

Remarks and Replies

Correspondence between XPs and Phonological Phrases

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Bresnan (1971, 1972) establishes an interaction between stress assignment and syntactic movement. We are interested in a restriction on this interaction. We argue that this restriction shows that the constraint STRESS-XP needs to be part of the syntax-prosody mapping and that it needs to be a restriction on a correspondence relation between syntactic XPs and phonological phrases. (A second constraint on the correspondence relation is either WRAP-XP or MATCH-XP.)

In the course of our argument, we analyze Bresnan's interaction between stress assignment and movement within an account in which Internal Merge induces reconstruction effects at both LF and PF.

Keywords: syntax-phonology interface, stress, movement, reconstruction, STRESS-XP

Chomsky and Halle's (1968) Nuclear Stress Rule (NSR) assigns stress rightmost in English as in (1a). Bresnan (1971, 1972) discusses the fact that syntactic movement can lead to a nonfinal stress pattern, as in (1b), and develops a cyclic account for this phenomenon.

- (1) a. Helen has written some books.
b. What books_i has Helen written t_i?

In section 1, we first review Bresnan's arguments and then turn to a revision of Bresnan's account developed in Truckenbrodt 2019. In this revised account, Bresnan's effect follows from the interaction of Internal Merge (Chomsky 2000, 2001, 2008) with the stress-assigning constraint STRESS-XP.

In section 2, we address an empirical problem: for (1b) to be a default stress pattern, the sentence subject *Helen* needs to be contextually given and destressed (Selkirk 1995). This does not follow from Bresnan's original account or from the update. We will show that the problem is overcome if there is a formal correspondence relation between syntactic XPs and phonological phrases that ties the effect of STRESS-XP together with the effects of another known constraint, WRAP-XP.

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In section 3, we extend this argument. MATCH-XP (Selkirk 2011) cannot replace STRESS-XP, but it could be that MATCH-XP and STRESS-XP jointly constrain a correspondence relation between XPs and phonological phrases.

Our main point is thus that there is a correspondence relation between syntactic XPs and phonological phrases and that it is restricted by STRESS-XP.

1 A Revision of Bresnan's Account of Stress-Movement Interactions

1.1 Preliminaries: Information Structure and Default Stress

Most words in a sentence can in principle be focused. The focus attracts the strongest stress (Chomsky 1970, Jackendoff 1972), marked here by double underlining: [Mary]_F *made the cake*, *Mary* [made]_F *the cake*, *Mary* made [the cake]_F. Inside a larger focused constituent, additional default rules of stress assignment must come into play: *What happened?* [*Mary* made a cake]_F. Classically, this was taken to be the NSR, which assigns rightmost stress.

Apart from focus, a further information structure effect is that contextually given constituents reject stress. Here is a simple example from Ladd 1983:164: *What about Fred? I don't like* [*Fred*]_{Given}. See Büring 2016b for references and detailed discussion.¹

This article is about default stress rules (such as the NSR) and their interaction with syntactic movement.

1.2 Bresnan's Stress-Movement Interaction

In this section, we review the evidence provided in Bresnan 1971, 1972 for an effect of syntactic movement on stress. Sentences (2a) and (3a) show the expected rightmost stress due to the NSR. Sentences (2b) and (3b) are exceptions to this in which the final element has moved (Newman 1946:179–180). Notice that (2b) is about George leaving some plans and (3b) is about George leaving a proposal.

- (2) a. George has plans to leave.
 b. George has plans₁ to leave t₁.
- (3) a. Mary liked the proposal that George leave.
 b. Mary liked the proposal₁ that George left t₁.

Another class of cases contrasts the unexpected stress pattern under movement ((4a) and (5a)) with corresponding sentences in which the overt exponent related to the moved element is pronominal ((4b) and (5b); these overt exponents are italicized there). The latter examples show the expected final stress due to the NSR again. The examples are from Bresnan 1971:258–259.

- (4) a. George found some friends₁ he'd like you to meet t₁.
 b. George found *someone*₁ he'd like you to meet t₁.

¹ Other such information structure effects involve topics (Jäger 2001, Truckenbrodt 2019) and contrastive topics (Büring 2003, 2016a,b, Constant 2014).

- (5) a. John asked what books₁ Helen had written t₁.
 b. John asked *what*₁ Helen had written t₁.

The context in (6) shows that neither narrow focus on the stressed element nor givenness of the final verb is required for the NSR-defying stress pattern. (Among other things, the verb *written* is new, rather than given, in this context.) The stress pattern must result from the interaction of default stress rules with syntactic movement, as claimed by Bresnan.²

- (6) A: Your colleague Helen doesn't have an online presence.
 B: I know her well. Do you have any questions about her?
 A: Yes, I wonder [what books she has written]_F.
 #Yes, I wonder [what books she has written]_F.

Bresnan (1971, 1972) offers a cyclic account of the effect. In (6), the NSR assigns final stress in [*she has written what books*] on the first cycle. This stress assignment is followed by movement on the second cycle, which takes the stress along, deriving [*what books has she written*].

1.3 Two Issues for Bresnan's Account

We now review two empirical problems for Bresnan's account. Following this, we will show in sections 1.4–1.6 how they are overcome in a revised account of stress-movement interaction. All this is preparation for the arguments for our main point in sections 2 and 3.

Bresnan's cyclic account has at its core the interaction of movement with *nuclear* stress assignment. As Bresnan (1971:272ff.) notes, the account makes the wrong predictions in structures of the form [. . . V object XP], where XP is moved. She predicts that the stress is again found on the moved element. Instead, stress is on the postverbal object.

- (7) a. #[Whose knife]₁ did Peter slice the salami with t₁?
 b. [Whose knife]₁ did Peter slice the salami with t₁?

Lakoff (1972) notes a related problem, shown in (8): when they undergo *wh*-movement, clause-final adjuncts do not bear sentence stress in their derived position.

- (8) a. #[At what time]₁ did Sam collapse t₁?
 b. [At what time]₁ did Sam collapse t₁?

