Focus below the Word Level *

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Abstract. Intonational focus can be observed on parts of words that appear to lack intrinsic meaning, and triggers alternatives that are similar in form. In order to provide a unified treatment of focus above and below the word level (they do, after all, behave the same in most respects), I develop a theory of denotations for arbitrary word parts in which focused word parts denote their own sound and the unfocused parts are functions from sounds to word meanings. This allows focus theories to generalize below the word level; any differences with focus above the word level are located in the semantics of word parts. The paper also explores phonological constraints on focus placement, and shows that the focusability of a word part depends solely on its prosodic status, not on any semantic factors.

1. Introduction

This paper deals with cases where intonational focus is realized on a different syllable in a word than the one stress normally falls on. The effect is very similar to familiar focus on higher constituents. The following example illustrates this point: Bolinger (1961:93) describes a cartoon from the *New Yorker* (April 14, 1956, p. 36) where a man stands upside down, with his feet on the ceiling, in a psychiatrist's office; the psychiatrist says the following sentence to the man's wife (throughout this paper I use SMALL CAPS to show prominence characteristically associated with focus).

(1) . . . our first concern is to persuade the patient that he is a stalagMITE. [last syllable underlined in the original]

This sentence implies that the patient thinks he is a stalactite. The mechanism at work appears quite simple: prominence on the syllable *mite* presupposes a context where both stalagmites and stalactites are salient (a more detailed account will be given in section 2.2). The link between the two concepts must

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follow not only from their semantic relatedness, but also from the fact that the words denoting these concepts are similar in form, otherwise we have no explanation why the contrasting syllable is prominent.

My claim is that this is an instance of focus, and should be analyzed through a theory of focus. Prominence on word parts can display additional characteristics of focus, for instance association with a focus-sensitive adverb like *only* (Jackendoff 1972; Rooth 1985, 1992; von Stechow 1989; Krifka 1991, 1992).

(2) John only brought home a stalagMITE from the cave.

Here prominence on the syllable *mite* serves to indicate the restriction on the domain of *only*, in a manner similar to focus on words and higher constituents. The location of prominence thus has an effect on the sentence's truth conditions: the sentence implies that John did not bring home a stalactite, but does not say anything about what else he might have brought; the sentence is true in case John returns from the cave with a stalagmite and a rock.

Focus below the word level appears in other languages as well, as in the following example from Hebrew, a language where intonational focus behaves in a similar (though not identical) way to English.

(3)	astronawtim	higiu	la-yareax,	aval	KOZMOnawtim	hayu rišonim	ba-xalal.
	astronauts	arrived	to.the-moon	but	cosmonauts	were first	in.the-space

'Astronauts reached the moon, but cosmonauts were first in space.'

Prominence in KOZMO*nawtim* 'cosmonauts' is due to focus – the unmarked stress pattern is *kozmo'nawtim*. Here too we see that the placement of focus has to do with the phonological similarity between the words.

Since intonational focus has a similar function above and below the word level, we want to give it a uniform treatment. The problem we face is that theories of focus relate phonological prominence to compositional meanings, which certain parts of words do not have; in the standard view of semantics, such parts of words are simply inaccessible to compositional processes. The word parts *stalag* and *mite*, for instance, appear to lack any compositional meaning at all, and are in this respect similar to semantically empty prefix-stem constructions such as *suf-fer* (Aronoff 1976). In order to allow the theory of focus to take care of all the examples above we need to extend the semantics so that it can deal with units that do not have an independent meaning.

Previous treatments of focus have shied away from providing such an extension. When focus below the word level is encountered, for example in Selkirk (1984:271) and Rochemont (1986:6), it is labeled as "metalinguistic" and not discussed further. This sort of labeling implies that focus below the word level depends on the actual form of the expressions involved, but placing the phenomenon outside the general theory of focus does little to explain how it works. I show how this "metalinguistic" notion fits in with an explicit theory of meanings for opaque word parts; this captures the observation that compositional semantics below the word level is sensitive to the phonological shape of its constituents, while retaining the intuition that focus operates the same way above and below the word level.

I propose a semantic process of *phonological decomposition*, which assigns denotations to units that lack an independent meaning. Parts of words in focus constructions receive meanings in the following manner: the focused part denotes a string of sound, and the rest of the word is a function from sounds to word meanings. The relation between the meanings of the parts and the meaning of the whole word is thus fully compositional, in the sense that the semantic rules yield the correct meaning of the word when the meanings of the parts are given. A theory of focus can therefore apply to parts of words without any modification, and indeed the analysis is compatible with more than one theory of focus. The same theory of compositional meanings for opaque word parts also accounts for coordination of parts of words (e.g., *ortho- and periodontists*: Artstein 2002b, chap. 4; Artstein, forthcoming).

The paper is structured as follows: we start with the desired representation for sentence (2), working from this representation to arrive at the formal proposal for the semantics of word parts in section 2.1, with some elaborations in section 2.2. Section 3 explores phonological constraints on the distribution of focus, and section 4 offers some concluding remarks.

2. The Semantics of Word Parts

The theory of meanings for word parts in focus constructions will be developed within the framework of alternative semantics (Rooth 1985, 1992, and subsequent work). Nothing in my theory hinges on this particular framework, and I believe it can be equally well developed with structured meanings (von Stechow 1989; Krifka 1991, 1992). The choice of using a basic version of alternative semantics serves to highlight the contribution of phonological decomposition.

