following ones: annotation schemes that focus on form description and gestures classification in terms of a taxonomy like the one introduced in Section 2 have been developed by R. Breckenridge Church, published in the appendix of McNeill (1992); CoGEST (Gibbon et al. 2003); FORM (Martell et al. 2002) and the SaGA annotation (Lücking et al. 2013). The form of gestures and their timing with speech is the object of the coding scheme of Kipp et al. (2007). An interaction-oriented scheme has been proposed by Allwood et al. (2007), which is formulated on the level of turns and dialogue management. A detailed annotation scheme for the form and function of gestures has been developed in terms of "annotation decision trees" within the NEUROGES system (Lausberg & Sloetjes 2009).

Annotated videos of real life interactions give rise to multimodal corpora. Among those that include data on gestures are the following ones.

The multimodal SmartKom Corpus (Schiel et al. 2003), which grew out of the SmartKom project (Wahlster 2006), comprises recording sessions of various Wizard-of-Oz experiments (that is, human-computer interaction where the human participant is made to believe that the system she or he interacts with is autonomous while in fact it is, at least partly, operated by another human). Recordings are extended basically by a transliteration and labelling of natural speech, labelling of gestures and annotation of user states (in the corpus' first release). The first public release, SKP 1.0, contains 90 recording sessions of 45 users. The multimodal SmartKom corpus as well as further SmartKom resources are hosted at the *Bavarian Archive for Speech Signals* (https://www.bas.uni-muenchen.de/Bas/).

The AMI Meeting Corpus (Carletta et al. 2006) consists of 100 hours of meeting recordings. The meetings were recorded in English but include mostly non-native speakers. The AMI Meeting Corpus provides orthographic transcriptions, but also has a couple of further annotations, including dialogue acts, named entities, head gesture, hand gesture, gaze direction, movement and emotional states.

The SaGA ("Speech and Gesture Alignment") corpus consists of 24 German route direction dialogues obtained after a bus ride through a virtual town (Lücking et al. 2010). Audio and video data from the direction-giver were recorded. The SaGA corpus consists of 280 minutes of video material containing 4,961 iconic/deictic gestures, approximately 1,000 discourse gestures and 39,435 word tokens (Lücking et al. 2013). Gesture annotation has been carried out in great detail, following a kinematic, form-based approach (cf. the above-given remark on annotation schemes). Part of the SaGA corpus is available from the *Bavarian Archive for Speech Signals* (https://www.bas.uni-muenchen.de/Bas).

The DUEL ("Disfluency, exclamations and laughter in dialogue") corpus (Hough et al. 2016) comprises 24 hours of natural, face-to-face dialogue in German, French

and Mandarin Chinese. It includes audio, video and body tracking data and is transcribed and annotated for disfluency, laughter and exclamations.

The FIGURE (derived from "Frankfurt Image GestURE") corpus (Lücking et al. 2016) is built on recordings of 50 participants with various mother tongues (though mostly German) spontaneously producing gestures in response to five or six terms from a total of 27 stimulus terms, which have been compiled mainly from image schemata (Lakoff 1987). The gestures have been kinematically annotated by means of a variant of the SaGA annotation scheme. The FIGURE annotation is available from the Text Technology Lab Frankfurt (https://www.texttechnologylab.org/applications/corpora).

4.2 … robots and virtual agents

In the context of Human-Computer Interaction (HCI) or Human-Robot Interaction (HRI), gesture plays an important role (in fact, the formal modelling of deictic and iconic gestures has been initiated in these fields, cf. Section 3.2). One reason for this prominence of gesture in technical areas is that people who interact with a robot evaluate it more positively when the robot displays non-verbal behaviours such as hand and arm gestures along with speech (see e.g. Salem et al. 2012). Within HCI/HRI, two kinds of distinctions have to be made. The first is a distinction between "robot" in the sense of virtual avatars and "robot" in the (probably more common) sense of physical devices (only the latter will be henceforth called a "robot"). The second distinction discerns gesture generation from gesture recognition. Given this simple systematization, altogether four divisions of gesture and virtual avatars/robots arise (references are just exemplary and preferably from earlier HCI/HRI times): (i) gesture generation by robots (e.g. Le et al. 2011); (ii) gesture recognition by robots (e.g. Triesch & von der Malsburg 1998); (iii) gesture generation by virtual avatars (e.g. Cassell et al. 2000); and (iv) gesture recognition in VR/AR (e.g. Weissmann & Salomon 1999). For a more detailed overview see Lücking & Pfeiffer (2012). Enabling humans to act and interact in virtual rooms (e.g. Pfeiffer et al. 2018) can be seen as recent extension of gesture use in HCI/HRI.

