic operation \( o \), while projecting an additional focus from the first (left) argument.

In sum, the \( l \)'s and \( r \)'s in representations such as Figure 3 are given a semantic interpretation as modifiers of semantic operations. When \( l \) modifies a given operation \( o \), the combination \( lo \) projects an extra widest-scope focus from the left child. When \( r \) modifies an operation \( o \), the combination \( ro \) projects an extra widest-scope focus from the right child. A composite operation \( l(o(r)) \) projects a widest-scope focus from the left child, and a narrower-scope focus from the right child.

There is another part of the semantic analysis which I will only sketch. The \( lr \) operators have a systematic correspondence with focusing operators. For instance we would not want a phrase whose right child contains no F to be annotated with the semantic operator \( c(ra) \), since \( r \) projects a focus from the right child. This kind of issue comes up in a couple of places in variable-free and structured approaches to compositional semantics. Pieces of meaning of functional type have certain intended interpretations (with one argument position corresponding to a free pronoun, another argument position corresponding to a free trace, another corre-
\[
\begin{align*}
\text{ar} &= \lambda a \lambda b. ab \\
\text{al} &= \lambda a \lambda b. ba \\
\text{fnl} &= \lambda a \lambda b. \text{nil} \\
a &= \text{pr ar fnl} \\
b &= \text{pr al fnl}
\end{align*}
\]

Figure 7: \textbf{a} is the type-raised rightward function application operator. \textbf{b} is the type-raised leftward function application operator. \textbf{b} and \textbf{a} can be modified by \textit{l} and \textit{r}, e.g. \(r(l(a))\).

Shan (2003) suggested an approach which uses an enriched system of semantic-type labels to regulate semantic composition. For instance, consider a type system where a VP has the type \(et\), and a subject NP has type \(e\). Given the phrase order \([\text{NP VP}]\), these are combined with a leftward function composition operator of type \(e(\text{et})t\). Suppose an NP with a free focus of type \(e\) has a type label \(e \triangleright e\). This is not an appropriate argument for a leftward function application operator of type \(e(\text{et})t\). The mismatch is fixed with a type-raising operator \(l\) with type \((e(\text{et})t)(e \triangleright e)(\text{et})(e \triangleright t)\), which modifies rightward function application to propagate a focus from the first (left) argument. The ultimate value type \((e \triangleright t)\) type represents a standard type \(t\) with a free focus of type \(e\). On this approach, regulating the distribution of \(l\)’s and \(r\)’s is reduced to checking type consistency.

This completes the semantics of \(lr\) sequences. The phonology is stated in (20). It can be related to the formalism of sw-trees from Liberman and Prince (1976), where any binary-branching node has one metrically strong (s-labeled) child, and a metrically weak (w-labeled) child. The constraint says that a node labeled with sequence which starts with \(l\) must have a strong left child, while a node labeled with a sequence that starts with \(r\) must have a strong right child.

(20) Phonology of \(lr\) labels.

i. The left child of any node labeled \(l\alpha\) is stronger than the right child.

ii. The right child of any node labeled \(r\alpha\) is stronger than the left child.

5 Rice and crepe examples

This section comments on a couple of loose ends having to do with culinary examples in the literature. Figure 5 is the logical form for the “rice example” (21) that was suggested in Rooth (1992). The point of that example was that while no prominence is detectable on \textit{rice}, certain theoretical arguments indicate that there is
a second occurrence focus on \textit{rice}. Indeed as pointed out in Tancredi (2005), there is weak pronoun evidence for an SOF in the \textit{rice} position: in (22) and (23), reduction of the pronoun is blocked on the relevant readings, indicating the presence of SOF.

(21) People who grow rice generally only \textsc{eat} rice.

(22) #People who grow beans generally only \textsc{eat}em.

(23) Do you only grow \textsc{cherries}\textsubscript{F}?
    
    #No, but we only \textsc{sell}em these days.
    
    No, but we only \textsc{sell}\textsubscript{F} \textsc{cherries}\textsubscript{SOF} these days.