Every constituent will be associated with two semantic values: the ordinary semantic value $[\![\cdot]\!]^o$ is the familiar denotation, and the focus semantic value $[\![\cdot]\!]^f$ is a set of alternative denotations. Intonational focus is made accessible to semantic interpretation through syntactic marking on constituents $[]_F$. I choose to interpret natural language directly rather than through the use of a translation language; typed denotations will be assigned to English expressions. Following von Stechow (1989) I will assume that type t is the type of propositions, that is, sets of possible worlds, as in Cresswell (1973). For conciseness and clarity I will often use variables, functional notation, and set notation in my exposition; these are to be understood as part of the meta-language and do not constitute a formal translation language. I also simplify matters by assuming that the denotation assignment $[\![\cdot]\!]$ is a function, without specifying a mechanism for the resolution of ambiguous English expressions.

I will use Rooth's (1992) mechanism of association with focus, where association relations are mediated by context. Sentence (2), repeated below, can have the logical form in (4), with *only* coindexed with a context variable C_2.

(2) John only brought home a stalagMITE from the cave.

(4) John only$_2$ [$_{\text{VP}}$ [$_{\text{VP}}$ brought home a stalag[MITE]$_{\text{F}}$ from the cave] $\sim C_2$].

The meaning of *only* is interpreted relative to the meaning of the context variable C_2, whose meaning is in turn constrained by the focus interpretation operator $\sim$. *Only* says that from a context of salient properties, the only one that applies to John is that of bringing home a stalagmite from the cave; the meaning of (4) is therefore the following proposition.

(5) $\{\, w \mid \forall P[w \in P([\![\text{John}]\!]^o) \wedge P \in [\![C_2]\!]^o \rightarrow$
$P = [\![\text{brought home a stalag[MITE]}_\text{F} \text{ from the cave}]\!]^o] \,\}$

The context of salient properties $[\![C_2]\!]^o$ should include just the property of bringing a stalagmite from the cave and the property of bringing a stalactite from the cave – this is based on the intuition that sentence (2) is true if John returns from the cave with a stalagmite and some other stuff, say a rock, as long as he doesn't bring home a stalactite. We will develop the semantics of word parts so that the context is constrained in this way.

The connection between focus and the context represented by C_2 comes from the focus interpretation operator $\sim$. The focus interpretation operator does not uniquely determine the value of the adjoined context variable, but rather serves to constrain it (the set case of Rooth 1992:93): $[\![C_2]\!]^o$ is a subset of the focus semantic value of the VP to which it is adjoined, and it contains both the ordinary semantic value of the VP plus at least one additional distinct member.

(6) a. $[\![C_2]\!]^o \subseteq [\![\text{brought home a stalag[MITE]}_\text{F} \text{ from the cave}]\!]^f$

b. $[\![C_2]\!]^o \supsetneqq \{\, [\![\text{brought home a stalag[MITE]}_\text{F} \text{ from the cave}]\!]^o \,\}$

We therefore know, at the very least, that the above two properties – bringing a stalagmite and bringing a stalactite – should be included in the focus semantic value of the lower VP in (4).

I claim that these should be the only properties in this focus semantic value. While the focus semantic value of an expression can in principle include additional properties that are not members of the context it constrains, context has no way of affecting intonational prominence in this theory other than through the focus semantic value, and we want the contextual restriction to explain why the final syllable of *stalagmite* is prominent. Moreover, it is exactly this prominence that confines the context to stalagmites and stalactites alone. If stress on *stalagmite* is in its normal position, as in (7), then the relevant context for the interpretation of *only* can be wider.

(7) John only brought home a STAˈLAGMITE from the cave.

Sentence (7) can be considered false in case John returns from the cave with a stalagmite and a rock; I find it much harder to judge (2) to be false in this scenario. So it is the positioning of prominence on the final syllable of *stalagmite* that restricts the context for the interpretation of *only* to the two properties mentioned above.

Having determined what the focus semantic value of the lower VP in (4) should be, we use the compositional semantics for focus to determine the focus semantic values of the lower constituents. The literature offers several algorithms for determining focus semantic values (Rooth 1985; von Stechow 1989, 1991; Kratzer 1991); all we need is the following three rules.

(8) The focus semantic value of a focused constituent is the entire set of denotations that match the ordinary semantic value in type:

$[\![A_{\mathrm{F}}]\!]^f = D_\tau$, when A is an expression of English and $[\![A_{\mathrm{F}}]\!]^o \in D_\tau$.

(9) The focus semantic value of an unfocused basic expression is a singleton set that includes the ordinary semantic value as a sole member:

$[\![A]\!]^f = \{\, [\![A]\!]^o \,\}$, when A is a basic expression that is not focus marked.

(10) An unfocused expression whose ordinary semantic value is determined compositionally receives its focus semantic value in an analogous way. For example, if $[\![A]\!]^o = [\![B]\!]^o([\![C]\!]^o)$ then the focus semantic value of A is defined as

$$[\![A]\!]^f = \{\, \beta(\gamma) \mid \beta \in [\![B]\!]^f \wedge \gamma \in [\![C]\!]^f \,\}$$

that is, the set of all the results of applying a member of $[\![B]\!]^f$ to a member of $[\![C]\!]^f$.