In what follows, we present a revised account that overcomes these two problems. We begin with updating the account of stress assignment.

1.4 An Updated Account of Stress Assignment

Since Selkirk 1980, 1984 and Gussenhoven 1983a, sentence stress is mostly analyzed in terms of (at least) two prosodic layers above the word; see, for example, Nespor and Vogel 1989,

² See Jacobs 1991 and Truckenbrodt 2012 for detailed discussion of focus and givenness in *wh*-questions; see also Büring 2016a and Truckenbrodt 2019.

Uhmann 1991, Gussenhoven 1992, 2004, Jacobs 1993, Truckenbrodt 1995, 2007, 2017, Selkirk 1996, 2008, 2011, Frota 2000, Kahnemuyipour 2004, 2009, Wagner 2005, Büring 2006, 2012, 2016b, Kratzer and Selkirk 2007, to appear, Richards 2010, 2016, 2017. Many of the accounts work across English, Dutch, and German without parameterization.

We refer to the lower prosodic layer as *phrasal stress* and represent it with single underlining. Phrasal stress is correlated with an obligatory pitch accent in English, Dutch, and German. We derive phrasal stress using the constraint STRESS-XP (Truckenbrodt 1995, 2006, 2007, 2017) that incorporates many of the insights of the other authors just mentioned; see also its applications in Féry and Samek-Lodovici 2006 and Büring 2016b, among others.

(9) *STRESS-XP*

Each XP must contain a beat of phrasal stress.

Phrasal stress is assigned minimally but enough to satisfy STRESS-XP for all XPs in the structure.³ Comparing the English VP [*teach linguistics*] with its German translation [*Linguistik unterrichten*], lit. ‘linguistics teach’, stress is not consistently rightmost, but it is consistently on the complement of the verb (see also Cinque 1993). STRESS-XP correctly predicts this dependency on the phrase structure. Stress on [_{DP} [_{NP} *linguistics*]] and [_{DP} [_{NP} *Linguistik*]] is unavoidable for satisfying STRESS-XP for DP and NP. This stress then also satisfies STRESS-XP for the VPs [_{VP} *teach linguistics*] and [_{VP} *Linguistik unterrichten*], since this stress is also inside the VP. Here, one beat of stress does duty for multiple XPs, which is expected in the account. More generally, for a set of XPs nested one within the next higher one, as in [_{XP} ... [_{XP} ... [_{XP} *X*] ...] ...], STRESS-XP is satisfied if phrasal stress is placed within the innermost XP as in [_{XP} ... [_{XP} ... [_{XP} *X*] ...] ...], since this innermost XP and all higher XPs then satisfy STRESS-XP.⁴

The structure [*slice the salami with a knife*] receives two beats of phrasal stress: [*slice [the [salami]] [with [a [knife]]]*]]. Stress on [*the [salami]*] satisfies STRESS-XP for this NP and DP but not for the XPs that follow, which thus require separate stress: [*with [a [knife]]]*]. The VP then also contains stress. More generally, separate XPs next to each other will require separate phrasal stress to satisfy STRESS-XP.

Turning to the second, higher layer, the nuclear stress is the strongest stress of the intonation phrase in the two-level accounts. In English, Dutch, and German, this is obtained by strengthening the rightmost phrasal stress.

(10) *NSR-ι*

Strengthen the rightmost phrasal stress in the intonation phrase *ι*.

(Uhmann 1991, Selkirk 1995)

³ The analysis is embedded in a range of crosslinguistic evidence that XPs play a crucial role in the assignment of phrasal prosody; see, for example, Selkirk 1986, Selkirk and Shen 1990, and Selkirk and Tateishi 1991.

⁴ Cinque (1993), building on Halle and Vergnaud 1987, postulates an effect of syntactic structure attracting stress, which he formalizes in terms of X getting more stress in [Y[X]] than in [X] (where brackets are syntactic constituents). STRESS-XP modifies this in two ways. For one thing, it is the presence of an XP that attracts the stress—for example, in [_{YP} Y [_{XP} *X*]] and in [_{YP} [_{XP} *X*] Y]. For another, this effect is not cumulative: the amount of stress assigned to *X* in [_{XP} *X*] and in [_{YP} Y [_{XP} *X*]] is the same. See Truckenbrodt 2006 for empirical arguments for this modification.

We represent this strengthened nuclear stress using double underlining. We obtain:

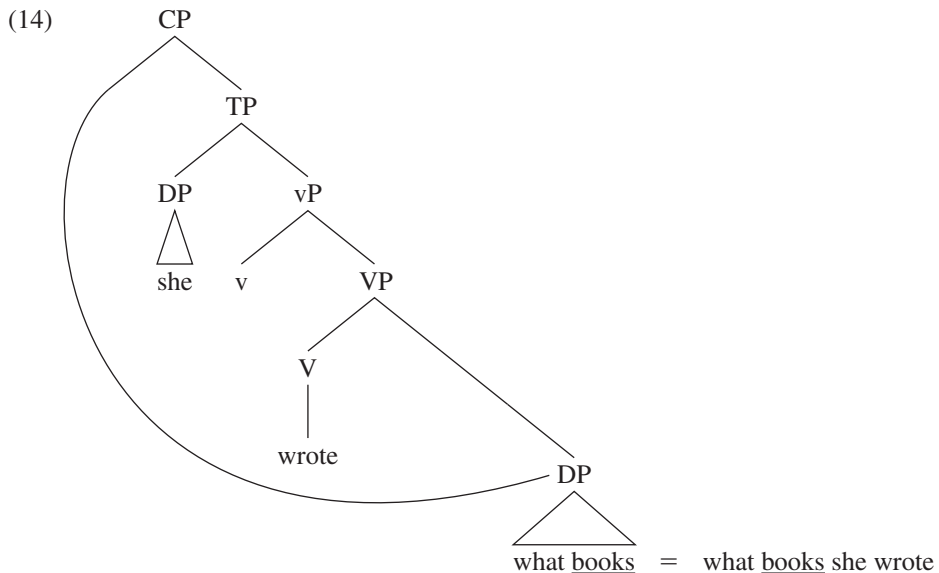
- (11) a. [[Helen] [wrote [some [books]]] STRESS-XP
 b. Helen wrote some books NSR-ι
- (12) a. [[Peter] [sliced [the [salami] [with [a [knife]]]]] STRESS-XP
 b. Peter sliced the salami with a knife NSR-ι
- (13) a. [the [professor] [_{vP} recommended it] STRESS-XP
 b. the professor recommended it NSR-ι

The pronoun in (13) is stress-rejecting. This is discussed below.

