Syntax and phonology in parallel systems
An analysis of mismatches and influences at the DP level in German

1 Conception of grammar

Syntax and phonology constitute two components of grammar. They combine or break down building blocks of different size to compose or decompose utterances within their area of responsibility. The structures, which they set up for language production or strip down for language comprehension, show strong correspondences. Nevertheless, they are far from being completely isomorphic (cf. e.g. Shattuck-Hufnagel / Turk 1996). The accordance on the one hand and the discrepancies on the other hand provide a challenge for the development of a translation mechanism which is able to capture the relationship between the structures of both components of grammar. We will concentrate our examinations on the derivation of phonological structures, based on syntactic information at the DP level in German in order to restrict the center of attention. While it is widely accepted that phonology is influenced by syntax during language production processes (cf. e.g. Selkirk 1984, Nespor / Vogel 1986),[1] the reverse direction of influence has received less attention in the literature on German. So, we will not only proceed along the path going from syntax to phonology: we will also take a look from the opposite side, discussing whether and how phonology realizes its wishes by forcing the syntactic component to change its structure.

Structural mismatches and reciprocal influences of both components on each other can be handled in a modular grammar with parallel architecture, of which different versions have been developed so far. Approaches of this kind have been proposed by Jackendoff (1997, 2002), Ackema / Neeleman (2004, 2007), and many others. A parallel architecture is also found in frameworks like Autolexical Syntax (Sadock 1991, 2012), Construction Grammar (Goldberg 1995, 2006, Booij 2010), Head-Driven Phrase Structure Grammar (Pollard / Sag 1994, Müller 1999), and Lexical Functional Grammar (Bresnan 2001).

Every module in a parallel system has its own inventory, which consists of basic elements, as well as of rules or rule-like elements and conditions. The modules are able to act independently of other modules. So, phonology can create nonsense utterances as in (1). Such an utterance has a complete phonological structure with syllables, stresses, prosodic phrasing units, and more, but it lacks syntactic and semantic information. The constituents of the individual phrasing levels are named as syllables (σ), prosodic words (ω), phonological phrases (φ), and intonational phrase (ι) according to the prosodic hierarchy (cf. Selkirk 1978).[2] We will later do without such constituents in favor of only one recursive prosodic phrasing unit.

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(1)    (                                    x                              )  ι
       (    x                        )(    x                          )  φ
       (    x            )(    x      )(    x            )(    x        )  ω
       (    x   )(   x   )(   x   )(   x   )(   x   )(   x   )(   x   )(   x   )  σ
           pi        lo       gu       da       mi       de       fa       sa
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We can produce such utterances just for fun. Children like them and Dadaists in the second and third decade of the 20th century based their poetry on them. But most of our utterances are intended to give information to the audience. It is therefore necessary that the modules work together to construct useful statements. The modules communicate via correspondence conditions at the interfaces, which help to translate structures of one module into structures of another module. The structures cannot be transferred with all their details, because every module has its own restrictions. These restrictions are able to overwrite the information from the interface. Mismatches are an unavoidable consequence. The most famous mismatches are bracketing paradoxes like (2), which occur at the interface between semantics and syntax (cf. e.g. Spencer 1988).

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[1] Interface models which consider German data have been proposed by e.g. Kiparsky (1966), Cinque (1993), Jacobs (1993), Wagner (2005), and Kratzer / Selkirk (2007). A documentation of different approaches and their relevance for the analysis of German is given in Korth (2018).

[2] In contrast to Selkirk's hierarchy, the foot (as well as the super-foot) is absent in (1). See Fudge (1999) and Korth (2014: §1) for problems with respect to prosodic words and feet and arguments for a split hierarchy.

(2) {*gebratene Garnelen*} *-pfanne*   semantic bracketing
     gebratene [*Garnelen -pfanne*]   syntactic bracketing
     roasted   prawns   -pan

     'pan with roasted prawns'

Mismatches occur at every interface, but not all kinds of mismatches are as famous as the often cited phenomenon in (2). Mismatches and other difficulties at the interfaces force the modules to find compromises and alternatives. An evaluative system with access to the information of all modules compares possible structures and elects the winner. Such a system is close to evaluation processes in Optimality Theory (= OT, cf. Anttila 2016). We will take a closer look at this evaluative system at the end of our examinations.

The modules in a grammar with parallel architecture work simultaneously, although with a little time shift. According to the processing model of Bock / Levelt (1994), we start with a rough conceptual idea for our utterance during language production and build parts of semantic structure. Syntax sets in after the first pieces of structure have been generated by the semantic component. Semantic information is taken by syntax via correspondence conditions at the interface. The arising syntactic structure serves as a base for phonology, which is involved in the process after the first steps have been made by syntax.[3] Semantics and syntax meanwhile continue their structure building processes. The modules work in parallel and do not have to wait until the information of other modules has been completed. This is in contrast to a purely linear ordering of the components of grammar and differs from the T-model (also called Y-model) of Government and Binding Theory (Chomsky 1981), in which syntax is prior to semantics and phonology. A cyclic structure building can be found in Phase Theory (Chomsky 2001), but the derivational process therein starts with the deepest phase, which is most often situated at the end of the sentence, and the semantic interpretation follows the syntactic structure building in each cycle.

A parallel model allows that information goes both ways – from syntax to phonology, as well as from phonology to syntax. The way from phonology to syntax is needed for language perception and plays a crucial role in language acquisition, where phonological bootstrapping helps to identify syntactic information (cf. e.g. Christophe et al. 1997, van Heugten et al. 2014). Phonological structure constitutes the basis for language comprehension processes. It indicates where syntactic boundaries are expected to be, and which parts of the utterance form putative syntactic constituents. Phonology does not determine the whole syntactic structure (as well as syntax is not able to determine the whole phonological structure during language production processes), but it gives helpful hints and can contribute to disambiguation (cf. Price et al. 1991). The way from phonology to syntax should also be available in language production due to the bidirectional relationship of the modules. The question whether phonology is able to influence syntax during language production processes is discussed in Section 3. Beforehand, Section 2 starts with a closer look at structural mismatches at the interface between both modules and gives insights to the derivation of prosodic phrasing units. The evaluative system, in which information units flow together, constitutes the topic of Section 4. The findings of our examinations are summarized in Section 5.

2   Structural mismatches

Prosodic boundaries and syntactic boundaries coincide to a certain extent. Such a structural correspondence can be seen in the sentence in (3).[4] Conforming to standard assumptions,[5] the subject-DP and the constituent which covers the finite verb and the direct object as parts of the syntactic representation are mapped to their own phrasing units in the prosodic representation. Both prosodic units

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[3]   We analyze morphology as part of different components – similarly, but not equally to Jackendoff (1997) and Ackema / Neeleman (2004). So, morphology takes part in the structure building processes of all three modules and is not mentioned separately here.

[4]   The syntactic structure is simplified here for ease of presentation. The finite verb has in fact been moved from the clause-final position to the head of the clause.

[5]   In terms of OT, the phrasing in (3) is predicted by Align$_R$ XP, which is used for the analysis of different languages, e.g. by Truckenbrodt (1995, 2007) and Selkirk (2000).

are conjoined into a higher-level unit which covers the whole sentence. All three prosodic constituents in (3) realize a syntactic constituent in a one-to-one-mapping.

(3)   [[   ][[   ]]]   syntactic phrasing
        ((x)(x))   prosodic phrasing

	der	*Jäger*	*traf*	*den*	*König*
	the.NOM	hunter	met	the.ACC	king

        'The hunter met the king.'

However, not every syntactic boundary of the sentence in (3) is transferred to a prosodic boundary. The object DP, which constitutes a unit in syntax, lacks an equivalent in phonology and shares a prosodic unit with the verb instead. Prosody is traditionally assumed to be much flatter than syntax. Its constituents are hierarchically ordered as in (1) above (cf. e.g. Selkirk 1978, Nespor / Vogel 1986), and recursion is largely avoided. The restrictions on hierarchically-ordered prosodic constituents are covered by the Strict Layer Hypothesis (cf. Selkirk 1984: 26), which does not get along without exceptions. Some approaches generate prosodic units which are closer to syntactic constituents. One of them is Match Theory (Kratzer / Selkirk 2007: §4, Selkirk 2011), which constitutes a subtype of OT with a relationship to Phase Theory. Match Theory uses interface constraints that serve to map the object of the sentence in (3) to its own prosodic unit. Further constraints are added to outrank the interface constraints in languages in which no evidence for separate phrasing of the object is attested.