Why does the representation of (21) have to be as in Figure 5?. On the assumptions of the “intermediate theory” of Rooth (1992), there is a complex subcategorization frame for \textit{only} [only(k) [XP $\sim k$]] which determines the tree shape in the neighborhood of \textit{only}. The focus on \textit{eat} is a symmetric-contrast focus with \textit{eat} contrasting with \textit{grow}. The location and indexing of $\sim 6$ and $\sim 8$ is constrained by the presuppositions they express. The presupposition for $\sim 6$ is satisfied if it has minimal scope over [\textsc{eat} \textsc{rice}], but not if \textit{only} is include in the scope. The reason is that there is no \textit{only} in the antecedent [\textsc{grow} \textsc{rice}]. Finally, given the presence of an indexed focus interpretation operator on the argument of \textit{only}, to express the intended reading, there must be a focus feature \textsc{Fm} on \textsc{rice}, where \textit{m} is the number of $\sim$ operators intervening between \textsc{rice} and the $\sim$ on the argument of \textit{only}, plus one. Since in this case one operator intervenes, \textit{m} is 2.

At this point, there is a problem. Application of relativized stress \textsc{F} to the tree in Figure 8 predicts that \textsc{rice} has more prominence than \textsc{eat}, because the focus on \textsc{rice} has wider scope. But it is \textsc{rice} which surfaces with SOF phonology. So this looks like a counterexample to the SOF scope generalization stated in Section 2.15

Maybe the problem somehow comes from the fact that in Figure 8, the scopes of the two \textsc{F}'s are not separated by any overt material. In (24), I try to fix this by putting \textit{only} higher up. If Figure 8 is right, this should not matter, because $\sim 10$ already outscopes $\sim 6$. The empirical question is whether (24b) can be pronounced with an SOF on \textit{beans}. Relativized Stress \textsc{F} predicts that it can’t, and that \textsc{beans} must be realized with a primary \textsc{F} associated with a pitch accent, cf. (25b). On my intuitions, this prediction is correct, with (25a) not expressing the intended reading. (26) is the representation with focus interpretation operators.

(24)a. What do they want people who grow beans to eat next year?
    
    b. They only want people who grow beans to eat beans next year.

(25)a. ?They only want people who grow\textsubscript{F} beans to eat\textsubscript{F} beans\textsubscript{SOF} next year.
    
    b. They only want people who grow\textsubscript{F} beans to eat beans\textsubscript{F} next year.

\footnote{I only noticed recently that the rice example comes out backwards. Irene Heim told me that this may have been pointed out in unpublished work of Dag Wold.}
generally NP

people S′

who, S only(10) VP

e, VP VP

∼ 10

VP, ∼ 8 VP, ∼ 6

V, NP V, NP

grow rice eat rice

Figure 8: Scope of focus in rice example.

(26) they only(4) [[want people who [grow beans],
to [eat, beans]∼ 3 next year]∼ 4]

(27) has the same scope relations. On a reading which excludes people who work for the boss voting for the boss’s competitors, there is a focus on boss with scope at the level of only. Any focus interpretation operators marking a symmetric contrast between working for the boss and voting for the boss have a narrower scope. Relativized Stress F predicts that boss must have a primary focus marked with a pitch accent, because the focus on boss has the wider scope. On my intuitions, the prediction is correct—the the realization with a primary focus on vote as in (27a) seems not to express the intended meaning.

(27)a. ?An elementary function of a political machine is to only allow people who work for the boss to VOTE for the boss.

b. An elementary function of a political machine is to only allow people who work for the boss to vote for the BOSS.

But consider (28), where only in not quite as far up. Here it seems clear to me that an accented symmetric contrast focus on eat is possible. This brings us back to the problem with (21). The scope relations are as indicated in (29). While the focus on mangoes has wider scope, the accent can fall on eat. In this case the two focus interpretation operators are hierarchically separated by overt material, namely want.

(28) Just because I GROW mangoes, don’t assume I only want to EAT mangoes.
(29) Just because I \([\text{grow}_F \text{mangoes}] \sim 1\), don’t assume I only(4) \([\text{want to [eat}_{p_1} \text{mangoes}_{p_2}]} \sim 3\) ~ 4\).