In order to plan and design the speech/gesture output of a virtual avatar or a robot, a multimodal representation format is required. To this end, the *Multimodal Utterances Representation Markup Language* for conversational robots (MURML) has been developed (Kranstedt et al. 2002). A similar purpose is served by the *Extensible MultiModal Annotation* (EMMA; Johnston 2009).

4.3 … learning

Following a "gesture as a window to the mind" view, gestures must be a prime object of educational theory and practice, and they are indeed, as demonstrated by research of Cook & Goldin-Meadow (2006) and colleagues. Effectiveness of gestures has been studied in math lessons (Goldin-Meadow et al. 2001), in the acquisition of counting competence (Alibali & DiRusso 1999) and in bilingual education (Breckinridge Church et al. 2004), among other areas. The fairly unanimous result is that gestures can indeed reflect students' conceptualisations and provide insights into cognitive processes involved in learning. Therefore, they can be used as a teaching device as well as an indicator of learning progress and understanding.

4.4 … aphasia

Current models of utterance production are speech-gesture production models, assuming a (more or less) integrated generation of multimodal utterances. Based on such models, one expects an effect on gesture performance when speech production is impaired, as is the case with aphasic speakers. Aphasia is an acquired speech disorder, which can be caused by a stroke, ischaemia, haemorrhage, craniocerebral trauma and further brain-damaging diseases. Different speech-gesture production models make slightly different predictions for speakers suffering from aphasia and can be evaluated accordingly (de Ruiter & de Beer 2013). Indeed, observing the gesture behaviour of aphasic speakers is one aspect of gesture and aphasia (Jakob et al. 2011; Kong et al. 2017; Sekine & Rose 2013). With the exception of the growth point theory, speech-gesture production models are based on Levelt's (1989) model.

The *Growth Point model* (McNeill & Duncan 2000) assumes that the "seed" of an utterance is an inherently multimodal idea unit that comprises imagistic as well as symbolic proto-representations which unfold into gesture and speech respectively in the process of articulation (see also Röpke 2011 on the growth point's entrenchment in contexts and frames).

The *Sketch model* (de Ruiter 2000) reflects explicitly different kinds of gestures (see Section 2). Its name is due to the sketch component, an abstract spatio-temporal representation alongside Levelt's preverbal message. Independently from each other, the sketch is sent to a gesture planner, while the preverbal message is processed by the formulator.

According to the *Lexical Access model* of Krauss et al. (2000), iconic gestures are related to words and are used in order to facilitate speaker-internal word

retrieval rather than communicating pictorial information.

The *Interface model* (Kita & Özyürek 2003) assumes that the processes for speech and gesture generation negotiate with each other and therefore can influence each other during the production phase.

Other aspects include the use of gesture in speech therapy. Very much in line with the lexical access model, gestures have been used in order to facilitate word retrieval in what can be called *multimodal therapy* (Rose 2006). Following a different strategy, gestures are also used in order to enhance the communicative range of patients: they learn to employ gestures instead of words in order to communicate at least some of their needs and thoughts more fluently (Cubelli et al. 1991; Caute et al. 2013).

However, just counting on gestures in therapy does not automatically lead to success (Auer & Bauer 2011). The type and severity of aphasia, the individual traits of the aphasic speaker and the kinds of gestures impaired or still at disposal, among other factors, seem to constitute a complex network for which currently no generally applicable clinical pathway can be given.

5 Outlook

What are (still) challenging issues with respect to grammar-gesture integration, in particular from a semantic point of view? Candidates include:

- gestalt phenomena: the trajectories described by a gesture are often incomplete and have to be completed by drawing on gestalt principles or everyday knowledge (Lücking 2016).
- negligible features: not all formal features of a gesture are meaning-carrying features in the context of utterance. For instance, in a dynamic gesture the handshape often (though not always) does not provide any semantic information (cf. also examples (17) and (21)/(22)). How can we distinguish between significant and negligible gesture features?
- "semantic endurance": due to holds, gestures can show their meaning contributions for some period of time and keeps available for semantic attachment. This may call for a more sophisticated algebraic treatment of speech-gesture integration than offered by typed feature structures (Rieser 2015).