We will maintain the structure in (3), as it coincides with traditional analyses. In contrast to approaches which use a version of the prosodic hierarchy, we do without individualized constituents like prosodic words or phonological phrases. This is because phonological rules and phonotactic restrictions, which are often attributed to constituents of one specific kind, are variably limited to different levels depending on speech rate and style (cf. Kleinhenz 1998).[6] Assimilation processes which are restricted to level x in slow or formal speech can expand to level x+1 (or even level x+2) in fast or informal speech. The prosodic phrasing structure in our analyses is recursive. It is directly derived from syntactic and metrical cues, whereby restructuring is avoided. A fully recursive structure is also assumed by Wagner (2005), a partially recursive structure by Ladd (1996), as well as by Ito / Mester ([1992] 2003) and Selkirk (1996) in the context of OT.[7]

Example (3) shows that prosodic boundaries cannot be placed arbitrarily if syntactic information is available. But there is no perfect isomorphism between syntactic and prosodic units: phonology looks at syntax to generate prosodic constituents, but it has the power to overwrite the information from the interface to fulfill its own conditions. A mismatch between syntactic and prosodic phrasing units can be observed in the clause in (4), which contains an unaccusative predicate. The indicated stress pattern results from partial integration of the underlying object into the predicate.[8] The integration leads to a thetic clause, which lacks an overt topic. The underlying object, which has turned into a surface subject, is taken as one constituent in syntax, but it is split up by prosody just in the middle. The first part of the subject forms a prosodic phrasing unit with the complementizer, whereas the modifying second part combines with the verb in phonology.

(4)   [CP [VP [DP   [DP   ]]]]   syntactic phrasing
        ((x)(x   ))   prosodic phrasing

	dass	*der*	*Jäger*	*des*	*Königs*	*starb*
	that	the.NOM	hunter	the.GEN	king	died

        'that the hunter of the king died'

Prosodic phrasing is a product of interacting conditions. One is the metrical phrasing condition in (5), which only takes phonological information into account. The metrical elements mentioned therein

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6   Further arguments for an abandonment of the prosodic hierarchy are given in Korth (2014: §1).

7   Ito / Mester ([1992] 2003) and Selkirk (1996) split up the Strict Layer Hypothesis into violable constraints to make it compatible with partial recursion.

8   The special characteristics of unaccusative predicates and their parallel to passive constructions are outlined in Perlmutter (1978). The concept of (partial) integration is explicated in Jacobs (1993).

can be interpreted as syllables here, for ease of presentation. The metrical phrasing condition allows us to move further down the structure, taking into account moras as metrical elements. This results in a more fine-grained analysis, which is not necessary for our present purposes. The metrical structure, which serves as base for the application of (5), is independently derived from syntactic cues by considering the structural relationship of hierarchically-adjacent constituents (cf. Korth 2014).

(5)   Metrical phrasing condition
        a. Locally strong metrical elements build up their own prosodic phrasing units.
        b. Locally weak metrical elements integrate into adjacent prosodic phrasing units.

The schematic example in (6) illustrates how the metrical phrasing condition works. The globally strongest of the four metrical elements is the third one. It introduces a prosodic phrasing unit, which expands to the whole utterance, because all other elements are metrically subordinated. The next lower level in the metrical structure shows two locally strong elements. The first and the third element are strong at the middle level and therefore phrase separately. The two remaining weak elements integrate as before. At the lowest level, all four elements are locally strong and build up their own prosodic units. The metrical phrasing condition thereby creates a hierarchical phrasing structure.

(6)   (x   )
        (x   )(x   )
        (x   )(x   )(x   )(x   )
             a   b   c   d
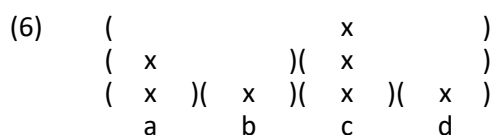
The boundaries, which separate two locally strong elements, are not anywhere between the two prominences. The example in (6) only represents a schematized prosodic structure as it could be used for nonsense utterances. It lacks a syntactic context, so that it gets organized in an optimal, balanced structure. Meaningful real utterances also show effects of balance (cf. Augurzky 2008), but the direction to which locally weak elements integrate is usually determined by a condition which operates at the interface to syntax. We set up the syntactic phrasing condition in (7) for directional integration processes. The condition differs from Wrap XP, which is used in the context of OT (cf. Truckenbrodt 1995), in that it is not restricted to lexical heads and only refers to minimal projections and their respective sister. Wrap XP, in contrast, is limited to lexical heads and combines them with all their arguments. The condition for phonological phrase formation by Nespor / Vogel (1986), which also refers to heads, is also restricted to lexical categories. It furthermore adds material of the non-recursive side to the phonological phrase of the head, whereas the condition in (7) considers the recursive side.[9]

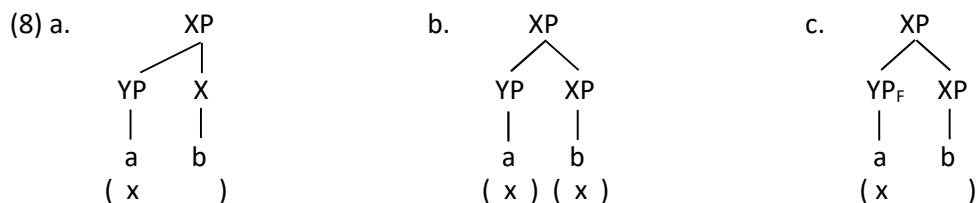(7)   Syntactic phrasing condition

        Syntactic heads integrate into the prosodic phrasing unit of their complement.[10]

The examples in (8), which are represented in a simple syntactic structure, demonstrate the effects of the condition in (7). We will do without intermediate projections here, because they do not behave differently from maximal projections with respect to our conditions. The XP in (8a) consists of the head X and its complement YP. We will link heads like X to the superordinate node by a vertical line, other constituents by diagonal lines. The syntactic phrasing condition requires that X integrates into the prosodic unit which is given to the designated syllable of its complement YP by the metrical phrasing condition. The representations in (8b) and (8c), in contrast, contain an adjunct structure, not subject to the condition in (7). No process of integration takes place in (8b), where both subconstituents are locally strong. The integration in (8c) results solely from the second part of the metrical phrasing condition. The metrically weaker element b has no other possibility to integrate. We indi-
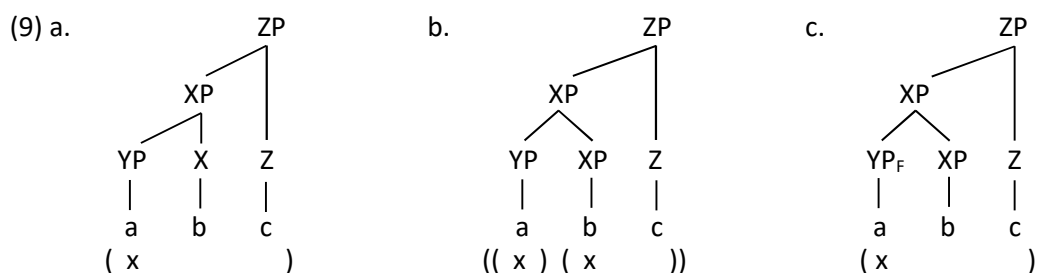
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[9]   Nespor / Vogel (1986: 186) already mention that their condition for phonological phrase formation is not compatible with the structure of languages like Dutch.

[10] We use the notion complement only for sisters of minimal projections here. This usage corresponds to the concept of complement by Glück (ed., 2000) and Pafel (2011).

cated the constituent YP in (8c) as focused with the subscript F, in order to motivate metrical differences in this example.[11]

(8) a.
```
        XP
       /  \
     YP    X
     |     |
     a     b
    ( x       )
```
b.
```
        XP
       /  \
     YP    XP
     |     |
     a     b
    ( x ) ( x )
```
c.
```
        XP
       /  \
    YP_F   XP
     |     |
     a     b
    ( x       )
```

A higher ordered head which takes the structure in (8c) as a complement can also force the integration of b into the prosodic phrasing unit of a. This is indicated in (9c). The representations in (9a) and (9b) exemplify what happens to (8a) and (8b) if they are embedded under a higher-level head. The structure in (9a) shows double integration, whereas (9b) is expanded by an extra phrasing level. The additional head Z with the phonological representation c needs to be phrased with its complement not only in syntax, but also in phonology. The phonological representation of the complement in (9b) already consists of two separate prosodic units, that cannot be removed. The element c therefore combines with b at the existing phrasing level and introduces a new level, covering all elements that belong to ZP. The element c cannot remain unphrased at the lower level because of the second part of the metrical phrasing condition in (5), which requires integration of locally weak metrical elements at all levels.

(9) a.
```
              ZP
             /  |
        XP     |
       /  \    |
     YP    X   Z
     |     |   |
     a     b   c
    ( x            )
```
b.
```
              ZP
             /  |
        XP     |
       /  \    |
     YP    XP  Z
     |     |   |
     a     b   c
   (( x ) ( x    ))
```
c.
```
              ZP
             /  |
        XP     |
       /  \    |
    YP_F  XP   Z
     |     |   |
     a     b   c
    ( x            )
```

The structures in (8) – in addition to the structures in (9) – show differences in meter. These differences are not accidental. They are subject to an interface condition which refers to the same structural characteristics as the syntactic phrasing condition does. Lexical and functional heads have a special relationship with their complement. In stress-based languages like German, they reject stress and subordinate to their partner, whereas adjuncts (as well as specifiers) and their partner demand for equally high stresses. The absent stress on heads forces their integration and thereby assists the syntactic phrasing condition. This largely matches with the conception of the constraint Stress XP in OT (cf. Truckenbrodt 2007), as well as with the Sentence Accent Assignment Rule of Gussenhoven (1992). A difference comes again through the consideration not only of lexical, but also of functional heads in our approach. The stress assignment process is further influenced by information-structural partitioning. The metrical subordination of XP compared to YP in (8c) and (9c) results from narrow focus on YP.