One structural difference between (24a) and (28) is that (24a), the focus-sensitive operator only has scope over the entire symmetric-contrast configuration, i.e. over both grow and beans, while in (28), it has scope only over the second part of the configuration. As suggested to me by Ken Shan, this could be interpreted as indicating that the relevant notion of scope in the symmetric-contrast configuration is wider than what was supposed in Rooth (1992) and Truckenbrodt (1995). However, I don’t see how to incorporate that into a anaphoric-givenness account of focus interpretation. This problem must be left open in this paper.\(^{16}\)

The next empirical loose end has to do with data given in Schwarzschild (2003), and discussed in the context of the Stress F by Büring (2005). According to Schwarzschild and Büring, there is no way of pronouncing (30b) which fits in with the question context (30b). On these intuitions, neither placing the nuclear accent on crepes (30c), or on Paris (30d) works.

(30)a. What food will Renee only eat in Paris?
   b. She’ll only eat crepes in Paris.
   c. # She’ll only eat CREpes in Paris.
   d. #She’ll only eat crepes in PARIs.

Büring (2005) attributes the unpronouncability effect to the syntax-phonology interface. If we assume a representation like (31) where both crepes and Paris have F-features, and these F’s take different scopes, then unrelativized stress F can not be satisfied. This is the argument from Büring that I reviewed in Section 3.

(31) \([\text{what food will Renee only eat in Paris}]_8 \[\text{she will only [eat crepes}_{p_1} \text{in Paris}_{p_2}] \sim 6\] \sim 8\)

I think it is not advisable to draw any deep conclusions from (30), because when it is adjusted by adding some material after the last focus as in (32), by adding some syllables after the stressed syllable marking the first focus as in (33,) or both (34), it becomes good.\(^{17}\) It’s familiar that such adjustments improve SOF examples. Presumably, they help because they add non-prominent material relative to which the SOF can be perceived as prominent. These adjustments do not affect the scope of focus. If (32)–(34) are good, they are counterexamples to the simple Stress F rule.

(32) What foods will Renee only eat in Paris next year?

\(^{16}\)The weak-pronoun version of (28) also is good:
(i) Just because I GROW mangoes, don’t assume I only want to EATem.
I’m inclined to conclude that in these examples there is no F at all on the object, so that it is after all possible for the narrow focus of only to be unexpressed.

\(^{17}\)I don’t think these judgments are more dicey than judgments about other second occurrence data.
She’ll only eat CREPES in Paris next near.

(33) What foods will Paul only eat in Paris?
He’ll only UDO noodles in Paris.

(34) What foods will Renee only eat in Paris next year?
She’ll only eat UDO noodles in Paris next near.

But what about (30)? Maybe it has the status of a garden path, where because there is no phonetic evidence for a focus on Paris, the only reading which is recovered is one where only is associated with a focus on crepes. Another way of improving (30c) is to put a rising intonation indicating a partial answer on the first focus crepes. With this intonation and pragmatics, the example is perfect. The rising intonation obviates the garden path effect, because the focus with a rising intonation can not in this example be read as associated with only.

A slightly different hypothesis is that a purely phonological constraint on good metrical configurations is responsible for the judgment that (30) is bad. In fact I think the example can be perceived as okay, if one keeps one’s mind resolutely on the intended meaning.

(35) Who does only John like?
??Only John$_F$ likes Mary$_F$.

(36) Who does only Abernathy like?
Only Abernathy$_F$ // likes Mary$_F$.

6 Discussion

(37) is the new representation of the SOF configuration. The operators $l$ and $r$ fix the scope of the F’s, and have a phonological interpretation in terms of metrical prominence. To complete the account, that interpretation should be embedded in an account of prosodic phonology, including matters such as pitch accent assignment and the correspondence among metrical structure, phrasing, and syntactic structure. This is the “stress first” architecture for the phonology-interface for focus. Two developments of the phonological part of the architecture are Fery and Samek-Lodovici (2006) for English and Selkirk (2006) for Bengali.