Finally, the empirical domain of "gesture" has to be extended to other non-verbal signals, in particular propositional ones such as laughter (Ginzburg et al.

2015), facial expressions or gaze (see Section 1 for a brief list of non-verbal signals), in isolation as well as in mutual combination. Thus, there is still some way to go in order to achieve a fuller understanding of natural language interaction and thereby natural languages.

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Part V

The broader picture

Chapter 32

HPSG and Minimalism

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This chapter compares work done in Head-Driven Phrase Structure Grammar with work done under the heading *Minimalist Program*. We discuss differences in the respective approaches and the outlook of theories. We have a look at the procedural/constraint-based views on grammar and discuss the differences in complexity of the structures that are assumed. We also address psycholinguistic issues like processing and language acquisition.

1 Introduction

The Minimalist framework, which was first outlined by Chomsky in the early 1990s (Chomsky 1993; 1995b), still seems to be the dominant approach to syntax. It is important, therefore, to consider how HPSG compares with this framework. In a sense both frameworks are descendants of the transformation-generative approach to syntax, which Chomsky introduced in the 1950s. HPSG is a result of the questioning of transformational analyses that emerged in the late 1970s. This led to Lexical Functional Grammar (Bresnan & Kaplan 1982) and Generalized Phrase Structure Grammar (Gazdar et al. 1985), and then in the mid 1980s to HPSG (Pollard & Sag 1987, see Flickinger, Pollard & Wasow (2019), Chapter 2 of this volume for more on the origins of HPSG). Minimalism in contrast remains committed to transformational, i.e. movement, analyses. It is simpler in some respects than the earlier Government and Binding framework (Chomsky 1981), but as we will see below, it involves a variety of complexities.

Robert D. Borsley & Stefan Müller. N.d. HPSG and Minimalism. In Stefan Müller, Anne Abeillé, Robert D. Borsley & Jean-Pierre Koenig (eds.), *Head-Driven Phrase Structure Grammar*. prepublished version. Berlin: Language Science Press. [Preliminary page numbering]

The relation between the two frameworks is clouded by the discourse that surrounds Minimalism. At one time "virtual conceptual necessity" was said to be its guiding principle. A little later, it was said to be concerned with the "perfection of language", with "how closely human language approaches an optimal solution to design conditions that the system must meet to be usable at all" (Chomsky 2002: 58). Much of this discourse seems designed to suggest that Minimalism is quite different from other approaches and should not be assessed in the same way. In the words of Postal (2003: 19), it looks like "an attempt to provide certain views with a sort of privileged status, with the goal of placing them at least rhetorically beyond the demands of serious argument or evidence". However, the two frameworks have enough in common to allow meaningful comparisons.

Both frameworks seek to provide an account of what is and is not possible both in specific languages and in language in general. Moreover, both are concerned not just with local relations such as that between a head and its complement or complements but also with non-local relations such as those in the following:

(1) a. The student knows the answer.
    b. It seems to be raining.
    c. Which student do you think knows the answer?

In (1a), *the student* is subject of *knows* and is responsible for the fact that *knows* is a third person singular form, but *the student* and *knows* are not sisters if *knows* and *the answer* form a VP. In (1b) the subject is *it* because the complement of *be* is *raining* and *raining* requires an expletive subject, but *it* and *raining* are obviously not sisters. Finally, in (1c), *which student* is understood as the subject of *knows* and is responsible for the fact that it is third person singular, but again the two elements are structurally quite far apart. Both frameworks provide analyses for these and other central syntactic phenomena, and it is quite reasonable to compare them and ask which is the more satisfactory.[1]

Although HPSG and Minimalism have enough in common to permit comparisons, there are obviously many differences. Some are more important than others, and some relate to the basic approach and outlook, while others concern the nature of grammatical systems and syntactic structures. In this chapter we will explore the full range of differences.

The chapter is organized as follows: in Section 2, we look at differences of approach between the two frameworks. Then in Section 3, we consider the quite different views of grammar that the two frameworks espouse, and in Section 4,

[1] As noted below, comparison is complicated somewhat by the fact that Minimalists typically provide only sketches of analyses in which various details are left quite vague.

we look at the very different syntactic structures which result. Finally, in Section 5, we consider how the two frameworks relate to psycholinguistic issues, especially processing and language acquisition.

