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Constraints on intonational phrasing in English[1]

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This paper argues that intonational phrasing in English is subject to two constraints formulated purely in terms of surface syntax. The first applies to all headed structures, and the second to all structures of coordination. It is claimed that these constraints account for the facts more adequately than Selkirk's Sense Unit Condition. Several problematic types of constructions are discussed in this context, including structures with parentheticals. In addition to the syntax, accent placement is also shown to be relevant to intonational phrasing. Finally, proposals are made for the incorporation of the syntactic constraints in an HPSG grammar of English.

1. Introductory remarks

1.1 *Previous work and the aims of this article*

Intonational phrasing reflects the parcelling of speech into 'units of information' – batches calculated to be conveniently processed by speaker and listener (Halliday 1967, Laver 1970, Cruttenden 1986). It is natural, therefore, that syntactic structure should underdetermine the division of an utterance into intonational phrases. Studies of the relationship between syntactic phrases and intonational phrases have generally distinguished either between unmarked choices and the reasons for deviating from them (Halliday 1964, 1967) or between more frequent and less frequent choices (for example Quirk et al. 1964, Crystal 1969, Altenberg 1987). The first attempt to formulate rigorous well-formedness conditions on intonational phrasing is due to Selkirk (1984), where it is claimed (section 5.4.1), that

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intonational phrasing is not directly dependent on syntax, but is subject to a semantic constraint, the Sense Unit Condition (SUC), which is formulated as follows:

(1) *The Sense Unit Condition on Intonational Phrasing*
   (a) The immediate constituents of an intonational phrase must together form a sense unit (p. 286).
   (b) An immediate constituent of an intonational phrase IP_i is a syntactic constituent contained entirely within ('dominated' exclusively by) IP_i and not dominated by any other syntactic constituent contained entirely within IP_i (p. 290).
   (c) Two constituents C_i, C_j form a sense unit if ([i]) or ([ii]) is true of the semantic interpretation of the sentence: ([i]) C_i modifies C_j (a head), ([ii]) C_i is an argument of C_j (a head) (p. 291).
   (d) We ignore the status of complementizers here (p. 294).
   (e) For the purpose of [the Sense Unit Condition] we view the argument-head relation as obtaining between the head of an argument phrase and the immediate constituent head (p. 294).

But the Selkirk (1995: 567) it is admitted that '[the idea that] the material contained within an IP must constitute a "sense unit"…is difficult to implement'.

I shall endeavour to show that the facts are better accounted for by two purely syntactic constraints, one for headed structures and one for coordinate structures. These constraints admit a considerable variety of phrasing patterns which are unjustifiably excluded by the SUC, and bar other patterns, which the SUC unjustifiably admits as well-formed. The constraints are formulated in configurational terms relating to surface syntax only.[2] They will require supplementation, however, by conditions on well-formedness involving accentuation (a subject on which Selkirk's account says nothing). The aim is to account for what is recognized by speakers and hearers as fluent speech, that is speech uninterrupted by hesitations. Finally, I shall consider how the syntactic constraints proposed here could be incorporated in an HPSG grammar. The arguments for the constraints proposed here do not depend on the choice of theoretical framework: where the present paper differs from other studies of intonational phrasing (for example Selkirk 1984, Nespor & Vogel 1986) the points at issue are particular analyses or particular data – not differences of grammatical theory.[3]

[2] Nespor & Vogel (1986: 197) also formulate 'syntactic constraints on where an [IP] may be broken in order to form smaller [IPs]'. But in their use of the term, 'constraint' does to involve a prohibition of a particular type of division but merely a bias against it. Nothing in their section on the 'restructuring of the phonological phrase' amounts to a constraint in the sense in which the term is used in the present paper.

[3] See sections 3 and 4 below.

1.2 *Some theoretical assumptions*

Like Selkirk, I am taking IP boundaries to be marked by the occurrence of one or both of the following: (a) final lengthening (distinct from the drawling of hesitation), (b) the deliberate insertion of a longer or shorter period of silence). By IP-final lengthening I mean lengthening beyond that which is associated with pre-proclitic syllables within IPs (see Jones 1940, Abercrombie 1964, Catford 1966). IP as here defined corresponds closely to IP as used by Pierrehumbert (1980) and Selkirk (1984); but it also includes Pierrehumbert's 'intermediate phrase' (Beckman & Pierrehumbert 1986, Pierrehumbert & Hirschberg 1990). I am making no distinction here between intonational boundaries of different strengths (Beckman & Pierrehumbert 1986, Ladd 1986). Though there is experimental evidence showing that a hierarchy of intonational boundaries is probably needed (Ladd & Campbell 1991, Wightman et al. 1992), the precise nature of this hierarchy remains to be established.

I am taking IP BOUNDARIES to be distinct from IP BREAKS, which reflect unplanned interruptions in utterances and therefore constitute one kind of disfluency. This corresponds to the distinction made by Nespor & Vogel (1986: 219) between 'grammar-related pauses' and 'those that depend solely on performance factors and cannot, therefore, be said to be rule-governed'. Compare (2a–c), with '%' for IP boundary and '–' for IP break:

(2) (a) He never completed % the list of references %
(b) ?He never completed the – list of references %
(c) *He never completed the % list of references %

Utterance (2a) is normal and well-formed. Utterance (2b) is also normal (insofar as it is normal to hesitate), and is ill-formed only if a hesitant utterance is by definition an ill-formed one. Since I assume that the break does not constitute an IP ending, (2b) has only one IP. With a deliberate internal division in place of the hesitation break, as in (2c), the result is not only not normal but also ill-formed.

In addition, I shall be making the following general assumptions: (i) the grammar contains distinct phonological and syntactic structures, and constrains the manner in which they may be mapped into one another, (ii) syntactic structure is based on constituency relations, and (iii) within constituent structure there is a fundamental distinction between HEADED STRUCTURE, in which a syntactic phrase has one and no more than one head, and COORDINATE STRUCTURE, for which no relation between head and nonhead is posited (see Borsley 1994). Of course this distinction is not peculiar to any one theory of grammar. I shall be assuming, in fact, some version of phrase structure grammar, but a transformational grammar that has an appropriate level of syntactic structure could also serve as a basis for the formulation of constraints of this kind.

It follows from assumption (i) above, that well-formedness and ill-formedness can be predicated not just of sentences but also of utterances, where the use of the latter term implies the inclusion of the relevant prosodic features. The use of the usual star with example utterances is to be taken to mean not just that we can expect speakers and hearers to feel uncomfortable about utterances marked in this way, but that (apart from any other contributing factors which might also be present) this discomfort is due to the breach of a rule of grammar. Unacceptability in the intonational phrasing of utterances may be due to various factors, including communicatively inappropriate parcelling (see section 1.1 above). The latter is probably not amenable to treatment by grammatical rules.

2. The two syntactic constraints

2.1 *The Headed Structure Constraint* (*HSC*)

The functional load of intonational phrasing has a considerable range. At the lower end, we have cases like (3) and (4).[4]

(3) (a) But ″surely ″all of them ″knew that %
    (b) But ″surely % ″all of them ″knew that %
(4) (a) On ″Monday ″most of them ″left %
    (b) On ″Monday % ″most of them ″left %

The difference between the (a) forms, the ones without the internal boundary, and the (b) forms, the ones with the internal boundary, seems to represent nothing but the difference in information parcelling. Yet with the same prosodic patterns, and different syntactic ones, the presence or absence of the boundary makes a clear difference in acceptability.

(5) (a) But ″almost ″all of them ″knew that %
    (b) *But ″almost % ″all of them ″knew that %
(6) (a) On ″Monday ″morning they ″left %
    (b) *On ″Monday % ″morning they ″left %

Here the (a) patterns are well-formed, and the (b) patterns are not. And here we come to the first of our two general syntactic constraints on intonational phrasing – the Headed Structure Constraint (HSC).[5]

[4] Here and in all other example sentences, double primes are used to mark accents (or more specifically pitch accents), in the sense in which these terms are used in Cruttenden (1986: 16, 48 ff.).