With this background, we return to the interaction of movement and stress. To begin with, we need to put aside an issue that is discussed at length in section 2. This is the issue of stress on the sentence subject when another constituent moves across the subject. We will avoid this issue until section 2 by replacing the names in subject position with unstressed pronouns in the examples.

1.5 The Interaction of Movement and Stress in Terms of Stress Reconstruction

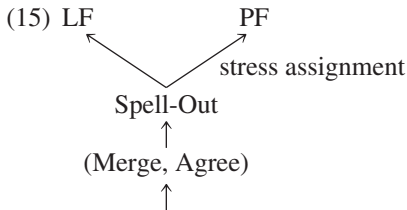
For concreteness, we adopt Truckenbrodt's (2019) account of Bresnan's effect in terms of Internal Merge (Chomsky 2000, 2001, 2008). The account employs the view that Internal Merge of α retains the original attachment of α and adds a second attachment in a higher, c-commanding position, as in (14). (Here and in what follows, we omit the role of the vP phase, including the intermediate landing at the edge of vP. The vP phase is orthogonal to the issue at hand.)



Only the highest attachment is spelled out at PF. However, the lower attachment is still crucial for phenomena involving LF reconstruction, as Chomsky (1993) first suggested with the copy

theory of movement and reconstruction. Chomsky (1993) postulated that the higher or the lower copy is partly deleted at LF, while Safir (1999) maintained that they can both be retained at LF. Either way, the multiply-linked structure is present before and at Spell-Out.

In the model in (15), the structure in (14) will pass through Spell-Out to LF, where the lower attachment can have consequences for LF reconstruction.



According to Truckenbrodt (2019), Bresnan's observation shows that the lower attachment also has consequences for the stress assignment constraints that map from Spell-Out to PF, and that STRESS-XP detects the silent lower attachment. In (14), in particular, the VP must satisfy STRESS-XP. This would require stressing the verb as in (16), if the trace were simply an empty category. However, if we assume the multidominance structure in (14), the VP dominates the stressed word *books*, satisfying STRESS-XP without verb stress. This results in the empirically attested stress pattern in (17).

- | | | |
|---------|--|-------------------|
| (16) a. | #(I wonder) what <u>books</u> she had [_{VP} <u>written</u> t] | STRESS-XP |
| b. | #(I wonder) what <u>books</u> she had <u>written</u> | NSR- _l |
| (17) a. | (I wonder) what <u>books</u> she had [_{VP} written <u>what books</u>] | STRESS-XP |
| b. | (I wonder) what <u>books</u> she had written | NSR- _l |

In this account, then, the representation in (14) leads to PF stress reconstruction for STRESS-XP in its application to VP. This is the updated analysis of Bresnan's effect.

For cases in which the moved element is pronominal, as in (4b) and (5b), we follow Bresnan (1971, 1972) in assuming that pronouns are stress-rejecting (see also Richards 2017 for discussion). This effect needs to override STRESS-XP so as to prevent it from assigning phrasal stress to [_{DP} *she*], [_{DP} *it*], and [_{DP} *what*].⁵ We obtain (18). Here, the application of STRESS-XP to the VP requires verb stress, with or without PF reconstruction. There is no stress to reconstruct.

- | | | |
|---------|--|-------------------|
| (18) a. | (I wonder) what she had [_{VP} <u>written</u> <u>what</u>] | STRESS-XP |
| b. | (I wonder) what she had <u>written</u> | NSR- _l |

More generally, the revised account correctly predicts that the interaction of *wh*-movement with stress assignment is a fairly narrow phenomenon. It concerns primarily the satisfaction of STRESS-XP by the VP, and empirical consequences for stress assignment are primarily predicted

⁵ *Wh*-pronouns in situ show an additional effect of stress attraction. This is not shared by moved *wh*-pronouns in single-*wh* questions, whose pronominal nature determines their prosody. See Chomsky 1995:397n69, Haida 2007, and Truckenbrodt 2012, 2013 for observations and analysis.

where stress reconstruction into the VP exempts the verb from requiring stress as in the distinction between (16) and (17).

Furthermore, there can be no reconstruction for the “rightmost” property of the NSR- ι , unlike in Bresnan’s account. The reason is this. While illustrations like (16)–(18) combine syntax and prosody for reasons of space, the actual relation is between a syntactic structure like (14) and a phonological string with prosodic structure and stress but without a copy of the moved element. The NSR- ι can only strengthen an overt element in the phonology. It would not be able to apply to a covert, reconstructed one, since there are no empty copies in the phonology.

The revised account also correctly handles the cases that Bresnan notices as a problem for her analysis. (19) shows the derivation of (7).

- (19) a. [whose knife] did he [slice [the salami]]
 [with {whose ~~knife~~}] STRESS-XP
 b. whose knife did he slice the salami with NSR- ι

No effect of stress reconstruction is expected: phrasal stress on [*the salami*] and its absence on [*slice*] are determined by the structural properties of these elements, whether another stressed element is reconstructed into the VP or not.

We next turn to stress in connection with adjuncts and Lakoff’s (1972) case in (8).

1.6 The Stress Pattern of Verbs next to Adjuncts

Stressed objects and stressed adjuncts affect default stress on the verb differently (Gussenhoven 1983a,b, 1984, Krifka 1984). The verb does not receive default phrasal stress next to a stressed object, as in (20a–b). The verb does receive default phrasal stress next to a stressed adjunct, as in (20c–d).