Working down from the focus semantic value of the lower VP in (4), we find that the focus semantic value $[\![\text{stalag}[\text{MITE}]_{\mathrm{F}}]\!]^f$ should be the set consisting of the denotations of the words *stalagmite* and *stalactite*. My claim is that this is due to the phonological similarity between the words, not to their semantic relatedness. The next step then is to develop a semantics for parts of words based on their phonological composition; this semantics will give us the desired focus semantic values for words that have focus marking on their parts.

2.1. Phonological Decomposition

Let's start with the assumption that the ordinary semantic values of word parts form a function-argument structure, so that when one part applies to the other, the meaning of the original word is retrieved. The focus semantic value of a complex expression can be thought of informally as a lambda abstract over the ordinary semantic value of that expression, with the focused part replaced by a variable (cf. Jackendoff 1972); abstraction is straightforward when the focused part is the argument and the rest of the word is a function. In a word like *stalag*MITE$_{\mathrm{F}}$, then, the meaning of unfocused *stalag* will be a function from meanings of focused parts to word meanings, which maps the denotation of MITE$_{\mathrm{F}}$ to the denotation of *stalagmite*. Notice how focus plays a role in determining the *ordinary* semantic values of the word parts: it is focus marking that decides which word part is the function and which is the argument.

We need to determine the full specification of the function denoted by *stalag*. Since *stalag* is not focused, we know from rule (9) that its focus semantic value is the unit set containing its ordinary semantic value. Rule (8) tells us that the focus semantic value of MITE$_{\mathrm{F}}$ is the set of all denotations that match it in type (we still don't know what type this is). Rule (10) therefore says that the focus semantic value of the whole word *stalag*MITE$_{\mathrm{F}}$ is the set of all the results of applying $[\![\text{stalag}]\!]^o$ to the denotations in $[\![\text{MITE}_{\mathrm{F}}]\!]^f$. But we have already determined that the focus semantic value of the whole word should be the set containing the denotations of *stalagmite* and *stalactite*. So the following specification of the meaning of *stalag* will yield the desired results.

(11) $[\![\text{stalag}]\!]^o$ is the function f such that:

$f([\![\text{MITE}_{\mathrm{F}}]\!]^o) = [\![\text{stalagmite}]\!]^o$,
$f([\![\text{TITE}_{\mathrm{F}}]\!]^o) = [\![\text{stalactite}]\!]^o$,
and $f(\alpha)$ is undefined for all other α.

Notice how it doesn't matter what the meanings of the word parts MITE$_{\mathrm{F}}$ and TITE$_{\mathrm{F}}$ are, or even what type they are, as long as the meaning of *stalag* operates on these meanings in the way specified above.

We want to derive the meanings of parts of words in a principled way that will predict that alternatives to words with focused parts have to be similar in form. I make the following concrete proposal: the focused part of a word will denote its own sound, which is an object of type *e*. Thus, in a sentence like (1) or (2), the focused syllable *mite* simply denotes the sound [ma$^{\mathrm{j}}$t].

(12) $[\![\text{MITE}_{\mathrm{F}}]\!]^o \in \mathrm{D}_e$: the string [ma$^{\mathrm{j}}$t].

Incidental evidence that the meaning of the focused word part is indeed an object of type *e* is that word parts in echo questions are replaced by *what* rather than *which* (see Artstein 2002a, Artstein 2002b, chap. 5 for a discussion of echo questions).

(13) a. This is a stalag-what?

b.*This is a stalag-which?

Referring to strings of sound by their own mention is not surprising: there even exist predicates that apply exclusively to such meanings, as in the sentence *Mite begins with a sonorant and tite begins with an obstruent*. I claim that it is exactly this denotation that we see in focused parts of words; this provides the desired connection between the form of a word part and its meaning. (A reviewer points out that if a word can denote its sound in any context then a word like *might* could trigger deaccenting of the word part *mite* in *stalagmite*; this is not a problem if we assume that any single occurrence of an expression can have only one denotation, so one instance of *might* cannot denote both a modal verb meaning and its own sound at the same time.)

We now know the meaning of the whole expression and that of the focused part; the unfocused part will denote a function that takes us from the focused part to the whole – it takes a sound and returns the original meaning of the word.

(14) Let A be the unfocused part of a word, and let τ be the type of the whole word. Then $[\![A]\!]^o \in \mathrm{D}_{e\tau}$ is the function $h : \mathrm{D}_e \to \mathrm{D}_\tau$ such that for all $\beta \in \mathrm{D}_e$, $h(\beta) = [\![A\beta]\!]^o$ if $A\beta$ is a word and $[\![A\beta]\!]^o \in \mathrm{D}_\tau$, undefined otherwise.

A few notes are in order regarding the formulas above. The symbol A stands for an expression of English, and the symbol β stands for a denotation – that is, an object in the model. The symbol β plays an additional role, however: since the meaning of the focused part of a word is identified with its phonological form, then in all the cases of interest β is also an expression of English. Thus, the sequence $A\beta$ stands for the concatenation of the phonological characterization of an expression A with an alternative meaning β, which is itself the phonological characterization of a linguistic expression. The function h in (14) is undefined for all β that denote sounds whose concatenation with A does not form a word, as well as for all objects of type e that do not denote sounds. This is not surprising, as many denotations of a functional type are only partial functions (for example, feeding the transitive verb *eat* with the direct object *thoughtfulness* results in nonsense).