[5] This is identical in substance to the End Stop Principle (ESP) stated in Taglicht (1994), except that the application of the ESP was not limited to headed structure. Compare also the statement in Nespor & Vogel (1986: 190) that 'it seems that [IPs] that are not isomorphic to a syntactic constituent may appear only to the left of [a parenthetical IP]'. Nespor & Vogel make the plausible suggestion that this is a characteristic of right-recursive languages in general. Selkirk (1986) proposes a theory of phonological domains derived from syntax, but intonational phrases are expressly excluded.

(7) *Headed Structure Constraint* (*HSC*)
A headed node is ill-formed if it has a daughter ending in an IP boundary followed by a daughter not ending in an IP boundary.

It is worth noting that although headedness is material here, the position of the head within its phrase is not. The constraint applies equally, therefore, to verb + complement phrases and to adjective + noun phrases; and it makes no difference to the operation of the HSC whether determiners are taken to function as specifiers of NPs or as heads of DPs. The partial bracketing in (5b′) and (6b′) shows that the HSC does indeed predict ill-formedness for the (b) examples of (5) and (6):

(5b′) *But [[″almost] % [″all of them]] ″knew that %
(6b′) *On [[″Monday] % [″morning]] they ″left %

In each case the outer brackets mark the relevant headed node, and the inner brackets mark the daughter nodes, with an IP boundary at the end of the first but not at the end of the second.

For reasons which will become apparent presently, we shall distinguish five different patterns of phonology-syntax mapping. The first of these is Congruent Mapping, which is defined as follows:

(8) *Congruent Mapping* (*CM*)
An IP corresponds exactly to a single syntactic node.

No instance of congruent mapping can involve a breach of the HSC, though instances of Congruent Mapping may rate low in acceptability without breaking any constraint that can be formulated as a grammatical rule, e.g.:

(9) Some % of the examples of congruent mapping that we could dream up % would % sound % odd %

The anomaly here is in the information parcelling (see 1.1). A more extreme case is represented by (10).

(10) *There % was no one at home %

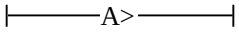
This can be blocked – not by the HSC but by the lexical entry for existential *there*, which has to include the specification [unaccented]. Since the phrasing of (10) implies that *there* is accented (every IP has to contain at least one accent), (10) is necessarily ill-formed.

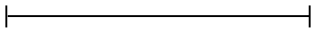
Of the other four patterns, two involve breaches of the HSC, and all breaches of the HSC involve one (or both) of these two patterns. They are Rightward Annexation, which is defined in (11), and Rightward Grouping (which will be defined below).

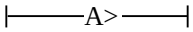
(11) *Rightward Annexation* (*RA*)
The rightmost daughter of a node X (but not its leftmost daughter) is incorporated in a single IP together with a node to the right of X.

We can now say that (5a) and (6a) above are instances of Congruent Mapping, while (5b) and (6b) above contain examples of Rightward Annexation (RA). This is shown in (12)-(13) below, where the brackets mark the relevant nodes, the lines below the text mark the IPs in question, and 'A> ' within the IP line indicates Rightward Annexation:

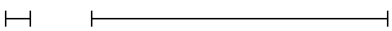
(12) (a) [but almost all of them knew that] %–CM

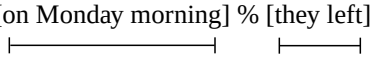
(b) *but [almost % all of them] knew that %–RA


(13) (a) [on Monday morning they left] %–CM


(b) *on [Monday % morning] they left %–RA


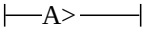
Examples (14) and (15) would be further instances of Congruent Mapping:

(14) [but] % [almost all of them knew that] %–CM


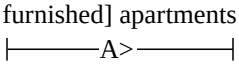
(15) [on Monday morning] % [they left] %–CM


(16a–b) and (17a–b) below are further examples of the contrast between Congruent Mapping and Rightward Annexation.

(16) (a) [Danish beer] % [is better] %–CM


(b) *[Danish % beer] is better %–RA


(17) (a) [elegantly furnished apartments] %–CM


(b) *[elegantly % furnished] apartments %–RA


Another type of example is given by Halliday (1967: 220), though his formulation (inevitably, in view of the different theoretical framework) is quite different: '… a theme which is a separate information unit seems … to be presupposed in any clause included within the next information unit … so

that ‖ *John* ‖ *saw the play and Mary went to the concert* ‖ is unacceptable, [unlike] ‖ *John* ‖ *saw the play and liked it* ‖ '. In our notation, these are given in (18) and (19).

(18) *[John % saw the play] [and Mary went to the concert] %–RA
├————A>————————————————┤

(19) [John] % [saw the play and liked it] %–CM
├————————————┤

We now come to two further types of mapping: Rightward Grouping (RG) (which has already been mentioned as a pattern distinct from Rightward Annexation) and Leftward Grouping (LG):

(20) (a) *Rightward Grouping* (*RG*)
Two or more daughters of a node X other than the leftmost daughter are part of a single IP.
(b) *Leftward Grouping* (*LG*)
Two or more daughters of a node X, including the leftmost and excluding the rightmost, are part of a single IP.

The ill-formed utterances (21b) and (22b) below are examples of Rightward Grouping, as against (21a) and (22a), which are examples of Leftward Grouping (with the outer brackets marking the relevant headed node and with '< G' and 'G> ' within the IP line for Leftward and Rightward Grouping respectively):

(21) (a) [[Give] [your friend] % [a book]] %–LG
├—<G————┤

(b) *[[Give] % [your friend] [a book]] %–RG
├————G>———┤

(22) (a) [[Return] [the book] % [to John]] %–LG
├——<G———┤

(b) *[[Return] % [the book] [to John]] %–RG
├———G>———┤

Both versions of (21) and (22) represent odd choices from the point of view of information parcelling, though in each case one is well-formed and one ill-formed in relation to the HSC.[6]

[6] Neither the contours nor the places of the accents have been indicated in (12)–(19) and (21)–(22), since the HSC makes no reference to them. But sometimes accent placement is relevant in particular cases to the well-formedness of intonational phrasing. See section 5 below.

I am assuming, as do most syntacticians, that the two complements that follow the verbs in (21)–(22) cannot constitute single constituents in the context under consideration. This is not to ignore the fact that all syntactic theories have to make provision for the coordination of 'nonstandard' constituents, as in *return the tapes to Bob*, *the notes to John*, *and the book to the library* (see Hudson 1990 and Steedman 1991 for treatments of such coordinate structures). It does imply, however, that such nonstandard constituents can occur only in the contexts for which they are required.[7]

Just as Leftward Grouping (20b) must be distinguished from Rightward Grouping (20a), so Leftward Annexation must be distinguished from Rightward Annexation, which was defined in (11) above, and is repeated here as (23a).

(23) (a) *Rightward Annexation* (*RA*)
The rightmost daughter of a node X (but not its leftmost daughter) is incorporated in a single IP together with a node to the right of X.

(b) *Leftward Annexation* (*LA*)
The leftmost daughter a node X (but not its rightmost daughter) is incorporated in a single IP together with a node to the left of X.

Leftward Annexation is found, for example, in (24) and (25).

(24) Everyone [knows % that this is not true] %
├——<A——┤

(25) We know that [this charge % is completely baseless] %
├————<A————┤

The way in which the mapping patterns have been defined makes it possible for LA to overlap with LG, and RA with RG. The following utterance contains an instance of overlap between LA and LG:

(26) She [[gave] [her friend] % [an interesting book]] %–LA & LG
├<A————————┤
├—<G————┤

The notation in (27) may serve as a convenient abbreviation for that in (26).