- (20) a. teach linguistics b. Linguistik unterrichten (German)
 linguistics teach
 c. teach in Ghana d. in Ghana unterrichten (German)
 in Ghana teach

With the application of the NSR- ι in English and German, we obtain (21a–d).

- (21) a. teach linguistics b. Linguistik unterrichten (German)
 linguistics teach
 c. teach in Ghana d. in Ghana unterrichten (German)
 in Ghana teach

The distinction is empirically quite noticeable in head-final languages like German and Dutch, where it affects the position of nuclear stress. The nuclear stress is on the preverbal object in (21b) but on the verb when an adjunct precedes, as in (21d).

The distinction is subtle in English, where it does not affect the position of nuclear stress ((21a) vs. (21c)); it merely determines whether the pre-nuclear verb carries phrasal stress or not. Gussenhoven (1983b) shows experimentally that this more subtle distinction in English is also real.

The distinction between arguments and adjuncts is captured by STRESS-XP. We follow the standard assumption that θ -role assignment makes a distinction between arguments of X, which are merged inside XP, and adjuncts, which are merged at least partly outside. STRESS-XP sees the distinction in the same way as θ -role assignment: arguments count as inside, while adjuncts do not. Since an object is inside the VP, stress on it satisfies STRESS-XP for the VP, so that there is no incentive for stressing the verb. This is shown in (22). Since an adjunct does not count as inside the VP, stress on it cannot satisfy STRESS-XP for the VP. Satisfaction of STRESS-XP for the VP then requires stress on the verb. This is shown in (23).

- (22) a. [_{VP} teach [_{DP} linguistics]]
 b. [_{VP} [_{DP} Linguistik] unterrichten] (German)
 linguistics teach
- (23) a. [_{VP} teach] [_{PP} in [_{DP} [_{NP} Ghana]]]
 b. [_{PP} in [_{DP} [_{NP} Ghana]]] [_{VP} unterrichten] (German)
 in Ghana teach

With these refinements, we can analyze Lakoff's (1972) case in (8). As shown in (24a), the verb next to the adjunct requires stress by STRESS-XP to begin with.

- (24) a. [at [what [time]]] did he [_{VP} collapse] [at [what [time]]] STRESS-XP
 b. at what time did he collapse NSR- ι

Stress reconstruction does not have a detectable effect here, since the VP *collapse* requires phrasal stress regardless of the adjunct.

In the revised account, then, movement and stress interact in terms of stress reconstruction. A moved stressed object can satisfy STRESS-XP for the VP, exempting the verb from showing its otherwise expected stress.

Stress reconstruction is striking confirmation for the copy theory of movement and reconstruction (Chomsky 1993) and later versions of the theory: the copy (or the additional link) has effects not only at LF but also at PF.

The reader is referred to Truckenbrodt 2019 for a more detailed analysis of the relative clause cases in (2b), (3b), and (4a), and for independent support for this account from the interaction of stress reconstruction with LF reconstruction for idiom chunks and for Condition C effects.

2 A Restriction on Stress Reconstruction and Its Consequences

2.1 The Restriction

We now turn to the restriction on stress reconstruction that is crucial for our main argument. The restriction was noted by Selkirk (1995:561) in a comment on the example in (25).⁶ Selkirk notes

⁶ The restriction is also implicit in the formulation by Gussenhoven (1983b, 1992) of a descriptive stress rule without reference to movement. Closely related observations about movement across intervening stressed elements are made by Richards (2017:229) in the context of a discussion of why *tough*-movement does not affect stress assignment.

that the stress pattern shown is appropriate in a context in which *reviewed* is new but *Helen* is given and destressed (see also (6)).

(25) What books has Helen reviewed t?

The fact that *reviewed* can be new in this stress pattern is crucial for the reality of the movement-stress interaction. The fact that *Helen* needs to be contextually given does not undermine the reality of the effect. It is an apparent quirk that had been overlooked before, and it is also true of the names in subject position in earlier examples. However, an important problem is hiding behind this apparent quirk. (26) shows what the updated account predicts in case *Helen* is not given and destressed. *Helen* is stressed by STRESS-XP, the main verb is not stressed due to stress reconstruction, and the NSR- ι assigns sentence stress on *Helen*.

- (26) a. [what [books]] has [_{DP} [_{NP} Helen]] [reviewed]
 [what [books]]STRESS-XP
 b. #what books has Helen reviewedNSR- ι

This is not an intuitively valid default stress pattern. It is possible only if *Helen* is narrowly focused or if *reviewed* is contextually given. Instead, the stress in (27) is the only possible default stress if *Helen* is included with the new information.

(27) [There is a gap in the list of the institute's work during the past year.]
 [what [books]] has [_{DP} [_{NP} Helen]] [_{VP} reviewed]

A related contrast in German, inspired by examples in Gussenhoven 1983a, 1992, is shown in (28) and (29). In (28), the moved *wh*-phrase can satisfy STRESS-XP for the VPs.

(28) [Ob er die Prüfung besteht, hängt davon ab, . . .]
 'Whether he passes the exam depends on . . .'
 [wieviele Bücher]₁ er [_{VP} [_{VP} t₁ gelesen] hat]
 how.many books he read has
 'how many books he read.'

In (29a), the moved *wh*-phrase crosses the stressed adjunct [_{PP} *in* [_{DP} [_{NP} Ruhe]]]. Assuming stress reconstruction, the adjunct would be assigned the sentence stress by the NSR- ι as in (29a). However, (29a) is only possible empirically if the adjunct carries narrow focus or if the final verb is contextually given. The empirically correct default stress pattern is (29b).

(29) [Ob er die Prüfung besteht, hängt davon ab . . .]
 'Whether he passes the exam depends on . . .'
 a. #[wieviele Bücher]₁ er in Ruhe [[t₁ gelesen] hat]
 how.many books he in peace.and.quiet read has
 b. [wieviele Bücher]₁ er in Ruhe [[t₁ gelesen] hat]
 how.many books he in peace.and.quiet read has
 '. . . how many books he read in peace and quiet.'