2 Differences of approach and outlook

This section deals with some higher level differences between the two frameworks. We start with sociological differences in Section 2.1. We go on with the degree of formalization and the range of data that is covered (Section 2.2). Section 2.3 discusses the quality of empirical work. Finally, Section 2.4 deals with arguments for invisible entities and innate knowledge.

2.1 Sociological differences

A difference between Mainstream Generative Grammar[2] and HPSG that should not be underestimated is the fact that MGG has one very important key figure, the by far most-cited linguist (and scientist in general) Noam Chomsky. HPSG is different. This is how Carl Pollard put it:

> There is no Chomsky-like figure who is always assumed to be basically on the right track no matter what s/he proposes. HPSG research is normal science: the testing of hypothesies that appear plausible given accepted assumptions. The goal is not to fill in the details of a vague theory which is assumed to be basically right, but to successively replace empirical hypothesis with ones that make better predictions. (Pollard 1997: Section 1.2.1)

While Ivan Sag is perceived as the leading figure by outsiders, the fact that Ivan Sag's recent switch to Sign-Based Construction Grammar (Sag 2012) is not unanimously adopted by the HPSG community (see Müller (2019d), Chapter 36 of this volume and Müller (2018a: Section 10.6.2) for discussion), that empty elements are assumed by various researchers (Bender 2000; Müller 2014; Borsley 2009) even though Ivan Sag argued against them from 1994 (Sag & Fodor 1994) and that defaults are not used by all researchers even though they play a prominent role in Ivan Sag's work (e.g., in Ginzburg & Sag 2000) shows that Pollard's claim is correct. Of course Ivan Sag is the most influential HPSG grammarian but this influence is based on properly argued empirically interesting research.

[2] We follow Culicover & Jackendoff (2005: 3) in using the term *Mainstream Generative Grammar* (MGG) to refer to work in Minimalism and the earlier Government & Binding framework.

2.2 Formalization and exhaustivity

As many of the chapters in this volume emphasize, HPSG is a framework which places considerable emphasis on detailed formal analyses of the kind that one might expect within Generative Grammar.[3] Thus, it is not uncommon to find lengthy appendices setting out formal analyses. See, for example, Sag's (1997) paper on English relative clauses, Van Eynde's (2015) book on predicative constructions and especially Ginzburg & Sag (2000), which has a 50 page appendix. One consequence of this is that HPSG has had considerable influence in computational linguistics. Sometimes theoretical work comes paired with computer implementations, which show that the analyses are consistent and complete (e.g., all publications coming out of the CoreGram project (Müller 2015b) and the HPSG textbook for German that comes with implementations corresponding to the individual chapters of the book (Müller 2007b)). For more on the relation of HPSG and computational linguistics see Bender & Emerson (2019), Chapter 28 of this volume.

In Minimalism things are very different. Detailed formal analyses are virtually non-existent. There appear to be no appendices like those in Sag (1997) and Ginzburg & Sag (2000). In fact the importance of formalization has long been downplayed in Chomskyan work (e.g., by Chomsky in an interview with Huybregts & Riemsdijk (1982: 73) and in discussions between Pullum (1989) and Chomsky (1990: 146)), and this view seems fairly standard within Minimalism (see also the discussion in Müller (2016a: Section 3.6.2)). Chomsky & Lasnik (1995: 28) attempt to justify the absence of detailed analyses when they suggest that providing a rule system from which some set of phenomena can be derived is not "a real result" since "it is often possible to devise one that will more or less work". Instead, they say, "the task is now to show how the phenomena [...] can be deduced from the invariant principles of UG with parameters set in one of the permissible ways". Postal (2004: 5) comments that what we see here is the "notion that descriptive success is not really that hard and so not of much importance". He points out that if this were true, one would expect successful descriptions to be abundant

[3]We follow Ginzburg & Sag (2000: 2) in counting HPSG among Generative Grammar in the sense it was defined by Chomsky (1965: 4), namely as a framework that provides an explicit characterization of the theories developed within it. When we refer to work in Government & Binding or Minimalism, we follow Culicover & Jackendoff (2005: 3) in using the term *Mainstream Generative Grammar*. It should be kept in mind that there is another meaning associated with the term *generative*. A generative grammar in the latter sense generates a set (Chomsky 1957: 13. HPSG is not generative in this sense but rather model-theoretic. See Pullum & Scholz (2001) for differences between generative-enumerative and model theoretic approaches. See also Richter (2019), Chapter 3 of this volume and Wasow (2019), Chapter 27 of this volume.

within transformational frameworks. He argues that actual transformational descriptions are quite poor, and justifies this assessment with detailed discussions of Chomskyan work on strong crossover phenomena and passives in Chapters 7 and 8 of his book.