It is now clear why I have chosen to interpret natural language directly, rather than through the use of a translation language: since we are dealing with denotations that are also linguistic expressions, adding a layer of a translation language would just make the definitions more cumbersome. Anticipating the discussion of the phonology in section 3.1, I will add that the concatenation operation does not refer to linear strings of segments, but is rather an operation on phonological structures, i.e. prosodic constituents (see in particular the discussion on page 14).

The definition in (14) guarantees that the ordinary semantic value of a decomposed word is the same as that of the word when it is left intact as a terminal node on the tree. We now show that this definition also yields the desired focus semantic values for words which have focused parts.

Let AB_{F} be a word with a focused part B_{F}, and let τ be the type of AB ($[\![AB]\!]^o \in \mathrm{D}_\tau$). Then:

(15) a. $[\![A]\!]^o$ is the function $h : \mathrm{D}_e \to \mathrm{D}_\tau$ such that for all $\beta \in \mathrm{D}_e$, $h(\beta) = [\![A\beta]\!]^o$ if $A\beta$ is a word and $[\![A\beta]\!]^o \in \mathrm{D}_\tau$, undefined otherwise. (14)

b. $[\![A]\!]^f = \{\, [\![A]\!]^o \,\}$ (9)

c. $[\![B_{\mathrm{F}}]\!]^f = \mathrm{D}_e$ (8)

d. $[\![AB_{\mathrm{F}}]\!]^f = \{\, [\![A]\!]^o(\beta) \mid \beta \in \mathrm{D}_e \,\}$ (10)
$= \{\, [\![A\beta]\!]^o \mid A\beta \text{ is a word and } [\![A\beta]\!]^o \in \mathrm{D}_\tau \,\}$

So the focus semantic value of the focused syllable is the entire domain of individuals D_e, and the focus semantic value of a word with a focused part comes out to be the set of denotations (matching in type) of words that share the unfocused phonological material. For example, the alternative set for *stalag*MITE$_{\mathrm{F}}$ comes out to be a set with two members, the meanings “stalagmite” and “stalactite”.

The nature of the phonological representation that constitutes the meaning of word parts deserves further comment. We need a measure of flexibility when we apply the definition in (14) to the word part *stalag* in order to get it to work. The reason is that application of the meaning of *stalag* to the alternative string *tite* yields the meaning of the word *stala[g]tite*, with a voiced [g]. While this is the pronunciation used by many speakers of American English, others use it in free variation with *stala[k]tite* (voiceless [k]), and yet others use *stala[k]tite* exclusively. The semantics of (14) predicts that for the latter group of speakers, the meaning “stalactite” should not be an alternative to *stalag*MITE$_{\mathrm{F}}$, but this is not the case. A similar problem with phonetic detail appears in the following sentence, from a news broadcast on September 18, 2001 (thanks to Nancy Hall for bringing this example to my attention).

(16) I’d like to see the market show stability rather than VOLAtility.

As I will argue in section 3.1, focus has to be marked on metrical feet, so in the above example it has to be marked on the word part *vola*; this leaves *tility* as the unfocused part, which has to apply to the alternative *sta* to yield the meaning of *stability*, not **statility*. It appears then that the meanings formed by phonological decomposition through the rule in (14) can overlook certain segmental differences, particularly at the edges of a constituent; an exact characterization of the differences that can be thus ignored awaits further study.

2.2. GIVENNESS AND DEACCENTING

The above discussion keeps the semantics of focus without change: the difference between focus above and below the word level, namely the sensitivity of focus below the word level to the form of linguistic expressions, stems from differences in the meanings of words and word parts, not from the theory of focus. This means that we are not restricted to a particular way of doing focus semantics. An anonymous reviewer suggests that instead of affecting the focus semantic values of linguistic expressions, focus below the word level should be a direct reflection of discourse constraints on the interpretation of *only*. Such a move entails a change to the underlying grammar of focus; there are also independent motivations for such a grammar (Schwarzschild 1997; Kadmon 2001:330–339; Martí 2002, forthcoming).

A grammar in which deaccenting is dependent on previous discourse (or even the non-linguistic environment) is needed in order to account for the accent pattern in Bolinger's example (1), repeated below.

(1) ... our first concern is to persuade the patient that he is a stalagMITE.

This can be treated following the proposal in Schwarzschild (1999), augmented with the meanings for parts of words developed above. Schwarzschild proposes that the distribution of focus is governed by a notion of givenness – a requirement that for each constituent there should be an antecedent which entails the proposition formed by existentially closing all of the constituent's arguments and replacing all of its focused subconstituents with existentially closed variables.

Sentence (1) contains a number of pitch accents, but we can safely assume that in the subordinate clause *he is a stalagmite*, the only pitch accent is on the syllable *mite*. Replacing MITE_F with an existentially closed variable gives us the proposition 'For some α, he is a $[\![\text{stalag}]\!]\alpha$', which is equivalent to 'He is a stalagmite or he is a stalactite'. The context must supply an antecedent which entails this proposition; some natural candidates are the propositions 'He is a stalactite', 'He is a stalagmite', 'He is a cave formation deposited by dripping water'. The sentence has no such antecedent, so one has to be accommodated. I do not have a detailed theory of how such an accommodation process works, but somehow the position of the patient hanging from the ceiling together with the presence of a psychiatrist allow us to accommodate the proposition that the patient thinks he's a stalactite; this includes the constituent 'He is a stalactite', which serves as the required antecedent.