The restriction is schematically formulated in (30).

- (30) The following configuration is ruled out as default stress:
object . . . XP . . . [_{VP} verb object]

2.2 *Phonological Phrases and WRAP-XP*

We now develop an account of (30) in terms of the interaction of STRESS-XP with WRAP-XP. In the theory developed in Truckenbrodt 1995, 2007, 2017, STRESS-XP and WRAP-XP are the two constraints relating syntactic XPs to phonological phrases across languages (see also Féry and Samek-Lodovici 2006 and Büring 2016b, among others). WRAP-XP requires for each XP a phonological phrase of the same size or larger.

- (31) *WRAP-XP*
 Each XP is contained in a phonological phrase.

STRESS-XP and WRAP-XP target the same level of prosodic structure, the phonological phrase (p-phrase, ϕ). Phrasal stress is the prosodic head of a phonological phrase. It is expected to stand in a one-to-one relation with p-phrases.

- (32) *Faithfulness Condition* (Hayes 1995, here for p-phrases)
 Each p-phrase contains exactly one beat of phrasal stress, its prosodic head.

Together, STRESS-XP and WRAP-XP require of each XP the prosody shown in (33).

- (33) (x) ϕ Prosodic-metrical structure
 . . . [XP . . .] . . . Syntactic structure

WRAP-XP requires a p-phrase around XP that is at least the size of the XP. STRESS-XP requires a beat of phrasal stress inside the XP. In examples, we have represented such phrasal stress by single underlining; here, we represent it as an “x” on the line of the p-phrase. Furthermore, “x” is the prosodic head of ϕ in this case.

The strongest arguments that WRAP-XP is needed in addition to STRESS-XP come from the Native American language Tohono O’odham and the Bantu languages Chichewa and Kimatuumbi (see Truckenbrodt 1995, 1999). However, we will now show that there is a crucial link between STRESS-XP and WRAP-XP that is relevant to the interaction of stress assignment with movement in English.

Let us first consider how WRAP-XP works in more detail. When a number of XPs are nested one within the next higher one, WRAP-XP is satisfied if there is a single large p-phrase around the entire structure: ([XP . . . [XP . . . [XP X] . . .] . . .) ϕ . In this way, the largest XP is contained in a p-phrase, and the lower ones are as well. One p-phrase does multiple duty for several XPs, which is expected in this account. Matters become more complex when there are several XPs next to each other inside a higher XP, as in (34c). Possible prosodic structures for such cases are shown in (34a) and (34b). WRAP-XP requires a single p-phrase around the largest XP in (34c), wrapping this largest XP (and the lower ones), as in (34a). We add a single grid-mark “x” in

(34a) for the Faithfulness Condition (32). STRESS-XP, however, wants a grid-mark on each of the smaller XPs next to each other in (34c), as in (34b). STRESS-XP and WRAP-XP are in conflict. (34a) satisfies WRAP-XP but does not satisfy STRESS-XP. (34b) satisfies STRESS-XP but does not satisfy WRAP-XP.

- (34) a. (x)_φ (x)_φ
 b. (x) (x)_φ (x) (x)_φ
 c. [XP A [XP B] [XP C]] [XP [XP A] [XP B [XP C]]]

In the typology proposed in Truckenbrodt 1995, (i) this conflict can be resolved in favor of WRAP-XP as in (34a); (ii) it can be resolved in favor of STRESS-XP as in (34b); or (iii) the resulting representation can include both (34a) and (34b), the former on top of the latter, as shown, so that both STRESS-XP and WRAP-XP are satisfied, but a constraint against recursive structure, NONRECURSIVITY, is violated. We will assume this third case here, in part because that assumption will be useful later. It is compatible with the empirical situation that the effects of STRESS-XP are not suppressed by WRAP-XP in German, as discussed in Buring 2016b. We think this is true for English as well (see, e.g., the phrasings diagnosed in Hayes 1989 and the accent assignments in Selkirk 1984).

We further assume that the choice to add the grid-mark on line (34a) rightmost on C rather than farther to the left on A or B is indirectly required by the NSR- ι , since this grid-mark is the target of strengthening by the NSR- ι . Thus, (A B C) _{ι} will better satisfy the NSR- ι than (A B C) _{ι} .⁷

2.3 Correspondence between XPs and P-Phrases

We return now to stress reconstruction. The case of successful stress reconstruction is shown in (35). Anticipating the syntax-prosody correspondence that we will argue for, we coindex relevant XPs with their corresponding p-phrases and their prosodic heads. The DP *what books* carries the index 1. It is wrapped by the p-phrase that also carries this index ($\phi_{1,2}$), and stressed by the head “x” of the p-phrase that also carries this index ($x_{1,2}$). The VP is indexed 2. It includes the verb *written* and the words of the moved *wh*-phrase *what books*. This VP satisfies WRAP-XP since the coindexed ϕ ($\phi_{1,2}$) contains *what books* and *written*.⁸ The VP satisfies STRESS-XP since *what books* is a VP element through the link to its underlying position and since it carries phrasal stress by $x_{1,2}$.

⁷ Technically, we assume a formalization of the NSR- ι in the constraint format of McCarthy 2003 that assigns a violation mark for each p-phrase that intervenes between the prosodic head of ι and the right edge of ι . It will thus rule out ((A B) _{ϕ_1} (C) _{ϕ_2}) _{ι} as an alternative to (34) (on the left) because of the intervening ϕ_2 . At the same time, it will not require rightward shift of p-stress within its p-phrase. The NSR- ι in this formulation is satisfied, for example, in (... ((_{VP} DP V)) _{ϕ}) _{ι} .

⁸ Note that VP₁ satisfies WRAP-XP only if ϕ_1 contains the overt *what books*: there is no silent copy of *what books* in the phonology that could allow the phrasing (*written what-books*) _{ϕ} with satisfaction of WRAP-XP.

- (35) ($x_{1,2}$) $_{\phi_{1,2}}$
 [what books]₁ she had [written {~~what books~~}]_{VP₂}
 VP₂ satisfies WRAP-XP by $\phi_{1,2}$ and satisfies STRESS-XP by $x_{1,2}$.