There has also been a strong tendency within Minimalism to focus on just a subset of the facts in whatever domain is being investigated. As Culicover & Jackendoff (2005: 535) note, "much of the fine detail of traditional constructions has ceased to garner attention". This tendency has sometimes been buttressed by a distinction between core grammar, which is supposedly a fairly straightforward reflection of the language faculty, and a periphery of marked constructions, which are of no great importance and which can reasonably be ignored. However, as Culicover (1999) and others have argued, there is no evidence for a clear cut distinction between core and periphery. It follows that a satisfactory approach to grammar needs to account both for such core phenomena as *wh*-interrogatives, relative clauses, and passives but also with more peripheral phenomena such as the following:

(2) a. It's amazing the people you see here.
b. The more I read, the more I understand.
c. Chris lied his way into the meeting.

These exemplify the nominal extraposition construction (Michaelis & Lambrecht 1996), the comparative correlative construction (Culicover & Jackendoff 1999; Borsley 2011), and the *X's Way* construction (Salkoff 1988; Sag 2012). As has been emphasized in other chapters, the HPSG system of types and constraints is able to accommodate broad linguistic generalizations and highly idiosyncratic facts and everything in between.

The general absence in Minimalism of detailed formal analyses is quite important. It means that Minimalists may not be fully aware of the complexity of the structures they are committed to and this allows them to sidestep the question whether it is really justified. It also allows them to avoid the question of whether the very simple conception of grammar that they favour is really satisfactory. Finally, it may be that they are unaware of how many phenomena remain unaccounted for. These are all important matters.

The general absence of detailed formal analyses has also led to Minimalism having little impact on computational linguistics. There has been some work that has sought to implement Minimalist ideas (Stabler 2001; Fong & Ginsburg 2012; Fong 2014), but Minimalism has not had anything like the productive relation with computational work that HPSG has enjoyed. Existing Minimalist imple-

mentations are rather toy grammars analyzing very simple sentences, some are not faithful to the theories they are claimed to be implementing,[4] and some do not even parse natural language but require pre-segmented, pre-formatted input. For example, Stabler's test sentences have the form as in (3).

(3) a. the king will -s eat
b. the king have -s eat -en
c. the king be -s eat -ing
d. the king -s will -s have been eat -ing the pie

See Müller (2019c: Section 4.7.2) for discussion.

As far as large-scale coverage is concerned, the more recent work by Torr, Stanojevic, Steedman & Cohen (2019) is an exception to what was said above. They state that their parser is the first one to take up the Sproat & Lappin Challenge to the Minimalist community (2005). The work of the authors is impressive and they really implemented a wide-coverage statistically trained parser based on Transformational Grammar but what they did is different from standard Minimalism since they assume "around 45" versions of Move and Merge (p. 2488) in comparison to the two versions usually assumed in Minimalism (Move and Merge or Internal and External Merge).[5] Torr & Stabler (2016) explain some of the schemata that are assumed: there are versions of Merge that combine a head with a complement and versions that combine a head with a specifier (see Müller (2013) for a comparison of Minimalist Grammars with HPSG. Müller notes that the respective schemata correspond to the Specifier-Head Schema and the Head-Complement Schema, respectively). Torr & Stabler (2016: 4) assume four schemata for adjunction (HPSG has one such schema and use underspecification with respect to order, see Müller (2019a), Chapter 10 of this volume). They assume a special rule for rightward movement (p. 5) corresponding to **Keller95a**'s (**Keller95a**) and Müller's (1999b) Head-Extra Schema for extraposition. In addition the authors assume two schemata for head movement. HPSG assumes a

[4]Fong's grammars are simple Definite Clause Grammars, that is, context-free phrase structure grammars, and hence nowhere near an implementation of Minimalism, contrary to claims by Berwick, Pietroski, Yankama & Chomsky (2011: 1221). Lin's parsers PrinciPar and MiniPar (1993; 2003) are based on GB and Miniamlism but according to Lin (1993: 116) and Torr et al. (2019: 2487), they are not transformational but use a SLASH passing mechanism like the one developed in GPSG (Gazdar 1981) and standardly used in HPSG (see Borsley & Crysmann 2019, Chapter 14 of this volume).