Focus on the syllable *mite* in the above example is crucial for the correct interpretation: if the whole word *stalagmite* were focused, then the proposition that needs to be entailed by context would be 'For some α, he is a/an α'; consequently, the clause would also be licensed by accommodating the proposition that the patient thinks he's an icicle, as suggested by Bolinger. The implication that the patient thinks he is a stalactite would be lost.

Meanings for parts of words also play a crucial role in predicting accent patterns from the contextual information, for instance predicting that in the situation depicted in the *New Yorker* cartoon (1), the psychiatrist must focus the syllable *mite*. The givenness requirement does not penalize gratuitous focus marking, but an independent constraint keeps focus marking to a minimum (Schwarzschild 1999:156). Focus marking on part of a word is therefore preferable to focus on the whole word when both options are licensed by givenness. Since parts of words have their own meanings, they can be considered "given" in the technical sense: in a discourse where stalactites are salient the word *stalagmite* is not given, because the existence of a stalactite does not entail the existence of a stalagmite, but the word part *stalag* is given, because the existence of a stalactite entails the proposition $\exists\alpha\exists\beta[[\![\text{stalag}]\!](\beta)(\alpha)]$. Since the word part *stalag* is given, focus must fall on the word part *mite*.

Phonological decomposition, which assigns meanings to parts of words, is also compatible with other variants of alternative semantics (e.g. Kratzer 1991) as well as with other theories of focus such as structured meaning theories (von Stechow 1989; Krifka 1991, 1992) and theories of focus movement (Chomsky 1976, Rooth 1996a). The latter may be incompatible syntactically, since words appear to be islands to other long-distance dependencies.

(17)*Sue knows who has appointments with what-dontists.

(cf. Sue knows who has appointments with which specialists.)

(18) Sue knows only who has appointments with ORTHOdontists.

But the semantic mechanism in both structured meaning and movement theories is the same, involving abstraction over the focused constituent, and this works with the meanings proposed for parts of words. The meanings derived by phonological decomposition are also needed for an account of coordination of parts of words (Artstein 2002b, chap. 4; Artstein, forthcoming), and this provides further support for having phonological decomposition as a component of the grammar.

3. Focusability and Prosodic Structure

The semantics of phonological decomposition can interpret focus on any part of a word. This leads to two kinds of problems. On the one hand, the theory is too strong: it predicts focus marking on parts of words where it is in fact impossible, as in the following example from Bolinger (1986:104).

(19) You say it blasts easily? — No, it ˈBLASTED easily (*blastED).

The semantics has no problem interpreting the starred structure, and thus fails to predict its ungrammaticality.

At the same time, the semantics fails to predict the location of focus in the following sentences (the first one I heard in natural speech on more than one occasion; the latter two are from Bolinger 1961:93).

(20) This is the INdependent variable ... and this is the DEpendent variable.

(21) natural REgularity ("in a context that implied an opposition to IRregularity")

(22) Avoid foods that are indiˈgestible – favor those that are DIgestible.

We see the problem, for instance, in (20): prior discourse contains the word *independent*, so all parts of the word *dependent* should be given; there is no apparent reason to put accent on anything but the default syllable. The same holds for (21) and (22).

3.1. Focus Marking and Foot Structure

Both of the above problems are explained if phonological decomposition is constrained phonologically, so that meanings are only assigned to prosodic units the size of a metrical foot or larger. This gives a straightforward explanation to the non-availability of focus on the contrasting syllable in (19), because the contrast is in the weak syllable of a foot: (ˈbla.sted) (the period marks a syllable boundary, and parentheses show the grouping of syllables into feet). Focus should be minimal (cf. section 2.2) so we would expect it to be marked on the final syllable, but since the minimal unit for focus marking is a foot, we get focus on a whole foot as in (19).

The same hypothesis also explains accent placement in (20)–(22). The word *independent* has the prosodic structure (inde)(pendent), with two metrical feet (the structural details of the *pendent* part are not important for this example, but see discussion of *informant* later in this section). Focus is marked on the entire foot (inde), so the semantics assigns meanings to the word parts (inde) and (pendent). Now the word *dependent* is not given, because there is no antecedent that entails it, but the word part (pendent) is given. Focus thus has to be marked on the novel element *de*. The same holds for the other examples, given their metrical structures: i(rregu)(lari)ty, (regu)(lari)ty; (indi)(gesti)ble, (di)(gesti)ble.

The following contrast is an additional demonstration that focus marking respects the footing of a word. The words *phonological* and *phonology* differ in their unmarked metrical patterns: the morpheme *phono* forms a foot in (ˌphono)(ˈlogi)cal but not in pho(ˈnolo)gy. This difference affects the possibility of marking focus on the string *phono*.

(23) This is a morphological problem that gets a (ˈPHONO)(ˌlogi)cal solution.

(24) I have trouble with morphology, but he will only discuss pho(ˈnolo)gy.
*(ˈPHONO)(ˌlogy).
?(ˈPHO)(ˌnolo)gy.