Metrical equality of two or more constituents is compensated by processes of rhythmical adjustment, which affects adjacent elements of all metrical levels (cf. Korth 2014: §3.3). The purely schematic examples in (1) and (6), in which no interface condition applies, can directly be constructed in a rhythmically optimal fashion, so that no further adjustment is necessary. Jacobs (1993), whose model also generates metrical equality, solves the identical strength by a rule of final accent strengthening; whereas Wagner (2005) assumes a nuclear stress generalization, by which the last metrical element is only perceived as stronger than equally high preceding marks.

Let us look back at example (4), to see how its prosodic structure can be generated by our two conditions. The clause contains strong stresses on both nouns. The metrical phrasing condition requires a prosodic boundary anywhere between their designated syllables. The rest of the prosodic structure is determined by the syntactic phrasing condition. The second determiner, which consti-

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[11] The XP could alternatively be marked as given. The advantage of focus features compared to givenness features is discussed in Korth (2011) and more detailed in Korth (2014: §4).

tutes the head of the lower DP, integrates into the prosodic unit of the noun *König*. The other heads – the determiner of the higher DP, the verb, and the complementizer – also want to combine with their respective complement phonologically, but they face the problem that the phonological equivalent of their syntactic partner is already split up by the first part of the metrical phrasing condition. So, they integrate into the closest prosodic unit which belongs to their complement and build up one higher prosodic phrasing level to satisfy the syntactic phrasing condition entirely. This equals the operation in (9b) with the exception that more than one head is involved.

The mismatch in (4) is not fatal, because only one syntactic structure with only one semantic interpretation is available for the clause under discussion. Other examples like the one in (10), in which the postnominal attributive DP is replaced by a PP, are more problematic.

(10)   ((x   )(x   ))
          dass   der   Jäger   vom   König   sprach
          that   the.NOM hunter of.DAT king   spoke

The clause in (10) is ambiguous. It allows for an interpretation in which the PP constitutes a postnominal modifier of the preceding noun, just as in the original clause in (4), but it is also compatible with an interpretation in which the PP serves as an argument of the verb. Both interpretations with a simplified syntactic bracketing are indicated in (11). The prosodic phrasing in (10) fits better with the syntactic organization in (11b), because PP and verb are combined into a constituent in syntax, as well as in prosody.

(11) a. *dass* [DP *der Jäger vom König*] *sprach*
        'that the hunter of the king spoke'

    b. *dass der Jäger* [VP *vom König sprach*]
        'that the hunter spoke of the king'

Stevenson / Smolensky (2006), who discuss parsing in OT, assume the constraint ASSIGN-θ in (12). Looking at the whole clause at once, ASSIGN-θ favors (11b) over (11a), because the structure in (11b) realizes one more argument.

(12)   ASSIGN-θ

        A predicate must assign all of its thematic roles.   (Stevenson / Smolensky 2006: 833)

However, taking the perspective of the hearer in language perception, a preference for (11b) is less obvious. At the time, when the hearer is confronted with the phonological string belonging to the PP, the verb has not yet been mentioned. We already expect a verb because of our language competence and our knowledge of German syntax, but we expect a rather unspecific one. Konieczny et al. (1997) found in their studies that speakers prefer to attach structurally ambiguous constituents in German verb-final clauses to the preceding noun. This is compatible with two strategies by Frazier (1978) – late closure and minimal attachment. Late closure demands that incoming material is attached to the currently parsed constituent and minimal attachment requires that the simplest possible structure is chosen. Connecting the PP to the noun is simpler than connecting it to hypothetical nodes and reserving it for a potential two-place predicate in the following structure.

Some structural ambiguities can be solved by prosody quite easily (cf. Price et al. 1991, Shattuck-Hufnagel / Turk 1996). Among them are calculations like (13) and coordinate structures like (14). The adjectival attribute *famous* combines with the first noun in prosody in the narrow scope reading (14a), whereas both nouns are bunched together in a prosodic unit in the wide scope reading (14b). Prosodic differences in similar examples of French are discussed by Artésano et al. (2007).

(13) a. (2 + 3) x 4
     b. 2 + (3 x 4)

(14) a. (famous writers) (and painters)   → writers are famous
   b. (famous) (writers and painters)   → writers and painters are famous

Not all ambiguities can be solved by prosody (cf. again Price et al. 1991, Shattuck-Hufnagel / Turk 1996 for English). But sentences only rarely occur completely isolated. They are normally embedded in a context, so that we know which structure is meant and which interpretation is suitable. The context causes us to fail to notice the ambiguity. We are thus not conscious of the second interpretation in most situations. Our example is special with respect to disambiguation. A prosodic disambiguation of the two interpretations becomes possible when we adjust the metrical structure by giving sentence level stress not only to the nouns, but also to the verb. Such an adjustment needs a motivation. It goes along with a change in information structure, which leads to a structural separation of predicate and argument (see below). The additional stress on the verb makes it possible to expand the prosodic phrasing structure by an extra level, which can disambiguate the clauses prosodically.

Example (15) shows the prosodic changes for the clause with attributive PP. The metrical phrasing condition divides the clause into three prosodic units. An additional prosodic boundary arises between the second noun and the verb. The application of the syntactic phrasing condition to the first determiner now creates a further phrasing level, which covers the whole subject. The complementizer is integrated as well, because it cannot remain unphrased. The prosodic separation of verb and subject leads to an extra phrasing level, which is responsible for a boundary strength higher after the subject constituent than inside it.

(15)   (((x)(x   ))(x))
       dass [$_{DP}$ *der Jäger   vom König*] *sprach*

       'that the hunter of the king spoke'

The counterpart of (15) is given in (16a). It demonstrates the prosodic changes for the clause with a non-attributive PP. The additional stress leads to a prosodic boundary between PP and verb, but does not cause an extra phrasing level. The additional stress results from structural separation processes, which match with the concept of non-integration in the sense of Jacobs (1993).[12] A structural separation goes along with changes in syntax, as it is shown in (17b); whereas the representation in (17a) illustrates the connection of PP and verb by integration. Separation means that the verb does not take the PP as its syntactic sister any longer. The PP is scrambled out to bind to a higher projection. It thereby prevents the verb from metrical subordination, just as in the schematic example in (8b). The syntactic phrasing condition cannot have access to the structure in (17b), because the prerequisites are not met. A disambiguating phrasing level, as indicated in (16b), can only be intentionally added by the speaker.
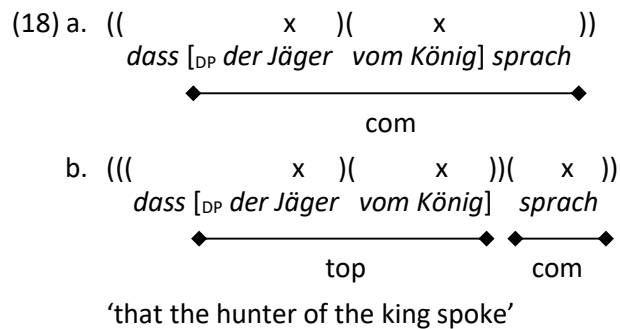
(16) a. ((x   )(x)(x))
       dass der Jäger [$_{VP}$ *vom König   sprach*]

   b. ((x)((x)(x)))
       dass der Jäger [$_{VP}$ *vom König   sprach*]

       'that the hunter spoke of the king'
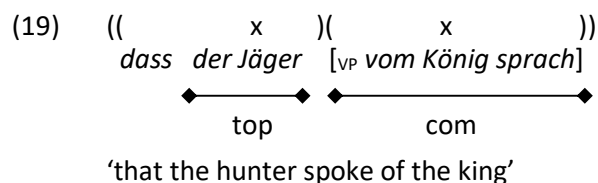
(17) a.
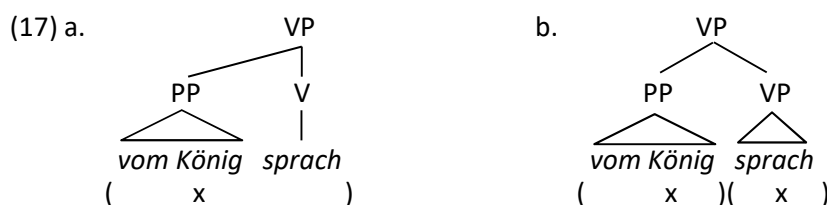
There is another possibility to disambiguate the two interpretations in (11). Clauses are characterized by a subdivision into topic and comment. The topic is overtly realized in most clauses. Only a few clauses in German have a non-overt stage topic, which is related to the temporal or local placement of the described event. Such an implicit stage topic (cf. Erteschik-Shir 1997) can be set up for thetic structures like the clause in (4), as well as the clause in (10) with the interpretation in (11a). An overt

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12   See also the discussion of necessary integration, necessary isolation, and optional integration/isolation by Kohlhof (2002).

topic is much more common, and the subject constitutes a good candidate for it. A clause like (11a) can be realized either with a thetic structure, as in (18a), or with a categorical structure, as in (18b).[13] The categorical structure is much more preferred for clauses with definite subject, because the referent of the DP is contextually available and provides an appropriate candidate for the topic of the clause. The topic is structurally separated from the rest of the clause, so that topic and comment cannot be realized by syntactic and prosodic integration. This leads to an additional prominence on the verb.