[5]Torr explained in p.c. 2019 that these 45 rules can be folded into two Merge functions and two Move functions. But in the end this is just a clever way of hiding complexity. It is like Chomsky **ref** revising the theory with Move and Merge into one with just one operation Merge but assuming two subcases of Internal and External Merge.

lexical rule or a unary branching schema applying to words or coordinations of words (Müller 2017 and Müller (2019a), Chapter 10 of this volume). Across the Board extraction is taken care of by four special schemata. See Abeillé & Chaves (2019), Chapter 17 of this volume for the treatment of coordination in HPSG. The treatment of Across the Board Extraction (Ross 1967b) is non-standard Minimalism. For the analysis of examples like (4) in which one filler corresponds to two gaps in two conjuncts, the authors build on Kobele (2008) who uses a SLASH passing mechanism going back to Sag (1983) and Gazdar (1981). While Koeble assumes the SLASH passing mechanism of GPSG, Torr & Stabler (2016) suggest an analyis of (4) with two instances of *who* in object positions, which are later unified into one when the second conjunct is merged into the main structure.

(4) Who$_i$ did Jack say Mary likes $\__i$ and Pete hates $_i$?

An interesting property of the analysis is that *who Pete hates* forms a discontinuous constituent: *who* is combined with *hates* despite its sentence-initial position. Information about this *wh* element is passed up the tree in an GPSG-style way. The difference is that there is no trace but the extracted element is identical in phonological material with the filler. Interestingly, there is an HPSG variant of nonlocal dependencies that is very similar to what Torr & Stabler (2016) suggest and together with a modified Filler Head Schema the analyses are parallel: Hinrichs & Nakazawa (1994b) suggested that the linguistic objects that are involved in nonlocal dependencies are of type *sign* rather than *local*. This makes it possible to pass up information about a daughter including its phonological make up. If one assumes a version of HPSG permitting discontinuous constituents (Reape 1994; Müller 2019a, Chapter 10 of this volume) and a Filler Head Schema that requires that the phonology of the filler is identical to the phonology in the SLASH list and that does not insert the fronted element into the constituent order domain of the head (since it is in there already), we get an analysis of the type described in Torr & Stabler (2016). Figure 1 shows the analysis that was suggested by Torr & Stabler (2016) and Figure 2 the HPSG analog. Directional Minimalist Grammars use the '=' sign to indicate the direction in which an argument is required. =d means that a DP is required to the left of a head and d= encode the requirement of a DP to the right. This is like the '/' notation of Categorial Grammar (see Steedman 2000 and Kubota 2019, Chapter 33 of this volume). *likes* has the category d= =d v, which means that it is a verb requiring a d to its right (the object) and a d to its left (the subject). *who* is of category d and has a −wh feature, something that has to be checked for a derivation to be complete. *Jack* is the subject of *likes* and fulfills the =d requirement of *likes*. Items like [pres] and [int] are empty elements. [pres] has a +case feature and can make *Jack* move to its