(27) She [[gave] [her friend] % [an interesting book]] %–LA & LG
├<A—<G————┤

LA and RA are mirror images, but LG and RG are not, since LG is defined as including the leftmost sister, but RG does not necessarily include the

[7] Abbot (1976) draws attention to the fact that what look like nonstandard constituents may occur in Right Node Raising constructions as well. See section 4.2 below for a discussion of this problem.

rightmost sister. If we replaced RG by RG′, defined as the mirror image of LG, that is as in (28),

(28) *RG′*
Two or more daughters of a node X, including the rightmost and excluding the leftmost, are part of a single IP.

we would have to set up an additional pattern, which could be called M(edial) G(rouping), defined as follows:

(29) *Medial Grouping* (*MG*)
Two or more sister nodes are included in an IP that excludes both their leftmost and their rightmost sister.

But there seems to be no need for a distinction between RG′ and MG, and RG has therefore been defined so as to subsume these two.

It might seem at this stage that the same reasoning ought to apply to the distinction between LA and LG, and between RA and RG, since the Headed Structure Constraint requires only a distinction between what could be called 'Rightward Linkage' and all the rest, where Rightward Linkage would correspond to the union of RA and RG. But the four-way distinction (LA, LG, RA, RG) is useful for showing the relationship between the Headed Structure Constraint and the second general syntactic constraint on intonational phrasing, the Coordination Constraint (CC). Furthermore, the distinction between LA and LG seems to be required in order to deal with accentuation in relation to phrasing (see section 5 below).

2.2 *The Coordination Constraint* (*CC*)[8]

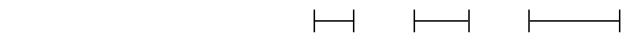
The second constraint is formulated as follows:

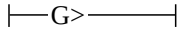
(30) *Coordination Constraint* (*CC*)
For any coordinating node X, if any two daughter nodes of X are separated by an IP boundary, all the daughter nodes of X must be separated by IP boundaries.

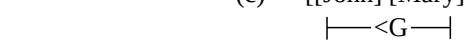
The CC differs from the HSC both in what it disallows and in what it allows. Whereas the HSC bars only Rightward Annexation and Rightward Grouping, the CC bars only Rightward Grouping and Leftward Grouping.

[8] This is a reformation of the Coordination Principle stated in Taglicht (1994). It is called the Coordinate Structure Constraint in Taglicht (1996).

Here are some examples (the outer brackets mark the coordinating node):

(31) (a) [[John] % [Mary] % [and Peter]] %–CM


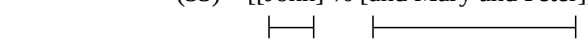
(b) *[[John] % [Mary] [and Peter]] %–RG


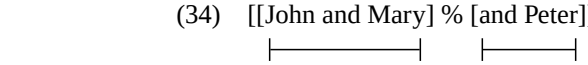
(c) *[[John] [Mary] % [and Peter]] %–LG


(32) (a) the [[larger] % [and more expensive]] models %–LA & RA


(b) the [[larger] % [more expensive]] models %–LA & RA


Example (32b) shows that we are making provision for asyndetic coordination as well. Divisions similar to those in (31b–c) are of course possible, but only where the structure of the coordination is recursive, as in (33) and (34).

(33) [[John] % [and Mary and Peter]] %–CM


(34) [[John and Mary] % [and Peter]] %–CM


Unlike the non-binary coordination of (31), the coordination in (33) and (34) is binary recursive, so that both (33) and (34) are instances of Congruent Mapping.

2.3 *Comparison of mapping patterns*

The patterns allowed and disallowed by the HSC and by the CC are set out in (35):

(35)

	HSC	CC
Congruent Mapping (CM)	+	+
Leftward Annexation (LA)	+	+
Leftward Grouping (LG)	+	–
Rightward Grouping (RG)	–	–
Rightward Annexation (RA)	–	+

The ten patterns distinguished in (35) are illustrated in (36), for the HSC, and (37), for the CC. The outer brackets, in each example, mark the relevant node.

(36) (a) [[Mary] % [preferred his first book]] % – CM
(b) [[This time] % [seven out of ten were in favour]] – CM
(c) Mary [[preferred] % [his first book]] % – LA
(d) [[Put] [the keys] % [in the top drawer]] % – LG
(e) *[[Return] % [the book] [to John]] % – RG
(f) *[[Seven people] % [out of ten]] were in favour – RA

(37) (a) (Who's coming?) % [[John] % [Mary] % [and Peter]] % – CM
(b) (Who's coming?) % [[John] [Mary] [and Peter]] % – CM
(c) I've invited [[John] % [Mary] % [and Peter]] % – LA
(d) (Who's coming?) *[[John] [Mary] % [and Peter]] % – LG
(e) (Who's coming?) *[[John] % [Mary] [and Peter]] % – RG
(f) [[John] % [Mary] % [and Peter]] will be there % – RA

3. The HSC compared with the Sense Unit Condition

The time has now come to compare the predictions of the Headed Structure Constraint (HSC), formulated in (7) above,[9] with those of Selkirk's Sense Unit Condition (SUC) (see (1) above). It is clear that all the examples in (36) are accounted for by the SUC just as they are by the HSC. This is not surprising, since all of them represent patterns used by Selkirk herself to demonstrate the workings of the SUC. However, it is not difficult to find types of examples which the SUC simply cannot handle: ill-formed utterances which the SUC allows, for example those in (38) below, and well-formed ones which the SUC disallows, for example those in (41)–(44).

(38) (a) *[[Danish] % [beer]] is better % – RA (= (16b))
(b) *[[elegantly] % [furnished]] apartments % – RA (= (17b))

Examples (38a–b) should be well-formed by virtue of Selkirk's 'extension of argumenthood to the head of an argument phrase' (p. 294, and see also the quotation in (1.e) above). Selkirk needs this extension to account for examples like (39) and (40), both of which are, in our terms, just normal instantiations of LA (the bracketing ignores the irrelevant nodes):

(39) This is the [[cat] % [that chased the [[rat] % [that ate the cheese]]]] % (two instances of LA)
(40) Jane tried to [[begin] % [to learn Spanish]] (LA)

[9] Selkirk says nothing about coordinate constructions.

But if the first IP of (39), for instance, is well-formed because *cat*, which is the head of the phrase *cat … cheese*, can, as it were, represent the whole phrase for the purpose of the SUC, the same ought to apply to the second IP of (38a), for instance, with *beer* 'representing' the phrase *Danish beer*. But (38a) is clearly ill-formed. The situation in (38b) is similar. Now consider (41):

(41) (a) These [[international] % [linguistic conferences]] % – LA
(b) In [[fourteenth century] % [alliterative verse]] % – LA

In both these examples, the first IP should be ill-formed, according to the SUC. Similarly with the examples in (42):

(42) (a) I know that [[Mary] % [preferred his first book]] % – LA
(b) But [[Peter] % [preferred the second]] % – LA
(c) Of course [[his father] % [dislikes them all]] % – LA

In each of these examples, too, the first IP should be ill-formed, according to the SUC.

4. Some problems of syntactic analysis

So far, we have been considering syntactic constructions on which there is something approaching a general consensus, or at least where such differences in analysis as do exist do not affect the application of the constraints in any way. Examples of differences of analysis that are immaterial in the present context may be found in (41a) and (42a). *These international linguistic conferences* (in (41a)) could be taken either as a DP or as an NP; and the complementizer *that* in *that Mary preferred his first book* (in (42a)), could be taken as head in a head-complement construction (the majority view), or as marker in a marker-head construction (Pollard & Sag 1994). Neither of these questions affects the point at issue. The situation is different with the subjects that will be dealt with below. On one of these, that of the 'Exceptional Case Marking' constructions, it will be necessary to take sides in a long-standing controversy, and on others, which have attracted comparatively little attention, we shall try to establish what seem to be appropriate analyses.