(18) a. ((x   )(x   ))
         dass [DP *der Jäger   vom König*] *sprach*
         ◆━━━━━━━━━━━━━━━━━━━━━━━◆
                         com

    b. (((x   )(x   ))(x   ))
         dass [DP *der Jäger   vom König*]   *sprach*
         ◆━━━━━━━━━━━━━━━━━━━◆ ◆━━━━◆
                     top   com

        'that the hunter of the king spoke'

The clause in (11b) is more likely uttered with only two metrical prominences. The subject represents the topic, whereas the PP is left for the comment and directly tied to the verbal head in an integrating structure, in which the verb is metrically subordinated to its complement (cf. (19)). Both interpretations in (11) can thus be disambiguated by stress. Their different stress patterns result from the assignment of topic status to the subject. Additional stress on the verb is quite common for intransitive clauses like (11a), but not for transitive clauses like (11b). The tendency to separate the verb from its argument in (11a) is further influenced by the definiteness of the subject, which usually results from contextual salience. According to von Stechow / Uhmann (1984), clauses with unaccusative predicates (like the one in (4)) can more easily be uttered with a prosodically subordinated verb than clauses with one-place predicates whose surface subject has not been externalized from an internal object position.[14]

(19)   ((x   )(x   ))
         dass   der Jäger   [VP *vom König sprach*]
         ◆━━━━━━━━━◆ ◆━━━━━━━━━━━━◆
               top   com

        'that the hunter spoke of the king'

The previous examples have shown that the direction of prosodic integration depends on the special behavior of syntactic heads. Heads occur without prosodic prominence and integrate in the direction of their complement. But not all metrically subordinated elements are heads with a syntactic complement. Pronouns tend to show up unstressed, because they belong to the background information of the utterance.[15] They are free to choose the side of integration without syntactic demands. This can be seen in the clause in (20), which has two possible prosodic realizations. The pronoun *therein* is metrically weak, because it refers to people in the context which are known by speaker and hearer. It therefore needs to be included in an adjacent prosodic unit. However, it is neither a head with a complement nor the sister of a higher ordered head. The verb is already supplied with a syntactic complement – namely, the direct object which fills the complement position. A second constituent cannot connect to its minimal projection, so that only higher-level projections of the verb remain as a

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[13] See Krifka (1984) for the distinction between thetic and categorical structures.

[14] Von Stechow / Uhmann (1984) use the notion ergative instead of unaccusative. Metrical prominence is also related to the distinction between individual-level predicates and stage-level predicates. Structural separation, which leads to stress on the verb, is necessary for individual-level predicates but is optional for stage-level predicates (cf. Diesing 1992, Selkirk 1995).

[15] The mechanism for their prosodic weakening depends on the respective theoretical modelling. They can be marked by a givenness feature (or background feature), which blocks stress; or the non-background material is accompanied by a focus feature to raise its prominence (cf. Korth 2014: §4). Another possibility is the assumption of a lexical category condition which excludes function words and their projections from interface constraints in OT (cf. Truckenbrodt 1999: 226).

linking site for the pronoun. The next higher head (in a simple syntactic structure) is the complementizer, which takes the rest of the clause as its sister. The pronoun, which is embedded therein, can bind to the left or to the right without violating any conditions. Both prosodic phrasings in (20) are equally possible. The phrasing in (20b) should be preferred, because it is more balanced. The prosodic units in this variant contain the same number of syllables in an identical rhythmical structure. The prosodic organization of (20b) thereby matches the second formation rule for prosodic phrasing units stipulated by Jackendoff (2002: 119), by which such units are preferably of equal length. Preferences for balanced structures have been observed by e.g. Gee / Grojean (1983), Atterer (2005), and Augurzky (2008).

(20) a. ((x   )(x   ))
      dass der   Jäger ihnen   einen König zeigte
      that the.NOM hunter them.DAT a.ACC king   showed

   b. ((x   )(x   ))
      dass der   Jäger ihnen   einen König zeigte
      that the.NOM hunter them.DAT a.ACC king   showed

   'that the hunter showed them the king'

Accented DPs, however, are not affected by (5b). The indirect object in (21) can nevertheless be combined with the material to the left, as in (21a), or with material to the right, as in (21b). The additional phrasing level arises due to effects of balance, which stand in a close relationship to rhythmical readjustment processes. Such phrasings are compatible with the above-mentioned studies on balance. Constraints like Wrap XP in traditional OT (cf. Truckenbrodt 1995) and Match (α,π) in Match Theory (cf. Selkirk 2011), in contrast, would favor integration of the indirect object to the right in both examples. Fortunately, the constraints in traditional OT and Match Theory are violable.

(21) a. (((x   )(x   ))((x   )(x   )))
      dass der   Jäger dem   Jungen den   König von Schweden   zeigte
      that the.NOM hunter the.DAT boy   the.ACC king   of Sweden.DAT showed

   'that the hunter showed the king of Sweden to the boy'

   b. (((x   )(x   ))((x   )(x   )))
      dass der   Jäger des   Fürsten dem   Jungen den   König zeigte
      that the.NOM hunter the.GEN prince the.DAT boy   the.ACC king   showed

   'that the hunter of the prince showed the king to the boy'

Structural mismatches between syntactic and prosodic constituents arise due to an interaction of interface conditions and purely phonological conditions. They are normally not fatal, because other data like case or contextual information ensure that utterances are decoded correctly by the hearer.

3   Reciprocal influences

It is quite uncontroversial that syntactic properties influence the phonological organization of utterances in language production processes by providing a base for metrical differentiation processes, as well as for the derivation of prosodic phrasing units. Influences from phonology to syntax (including morphosyntactic structures) marginally occur via reanalysis in diachronic processes. This holds for the English suffix *-ness*, which comes from the form *-assu* in combination with n-stems (cf. Joseph 1998: 359). The reanalysis leads to a suffix in which the morpheme boundary is aligned to a syllable boundary at the left border. The suffix does not need to syllabify with its base any longer. It is already equipped with an onset consonant. A similar process can serve as an explanation for the development of *-ner* and *-ler* as variants of the German suffix *-er* in (22).

(22) a. *Städt-er*   b. *Rent-ner*   c. *Dörf-ler*
      town-PERSON   pension-PERSON   village-PERSON
      'townsman'   'pensioner'   'villager'

Synchronically, prosody influences the occurrence of the prefix *ge-* in participle forms, which only appears with stems with main stress on the initial syllable (cf. Vogt 2013), as shown in (23). Such examples can be analyzed in (at least) two ways. Either phonology decides among alternative realizations for the participle feature, or it deletes the incoming prefix in (23b), because the phonological conditions for a realization of the prefix are not met. Deletion causes a mismatch at the interface to (morpho-)syntax. This mismatch is not fatal, because the participle feature is represented by the suffix.

(23) a.   x   b.   x
      ge-trommel-t   *(*ge-)trompet-(e)t*
      PTCP-drum-PTCP   PTCP-trumpet-PTCP
      'drummed'   'trumpeted'

Several researchers suggest an influence of phonology to the linear order of constituents. It has often been mentioned that short constituents tend to precede long constituents (cf. Behaghel 1932, Hawkins 1992, Wasow 1997, Stallings et al. 1998 among many others). But Zec / Inkelas (1990, as well as Inkelas / Zec 1995) and Jackendoff (2002) assume that speaker's preferences for the realization of complex constituents at the end of utterances go back to phonological requirements for the optimization of prosodic phrasing.

It is questionable whether a rearrangement in the linear order of constituents results from the rules or conditions by which phonology influences syntax. The reordering of complex and less complex constituents can better be explained by more general principles, which provide for the economy of processing. We are used to going the easiest way first, before moving onto a more difficult one. So, we start with simple things and postpone more complex ones not only in language production processes, but also in other situations of life. Favoring the simple way at a junction has the advantage that it is easier to return to the point from which we left. An early realization of complex constituents with several subconstituents would give us many intermediate junctions to go back to and would force us to remember for quite a long time that there are one or two simple constituents left at the first junction and further ones at intermediate junctions, still waiting for their realization.[16] Thus, heavy XP-Shift is based on general tendencies for postponing complex things. A more balanced prosodic phrasing structure is only a side-effect thereof.

Frazier / Fodor (1978) use a two-stage model with a Preliminary Phrase Packager (= PPP) and a Sentence Structure Supervisor (= SSS) to explain language perception. The PPP is a first-stage parser. It bundles groups of words into small packages and hand them over to the second-stage parser SSS, where the packages are fit into the sentence structure. Transferring the idea to language production and taking the viewpoint of the speaker, SSS is prior to PPP. It sets up the higher-level sentence structure and gives pieces of it to PPP, where constituents like DPs or PPs are generated. If less complex pieces are passed on first, the SSS is free to look for new tasks and to prepare the next clause, while the PPP is still busy with the composition of the last complex constituent.