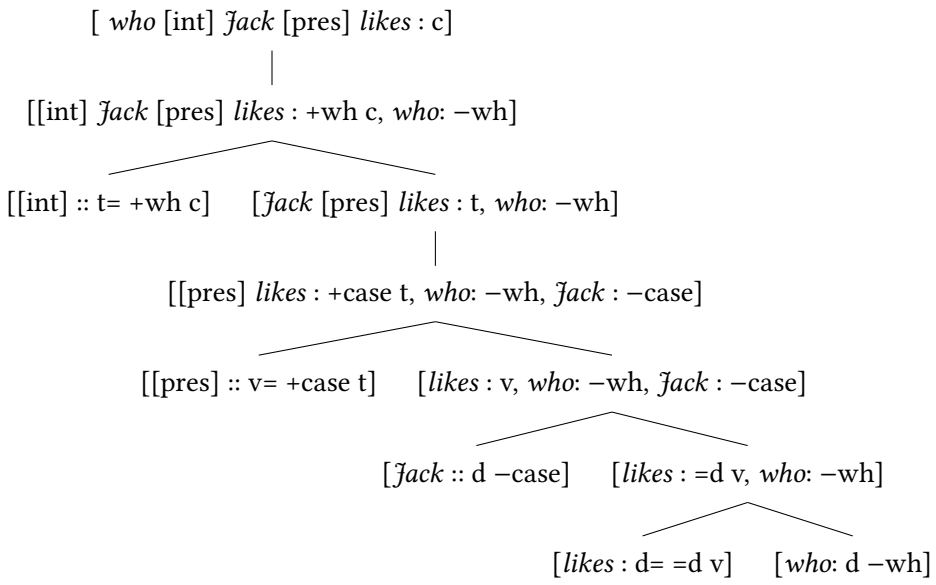


Figure 1: Derivation tree of *who Jack likes* in Directional Minimalist Grammar according to Torr & Stabler (2016)

specifier. The movement consumes the −case feature and puts *Jack* to the front of the string. This looks like a unary projection in the derivation tree. The empty interrogative head [int] selects for a t to its right. The result is a C projection that has a +wh feature. In the final step *who*, which is −wh moves to the left and the wh feature are removed. The important thing is that the information about the phonology of *who* and its wh feature is percolated up in the tree until it is finally bound off in the last derivation step.

Figure 2 shows the HPSG analog. The information about the local properties of the *wh* word including its phonology are passed up in the tree until they are bound off in a filler head configuration. The Filler-Head Schema binds off the nonlocal dependency and makes sure that the phonology of the filler is not realized twice (see Reape 1994, Müller 2019a: Section 6, Chapter 10 of this volume on linearization domains and Abeillé & Chaves 2019: Section 7, Chapter 17 of this volume on multi-dominance approaches in HPSG). An alternative to a binary branching Filler-Head Schema would be a unary branching rule that binds off the element in SLASH and adds the stored phonology to the phonology of the daughter. This would then be completely parallel to the unary branching assumed in Torr's Directional Minimalist Grammar.

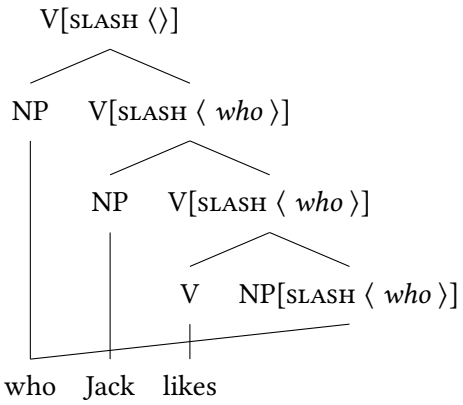


Figure 2: Possible HPSG analysis of *who Jack likes* using discontinuous constituents

Summing up: The fact that certain variants of Minimalism share properties with Categorial Grammar has been noticed early on (Berwick & Epstein 1995). Directional Minimalist Grammars were compared to CG and HPSG by Müller (2013). MGs were extended to include GPSG-style SLASH passing mechanisms by Kobele (2008) and continue to use them in the versions of Torr & Stabler (2016). We believe that this work is fruitful and well-formalized but formalization is insufficient for most of the work in Minimalism and idea from other frameworks are ignored more often than not.

2.3 Empirical quality

There are, then, issues about the quantity of data that is considered in Minimalist work. There are also issues about its quality (Schütze 2016). Research in HPSG is typically quite careful about data and often makes use of corpus and experimental data (see for example An & Abeillé 2017; Müller 1999b; 2002; Bildhauer & Cook 2010; Müller, Bildhauer & Cook 2012; Van Eynde 2015: Chapter 7; Abeillé et al. 2016; Shiraishi & Abeillé 2016 for examples of work with attested examples and for experimental work). This use of corpus data and attested examples is based on the insight that introspection alone is not sufficient, given that an enormous amount of time is spent to work out analyses and it would be unfortunate if these analyses were built on a shaky empirical basis. See Müller (2007a) and Meurers & Müller (2009) for the discussion of introspection vs. corpus data. Research in

Minimalism is often rather less careful.[6] In a review of a collection of Minimalist papers, Bender (2002: 434) comments that: "In these papers, the data appears to be collected in an off-hand, unsystematic way, with unconfirmed questionable judgments often used at crucial points in the argumentation". She goes on to suggest that the framework encourages "lack of concern for the data, above and beyond what is unfortunately already the norm in formal syntax, because the connection between analysis and data is allowed to be remote.". Similar things could be said about a variety of Minimalist work. Consider, for example, Aoun & Li (2003), who argue for quite different analyses of *that*-relatives and *wh*-relatives on the basis of the following (supposed) contrasts, which appear to represent nothing more than their own judgements (p. 110–112):

(5) a. The headway that Mel made was impressive.
b. ?? The headway which Mel made was impressive.