4.1 '*Exceptional Case Marking*' *vs.* '*Subject-to-Object Raising*'

The concept of Exceptional Case Marking is the standard GB solution to problems that were resolved at an earlier stage of transformational grammar by Subject-to-Object Raising. The crucial question from our point of view here is whether the verb is to be regarded as taking a single complement, as in the 'ECM' analysis (V [NP XP]), or a sequence of two complements, as in the 'Raising' analysis (V NP XP). The latter view is now common to

Relational Grammar, Lexical Functional Grammar, GPSG and HPSG. But with a suitable modification of the Projection Principle, GB theory could also accommodate a two-complement analysis, as has recently been proposed (Schein 1995). The evidence of intonational phrasing is unequivocal: the NP and XP that follow the matrix verb in these constructions are treated just like any other pair of complements, and putting the pair into a separate IP is therefore just as bad in (43)–(44) below as it is in (21)–(22) in section 2.1 above. Examples (43)–(44) contain 'small clauses', and the bracketing is in accordance with the 'V NP XP' analysis, which (unlike the 'V [NP XP]' analysis) predicts ill-formedness for the (b) versions:

(43) (a) We [[consider] [Mary] % [an excellent judge]] % – LA & LG
(b) *We [[consider] % [Mary] [an excellent judge]] % – LA & RG
(44) (a) You'd have [[found] [Mary] % [very charming]] % – LA & LG
(b) *You'd have [[found] % [Mary] [very charming]] % – LA & RG

Such data are as much of a problem for the SUC as they are for the ECM analysis, since neither *We consider Mary* nor *You'd have found Mary* is a sense unit in these sentences, but *Mary an excellent judge* and *Mary very charming* certainly should be.

In (45)–(46) we have examples of what Radford (1988) calls 'exceptional clauses'. Again the bracketing is in accordance with the 'V NP XP' analysis, which accounts for the difference in acceptability between (a) and (b):

(45) (a) We [[consider] [Mary] % [to be an expert]] % – LA & LG
(b) *We [[consider] % [Mary] [to be an expert]] % – LA & RG
(46) (a) She has [[proved] [the letter] % [to be a forgery]] % – LA & LG
(b) *She has [[proved] % [the letter] [to be a forgery]] % – LA & RG

'Exceptional clauses' are clearly distinct in syntactic structure from clauses with *for … to*, as can be seen by considering them, inter alia, in relation to *wh*-clefting and the insertion of parentheticals. Compare the (a) and (b) forms in (47)–(48), with *wh*-clefting, and in (49)–(50), with a parenthetical after the matrix verb, in the dialects that accept both 'exceptional clause' constructions and *for … to* constructions with the matrix verbs in these sentences.

(47) (a) *What we intended [[was] [Mary] [to review the book]].
(b) What we intended [[was] [for Mary to review the book]].
(48) (a) *What we'd prefer [[is] [Mary] [to review the book]].
(b) What we'd prefer [[is] [for Mary to review the book]].
(49) (a) *We [[intended] [of course] [Mary] [to review the book]] %
(b) We [[intended] [of course] [for Mary to review the book]] %
(50) (a) *We'd [[prefer] [of course] [Mary] [to review the book]] %
(b) We'd [[prefer] [of course] [for Mary to review the book]] %

The contrasts in acceptability are just what one would expect if the bracketing is correct in showing two complements in the 'exceptional

clauses' (the (a) forms), as against a single complement in the *for … to* clauses (the (b) forms): the 'equative' *be* takes one complement, not two; and a non-complement may precede one complement, but not two. When we consider the forms with an IP boundary after the matrix verb, as in (51)–(52),

(51) (a) *We [[intended] % [Mary] [to review the book]] % – LA & RG
(b) We [[intended]] % [for Mary to review the book]] % – LA & CM
(52) (a) *We'd [[prefer] % [Mary] [to review the book]] % – LA & RG
(b) We'd prefer % [for Mary to review the book] % – LA & CM

we see that the difference between the two constructions as here analyzed is reflected in their intonational phrasing options precisely as predicted by the Headed Structure Constraint.

4.2 '*Right Node Raising*' *constructions*

It has been pointed out (Abbot 1976) that what look like nonstandard constituents may occur in 'Right Node Raising' constructions. But it is significant that intonational phrasing makes a difference to the acceptability of such structures. Compare the (a) and (b) versions of (53) (= Abbot's (8), which she finds 'almost perfectly grammatical').

(53) (a) *″John ″tried to ″persuade % but ″failed to ″convince % his ″skeptical e″xaminers that he ″knew the ″right ″answers %
(b) ″John ″tried to ″persuade % but ″failed to ″convince his skeptical examiners % that he ″knew the ″right ″answers %

The very low acceptability of (a) provides no encouragement for any analysis that would join the two complements of *persuade* and *convince* into a single (raised) node. We seem to be left, if we want our grammar to generate such sentences, with three options: (i) ellipsis in the first conjunct, (ii) fusion of identical constituents in the manner of McCawley (1982), and (iii) recursive 'adjunction' (in transformational terms, RNR applying iteratively to its own output). None of these conflict with our constraints on intonational phrasing (on the assumption that in surface structure, (ii) can be regarded as a notational variant of (i)). If (i) is chosen, (53b) comes under the heading of LA and LG, as shown in (54) where the outer brackets mark the relevant headed node:

(54) ″John ″tried to ″persuade % but ″failed to ″[[convince] [his skeptical examiners] % [that he ″knew the ″right ″answers]] %

If we prefer (iii), the same phrasing brings the utterance under the heading of RA out of a coordinating node (*tried to persuade but failed to convince*), as shown in (55), where the coordinating node is marked by '{}'.

(55) ″John [[{[″tried to ″persuade] % [but ″failed to ″convince]} [his skeptical examiners]] % [that he ″knew the ″right ″answers]] %

In either case (53b) comes out as well-formed, and (53a) as ill-formed.

4.3 *Parentheticals*

Parentheticals have not received the attention they deserve from linguists. They have not, of course, been ignored.[10] But the notion has been allowed to remain pretheoretical and vague. I am here taking 'parenthetical' to mean an institutionalized form of 'intrusion' into a syntactic phrase. In spite of their intrusive nature, parentheticals are elements in the sentence that are provided for by the grammar of a language, unlike intrusive utterances addressed to a different person (like 'Come in!' said on hearing a knock at the door while speaking to someone), or addressed to the same person as the surrounding utterance but unconnected with it (like 'Thank you' said as the hearer hands the speaker a cup of coffee). In slightly more precise terms, I am defining the conceptual PARENTHETICAL provisionally as follows:

(56) *Parenthetical*
A syntactic node for which the grammar specifies no function in relation to any sister node.

A parenthetical, therefore, is a syntactic constituent of a phrase; but it does not function as head, complement, specifier, adjunct – or anything else that the grammar provides for – in the phrase of which it is an immediate constituent. In other words, it is a licenced intruder in its phrase. Thus *fortunately* is parenthetical in (57), but not in (58), where it is an adjunct to a following S node, or (59), where it is an adjunct to a preceding S.

(57) [[The passengers], [fortunately], [were unhurt]].
(58) [[Fortunately], [the passengers were unhurt]].
(59) [[The passengers were unhurt], [fortunately]].

I am assuming that the linear ordering of sister nodes is exclusively concatenative, or in other words that phrase structures are trees (see also section 7 below).

Though parentheticals are typically separated from preceding and following syntactic nodes by punctuation and by prosodic boundaries, the definition here adopted makes no reference to punctuation or to prosody. So, on the one hand, *in considerable detail* is NOT parenthetical in (60), and *therefore*, on the other hand, IS parenthetical in (61).

[10] See, for instance, Ross (1973), Emonds (1976, 1979), McCawley (1982, 1989).