The case we are seeking to rule out is shown in (36). With the account used up to here, it is wrongly predicted to be good. STRESS-XP requires stress on the DP *what books* and separate stress on the disjoint DP *Helen*. This requires building two separate p-phrases at the lower ϕ -level. An additional higher ϕ -level is added, where ϕ_3 can satisfy WRAP-XP for the VP₃ elements *what books* and *written*. VP₃ also appears to satisfy STRESS-XP by x_1 on *what books*. Importantly, x_3 cannot satisfy STRESS-XP for VP₃, since x_3 is on *Helen* and thus not on an element of VP₃.

- (36) # (x_3) $_{\phi_3}$
 (x_1) $_{\phi_1}$ (x_2) $_{\phi_2}$
 [what books]₁ [Helen]₂ had [written {~~what books~~}]_{VP₃}
 VP₃ satisfies WRAP-XP by ϕ_3 and satisfies STRESS-XP by x_1 .

This, then, is a unique case. As we showed in connection with (33), an XP will normally satisfy WRAP-XP and STRESS-XP via the same prosodic constituent, (x_i) $_{\phi_i}$. In (36), however, the interaction with movement leads to an atypical situation. The discontinuous VP₃ *what books . . . written* is wrapped by a p-phrase (ϕ_3), but the head of that p-phrase, x_3 , is not in VP₃ because VP₃ is discontinuous. Instead, STRESS-XP could only be satisfied for VP₃ by the head of another p-phrase (the head x_1 of ϕ_1). Since this unique case is actually ill-formed, we are led to conclude that the grammar disallows this. We can rule it out by insisting that if VP₃ is wrapped by ϕ_3 , then it must be stressed by x_3 . That is, we can rule it out by tying the effects of WRAP-XP and STRESS-XP to each other.

For comparison, consider the acceptable stress pattern for this case in (37). If a further p-phrase, here labeled ϕ^* , is added to the lower ϕ -level, the prosodic head x_3 of ϕ_3 can be on *written*. In this case, then, ϕ_3 wraps VP₃ and at the same time the head x_3 of ϕ_3 satisfies STRESS-XP for VP₃, since it is on an element of VP₃ (i.e., on *written*).

- (37) (x_3) $_{\phi_3}$
 (x_1) $_{\phi_1}$ (x_2) $_{\phi_2}$ (x) $_{\phi^*}$
 [what books]₁ [Helen]₂ had [written {~~what books~~}]_{VP₃}
 VP₃ satisfies WRAP-XP by ϕ_3 and satisfies STRESS-XP by x_3 .

We think that the unique case in (36) allows us to see that the effects of WRAP-XP and STRESS-XP are tied to each other for each XP. In implementing this connection, we draw on an idea of Selkirk's (2011), namely, that XPs and p-phrases are in a correspondence relation. We formalize this here in a way similar to the classical analysis of correspondence in McCarthy and Prince 1999.

Our suggestion is formulated in (38) (see also Büring 2016b:sec. 6.3.2). MAX-XP requires a correspondent for each XP. This is only a requirement for coindexing each XP with some p-

phrase. MAX-XP does not put any conditions on this p-phrase. As in McCarthy and Prince's Correspondence Theory more generally, other constraints then restrict the correspondence relation. In the case at hand, these are the correspondence versions of WRAP-XP and STRESS-XP in (38b–c). We name them $WRAP-XP_c$ and $STRESS-XP_c$.⁹

- (38) a. *MAX-XP*
 Each overt XP must have a corresponding p-phrase ϕ .
 Let us notate a correspondence relation as $[XP_i, \phi_i]$.
- b. *WRAP-XP_c*
 For all $[XP_i, \phi_i]$, XP_i must be contained in ϕ_i .
- c. *STRESS-XP_c*
 For all $[XP_i, \phi_i]$, XP_i must contain the prosodic head of ϕ_i .

For each XP, the effects of $WRAP-XP_c$ and $STRESS-XP_c$ are now tied to each other. In (35), then, VP_2 has the correspondent $\phi_{1,2}$, which satisfies $WRAP-XP_c$ and $STRESS-XP_c$. In (36), VP_3 has no correspondent that satisfies $WRAP-XP_c$ and $STRESS-XP_c$. While ϕ_3 satisfies $WRAP-XP_c$, it does not satisfy $STRESS-XP_c$, since *Helen* is not part of VP_3 . This is now ruled out by the correspondence constraint $STRESS-XP_c$. In (37), ϕ_3 is a correspondent for VP_3 that satisfies both constraints.

$STRESS-XP_c$ also remedies a conceptual oddness of $STRESS-XP$. $STRESS-XP$ seemed to cut corners in relating an XP to a prominence head “x” of a certain prosodic level without reference to a mediating p-phrase. This oddness is remedied in $STRESS-XP_c$.

2.4 A Positional Faithfulness Constraint on the Correspondence Relation

We now turn to a related issue. We derived the nonrecursive phrasing in the German case (39a) and the English case (40a), but what prevents the recursive phrasings with a different stress pattern in (39b) and (40b)? They also satisfy MAX-XP, $STRESS-XP_c$, and $WRAP-XP_c$.

- (39) a. (x) $_{\phi_{1,2}}$
 [[ein Buch]₁ lesen]₂
 a book read
- b. # (x) $_{\phi_2}$
 (x) $_{\phi_1}$ (x) $_{\phi^*}$
 [[ein Buch]₁ lesen]₂
 a book read

⁹ In segmental correspondence (McCarthy and Prince 1999), a typical constraint on corresponding sounds, *IDENT(fea)*, requires that the sounds share a phonological feature *fea*. $WRAP-XP_c$ and $STRESS-XP_c$ may similarly be thought of as requiring the sharing of elements: all words in XP_i must be shared by ϕ_i ($WRAP-XP_c$), and the elements in the prosodic head of ϕ_i must be shared by XP_i ($STRESS-XP_c$).