The arrangement of constituents is not only influenced by general tendencies for postponing complex things. It has often been observed that information structure is involved, too. Contextually given constituents precede new ones, themes precede rhemes, and topics precede their comment (cf. Behaghel 1932, Lenerz 1977).[17] Given constituents are easily available, because the salient lexical item and its referent are preactivated by contextual information. There is a strong correlation between the length of a constituent and its givenness or newness. Given constituents are most often short, whereas new constituents tend to be long, because we need more information to establish them in the discourse.[18]

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[16]   See also Kimball (1973), who discusses the perceptual complexity of non-shifted structures.
[17]   See also Höhle (1982), who discusses the relationship between normal word order, information structure and prosody.
[18]   Hawkins (1992), however, weakens the power of information structure in his model and sees length as the central criterium for the arrangement of constituents.

Stallings et al. (1998) furthermore found that deviations from standard word order in English are influenced by earlier occurrences of similar structures with the same verb. Verbs which tend to show up in structures with object shift often appear in constructions where they are accompanied by a verbal particle or where they take a clausal complement. As a consequence, verbs must be stored with possible constructional frames, which become activated when the speaker or hearer accesses the verb. These findings are in accordance with the conception of Construction Grammar, as well as with parallel processing (see Section 4).

The quite famous second-position clitics in Serbo-Croatian show another kind of reordering. They are able to split up syntactic constituents to be placed after the first phonological word of the clause (cf. Halpern 1995). A rearrangement in structures with clitics and affixes can take place at the interface of syntax and phonology as a result of a translation mechanism, which creates mismatches between the structures of both components of grammar. Such mismatches differ from the ones that we observed in Section 2, where the linear order had been preserved. A condition of this kind is the *Input Correspondence* (= IC-condition), stated by Ackema / Neeleman (2007). The IC-condition requires that affixes phonologically bind to the head of their (morpho-)syntactic sister. That is trivial if the affix has a non-branching sister, but leads to a mismatch between syntax and phonology in examples where the affix combines with a complex base. Both structural translations in (24) are possible according to the IC-condition. The translation in (24a) is managed by rebracketing, whereas the one in (24b) is further accompanied by a change in linear order.

(24) a. $[[_{X(P)}\ Y(P)\ X]\ \text{AFFIX}] \leftrightarrow [/y/\ [/x/\ /affix/]]$
     b. $[[_{X(P)}\ X\ Y(P)]\ \text{AFFIX}] \leftrightarrow [[/x/\ /affix/]\ /y/]$ (Ackema / Neeleman 2007: 344f.)

Rebracketing occurs e.g. when a derivational suffix combines with a right-headed compound, as in (25). The adjectival suffix takes the whole compound as its partner in morphosyntax and semantics, but binds to the head noun of the compound in phonology, where suffix and head noun syllabify together. A morphosyntactic and semantic subdivision into *staat(s)* and *männisch*, which is parallel to the phonological organization, can be excluded, because the compound *Staatsmann* is lexicalized and *männisch* does not occur unbounded, because it is blocked by the alternative *männlich* ('male').

(25)   (   )(   )
         $[_A\ [_N$ *staat-s-*   *männ*] *-isch*$]$
              state-INFIX-   man   -like
         'like a politician'

The analysis in (24) can be transferred to clitics, which are an intermediate stage on the way from free morphemes to affixes during morphologization processes.[19] Beyond the IC-condition, Ackema / Neeleman assume a condition for *Linear Correspondence* (= LC-condition), which excludes (24b). A reordering at the interface can nevertheless occur if a language allows that the LC-condition is overruled for selected phenomena by more significant conditions. But this does not really help us with Serbo-Croatian second-position clitics, which do not necessarily lean on the head of its sister. Clitics can occur as proclitic or as enclitic elements. Some of them are prespecified for a binding direction, just as affixes. According to Halpern (1995), Serbo-Croatian clitics occupy the clause-initial position in syntax. They are phonologically enclitic elements, so that they need material to their left to lean on. But there is no element to the left. The structure is rescued by phonological inversion, so that clitics can take the first available phonological constituent to tie it to their left.[20] This can be a phonological word or a phonological phrase. Connecting a clitic to the first phonological word often results in a split-up of a phonological string which corresponds to a syntactic constituent (cf. (26)). According to Sadock (1991: §4.3), who works with similar constraints, clitics attach to the nearest word, whereas affixes combine with the head of their partner. The linear rearrangements in (24b) and (26) represent

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[19] See Lehmann (³2015) for the role of clitics in grammaticalization processes.
[20] Werle (2009) argues for host raising, a kind of phonologically motivated PF movement, instead of phonological inversion or clitic lowering.

mismatches at the interface of syntax and phonology but do not give evidence for phonological influences on syntax.[21]

(26)   [CLITIC [$_{X(P)}$ Y(P) X]] ↔ [[/y/ /clitic/] /x/]

A study by Shih et al. (2015) examines possessive constructions in English and comes to the result that rhythm – next to other phonological and non-phonological factors – is relevant for the positioning of possessor phrases with respect to the noun to which they are related. Our following analyses also concentrate on structures with possessive phrases. We will look at pre- and postnominal genitive phrases and their alternatives in German. German offers the possibility to mark possessors by genitive case. Proper names receive the suffix *-s*. This holds for prenominal possessive proper names, as in (27a), as well as for postnominal ones, as in (27b). Demske (2001) and Nübling (2012) among others differentiate between two instances of the suffix *-s* – one is a case marker for postnominal common nouns, the other one is a possessive marker for proper names in prenominal position. At first glance, not all speakers accept proper names as possessors in postnominal position. But Eisenberg (2016) argues that complexity (resp. length) matters to the placement of a possessive proper name. Only short proper names are avoided in postnominal position. Longer proper names, as in (27c), are accepted. So, we have another case in which short constituents come first and longer ones later.

(27) a. *Olaf-s   Buch*   b. *das   Buch   Olaf-s*
        Olaf-GEN book.NOM   the.NOM book.NOM Olaf-GEN
        'the book of Olaf'   'the book of Olaf'

     c. *die   Brief-e   Napoleon-s*
        the.NOM letter-PL.NOM Napoleon-GEN
        'the letters of Napoleon'

Adding the inflectional suffix to proper names with a final sibilant leads to an illicit sequence of phones, so that the suffix cannot be realized directly. Degemination offers a possibility to avoid the problematic sequence. Degemination is a speaker-oriented process. It simplifies the articulation, but it increases the difficulties for the hearer to identify the correct grammatical features.

(28) a. *Jonas'   Buch*   b. *das   Buch   Jonas'*
        Jonas.GEN book.NOM   the.NOM book.NOM Jonas.GEN
        'the book of Jonas'   'the book of Jonas'

The missing segment is substituted by an apostrophe in written language. But there is nothing which marks the suppressed suffix phonologically, so that confusion with other proper names or other syntactic structures can arise. The phonological realization of (28) is quite similar to that of (29), in which the name *Jona* is expanded by the genitive-marking suffix *-s*. There might be only a slight difference in the length of the vowel /a/.

(29) a. *Jona-s   Buch*   b. *das   Buch   Jona-s*
        Jona-GEN book.NOM   the.NOM book.NOM Jona-GEN
        'the book of Jona'   'the book of Jona'

Furthermore, the phonological realization of (28a) does not differ from a structure in which *Buch* is a surname, while the phonological realization of (28b) can be confused with a syntactic representation in which the proper name serves as an apposition to the preceding noun (cf. (30)). Appositional structures of this kind can be found in e.g. biblical titles like *the book Ezra* or *the book Moses*.

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[21] Bošković (2001) discusses other solutions for Serbo-Croatian second-position clitics: "Two ways in which PF affects word order without actual PF movement […] are through determining which copy of a non-trivial chain is to be pronounced […] and by having a filtering effect on the output of the syntax" (p. 283).

(30) *das   Buch   Jonas*
    the.NOM   book.NOM   Jonas
    = 'the book named Jonas'
    ≠'the book owned by Jonas'

Epenthesis offers another possibility to rescue morpheme combinations with illicit geminates. It is less problematic than deletion, because confusion with other constructions can be avoided. It preserves the existing phonological material, but further segments without a corresponding element in at least one other module are added. The name *Jonas* can be expanded either by schwa or by a syllabic nasal (cf. (31)). The letter <e> in *Jonasens* is normally not pronounced. It is used to mark the following /n/ as syllabic. The epenthetic process in (31) is hearer-oriented, because grammatical features are phonologically realized.

(31) a. *Jonas-e-s   Buch*   b. *das   Buch   Jonas-e-s*
       Jonas-en-s   Buch   *das   Buch   Jonas-en-s*
       Jonas-ø-GEN book.NOM   the.NOM   book.NOM   Jonas-ø-GEN
       'the book of Jonas'   'the book of Jonas'

Both options are non-optimal, because the phonological output contains either more or less material than the input. Speaking in terms of OT, examples like (31) violate the constraint DEP-IO in (32a), whereas forms like (28) violate the constraint MAX-IO in (32b). Deletion, as well as epenthesis, leads to a mismatch between syntax and phonology.