(60) (a) He [[[describes the incident], [in considerable detail]], [in a letter to his parents]].
(b) He [[[describes the incident] % [in considerable detail]] % [in a letter to his parents]] %

(61) (a) [[The neighbours]] [therefore] [decided to sue him]].
(b) [[The neighbours]] [therefore] [decided to sue him]] %

Parentheticals may be (i) vocatives, (ii) sentential connectives, like *however*, *then* or *therefore*, (iii) utterance modifiers, like *frankly*, *strictly speaking* or *if you don't mind my saying so* and (iv) sentence modifiers, like *fortunately*, *of course* or *you see*.[11]

As regards the positions of parentheticals in their phrases, the following statement seems to be required for English:

(62) *Linear Ordering of Parentheticals*
A parenthetical node is always a noninitial and nonfinal daughter of its mother.

The constraint stated in (62) leaves open the question of how parentheticals are ordered in relation to one another when there is more than one in a single phrase. But this has no bearing on the operation of the HSC and can therefore be disregarded here. In English, parentheticals may occur between subject and predicate, between a sentence-initial element and a following S, or after the head within an NP, as in (63)–(65).[12]

(63) They, however, did not know this.
(64) This, however, they did not know.
(65) The cost, however, of such a scheme would be enormous.[13]

But they cannot occur, for example, between specifier and N-bar, or between an adjunct and a following N-bar, as seen in (66)–(67).

(66) *This, however, question is difficult.
(67) *A thorough, however, investigation has now been instituted.

As regards intonational phrasing, parenthetical elements behave like other medial elements in headed structure, in that they may group to the left (provided there is no other impediment), but not to the right. The following examples illustrate the Leftward Grouping of parentheticals of different kinds:

[11] This list of types is not necessarily exhaustive. In Quirk et al. (1985), the corresponding terms are 'conjuncts' for sentential connectives, 'style disjuncts' for utterance modifiers and 'content disjuncts' for sentence modifiers.
Non-restrictive relative clauses are frequently regarded as parenthetical elements (see, for instance, McCawley 1982). However, I take the position that the resemblance between parentheticals and non-restrictive relatives is only partial and superficial.

[12] In transformational terms, structures with parentheticals are most naturally described as the outputs of lowering transformations. This means saying that a parenthetical is a kind of moved element that does not c-command its trace.

[13] For the analysis of structures like this, see 7.3 below.

(68) (a) [[Mary] [to my surprise] % [preferred this book]] % – LG
(b) *[[Mary] % [to my surprise] [preferred this book]] % – RG
(69) (a) [[Peter] [though] % [preferred the other one]] % – LG
(b) *[[Peter] % [though] [preferred the other one]] % – RG
(70) (a) Now [[this one] [dear] % [is really good]] % – LG
(b) *Now [[this one] % [dear] [is really good]] % – RG
(71) (a) [[Later] [to my regret] % [he changed his mind]] % – LG
(b) *[[Later] % [to my regret] [he changed his mind]] % – RG
(72) (a) [[In Scotland] [however] % [the law is different]] % – LG
(b) *[[In Scotland] % [however] [the law is different]] % – RG
(73) (a) And [[now] [children] % [I'll tell you a story]] % – LG
(b) *And [[now] % [children] [I'll tell you a story]] % – RG

The positions of the parentheticals here illustrated are probably the most common ones: after the subject in (68)–(70), and after an initial adverbial in (71)–(73).[14]

Apparent counterexamples to the constraint against Rightward Grouping involve alternative parsings. For example:

(74) [[Mary] [I think] % [rather liked this book]] % – LG
(75) [[Mary] % [I think rather liked this book]] % – CM (not RG!)

In (75), as indicated by the bracketing, *I think* is not a parenthetical, but represents the subject and verb of the matrix clause, with *Mary* as the topicalized subject of the complement clause. Though (74) and (75) may function as virtual paraphrases, they represent two different syntactic structures with different options for intonational phrasing. This is evident from the following comparison, where the different word orders show the distinction:

(76) [[How much of this] % [d'you think you'll really need] % – CM
(77) (a) [[How much of this] [d'you think] % [will you really need]] % – LG
(b) *[[How much of this] % [d'you think] [will you really need]] % – RG
(78) [[Very little of this] % [did he think he would really need] % – CM
(79) (a) [[Very little of this] [he thought] % [would he really need]] % – LG
(b) *[Very little of this] % [he thought] [would he really need]] % – RG

[14] I leave open here the question whether the sentence-initial elements in (71)–(73) are sentence adjuncts or 'extracted' from VP. The possibility of adjunct extraction, even from a lower clause, as in (i) cannot be excluded.

(i) In Scotland, however, I suspect that the law is different.

(See Pollard & Sag 1994 and Hukari & Levine 1995). We may contrast (ii):

(ii) In my opinion, however, the law should be changed.

Here the initial element is clearly a sentence adverbial which is included in the scope of the parenthetical *however*.

Some adverbs that can function as sentence modifiers and may be used parenthetically, have alternative uses as intensifying premodifiers of VPs. These give rise to further apparent counterexamples, as is shown by (80)–(81), in the context of *I suppose there were lots of complaints about the meals – Well, not as many as you might have expected…*

(80) [[Some of them] [actually] % [didn't mind the food]] % – LG
(81) [[Some of them] % [actually liked the food]] % – CM (not RG!)

Actually is a sentence modifier, and hence a parenthetical, in (80), but an intensifier of the VP, and hence not a parenthetical, in (81). In (80), *actually* is very similar to *in fact*; but in (81) it has something in common with *even*.[15]

It has been suggested (see, for example, McCawley 1982, 1989, Nespor & Vogel 1986), that parentheticals might not be considered to combine with their hosts to form syntactic structures at all; but this leaves unaccounted for not only constraints on linearization such as those illustrated in (66)–(67) above, but also the facts of intonational phrasing pointed out in (68)–(73).

The examples in (68)–(73) above represent further difficulties for the SUC, according to which the first IPs in all these sentences should be ill-formed. Selkirk – like some other linguists, (for example Bing 1979, Nespor & Vogel 1986) – claims that 'vocatives, certain types of parentheticals… and other sorts of nonargument, nonmodifier expressions' are always separate IPs (Selkirk 1984: 295). As she says subsequently, this 'would seem to follow… from the Sense Unit Condition'. But there is evidence to the contrary in the observations of a long line of analysts of English intonation, including Armstrong & Ward (1931), Jones (1940), Pike (1945), Kingdon (1958a,b), Crystal (1969), Halliday (1970), and Couper-Kuhlen (1986). And as Bolinger (1986) points out, the syntactic boundary between a parenthesis[16] and what precedes it need be no obstacle to the application of timing effects and assimilations that depend on the absence of 'a pausal break'. He cites the following pair (p. 41):

(82) He's sad, you see.
(83) He's Sadducee.

These 'may sound alike, so long as the speaker utters the *you see* as a run-on incidental remark: the reduced *you* adds no time to *sad*' and 'the *sad you* even permits the palatalization of [d] to [ʤ]'. Bolinger's theory of English intonation does not use the concept of Intonational Phrase, but the relevance of his observations is clear and their accuracy has not been challenged.

Not that such seamless joins between parentheticals and what precedes them are the norm: they represent the opposite extreme to separation by IP

[15] See Greenbaum (1969) for the distinction between these two uses of *actually*.

[16] Bolinger, like many other linguists, widens the definition of parenthetical to include items that could be medial, but are actually final in a given sentence. This makes no difference to the point at issue here.

boundaries, and there is at least one intermediate possibility – separation by a lesser prosodic boundary.[17] The relative frequency of the different options depends, inter alia, on the speed of utterance; but the omission of IP boundaries is not confined to fast speech.

5. Accentuation

So far we have ignored accentuation. A full account of constraints on intonational phrasing will have to deal with accent placement, at least in relation to Leftward Annexation. The present section is only a partial and tentative account of this area of the grammar.