- (40) a. (x) $_{\phi_{1,2}}$
 [what books] $_1$ she had [VP $_2$ written] $_2$
- b. # (x) $_{\phi_{1,2}}$
 (x) $_{\phi_1}$ (x) $_{\phi^*}$
 [what books] $_1$ she had [VP $_2$ written] $_2$

If it were for these cases alone, we could invoke the ban on recursive structures, NONRECURSIVITY, which favors the (a) structures over the (b) structures. Similarly, we could invoke the constraint *P-PHRASE (Truckenbrodt 1999; it punishes each p-phrase) to rule out the (b) structures, given the (a) structures with fewer p-phrases. Empirically, however, the gratuitous addition of a phrasal stress, which is not allowed in (39b) and (40b), is possible in prenuclear positions (see Wagner 2005:204ff. on this asymmetry). Thus, the German example (41a) is allowed to alternate with (41b), and (42a) is allowed to alternate with (42b).

- (41) a. (x) $_{\phi_{1,2,3,4}}$
 [der [Bruder [von [Maria] $_1$] $_2$] $_3$] $_4$
 the brother of Maria
- b. (x) $_{\phi_{3,4}}$
 (x) $_{\phi^*}$ (x) $_{\phi_{1,2}}$
 [der [Bruder [von [Maria] $_1$] $_2$] $_3$] $_4$
- (42) a. (x) $_{\phi_1}$ (x) $_{\phi_{2,3,4,5,6}}$
 [Helen] $_1$ [wants [to [read [some [books] $_2$] $_3$] $_4$] $_5$] $_6$
- b. (x) $_{\phi_{4,5,6}}$
 (x) $_{\phi_1}$ (x) $_{\phi^*}$ (x) $_{\phi_{2,3}}$
 [Helen] $_1$ [wants [to [read [some [books] $_2$] $_3$] $_4$] $_5$] $_6$

The additional p-phrase in the (b) structures of (39)–(42) is labeled ϕ^* . It does not contain a regular XP. It can therefore not be indexed to any XP without violating WRAP-XP $_c$.¹⁰ We could rule out these instances of ϕ^* by a constraint DEP- ϕ that requires that each ϕ have a corresponding XP. However, in order to distinguish (39b) and (40b) from (41b) and (42b), we require a positional faithfulness version of DEP- ϕ (see, e.g., Beckman 1999 on positional faithfulness). In formulating it, we call the ϕ that contains the strongest stress of the intonation phrase the *head ϕ* of that intonation phrase.

- (43) NUCLEAR-DEP- ϕ

In the head ϕ of an intonation phrase, each p-phrase must have a corresponding XP.

¹⁰ In (40b), ϕ^* does not wrap the VP, since the VP includes the overt occurrence of *what books*. Also, it could not be coindexed with [DP *she*], since STRESS-XP $_c$ would require stress on [DP *she*]. (If this stress were assigned, the result would suffer the same fate as (36), as well as violating the ban on stressing pronouns.)

NUCLEAR-DEP- ϕ rules out (39b) and (40b): ϕ^* has no corresponding XP and occurs in the position of nuclear strengthening. NUCLEAR-DEP- ϕ is not violated in (41b) and (42b): while ϕ^* has no corresponding XP, it does not stand in a position of nuclear strengthening.

A complete account will also include a constraint DEP- ϕ , dominated by eurythmic or related constraints that favor the addition of ϕ^* in (41b) and (42b). NUCLEAR-DEP- ϕ is ranked above these, making sure that the same eurythmic or related constraints cannot lead to the addition of ϕ^* in nuclear position in (39b) and (40b). NUCLEAR-DEP- ϕ is in turn dominated by MAX-XP, STRESS-XP_c, WRAP-XP_c, and the NSR-l. The latter jointly force a violation of NUCLEAR-DEP- ϕ in (37); the offending p-phrase is here also notated ϕ^* . Thus, NUCLEAR-DEP- ϕ suppresses “gratuitous” additions of stress in nuclear position, but its violation can be forced by other requirements of the syntax-prosody mapping.

The contrast addressed in this section cannot be captured in terms of STRESS-XP and WRAP-XP (or by various other mapping suggestions) without correspondence. The notions *prosodic matching* and *prosodic subordination* advanced in Wagner 2005—without reference to XPs—were tailored to account for this contrast. We have shown that an XP-based account using correspondence can also capture the asymmetry.

3 Extension to Match Theory

We now turn to conceivable analyses of stress reconstruction in terms of the constraint MATCH-XP from Selkirk’s (2011) Match Theory (see also, e.g., Myrberg 2013, Elfner 2015, Elordieta 2015). We begin by introducing the account.

3.1 Phrasal Stress and Match Theory

Selkirk (2011) provides two formulations of the match constraint format. The first formulation (for the level of XPs and p-phrases) is that each XP is matched by a corresponding p-phrase. This formulation gives a sense of the idea of correspondence of XPs and p-phrases that we adopt here. However, the notion of matching would need to be further formalized to make predictions for the more complex case of the interaction of movement and stress that we are concerned with. We show in the following that one way of making the notion of matching more precise does not work unless STRESS-XP is added to the account. We believe, on the basis of calculations not included in this article, that all ways of making the notion of matching more precise have this property.

We employ an adaptation of the second formulation of match constraints in Selkirk 2011: 451, shown in (44).

(44) *MATCH-XP* (our adaptation)

For each XP, there must be a p-phrase ϕ so that XP and ϕ share their initial word and their final word.

Unlike earlier accounts, Match Theory does not assume avoidance of recursive prosodic structure. Recursion is taken to be the norm and freely allowed by the grammar. All else being equal, a complex configuration of XPs is mapped to an isomorphic configuration of p-phrases.

In a brief discussion of stress, Selkirk (2011:470) suggests that stress constraints of two kinds interact with the match constraints. The Faithfulness Condition in (32) is an example of one kind, requiring prosodic heads for prosodic constituents. The NSR- ι in (10) is an example of the other kind, requiring a prosodic head to be close to the left or right edge of its prosodic constituent.