\[
\left[\ldots\left[\ldots[\ldots \alpha \ldots] \ldots\beta \ldots]\ldots\right]\ldots\right]\sim j\ldots \sim k\]

\[
\begin{array}{ll}
\text{ordinary F} & \text{SOF} \\
\text{phonology} & \text{phonology}
\end{array}
\]

18In fact I think the example can be perceived as okay, if one keeps one’s mind resolutely on the intended meaning.
In the empirical domain of focus, is there anything else involved in the semantics-phonology interface? There must be a bit more. Büring (1995) argued that focus features should be partitioned topic features (T features) and simple focus features (F features). He defined an interpretation of these features in alternative semantics, using alternatives at the question level. This provided a convincing analysis of topic-focus paradigms like (38) from Jackendoff (1972). Since in Büring’s theory, T and F features are interpreted with pitch accents (rather than prominence), it is not immediate how to proceed in the \( lr \) architecture. It seems attractive to treat metrical prominence as a common component in the phonology of T and F, and to distinguish them using independent tonal features. Semantically, it is possible to interpret T and F in one step in a representation like (39) that introduces two focus-constrained variables, one for the local question ‘what did Fred eat?’, and one for a contrasting question ‘what did \( y \) eat’. But in this structure, there is no place to locate tonal operators which differentiate T from F. Presumably, along the lines of Steedman (2003), there have to be separate topic and focus phrases, containing different tone morphemes.

(38) What about Fred? What did he eat?
Fred\(_T\) ate the beans\(_F\).

(39) \([\text{Fred}_F \text{ ate the beans}_F] \sim 1, 2\)

Something else that is missing in the current proposal is a stance on the representation of “out-of-the-blue” focus. When (40) is used in a discourse context with the right overt antecedent, it can be realized with an SOF on \( \text{one}_F \). But (40) could also be an abrupt beginning of a radio news segment. In this case, the sentence suggests an overall context where the mayor’s expense-free trips have been a topic of controversy, but there is no overt discourse context. In an out-of-the-blue context like this, the second F in (40) cannot be realized with SOF phonology.

(40) Even the mayor’s harshest\(_F\) critics are admitting he only took one\(_F\) junket.

The relevant phenomena are not restricted to multiple-focus examples, but also include out-of-the-blue examples with a single focusing adverb, or other motivation for focus. In a use of (41) at the start of a television or radio news segment, a rendition without any pitch accents after harshest would be unnatural. A natural pronunciation has accents on admitting, on law, and optionally on break. More subtly, I think there is also an accent on critics. In the context (42), it is natural to completely deaccent critics. This is unnatural in an out-of-the-blue use of (41).

(41) Even the mayor’s harshest\(_F\) critics are admitting he did not break the law.

(42) What do the mayor’s critics think?
Even the mayor’s harshest\(_F\) critics are admitting he did break the law.

One can articulate two major approaches to these issues. On one approach the sentence (42), given that all of it’s non-function words are accented, has no non-
trivial exploitation of focus semantics in the sense of anaphoric/givenness theories of focus interpretation. The fact that harshest critics are contrasted with other critics is entirely pragmatic, and is not represented in phonology or syntax. If it is represented in semantics, the representation is trivial, in the form of a free variable in the semantics of even which is not constrained by grammatical factors. If there is validity to the perception that harshest is more prominent than critics, this is an emotive factor which does not feed into compositional semantics.

The other approach maintains that there is a grammatically significant narrow focus on harshest in (42), with a relatively wide scope, which has both a phonological interpretation of prominence, and a semantic interpretation of the alternative-semantics kind. While there are accents on the other non-function words, these have a different grammatical status and a different semantics. This line of analysis has been advocated by Lisa Selkirk in a number of papers, most recently Selkirk (2006). The feature with an alternative-semantics interpretation is a “big focus” feature F. There is an independent distinction of givenness, expressed marked by a distinct “small focus” f, or alternatively by a givenness operator.

If the first approach is correct, then the theory proposed in this paper is a theory of overt-antecedent focus. The SOF-configuration is (37), with the proviso that k is an overt-antecedent variable. If the second approach is correct, the theory proposed here is a theory of big focus. But the empirical motivation in the paper is limited to examples with overt antecedents.

References