Let us start by considering the contrasts in (84)–(86) below (with '″' again representing the accents):

(84) (a) [[″But] % [they ″changed their ″minds]] % – CM
(b) *″But [[they] % [″changed their ″minds]] % – LA
(c) But [[″they] % [″changed their ″minds]] % – LA
(85) (a) [[When″ever] % [they ″changed their ″minds]] % – CM
(b) *When″ever [[they] % [″changed their ″minds]] % – LA
(c) When″ever [[″they] % [″changed their ″minds]] % – LA
(86) (a) I [[″think] % [they ″changed their ″minds]] % – CM
(b) *I ″think [[they] % ″changed their ″minds]] % – LA
(c) I ″think [[″they] % [″changed their ″minds]] % – LA

The (b) examples, in which a node is annexed to the left and unaccented, are clearly less well-formed (sound less fluent) than the (a) ones, in which the same node is unaccented but not annexed, and the (c) ones, in which it is annexed and accented. So there seems to be a constraint barring the leftward annexation of certain types, at least, of unaccented nodes. It applies, apparently, not only to the subjects of declarative-order finite clauses (as in (84)–(86)),[18] but also to specifiers of NPs and APs and to initial adjuncts in

[17] Something like the end of a 'clitic group' (Nespor & Vogel (1986) would seem to be quite common. Ladd's (1986) theory of recursive prosodic structure opens up additional possibilities (see also Ladd & Campbell (1991).

Reinhart (1975), in a study of sentences with parentheticals like *he said*, distinguishes between two types: 'parenthetical-subject oriented' and 'speaker oriented', identifiable inter alia by differences in pronominalization and tense agreement, and also by differences in intonational phrasing, with the 'speaker oriented' type characterized by lack of pause and the possibility of assimilation between the main clause and the parenthetical clause.

Ladd (1981) draws attention to the existence of a contrast between nuclear and post-nuclear intonation on question tags. The type with postnuclear intonation necessarily lack a separate IP.

[18] It is worth noting that the 'subject' of a 'small clause', which is not the initial sister in its node (see 4.1 above), is unaffected by the constraint. Compare the following examples:

(i) a. I ″never [[ex″pected] [it] % [to ″be so ″difficult]] % – LG
b. *I never [[ex″pected] [[it] % [would ″be so ″difficult]]] % – LA

V-bar (VP) and A-bar structures, as can be seen from the following examples:

(87) (a) ″They don't have % [his un″limited ″patience] %
(b) *″They don't have [his % un″limited ″patience] %
(c) ″They don't have [″his % un″limited ″patience] %
(88) (a) They ″seem to be % [very ″hard to ″please] %
(b) *They ″seem to be [very % ″hard to ″please] %
(c) They ″seem to be [″very % ″hard to ″please] %
(89) (a) ″Some of them % [never ″pay their ″bills] %
(b) *″Some of them [never % ″pay their ″bills] %
(c) ″Some of them [″never % ″pay their ″bills] %
(90) (a) ″This [old ″lambswool ″pullover] % is ″still quite ″useful %
(b) *″This [old % ″lambswool ″pullover] % is ″still quite ″useful %
(c) This [″old % ″lambswool ″pullover] % is ″still quite ″useful %

The constraint does not apply, in general, to initial head nodes:

(91) ″I [prefer % ″something more ″cheerful] % (V)
(92) There ″are [translations % of ″some of the poems] % (N)
(93) He ″was [willing % to ″leave it at ″that] % (A)
(94) He ″never ″looks [at % the ″person he's ″talking to] % (P)[19]

But here the finite aux-forms are an exception: they are subject to the constraint:

(95) (a) ″They % [could ″do it quite ″easily] %
(b) *″They [could % ″do it quite ″easily] %
(c) They [″could % ″do it quite ″easily] %
(96) (a) ″They % [are ″doing their ″best] %
(b) *″They [are % ″doing their ″best] %
(c) They [″are % ″doing their ″best] %
(97) (a) ″They % [have ″done their ″best] %
(b) *″They [have % ″done their ″best] %
(c) They [″have % ″done their ″best] %

As regards the finite forms of *be*, it seems that we have to distinguish between different syntactic frames. Compare (98)–(99):

(98) *The ″problem [is % a ″very ″serious one] %
(99) The ″problem [is % that the ″phone's out of order] %

The subject of a clause with 'subject-aux inversion', is also unaffected by the constraint. This is to be expected, of course, if it is taken to be the middle node in a V-NP-VP structure, in accordance with the HPSG analysis of Pollard & Sag (1987).

[19] A distinction must be made between Ps that head complements and Ps that head adjuncts. The latter resist annexation when they are not accented.

Only the strong forms of prepositions can be followed by the IP boundary. A weak form of a preposition followed by silence points to a hesitation break.

In (98), where *is* has a predicative complement, LA without accentuation is odd; in (99), with an equated complement, LA without accentuation is perfectly normal. The equated complement in sentences of this kind is typically a clause; but NPs are also possible:

(100) The ″problem [is % the ″shortage of ″manpower] %

The topic of accentual restrictions on intonational phrasing needs a good deal of further study; but it seems clear that while accentuation is relevant to the admissibility of Leftward Annexation, the option of Leftward Grouping is free in this respect. We may bring out the difference by juxtaposing embedded finite clauses, where the subject is phrase-initial, with ECM clauses, where the 'subject' is the second node in its phrase (see the discussion in 4.1 above), as in the following:

(101) *They con″sider [it % is ″absolutely ″vital] %
(102) They [con″sider it % ″absolutely ″vital]
(103) *″No one ex″pected [he % would ″get this job] %
(104) ″No one [ex″pected him % to ″get this job] %

We may conclude, therefore, that the distinction between Leftward Annexation and Leftward Grouping is required not only for the contrast between the Headed Structure Constraint and the Coordination Constraint, but also for an account of the interrelationship between phrasing and accentuation.

6. Well-formedness and acceptability

The task of giving rules for intonational phrasing is complicated by a number of factors. We have already mentioned (see 1.2 above) the need for distinguishing between IP boundaries and IP breaks. Although this is clear in principle, there are contexts (quizzes, announcements, jokes) in which deliberate use is made of pauses that produce abnormal utterance forms, including utterances with hesitations (with or without hesitation sounds). For example, from a very old music hall comedy routine:

(105) ″This is King ″Edward's ″crown % [pause] and ″this is King ″Edward's ″sceptre % [pause] and ″these are – King ″Edward's – po″tatoes %

The fact that hesitations, like other 'flaws' in performance, may be deliberate, makes the distinction between well-formed and ill-formed a little harder to draw than it would be otherwise.

The second factor is the need for making the division into IPs produce units of information (see 1.1 above) appropriate for convenient processing by speaker and listener. It follows that the acceptability of an utterance may be impaired – even though it does not offend against the HSC or any other

constraint based on syntactic phrasing – by a phrasing pattern that seems to assign to one of its parts a degree of prominence disproportionate to the amount or weight of the information it contains.

(106) But [almost all of them % knew it %–LA
├–<A———————┤

The mapping in (106), an instance of LA, is perfectly well-formed as far as the HSC is concerned, but the boundary after the subject is likely to seem less acceptable here than in (107), where the VPs are 'heavier'.

(107) (a) But [almost all of them % knew the answer] %–LA
├–<A———————┤

(b) But [almost all of them % knew the answer to this question] %
├–<A———————┤

Here we are concerned with a bias rather than a constraint, and a bias, moreover, that involves a gradient and ill-defined factor (length/weight). Then there are the biases mentioned by Nespor & Vogel (see footnote 2). These involve comparatively well-defined and discrete features – for example those involved in the distinction between NPs and other phrases, or between restrictive and nonrestrictive relative clauses. Though one may not entirely agree either with their analysis of the phenomena they discuss or with their judgements of particular examples, (see, for example, Taglicht 1977 on the intonation of relative clause constructions) it will hardly be disputed that such phenomena exist and that they add to the difficulties that have to be overcome in any attempt at a comprehensive account of intonational phrasing.

The factors discussed above tend to confuse acceptability judgements and so to blur the line between well-formed and ill-formed syntax-phonology mappings. In this paper, therefore, I have done my best to neutralize the influence of these additional factors by making use, wherever I could, of minimal pairs or the closest approach to minimal pairs.