In (23), where *phono* is contained in a foot, it can receive the pitch accent of a focus constituent; prominence relations between the feet change as a result. But in (24) we see that focus cannot be marked on *phono*, despite the fact that it is a morpheme: the second option, where footing of the word has changed, is completely ungrammatical; judgments differ with regard to the last option, where no foot boundaries have been destroyed but a new foot has been created.

Two qualifications need to be made to the statement that focus has to be marked on existing metrical feet. First, we have just seen that it is possible to focus a syllable that is normally unfooted, as in PHO*nology*, even if the acceptability is marginal; more will be said on such examples below. Second, Veneeta Dayal and an anonymous reviewer note independently that weak syllables are much more readily focused when the pronunciation of the word is the subject matter of discussion. Compare the following sentences.

(25) I didn't say plumbing, I said plumbER.

(26) The problem wasn't the plumbing, it was the ˈPLUMBER.
*plumbER.

Whereas focus on the contrasting part is natural in (25), it is much less acceptable in (26). I do not have a precise explanation for this observation; one could imagine that the explicit discussion of pronunciation simply allows speakers to entertain more prosodic analyses than they normally do. The discussion below pertains to examples where focus falls on a word part when pronunciation itself is not the topic of discussion.

Focus can change the metrical structure of a word, if only in a limited way: assuming that a stressed syllable is always the head of a metrical foot, the following examples show that the final syllable has been promoted to the status of a foot. Sentence (27) is taken from Bolinger (1986:104); sentence (28) shows that focus on the syllable *mant* is also possible when pronunciation is not the subject matter of the discussion.

(27) We got the information from your informer. — You mean from my inforMANT.

(28) While his main source of income was working as a police informer, he made a few extra bucks as a language inforMANT.

When not focused, the final syllable of *informant* is stressless. It is not clear to me whether it is incorporated as the weak syllable of a foot together with the preceding syllable, or if it is left unfooted: strictly bimoraic footing would make the syllable *for* a foot by itself; however, since the nucleus of unstressed *mant* is a syllabic nasal, the syllable is light and as such it may constitute the weak syllable of a foot (Pater 2000 argues that syllables with nasal nuclei are parsed this way in pre-tonic position). The acceptability of focus on a weak syllable depends on how good a foot it would form. With a full vocalic nucleus, *mant* is a heavy syllable and thus can easily form a foot in its own right. (The vowel in focused MANT is a schwa [ə], but syllabic nasals that are reduced forms of an underlying full vowel can have that vowel when focused, for instance the syllabic nasal in *San Fr[n̩]cisco*, which is an underlying [æ] – cf. *Fr[æ]nciscan*; see Pater 2000:247).

We find that while focus can attract stress and even form a new foot, it can not move heads of feet into a weak position: aside from the focused part, prominence relations in *inˌfor*ˈMANT are the same as in *inˈfor.mant* (contrast this with *ˌin.forˈma.tion*). Nor can focus perform profound segmental changes: the word *stalac*TITE, with focus on the final syllable, has the same segmental composition as unmarked [stəˈlækˌtajt]; focus thus differs from a process like affixation that produces *stalactitious*, where stress shift results in different vowels: [ˌstæləkˈtɪʃəs]. Phonologically, focus marking is similar to the postlexical Rhythm Rule, which also respects footing, hence *poˈlice officer* rather than **ˈpolice officer* (for those speakers who normally pronounce *poˈlice* and not *ˈpolice*).

The conclusion that phonological decomposition applies to units already marked for prosodic structure explains a particular difference between focus above and below the word level. An anonymous reviewer points out that only focus on phrases can appear in out-of-the-blue contexts, not focus on word parts; Hubert Truckenbrodt and Irene Heim have independently pointed out to me that focus is obligatory above the word level but optional below it. These observations are explained by noting a fundamental difference between word and sentence prosody: words but not sentences have a default stress pattern independent of information structure (Bolinger 1961). Whether word stress is completely determined by rule (Chomsky and Halle 1968) or is specified in the underlying structure (Booij and Lieber 1993), it can be determined without recourse to the notion of focus; but focus is an inherent component of the grammar of sentence prosody (Truckenbrodt 1995). Therefore an unmarked word accent can be determined in an out-of-the-blue (or very weak) context, but some minimal assumptions must be entertained about the context in order to determine sentence accent; and while the grammar of focus placement can conflict with the grammar of word stress, resulting in optionality, no such conflict arises at the phrase level because focus is part of the grammar of sentence prosody in the first place.

Why does phonological decomposition respect the metrical constituency of a word, and apply only to units the size of a foot or larger? One possible explanation is that this follows from the grammar of focus: focus is marked with a pitch accent, and pitch accents associate with stressed syllables (Selkirk 1984, 1995). If a syllable must be stressed prior to receiving focus, and in order to receive stress a syllable has to be the head of a metrical foot, then focus has to be marked on feet in order to get phonologically realized. This explanation suffers from two problems. First, we have seen that focus can target a syllable that is not normally stressed. Second, while pitch is the most salient physical property used to mark contrast (this observation dates back at least to Coleman 1914), Rooth (1996b) shows that in some cases focus-sensitive adverbs like *only* may associate with constituents that are prominent in intensity (loudness) and duration rather than pitch (Partee 1999 cites papers by Christine Bartels and Manfred Krifka in Kamp and Partee 1997 that point to similar conclusions; see also Beaver et al. 2002). If this is correct then the requirement that focus be marked on a prosodic unit the size of a foot or larger cannot be a consequence of pitch accent association, though it may still be the result of the grammar of focus.