(32) a. DEP-IO
       Output segments must have input correspondents. ('No epenthesis')

     b. MAX-IO
       Input segments must have output correspondents. ('No deletion')   (Kager 1999: 101f.)

Deletion furthermore violates an interface condition, by which essential elements of one module must be realized by corresponding elements in another module. The genitive suffix, which represents the possessive relation in syntax, lacks a phonological surface correspondent in examples with deletion like (28). The epenthetic segments do not have a correspondent in other modules as well, but they are not essential. They are based on a repair strategy by which unmarked segments are added to preserve the input material and rescue the structure. Deletion is generally not more problematic than epenthesis, unless essential syntactic features or especially semantic relations get lost, as these are not compensated by other parts of the structure (e.g. by congruence, word order etc.).

    Examples like (28) and (31) have an unmarked phonological surface representation, but they nevertheless constitute marked structures with respect to correspondences at the interface due to the performed phonological changes. So, speakers choose alternative structures instead. A prenominal alternative is given in (33). It is popular in Colloquial German, but not yet fully accepted in Standard German. A possessive determiner is used to combine the proper name with the core noun. The determiner agrees with the core noun, whereas its stem adjusts to the proper name. Dative case is given to the proper name but is not realized by a suffix. We can detect the case in those dialectal variants where proper names occur with a determiner (cf. (33c)). The case marking is dispensable and the absence of a case suffix not fatal. It does not constitute an essential element here, because the possessive relation is explicitly marked by the determiner, so that no confusion is possible.

(33) a. *Jonas   sein   Buch*   b. *Jana   ihr   Buch*
       Jonas.DAT his.NOM book.NOM   Jana.DAT her.NOM book.NOM
       'the book of Jonas'   'the book of Jana'

     c. *dem   Jonas   sein-e   Büch-er*
       the.DAT   Jonas.DAT   his-PL.NOM book-PL.NOM
       'the books of (the) Jonas'

Postnominal phrases which are headed by the preposition *von* ('of') provide another alternative to the non-optimal genitive phrases. In contrast to the prenominal dative possessors, they constitute an unmarked alternative not only in Colloquial German but also in Standard German.

(34) *das*   *Buch*   *von*   *Jonas*
      the.NOM   book.NOM   of   Jonas.DAT
      'the book of Jonas'

A non-optimal phonological representation can encourage us to look for alternatives. But how does it come to pass that a structure is replaced by an alternative one? We plan our utterances a bit in advance and look ahead for parts of the upcoming material.[22] It sometimes happens that we face a problem and look for a substitute, which fits better into our utterance. Individual modules and sub-modules, which are confronted with a non-optimal structure, can reject the incoming information by giving it back to the interface and asking for alternatives. This can be done by phonology for our problematic genitive phrases. We will largely restrict the following discussion to the prenominal variant.

Let us assume that we intend to express a possessive relation between Jonas and a book from the discourse context and that our syntactic component takes the prenominal genitive possessive structure as its first choice, because syntax is not able to see the problems which the phonological component will have with this choice later on. Syntax accepts the incoming information from the semantic component, but phonology is not really satisfied with the material, which is provided to it by the syntactic module. Different things can happen now. In a first scenario, another possessive marker is found in the lexicon, which can replace the disadvantageous suffix. The possessive determiner is a good candidate for this task; also, it is not fully established as a possessive marker for combining prenominal phrases as possessors to the core noun. The substitution does not occur without consequences, because a bound morpheme has been replaced by a free one. The syntactic representation (including the morphosyntactic one) must be accommodated. This leads to a different syntactic tree structure, additional congruence marking, and a change in case. Restructuring can start late in this scenario, because the alternative structure begins with the same phonological material.

(35) **Jonas-s*   *Büch-er*   → *Jonas*   *sein-e*   *Büch-er*
      Jonas-GEN   book-PL.NOM   Jonas.DAT   his-PL.NOM   book-PL.NOM

This does not hold for those dialectal variants in which proper names occur with determiners (cf. (33c) above) or for examples with prenominal possessor phrases other than proper names, as in (36).

(36) *dem*   *Lehrer*   *sein-e*   *Büch-er*
      the.DAT   teacher.DAT   his-PL.NOM   book-PL.NOM
      'the books of the teacher'

In a second scenario, syntax offers quite a different structure and changes the linear order of core noun and possessor. A reordering as indicated in (37) is costlier than a preservation of the linear order and must start earlier. The most economic restructuring is one which involves the fewest steps, still respecting the principles of grammar. Speakers whose grammar does not allow for prenominal dative possessors have postnominal PPs as best syntactic alternative.

(37) **Jonas-s*   *Büch-er*   → *die*   *Büch-er*   *von*   *Jonas*
      Jonas-GEN   book-PL.NOM   the.PL.NOM   book-PL.NOM   of   Jonas.DAT

Postnominal PPs constitute a real alternative in writing, where we have enough time to restructure our sentences until we have found the perfect implementation for them. They also provide a good alternative for postnominal genitive phrases, because the linear order of core noun and possessor does not need to be changed and restructuring can start late. Those who do not like short proper

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[22] Not only the speaker, but also the hearer, looks ahead and anticipates the upcoming material. The language processing system is predictive (cf. Ferreira / Çokal 2015), which can be seen from several eye-tracking studies (e.g. by Altmann / Kamide 1999, Weber / Grice / Crocker 2006).

names as genitive possessors in postnominal position can replace *Jonas* in (38) by the longer name *Aristoteles*. A possessive DP with a common noun instead of a proper name, as in (39), does not show the same difficulty, because genitive case is overtly realized by the determiner, so that the suffix does not need to show up at the noun (cf. DUDEN 2009: §307ff., §1534).[23]

(38) *die*   *Büch-er*   **Jonas-s*   → *die*   *Büch-er*   *von*   *Jonas*
      the.PL.NOM   book-PL.NOM   Jonas-GEN   die.PL.NOM   book-PL.NOM   of   Jonas.DAT

(39) *der*   *Stachel*   *des*   *Kaktus*
      the.NOM   spine.NOM   the.GEN   cactus.GEN
      'the spine of the cactus'

Prenominal possessor phrases which consist of a possessive determiner and a DP with dative case represent the semantic relation much better than genitive phrases or their postnominal alternative with a PP headed by the preposition *von*, because they mark the possessive relation explicitly, whereas genitive phrases and *von*-PPs are also used to display other semantic information. They are furthermore able to represent complex prenominal possessors, just as it is known to be in English.

(40) a. **des*   *Lehrer-s*   *aus*   *München*   *Buch*
        the.GEN   teacher-GEN   from   Munich.DAT   book.NOM

    b. *dem*   *Lehrer*   *aus*   *München*   *sein*   *Buch*
       the.DAT   Lehrer.DAT   from   Munich.DAT   his.NOM   book.NOM

      'the teacher from Munich's book'

Prenominal dative possessors are also qualified to realize feminine possessors in prenominal position. Feminine nouns (except female proper names) do not show overt case marking. Their determiner, which could compensate this deficit, is ambiguous between genitive and dative. The prenominal alternative with a dative DP is unproblematic, because the possessive determiner highlights the semantic relation. The possessive determiner in combination with a dative DP therefore has good chances of becoming a more established possessive marker in Standard German and of replacing genitive case in possessive constructions.

(41) a. *mein-er*   *Schwester*   *Büch-er*
        my-GEN   sister.GEN   book-PL.NOM

    b. *mein-er*   *Schwester*   *ihr-e*   *Büch-er*
       my-DAT   sister.DAT   her-PL.NOM   book-PL.NOM

      'my sister's books'

A structure with a feminine genitive possessor can be misleading, because the form of the possessor is identical to the form of an indirect object or a free dative. The structure in (42a) can therefore be confused with the structure in (42b). Taking the perspective of the hearer, late closure would favor the structure in (42a), but in this case, the verb still has an unassigned θ-role. According to the model of Stevenson / Smolensky (2006) for English, the assignment of a θ-role is more important and the more neutral case is preferred.[24]

(42) a. *Olaf*   *übergab*   *die*   *Keks-e*   *mein-er*   *Schwester*
        Olaf.NOM   handed.over   the.PL.ACC   cookies-PL.ACC   my-GEN   sister.GEN
        'Olaf handed over the cookies of my sister.'

    b. *Olaf*   *übergab*   *die*   *Keks-e*   *mein-er*   *Schwester*
       Olaf.NOM   handed.over   the.PL.ACC   cookies-PL.ACC   my-DAT   sister.DAT
       'Olaf handed over the cookies to my sister.'

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[23] A general tendency to lose the *-s* in the paradigms of strong nouns has often been observed and is discussed e.g. in Appel (1941) and Konopka / Fuß (2016).

[24] Dative is more neutral than genitive with regard to the case hierarchy (cf. Primus 1987, Dürscheid 1999).

Prenominal genitive possessors with monosyllabic proper names often causes a stress clash like in (43a), because many nouns from the native vocabulary carry stress on the initial syllable. The stress clash disappears if the prenominal genitive is replaced by a prenominal dative, as in (43b). The replacement in (43b) results in an alternating metrical structure.