But a fuller account must come to grips with the problems which I have merely side-stepped. This will require a fairly sophisticated procedure for eliciting acceptability judgements, one that can cope reliably with gradients of acceptability. The technique of MAGNITUDE ESTIMATION, which is used in psychophysics for the elicitation of judgements about physical stimuli, and has recently been adapted for the task of eliciting linguistic acceptability judgements (see Bard et al. 1996), seems well suited for the purpose of dealing with acceptability gradients of the sort encountered in any investigation of intonational phrasing. In magnitude estimation an arbitrary number is assigned to an initial stimulus and subjects are asked to assess the acceptability of each successive stimulus by assigning it a number expressing the perceived ratio between its acceptability and the acceptability of the

initial stimulus. The technique was used by Bard et al. for judgements of written sentences, the subject of the experiment being syntactic. If the same kind of method can be successfully adapted to the elicitation of judgements on a series of spoken utterances, it should serve to improve quite considerably the empirical foundations for studies of intonation.

7. The constraints as part of an HPSG grammar

I shall here consider how the two constraints on phonology-syntax mapping that I have proposed, the Headed Structure Constraint and the Coordination Constraint, could be incorporated in a version of HPSG.

7.1 *Phonology*

In HPSG, (in the version expounded in Pollard & Sag 1994) a linguistic expression is taken to be a feature structure with at least two attributes: PHON(OLOGY)[20] and SYN(TAX)-SEM(ANTICS). Any constraint must be statable in terms of the feature structures of signs and the relations between them.

The HSC (see (7) in 2.1 above) makes a distinction between syntactic nodes that do, and ones that don't, end in an IP boundary. Now the model of HPSG presented in Pollard & Sag (1994) does not, as it stands, make it possible to express such concepts. We would therefore need to elaborate the PHON attribute of signs by making its value include, in addition to the attribute STR(ING), whose value is a string of (strings of) phonological segments, an attribute that relates to the presence or absence of an IP boundary. We might call this additional attribute CLO(SURE), with values + or −, where 'CLO+' means 'ending in an IP boundary' and 'CLO−' 'not ending in an IP boundary'. For convenience, we can use 'closed' for CLO+ and 'open' for CLO−. The relevant part of the feature structure is shown in (108):

(108) $\begin{bmatrix}\text{PHON}\begin{bmatrix}\text{STR } \langle x,y,z \rangle \\ \text{CLO} + \text{or} -\end{bmatrix}\end{bmatrix}$

The phonological relationship between a phrasal sign and its daughters would be subject to the CLOSURE PRINCIPLE:

(109) *The Closure Principle*
For every phrasal sign, the PHON|CLO value of the mother is the same as the PHON|CLO value of that daughter which is last in linear order.

This is merely another way of saying that a string ends in an IP boundary if

[20] Phonological analysis in HPSG is a fairly recent development. See, however, Bird & Klein (1991, 1993) and Engdahl & Vallduvi (1995).

and only if its last substring ends in an IP boundary. From a commonsense point of view, such a statement seems so obvious as to be superfluous; but a generative grammar cannot shirk stating the obvious. In declaring a particular feature value to be necessarily identical in a mother and one of its daughters, the Closure Principle is similar in kind to the Head Feature Principle (HFP) of HPSG, which does some of the work done by the Projection Principle in GB: the HFP ensures, for example, that an NP will be headed by an N and a VP by a V. But whereas the HFP ignores linear order and necessarily appeals to headedness, the Closure Principle, dealing as it does with relations between strings and their substrings, ignores headedness and necessarily appeals to linear order. We have to remember that the linear order of the daughters is nowhere specified in the feature structure of a phrasal sign, but is subject to separate Linear Precedence constraints (see Pollard & Sag 1987). In other words, feature structures are not trees. If phrase structures (as opposed to feature structures) are trees nevertheless, this is due to the effect of the Linear Precedence constraints.[21]

7.2 *The constraints*

We could now formulate the Headed Structure Constraint and the Coordination Constraint as follows:

(110) *Headed Structure Constraint* (*HSC*)
If X is a sign of headed structure, and P is any daughter of X, and P is closed, then any sister of P that follows it in linear order must also be closed.

(111) *Coordination Constraint* (*CC*)
If X is a sign of coordinate structure, then all daughters of X other than the one that is last in linear order must have the same value for PHON|CLO.

The HSC of (110) is equivalent in effect to the HSC of (7), and the CC of (111) is equivalent in effect to the CC of (30). In (110)–(111), as in (109), the need for a combination of references to dominance ('mother', 'daughter', 'sister') with references to linear order follows from the nature of the task in hand: to mediate between syntax, where dominance is crucial, and phonology, where linear sequence is crucial.

[21] The Closure Principle presupposes the existence of a segmentation principle which ensures that for every phrasal sign, the value of STRING is a string of substrings such that each substring stands in one-to-one correspondence with one of the daughters specified by the SYNSEM feature structure for the same sign.

7.3 *Syntactic problems*

7.3.1 *Introducing parentheticals*

It would be necessary to enable the grammar to refer to structures containing parentheticals, which I have provisionally defined as in (112) (= (56) above):

(112) *Parenthetical*
A syntactic node for which the grammar specifies no function in relation to any sister node.

Current versions of HPSG include no ID schemata that contain parentheticals as optional elements. The list of schemata for headed structures in Pollard & Sag (1994) only contains structures with just one kind of nonhead daughter (head-subject, head-comps, etc.). Two possible exceptions (with a mixture of nonhead elements) are mentioned: a head-subject-complement schema for subject-aux inversion (reluctantly adopted in Chapter 9), and a schema for German 'that introduces both complements and adjuncts as sisters to a lexical head' (p. 391, fn. 49), but neither of these figures in Sag (1997) which again envisages only schemata (now called phrasal types) with 'unmixed' structures.

However, so long as phrase structures are trees, there seems to be no way of avoiding the introduction of schemata, or phrasal types, with optional parentheticals. This is clear for head-subject phrases and for head-filler phrases, as shown in (113)–(114) (= (63)–(64) in 4.3 above).

(113) They, however, did not know this. (subject + parenthetical + head)
(114) This, however, they did not know. (filler + parenthetical + head)

Parentheticals can also occur in head-adjunct phrases where the head is an S:

(115) In my opinion, however, he was right.
(116) He was right, however, in my opinion.

And parentheticals can occur within NPs, as seen in (117a–b), though the proper analysis of such NPs is problematic.

(117) (a) The cost, however, of such a scheme would be enormous.
(b) The cost, however, in foreign currency would be enormous.

On the other hand, it is also clear that the addition of parentheticals is not possible in every type of phrasal structure, since head-specifier phrases[22] (in English, at any rate) exclude this option:

(118) *[$_{NP}$This, however, question] is difficult. (= (66))
(119) *It was a [$_{AP}$very, however, difficult] question.

[22] Specifier in HPSG subsumes neither subject nor filler ('Spec of IP' and 'Spec of CP' respectively in GB grammars).

The option is also clearly excluded between prehead adjuncts and N-bar heads:

(120) *A thorough, however, investigation has now been instituted. (= (67))

(121) *It was a difficult, of course, question for them to answer.

It would be possible to accommodate parentheticals by making use of an option created by the proposal in Sag (1996) to introduce a multidimensional organization of phrasal sorts. In addition to the dimensions of Clausality (with a basic distinction between clause and non-clause) and Headedness (with a basic distinction between headed and nonheaded phrases), there could be a dimension of Continuity, which would give rise to the distinction between 'continuous' (= 'without-parenthetical' and 'noncontinuous' (= 'with-parenthetical'). This would allow, for example, for a 'noncontinuous (with-parenthetical) head-subject' structure sort, which would inherit its properties from a head-subject structure sort and a noncontinuous (with-parenthetical) sort.[23]

As regards linear ordering, the constraint stated in (62) above, repeated here as (122), seems to be required for English.