I suggest that the requirement that focus should be marked on existing prosodic structure, with only a limited possibility to change it, is not a consequence of the grammar of focus in particular, but rather constitutes part of the grammar of phonological decomposition itself. Recall that phonological decomposition splits the meaning of a lexical item into two components, each of which is assigned to part of the phonological representation. The phonological representation itself is not just a string of segments – it has the structure of syllables and feet, units that are important in determining where stress and pitch accents may be located. A simple hypothesis is that phonological decomposition assigns meanings to the prosodic constituents that make up a word, not to arbitrary parts of the linear segmental representation; any other relation would involve a nontrivial mapping between the word parts that carry semantic focus and those marked for phonological prominence. Such mappings are commonly referred to as "focus projection" (Selkirk 1984, 1995; Rochemont 1986; Gussenhoven 1983, 1999) and are often characterized in syntactic terms like head and argument, which are not applicable to all the kinds of word parts that can be focused. I therefore find it preferable to entertain the simple hypothesis that the same prosodic units on which prominence is marked are also the ones that are semantically focused. The same sensitivity of phonological decomposition to prosodic constituency is displayed in coordination of parts of words (Artstein 2002b, chap. 4; Artstein, forthcoming), so this sensitivity seems to reflect something basic about the kind of grammatical units that can participate in the semantics. An intriguing extension of this idea is that perhaps semantic interpretation overall has to proceed along the lines of prosodic rather than morphosyntactic constituents; see Steedman (1991, 2000a,b) for a grammar built along these lines.

3.2. Focusability: Phonology or Semantics?

The previous section has provided an explanation why some word parts can be marked by focus while others cannot be: the determining factor is phonological, namely the requirement that focus should be marked on a foot and that it cannot destroy existing prosodic structure. This stands in contrast to suggestions in the literature which tie the availability of focus to the semantic transparency of word parts. Chomsky (1970) states in a footnote that "the focus must be composed of full lexical items"; this amounts to the claim that the semantics of focus can only apply to units that have an independent lexical meaning. Bolinger (1986:104) uses both semantic and phonological notions: "… many words contain some rather transparently distinctive affixes, and the less bound these are, the easier it is to accent them separately." I will now examine these claims in greater detail, and show that what underlies this notion of semantic transparency is in fact the phonological intuition discussed in the preceding section.

Wennerstrom (1993) argues that semantically transparent prefixes ("analyzable" in her terms) form independent prosodic words within the lexical word, and that focusability can be used as a diagnostic for this property. She is unclear about the reason for this relation, whether it is a semantic property of the prefixes or their prosodic constituency that makes them focusable. So let's look at the hypothesis that it is the semantic properties of certain affixes that determine whether or not they can be focused. The following examples are taken from Wennerstrom (1993:311).

(29) This function is DEcreasing here, but INcreasing there.

(30) John expected to be promoted, and was shocked at being DEmoted.

(31) I still say she's a very effective manager; it's the equipment that's DEfective.

The analyzability of these prefixes is anything but clear. The semantic import of the prefix *in-* in *increasing* is not apparent (etymologically it is the *in* of direction, meaning roughly 'into'; *Oxford English Dictionary*), and the prefix *de-* in *defective* has little more to contribute than a general feel of negativity. And while the opaque prefixes in *promoted* and *effective* are not focused in the above examples, they can in principle receive stress. Indeed, if sentence (30) is reversed it is much easier to stress the prefix in *promoted* ((32a)), and rather odd to keep stress on the prefix in *demoted* alone ((32b)); deaccenting the prefix *pro* in the latter case is only possible if the entire word *promoted* is deaccented ((32c)).

(32) a. John expected to be demoted, and was surprised at being PROmoted.

b.*John expected to be DEmoted, and was surprised at being PROˈMOTED.

c. John expected to be DEmoted, and was SURPRISED at being promoted.

Semantic transparency thus fails to give an account of when focus is possible on parts of words and when it is not. On the other hand, prosodic constituency does provide an explanation: all the prefixes in (29)–(31) occur right before a main stress in the unmarked structure of the word, which means they either form a foot themselves or are unfooted.

(33) in(ˈcrea.sing), (ˌde)(ˈcrea.sing)

pro(ˈmo.ted), (ˌde)(ˈmo.ted)

e(ˈffective), (ˌde)(ˈfective)

Focus on the prefixes above is therefore the result of their prosodic status; there is no need to refer to their semantic properties.

We can also see why semantic transparency appears at first sight to determine focusability: there is a certain correlation between the semantic transparency of an affix and its prosodic status. Raffelsiefen (1993) shows that a certain class of prefixes which form prosodic words in English can be characterized through a historical notion of compositionality that links meaning shift over time in morphologically related forms. The following set of contrasts shows differences in the pronunciation of prefixes that arguably share the same underlying segmental representation: examples (34)–(36) show how a phonological process is blocked when the prefix is transparent, and in examples (37)–(38) we see certain segments that are present following a transparent but not an opaque prefix.