(43) a.
```
x           x                         b.  x                   x
x           x                             x       x       x
Jan-s    Buch                             Jan     sein    Buch
Jan-GEN  book.NOM                         Jan.DAT his.NOM book.NOM
'the book of Jan'                         'the book of Jan'
```

But this is only one side of the coin. A combination of the possessive determiner with a two-syllabic proper name like *Peter*, which carries stress on the initial syllable, leads to a less optimal metrical structure with a lapse (cf. (44a) vs. (44b)). The lapse disappears in contexts in which the determiner is inflected (cf. (44c)). Nespor / Vogel (1989: 87) state that lapses "are not felt to be quite as disturbing as clashes". So, the lapse in (44b) should be a less serious deviation from the optimal structure than the clash in (43a). There are nevertheless no fully convincing prosodic arguments for structures with prenominal datives.

(44) a.
```
x              x                      b.  x                     x
x  x           x                          x  x       x          x
Peter-s     Buch                          Peter      sein       Buch
Peter-GEN   book.NOM                       Peter.DAT  his.NOM    book.NOM
'the book of Peter'                       'the book of Peter'
```

c.
```
x                       x
x           x           x
x  x        x  x        x    x
Peter      sein-e       Büch-er
Peter.DAT  his-PL.NOM   book-PL.NOM
'the books of Peter'
```

In a third scenario, no alternative is found in time, so that phonology is left alone with the geminate and has to choose a purely phonological alternative to ensure the completion of the problematic part of the utterance. Thus, phonology does not fully reject incoming information, but looks for a phonological solution to the problem and keeps it ready, being prepared in case of a grammatical emergency. This solution can be an epenthesis, as in (45), or the more speaker-oriented deletion.

(45)   *Jonas-s   Büch-er   → Jonas-e-s   Büch-er
         Jonas-GEN   book-PL.NOM   Jonas-ø-GEN   book-PL.NOM

Blutner (2000) proposes a model for natural language interpretation in OT which involves the perspective of both speaker and hearer. Transferring this bidirectionality to all parts of grammar, the constraint DEP-IO in (32a) is related to the speaker-oriented R-principle in (46a), and the constraint MAX-IO in (32b) is related to the hearer-oriented Q-principle in (46b). A strong ranking should be avoided. Otherwise, one of the two solutions to the problematic structure with geminate would never occur.

(46) a. R-principle
         Say no more than you must.

    b. Q-principle
         Say as much as you can.   (Horn 1984: 13)

Phonology is not able to influence syntax directly in language production processes. It can only report disadvantageous incoming material and hope for solutions from the other components of grammar. The modules interact via the interfaces. Neither has the power to interfere in the processes of the

others. They take material from their cooperation partners as base for their own structures and have to find compromises in case of conflicts. The evaluative system, which is the subject of the next section, mediates between the modules and helps to find solutions.

4   Evaluative system

The collaboration of the modules is monitored by an evaluative system at the interface, which has access to information of all modules. The arrangement of the grammatical components can roughly be schematized as in (47). The overlapping areas represent the interfaces, by which the modules communicate. They contain the mechanisms for structural translations with the evaluative system in the middle. The diagram in (47) symbolizes the organization of grammar only for the core modules. There are also submodular components with further interfaces.

(47)
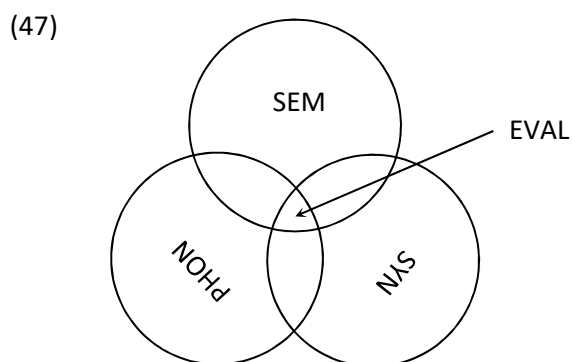
The lexicon is distributed over the components of the model. Lexical entries are typically a combination of semantic, syntactic, and phonological information. Every module only has access to that part of the lexicon which contains the relevant information for the respective component. Phonology only sees phonological information like the segmental string or the position of word stress, whereas information about meaning is only available to semantics. The stored information for the different modules is connected in lexical entries. The lexicon thus plays a crucial role in the interface activities.[25] If one module chooses a lexical entry for its structure, the other modules have to check whether the part of the lexical entry envisaged for them fits into their own structure.

Let us assume that the semantic component substitutes a part of its structure by a more appropriate one and takes an alternative lexical entry. Now, syntax and phonology must approve this change. Syntax looks for the category and other properties which are relevant to ensure a successful syntactic structure-building process. If some property is not suitable, syntax has the option to restructure or to reject the incoming new material. Rejection is more comfortable for syntax than restructuring, whereas semantics hopes that syntax will do the more elaborative job of restructuring. The evaluative system as a monitoring component takes the decision in case of a dissent between two modules. It does not decide between grammatical and ungrammatical implementations of the intended utterance.[26] It only decides which alternative fits best and which solution to the conflict is the most economic one.

The evaluation process can lead to an ungrammatical sentence. This happens, for example, if we find no grammatical alternative on time. Such a situation comes about quite often while talking in a foreign language. Either we do not know the correct structural realization for a specific construction in the target language or we fail to activate the necessary building blocks soon enough. In the first case, we do not have fully acquired the target grammar and use a still defective and incomplete system (with possible help of grammatical principles of our native language). A structure which is ungrammatical in the target language can be the best one for our defective and incomplete grammar to generate. In the second case, performance overrules competence. Our language system has the ability to generate a grammatical alternative, but we are not fast enough to find it, because we do not have as much practice as in our native language. That does not mean that the native language is free

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[25]   Sadock (1991) directly ties the lexicon to the monitoring interface component.
[26]   Sampson / Babarczy (2014) propose a model which completely abandons the concept of (un-)grammaticality.

of situations in which we fail to find an alternative structure under time pressure. It only happens less often. We normally do not stop an utterance completely and are then quiet, if we do not find the perfect variant in time. We keep on talking with suboptimal or even ungrammatical structures if necessary.

Another situation which leads to ungrammatical utterances appears if we decide too late for an alternative lexical entry or a change in structure, so that the alternative is not compatible anymore. This is shown with the example in (48). The infinite verb is replaced by one with a more neutral meaning. But we have already uttered a part of the clause and the substitute does not suit to the argument structure of the original verb. It requires dative instead of accusative case for the second pronoun. The substitution in (48) is not really triggered by grammatical difficulties. Speakers often deliberately make such changes to temper or refine their statement by using more suitable lexical entries, but changes for grammatical reasons can have the same effects. The ungrammaticality of (48) is not the result of insufficient competence. We choose between two grammatical alternatives, but unfortunately blend them.

(48) *Ich   habe ihn   gestern* | ~~*belehrt, dass…*~~
      I.NOM   have him.ACC   yesterday | ~~taught   that~~

                                           | *gesagt, dass…*
                                           | said   that

      'I taught/told him yesterday, that…'

The evaluative system in (47) contrasts with the control component in the work of Orgun / Sprouse (1999), which is also responsible for final judgments, but rules over only one candidate and classifies it as either grammatical or ungrammatical. A grammatical candidate passes the control component, whereas an ungrammatical candidate is rejected. The evaluative system of OT, which precedes the control component in the model of Orgun / Sprouse, comes closer to the evaluative system in (47). It also compares candidates, differentiates between good and less good ones, and elects the winner. The winning candidate is typically grammatical. An ungrammatical candidate can exceptionally win the election in the OT conception of Orgun / Sprouse if there is no other candidate which better satisfies the constraints; but such a candidate fails to pass the control component afterwards. Ungrammatical outputs of the evaluative system can directly be avoided under other OT conceptions by stipulating a null-parse candidate which does not assign any structure to the input. It only violates a constraint which demands for structural realization. It thereby performs better than all ungrammatical candidates (cf. Prince / Smolensky 1993, McCarthy / Wolf 2009).

The evaluative system of (47) and that of traditional OT differ with respect to competence and performance. The evaluative system of OT is a pure competence system, which selects the best overall candidate; whereas the system in (47) is influences by performance. Traditional OT generates and evaluates a quasi-infinite number of candidates, which differ in several properties. A restriction thereto is given by Harmonic Serialism (cf. McCarthy 2016), which allows for only one change at every evaluative step. Our evaluative system does not deal with tenth or hundreds of candidates at once. It looks at just a few alternatives. It usually needs to consider only two candidates at the same time. But before we can see the reason for this restriction, we need to settle the debates concerning which structure is generated first and which lexical entry has priority to other ones.

The most economical way is to start with material which comes first to our mind. Which lexical items and which syntactic structures are first available depends on different factors. An important factor is the frequency of occurrence (cf. MacDonald et al. 1994, Ferreira / Dell 2000 among others). Structural building blocks which are used quite often have a high level of preactivation; so, they are easier available then building blocks which are only rarely in use. Contextual saliency provides another factor which influences availability. Given or salient material is preactivated, too. It is thereby able to direct the structural choice, as has been shown in priming studies on active and passive constructions by Bock (1986, 1987). Starting with the material which comes first to our mind gives us time to look up less available material and to build up complex constituents. A third factor is simplicity (Gorrell 1995). A preference for syntactic simplicity is stated in the minimal attachment strategy which is known from language comprehension studies (cf. Frazier 1978, Frazier / Fodor 1978). This strategy can be adopted for language planning processes. Speakers as well as hearers tend to go the easiest way first.