(122) *Linear Ordering of Parentheticals*
A parenthetical node is always a noninitial and nonfinal daughter of its mother.

In addition, something clearly has to be said for those cases in which a single phrase contains more than one parenthetical, e.g.:

(123) That, of course, as you know, was a long time ago.

(124) The last part, however, not unnaturally, will be more difficult.

But this topic must be left for a separate paper (Taglicht (in preparation)).

7.3.2 *Parentheticals and extrapositions*

It is not always obvious whether a given deviation from the most straightforward ordering of elements should be accounted for as a structure with a parenthetical or as an extraposition structure. Clear examples of extraposition structures (see Keller 1995) are shown in (125)–(126), where the extrapositions (labelled 'E') have noun antecedents and are adjoined to an S node and a VP node respectively, and in (127), where the antecedent is a verb and E is adjoined to a VP:

(125) $[_{S}[_{S}$A review has just been published] $[_{E}$of his latest book]].

(126) He $[_{VP}[_{VP}$had copies sent to us] $[_{E}$of all the reviews]].

(127) He $[_{VP}[_{VP}$decided reluctantly] $[_{E}$to accept the offer]].

[23] I owe this suggestion to Bob Borsley (p.c.).

This makes it possible, prima facie, to give two different analyses of sentences like (128) and (129), though there are no ambiguities involved.

(128) I saw a review, however, of this latest book.
(129) He decided, I hear, to accept the offer.

These, it might seem, could equally well be taken to contain parentheticals (*however*, *I hear*) or extrapositions (*of his latest book*, *to accept the offer*). But the intonational phrasing data point to the extraposition analysis. Compare (131) and (132) as spoken utterances of (130).

(130) Most of them decided, however, to accept the offer.
(131) Most of them decided however % to accept the offer %
(132) *Most of them % decided however to accept the offer %

The clear inferiority of (132) favours the bracketing of (133) against that of (134), where A, E, P and C stand for Adjunct, Extraposition, Parenthetical and Complement, respectively.

(133) $[_{S}[_{S}[_{S}$Most of them decided] $[_{A}$however]] $[_{E}$to accept the offer]].
(134) *Most of them $[[_{VP}$decided] $[_{P}$however] $[_{C}$to accept the offer]].

In (133), *however* is an adjunct to the lowest S, and *to accept the offer* an extraposition to the middle S. With this bracketing, (131) instantiates Congruent Mapping, as against Rightward Annexation for (132). In (134), *however* is taken as a parenthetical, and here the phrasings would be Leftward Annexation and Leftward Grouping for (131) and Congruent Mapping for (132), which would imply no inferiority for (132). We may compare (133) with (135), where the VP adjunct *at once* has been substituted for the sentence adjunct *however*.

(135) Most of them % $[_{VP}[_{VP}$decided at once] $[_{E}$to accept the offer]] %

Both (133) and (135) end in an E phrase. But whereas E is adjoined to S in (133), it is adjoined to VP in (135). Hence the string that follows the subject is a phrase in (135), but not in (133). Thus (135) exemplifies Congruent Mapping, and is superior in acceptability to (132), which exemplifies Rightward Annexation. We may conclude from all this, at least provisionally, that putative parentheticals in post-V position are to be taken as sentence adjuncts followed by extrapositions, and not as parentheticals in head-complement phrases.

We now come to the analysis of parentheticals within NPs, as in (136a–b) (= (117a–b) in 7.3.1).

(136) (a) The cost, however, of such a scheme would be enormous.
(b) The cost, however, in foreign currency would be enormous.

The subject NPs in these sentences, though not ambiguous, would seem to be analysable either as containing parentheticals but no extrapositions, as

shown by the bracketing (137a–b), or as containing both, as shown in (138a–b), where P, C, A and E again stand for Parenthetical, Complement, Adjunct and Extraposition, respectively:

(137) (a) $[_{NP}$The $[_{N'}[_{N}$cost] $[_{P}$however] $[_{C}$of such a scheme]]].
(b) $[_{NP}$The $[_{N'}[_{N'}$cost] $[_{P}$however] $[_{A}$in foreign currency]]].
(138) (a) $[_{NP}[_{NP}$The cost] $[_{P}$however] $[_{E}$of such a scheme]]
(b) $[_{NP}[_{NP}$The cost] $[_{P}$however] $[_{E}$in foreign currency]].

In (137a), the parenthetical *however* is sister to an N, in (137b) to an N-bar, and in (138a–b) to an NP.

But again the intonational phrasing data help us to make a choice. Compare (140) and (141) as spoken utterances of (139).

(139) These children's eagerness, though, to learn English was quite amazing.
(140) These children's eagerness though % to learn English % was quite amazing %
(141) *These children's % eagerness though to learn English % was quite amazing %

The phrasing of (141) is clearly inferior, and points to (142) rather than (143) as the correct analysis of (139).

(142) $[_{NP}[_{NP}$These children's eagerness] $[_{P}$though] $[_{E}$to learn English]].
(143) *$[_{NP}$These children's $[_{N'}[_{N}$eagerness] $[_{P}$though] $[_{C}$to learn English]]].

Similar considerations will apply where the choice is between extraposition and adjunct, as in (144).

(144) These students' progress, though, in their first semester…

Provisionally, therefore, and in the absence of syntactic or other evidence to the contrary, it seems that we can (a) assume that parentheticals may stand between NP heads and extrapositions, and (b) exclude the option of parentheticals between N heads and complements or N-bar heads and following adjuncts.[24]

It is possible that the need for parentheticals as a distinct sort of dependent element, or for structures with extrapositions, could be obviated by admitting the option of using non-concatenative operations to relate the PHONOLOGY values of mother and daughters. Sag (1996) mentions wrapping (Bach 1979, Pollard 1984) and other nonconcatenative operations as compatible with an HPSG approach to phrase structure. However, in the absence (so far) of any

[24] It would follow from this, taken in conjunction with (120)–(121), that parentheticals cannot occur at all in head-adjunct phrases with N-bar heads.

The exclusion of parentheticals from phrases with complements may be more general; but this topic, together with many others relating to the grammar of parentheticals, must be left for a separate paper (Taglicht (in preparation)).

explicit proposals, it is hard to judge the prospects of such an approach. The need for accommodating syntactic constraints on intonational phrasing (whether in the form here proposed or in any other) might well be a problem for any nonconcatenative strategy.

If the analysis in terms of parentheticals and extrapositions on the lines here assumed turns out to be satisfactory, then it should be possible to account for all special linearization problems in English in terms of one or more of the following: (a) fillers, (b) extrapositions and (c) parentheticals.

8. Conclusion

In this paper I have tried to show that a satisfactory account of syntax-phonology mapping in English must include two purely syntactic constraints on intonational phrasing: one on headed structure and one on coordinate structure. Apart from the distinction required between these two sorts of constituent structure, the constraints are purely configurational. Thus in headed structure, they apply regardless of the category of the phrase (nominal, verbal, etc.), or the position of the head (initial or final in its phrase), or the syntactic relations between head and nonhead (head-complement, head-adjunct, etc.). In those structures in which the predictions made by these constraints differ from those of Selkirk's Sense Unit Condition, the constraints here proposed are shown to be more adequate. An examination of some problematic syntactic constructions shows how constraints on intonational phrasing can provide a principled basis for the use of intonational criteria in syntactic analysis. The intonational phrasing of headed structures is shown to be constrained in addition by accent placement. However, intonational phrasing is subject not only to grammatical constraints, but to biases of various sorts. These give rise to phenomena of gradient acceptability, whose investigation will require more sophisticated techniques of judgement elicitation (Magnitude Estimation, perhaps) than have been used in this area so far. Finally, I have sketched out a way in which the Headed Structure Constraint and the Coordination Constraint could be incorporated in an HPSG grammar of English. This would involve elaborating the phonology feature structure and the classification of phrasal structures.

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