A similar theory of stress assignment was developed in Féry 2011: all syntactic XPs are projected as prosodic domains into the phonology. Stress and accent are located in terms of prosodic heads of these constituents.

(45) illustrates the parallel between these accounts of stress and the account using STRESS-XP. As seen in (45a–b), STRESS-XP (in the correspondence version) may have all XPs correspond to a large p-phrase; and, for each XP_i, it localizes the stress of ϕ_i inside that XP, and thus inside the innermost XP. The alternative accounts of Selkirk (2011) and Féry (2011) derive a matching prosodic structure in (45c), for which the Faithfulness Condition then requires the stress in (45d). In the case at hand and many others, the predicted location of stress is identical, as noted also in Selkirk 2011:483n41 and Kratzer and Selkirk to appear.

(45) a.	$(\quad x \quad)_{\phi_{1,2,3}}$	$(\quad x \quad)_{\phi_{1,2,3}}$	STRESS-XP
b.	$[\text{read } [a \text{ [book]}_1]_2]_3$	$[[\text{ein [Buch]}_1]_2 \text{ lesen}]_3$	Syntax: XPs
		a book read	
c.	$(\quad (\quad (\quad) \quad) \quad)$	$((\quad (\quad) \quad) \quad)$	MATCH-XP
d.	$(\quad (\quad (\quad x \quad) \quad) \quad)$	$((\quad (\quad x \quad) \quad) \quad)$	Faith. Cond.

However, the predictions differ in the case of Bresnan's (1971, 1972) interaction of movement and stress assignment. For one thing, while STRESS-XP_(c) can derive Bresnan's effects in its interaction with Internal Merge, MATCH-XP faces empirical problems here. For another, deriving the crucial restriction in (30) is also not possible without STRESS-XP in a correspondence format. We show these points in turn.

3.2 Match Theory and Stress Reconstruction

We first consider how Match Theory can approach stress reconstruction. A multiply-linked structure like (14) is mapped to a p-phrasing as in (46) by MATCH-XP. We assume, as before, that the overt material that belongs to VP₂ is *what books* and *written*. This material is matched at its left and right edges with ϕ_2 in (46), as required by (44). Further, the *wh*-phrase is matched to a p-phrase. This derives to the correct stress pattern.

(46)	$((\quad x_{1,2})_{\phi_1} \quad)_{\phi_2}$
	$[\text{what } \underline{\text{books}}]_1 \text{ she had } [\text{written } \{\text{DP-what } \underline{\text{books}}\}]_{\text{VP}_2}$

However, this way of approaching stress reconstruction does not work more generally. Consider the case of a moved *wh*-pronoun with an intervening subject, as in (47).

$$(47) \#(\quad (x_{1,2})_{\phi_1} \quad)_{\phi_2}$$

what [Helen]₁ had [written ~~what~~]_{VP₂}

The VP to be matched is again expanded to the beginning of the sentence by movement of the *wh*-object. In this case, this wrongly derives the sentence stress on *Helen*, which is not a possible default stress empirically. The predictions here differ from those of STRESS-XP_(c) insofar as STRESS-XP_(c) sees the discontinuous VP₁ *what . . . written* (the words dominated by VP₂ in a structure like (14)) and requires stress on one of these, thus on *written*. MATCH-XP, on the other hand, left- and right-aligns *what . . . written* with a p-phrase, and there is no obstacle to its prosodic head being on *Helen*.

3.3 Match Theory and the Restriction on Stress Reconstruction

MATCH-XP also cannot account for the restriction in (30). The representation we would expect is (48).

$$(48) \#((x_{1,(3)})_{\phi_1} (x_{2,(3)})_{\phi_2})_{\phi_3}$$

[what books]₁ [Helen]₂ had [written [_{DP} what books]]_{VP₃}

Strengthening of the rightmost phrasal stress leads to the stress pattern with nuclear stress on *Helen*, which is not a default stress pattern.

3.4 A Correspondence Version of Match Theory

In the context of our argument for the need for STRESS-XP in a correspondence account, we point out that the problems raised in sections 3.2 and 3.3 disappear if we formulate MATCH-XP in a correspondence format that incorporates STRESS-XP_c, as in (49).

- (49) a. *MAX-XP*
 Each overt XP must have a corresponding p-phrase ϕ .
- b. *MATCH-XP_c*
 For all [XP_i, ϕ_i], XP_i must share its first and its final words with ϕ_i .
- c. *STRESS-XP_c*
 For all [XP_i, ϕ_i], XP_i must contain the prosodic head of ϕ_i .

(46) is still correctly derived. VP₂ has the correspondence ϕ_2 that matches the discontinuous VP₂ *what books . . . written* at its left and right edges. The head of ϕ_2 , $x_{1,2}$, is on *books*, an element dominated by VP₂ in the syntax. (47) is ruled out by STRESS-XP_c, since the correspondent ϕ_2 of VP₂ does not have a prosodic head on a word within VP₂. Here, STRESS-XP_c will correctly require a stress on *written*. In (48), the prosodic head of ϕ_3 is not clearly defined. This is remedied if we switch to the representation in (36), which is also ruled out by STRESS-XP_c for VP₃ in the extended Match Theory account in (49). The representation in (37) is correctly derived instead,

where STRESS-XP_c is satisfied for VP₃, since the prosodic head of ϕ_3 is on *written*, an element of VP₃.

4 Summary

In this article, we motivated and reviewed an updated account of Bresnan's (1971, 1972) interaction of stress assignment and movement. In this account, the interaction results from PF reconstruction for STRESS-XP, given Internal Merge (Chomsky 2000, 2001, 2008).

We discussed an empirical problem for accounts of this interaction: stress on an intervening element blocks stress reconstruction. We argued that this restriction shows that STRESS-XP is a restriction on a correspondence relation between XPs and phonological phrases. This relation is also restricted by WRAP-XP (in the theory of Truckenbrodt 1995 and later work) or MATCH-XP (in the theory of Selkirk 2011).

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