This shows that processing interacts with grammar, in that grammatical and extra-grammatical factors go hand in hand. The most frequent structures are also the most neutral ones. They fulfill more grammatical principles than infrequent structures; or taking the perspective of OT, they satisfy the higher-ranked constraints much better. The most frequent structures usually are the simplest ones, which are easiest to store and easiest to correct if necessary (cf. Frazier / Fodor 1978). So, markedness directly relates to processing.

The level of preactivation can change over time. Alternative lexical entries or alternative structures will be easier available when they become more and more frequent. If syntax is often asked to substitute a prenominal possessor with genitive case by something else, it will give up the problematic structure someday in future and generate the alternative first. Prenominal dative possessors become more preactivated through frequent restructuring and have chances thereby to replace prenominal genitive possessors entirely in Standard German. The preactivation level of prenominal dative possessors in Colloquial German is already higher, because different social registers can preactivate partially different areas of grammar and lexis next to a great overlap.[27]

Now, we can come back to the restriction of the number of candidates which our evaluative system has to consider. The restriction results from processing economy. Serial and parallel models have been proposed to explain language-processing strategies, especially from the hearer's perspective. In serial models (cf. Frazier 1978, Gorrell 1995), the language system builds up a structure in following requirements for simplicity and considers only one analysis in case of a temporary ambiguity. In parallel models (c.f. MacDonald et al. 1994, Melinger et al. 2014), different possible structures become activated simultaneously.[28] The processing system of our model is based on activation. But not all structures have the same activation level. Some of them can be accessed faster than others, and one structure wins the race, as we have seen before. So, we deal with only one structure in the beginning, which is constructed step by step out of activated structural pieces. Alternative structural pieces remain abstract. Their activation level decreases when the structure building process proceeds without accessing them.

If e.g. the phonological component askes the other components for an alternative, structures which have not yet been considered get a second chance. The one with the next highest activation level is rapidly available and enters the competition. So, the evaluative system takes only two candidates into account. The winner can take part in further competitions if at least one module is not fully satisfied and if time allows looking for other alternatives to optimize the utterance. The gradual decrease in the activation level of non-considered alternatives impedes late access to early activated material and makes late restructuring difficult.[29]

The evaluation process in our model can either be thought of as an OT-like ranking of constraints for alternative structures or as a comparison of well-formedness values. A combination of constraints and well-formedness values, as it is known from weighted constraints in Harmonic Grammar (cf. Legendre et al. 1990, Pater et al. 2007 among others), provides a further option. But there appears a challenge for the evaluation process. It seems that we have to rank or weight constraints of different modules against one another to compare semantic, syntactic, and phonological properties. This is undesirable and would give too much power to the evaluative system.

An alternative is provided by models which use a filtering effect (e.g. Vogel / Kenesei 1990, Golston 1995, Anttila 2016). Concentrating on the interface between syntax and phonology in language production, syntactic structure-building processes precede phonological ones (or syntactic constraints outrank phonological constraints in terms of OT). Syntax offers several structures which are equally well-formed with respect to syntactic conditions and out of which phonology selects the best one under purely phonological aspects. Thus, phonology acts as a filter on syntax. The idea of phonology-free syntax (Zwicky / Pullum 1986) is preserved; but a filtering effect of this kind does not neatly fit into our model, which is based on equality of grammatical components and considers pro-

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[27] See also Anttila et al. (2010), who assume that a speaker has different grammars due to different possible constraint rankings in OT.

[28] An activation of more material than the lexical item which is actually needed is well known from frame semantics (cf. Fillmore 1975).

[29] Difficulties with late restructuring in language perception have often been observed with garden path sentences. Ferreira / Henderson (1991) show that increasing distance disadvantageously influences reanalysis.

cessing economy. Generating several structures at once is ineffective if we take performance into account.[30]

We will assume that the evaluative system in (47) does not see concrete constraints or conditions of the individual components. It only gets well-formedness values for each alternative realization from the modules, out of which it calculates a general well-formedness value to elect the winning candidate. But does every value count the same? OT-like approaches use a ranking of constraints, by which some constraints are more important than others. They can either outrank each other as in traditional OT or take influence on the height of a candidate's value like in Harmonic Grammar. The modules in a grammar with parallel architecture have equal rights. No one should prevail over the others. So, the needs of syntax should not have more weight than the needs of phonology or semantics. We therefore assume equality for the modules from the viewpoint of competence, as long as there is no evidence for weighting. This means that their values are treated equally by the evaluative system at the interface.

However, there appears an indirect weighting due to performance. As we have seen in the beginning, language production processes start with a conceptual idea. The first steps of semantics precede the first steps of syntax, and the final steps of phonology follow the final steps of syntax. Thus, phonology is in the most disadvantageous position. If it detects an inconvenience and no other component can help in time, it has to deal with the unfavorable structure. This picture is mirrored in language perception, where phonology starts, and semantics finishes the task.

Assuming equal weight from the perspective of competence can lead to a structure in which two candidates get equally high values. Then, we stick to the variant which we had chosen first, because it does not require restructuring. Restructuring or even substitution of a lexical entry by another one can result in undesirable blending effects and therefore necessitates checking of compatibility with already uttered material.

Harmonic Grammar and traditional OT require that those candidates being compared must have the same input. This is not obvious under the described circumstances, in which values that have been given to different structural realizations by different modules are involved in the calculation. But we may not forget that the rough conceptual idea which we base our utterance on is the same for all alternatives.[31] If we want to say that a person named Hugo fills water into a contextually salient bottle, we can do this as in (49a), but we can likewise use (49b) or the passive sentence in (49c). Other structures are possible as well. Taking a lexicalist point of view, all three sentences differ not only in syntax and phonology, but also in semantics.[32] It matters whether we pick out the lexical entry *füll* ('fill') or its prefixed variant *befüll* ('fill'), and it also matters whether we use an active or a passive construction.[33] The idea is the same, but the structural realizations are different.

(49) a. *Hugo   füllt Wasser   in   die   Flasche*
       Hugo.NOM fills   water.ACC   into   the.ACC bottle

   b. *Hugo   be-füllt die   Flasche mit   Wasser*
       Hugo.NOM PREF-fill the.ACC   bottle   with water.DAT

   c. *die   Flasche wird von Hugo   mit   Wasser   befüllt*
       the.NOM   bottle   AUX by Hugo.DAT with water.DAT filled

       'Hugo fills water into the bottle.'

The alternatives which are subject to the judgements of the evaluative system often only differ with respect to two modules. So, the semantic structure can be identical, while variation arises in syntax and phonology – due to different possible translations.

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[30] A filtering effect in a purely competence-based model should always favor the same structural alternative; but see Anttila (2016), who assumes that there is no necessity for a strict ranking of the constraints of phrasal phonology in OT, so that variation can occur.

[31] Looking back to the possessive constructions of section 3, all alternative realizations are based on the same relationship, by which an entity is connected with its possessor.

[32] See Štekauer (1998, 2005) for the distinction between (extralinguistic) conceptual structure and (linguistic) semantic structure.

[33] See Pafel (1991: §4) for a lexicalist perspective on passives.

5 Summary

The previous sections have dealt with the interface between syntax and phonology. The structural relationship of both components of grammar, as well as their influences on each other, have been illustrated with data from German. A modular grammar with parallel architecture has served as base for the examinations.

Syntactic and prosodic constituents correspond to a certain extent, but their relationship is accompanied by mismatches. Phonology is able to split up syntactic constituents or combine elements which belong to different syntactic units. This non-isomorphism results from correspondence conditions at the interface which interact and compete with purely phonological conditions for the development of prosodic phrasing units. Phonology has the challenge to solve two tasks simultaneously. It needs to consider syntactic information to ensure that utterances can easily be decoded by the hearer, and it has to guarantee that phonological well-formedness conditions are satisfied. Even the best solution to the challenge goes along with discrepancies, which normally do not negatively affect comprehension. Global ambiguities arise only occasionally. They are compensated by contextual information or can be solved intentionally by the speaker through accommodating the stress pattern and its syntactic prerequisites.

Phonology can have influence on the choice of syntactic structures by giving non-optimal parts of the incoming information back to the interface. Phonologically illicit structures can thereby be avoided in collaboration with other modules. Alternatives are proposed and checked by each module as well as by an evaluative system, into which information flows together. The evaluative system calculates a general well-formedness value out of the values which the modules have been transmitted and decides which alternative performs best. Frequent restructuring can lead to a higher preactivation level for alternative realizations and is thereby able to support structural change.

A modular grammar with parallel architecture can capture non-isomorphism as well as influences on structural choice. It uses correspondence conditions and an evaluative system, which are located in the interface areas. The modules take information from other modules and adjust it to their own needs. They have the power to work autonomously, but they communicate and cooperate to find compromises for successful utterances.

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