(34)	Stress shift:	ˈimpetus (*im* = ?)	imˈproper (*im* = ‘not’)
(35)	Trisyllabic laxing:	[æ]symptotic (*a* = ?)	[e^j]symmetrical (*a* =‘not’)
(36)	Vowel reduction:	r[ɛ]n[ə]vation (*re* = ?)	r[i]l[o^w]cation (*re* = ‘again’)
(37)	Aspiration:	dis[t]urb (*dis* = ?)	dis[t^h]rust (*dis* = ‘not’)
(38)	[h] before [ə]:	pro[∅ə]bition (*pro* = ?)	pro[hə]waiian (*pro* = ‘for’)

The above examples all make a good case for the claim that prefixes which are semantically compositional form their own prosodic words. Now, since each prosodic word includes at least one metrical foot, it follows that these prefixes can be focused; we thus have an important class of focusable prefixes which are characterized through some semantic notion. But other word parts can be focused as well. Indeed, Raffelsiefen (1999:162) claims that independent phonological diagnostics show that some focused prefixes like the ones in (29)–(31) do not form prosodic words. The correct characterization of focusability is prosodic – focus is marked on feet – and the correlation between semantic transparency and focusability is only indirect.

A second claim about the relation between focus and semantic transparency is that focus is interpreted differently when it appears on transparent and opaque word parts. This is articulated by Selkirk (1984:271).

> We should distinguish between the intonational meaning associated with a prominence on affixes like [*in-*, *un-*, and *non-*] and the meaning associated with prominence on affixes not meaningful in themselves, such as might occur in the contrast between TRANS*fer* and RE*fer*, for example. In such cases something of a metalinguistic statement seems to be involved: possibly a comment is being made *about* the morphemes themselves. The "intonational meaning" in such instances is analogous to that found when syllables rather than morphemes are being contrasted: *I said co*FFIN*, not co*FFEE. It is also analogous to the pitch accenting of one of the parts of a frozen compound: *I said king*FISHER*, not king*PIN.
>
> Perhaps the generalization is that pitch accents can be assigned to anything of the level word or below, but that a pitch-accent-bearing element is only interpreted along the lines of a normal focused constituent when it has an identifiable separate meaning. When the pitch-accent-bearing element cannot be interpreted in this way, the presence of pitch accent is interpreted instead in metalinguistic terms.

The claim that focus on word parts is metalinguistic, or a comment about the parts themselves, seems to reflect the lack of a good semantic theory for such word parts. Phonological decomposition eliminates the need for a distinction between "normal focused constituents" and "metalinguistic" interpretation; both cases receive an identical treatment as far as the theory of focus goes, and the difference stems from the fact that meanings of opaque word parts make reference to their form. It is not quite clear to me what would amount to being a comment about word parts, but reflecting discourse givenness and restricting the domain of *only* seem like interpretations "along the lines of a normal focused constituent." Thus, focus on the last syllable of *stalag*MITE in examples (1) and (2) should be considered "normal" in Selkirk's terms, even though *mite* does not have a lexical meaning and it is doubtful if it is even a morpheme (etymologically it isn't: *stalagmite* derives from Greek *stalagma* 'a dropping'; *Oxford English Dictionary*). The same can be said for the Hebrew example (3), where focus shifts the prominence to the initial syllable of KOZMO*nawtim* 'cosmonauts': the sentence is not necessarily about the term *kozmonawtim* – it can also be interpreted as a statement about the space achievements of the Soviets.

At the same time, phonological decomposition explains our intuition that there is something metalinguistic about focus below the word level. This is because the meanings for parts of words make reference to the form of the word. Rather than take this as a reason to exclude such focus from the discussion, I have shown that acknowledging such meanings allows us to use a single theory for focus above and below the word level.

4. Conclusion

We have seen that with an adequate theory of semantic interpretation for arbitrary word parts, focus below the word level turns out to behave the same as above the word level, with any differences being attributed to the semantics of parts of words. The observation that focus on arbitrary word parts triggers alternatives that are similar in form motivates a semantics of these word parts that reflects their form.

This sort of connection between form and meaning is also evident in the psycholinguistic literature. Language users are able to extract information about meaning from parts of words: word recognition happens in real time, and lexical access begins as soon as the beginning of the word is heard, without waiting for the complete phonological shape. Tanenhaus et al. (1995) show, for instance, that as a word like *candle* is being heard, it activates the meaning of a word with a similar onset, such as *candy*; Allopenna et al. (1998) show that this is also true of syllables at the end of a word, so as the second syllable of *beaker* is being heard, it activates the meaning of the word *speaker*. This evidence shows that language users are able to give meanings to parts of words – they associate a sound with the set of meanings of words that match it in form. Similar things happen on the production side too: Dell (1995) shows that the number of speech errors (“slips of the tongue”) that combine phonological and semantic mistakes is greater than what would be expected based on mistakes that are solely phonological or semantic, suggesting an intimate connection between phonological and semantic processing.

This is not to say that these psycholinguistic observations are the same as the phenomena described in this paper. The motivation for choosing denotations for parts of words is entirely semantic, driven by the need to explain focus below the word level as part of the general theory of focus. And there are observed differences: while focus below the word level is limited to foot-size prosodic units, lexical activation can be triggered by phonetic material as short as a segment. Nevertheless, the similarity between these two kinds of observations is striking.

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