(6) a. We admired the picture of himself that John painted in art class.
b. * We admired the picture of himself which John painted in art class.

(7) a. The picture of himself that John painted in art class is impressive.
b. *? The picture of himself which John painted in art class is impressive.

None of the native speakers we have consulted find significant contrasts here which could support different analyses. The example in (8a) with a *which* relative clause referring to *headway* can be found in Cole et al. (1982). Williams (1989: 437) and Falk (2010: 221) have examples with a reflexive coreferential with a noun in a relative clause introduced by *which* as in William's (8b) and corpus examples like (8c,d) can be found as well:

(8) a. The headway which we made was satisfactory.
b. the picture of himself which John took
c. The words had the effect of lending an additional clarity and firmness of outline to the picture of himself which Bill had already drawn in his mind–of a soulless creature sunk in hoggish slumber.[7]

[6] We hasten to say that we do not claim this to be true for all Minimalist work. There are researchers working with corpora or at least with attested examples (Wurmbrand 2003) and there is experimental work. Especially in Germany there were several large scale Collaborative Research Centers with a strong empirical focus which also fed back into theoretical work, including Minimalist work. The fact that we point out here is that there is work, including work by prominent Minimalists, that is rather sloppy as far as data is concerned.

[7] Wodehouse, P.G. 1917. *Uneasy Money*, London: Methuen & Co., p. 186, http://www.literaturepage.com/read.php?titleid=uneasymoney&abspage=186, 2018-09-18.

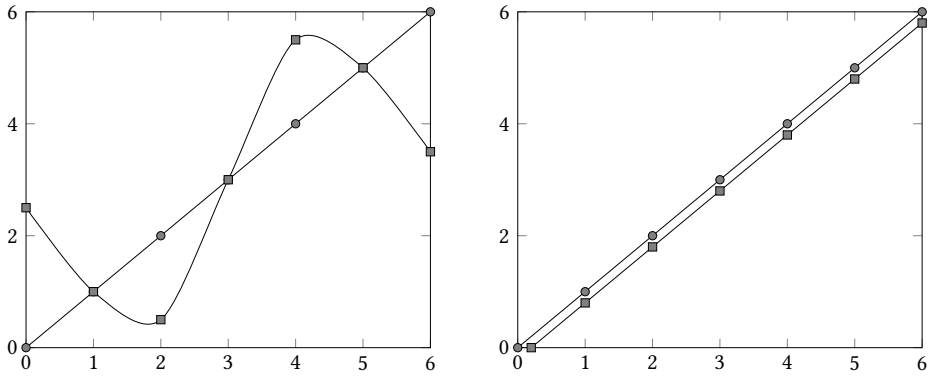
d. She refused to allow the picture of himself, which he had sent her, to be hung, and it was reported that she ordered all her portraits and busts of him to be put in the lumber attics.[8]

Given that it is relatively easy to come up with counterexamples it is surprising that authors do not do a quick check before working out rather complex analyses.

Note that we are not just taking one bad example of Minimalist work. It is probably the case that papers with dubious judgments can be found in any framework if only this is due to the repetitions of unwarranted claims made by others. The point is that Aoun & Li are influential (quoted by 455 other publications as of 2018-09-14). Others rely on these judgments or the analyses that were motivated by them. New conclusions are derived from analyses since theories make predictions. If this process continues for a while an elaborate theoretical edifice results that is not empirically supported. Note furthermore that the criticism raised here is not the sqabble of two authors working in an alternative framework. This criticism also comes from practitioners of Mainstream Generative Grammar. For example, Wolfgang Sternefeld and Hubert Haider, both very prominent figures in the German Generative Grammar school criticized the scientific standards in Minimalism heavily (Sternefeld & Richter 2012; Haider 2018). As Sternefeld & Richter (2012: 266–268) point out it is not just the case that Minimalist publications are based on empirically problematic foundations, it is even worse: researchers like Epstein & Seely (2006: Section 1.1) publish statements about research methodology that can only be understood as an immunization strategy. The authors discuss the two curves in Figure 3: one has a sine-like shape and hits three out of seven of the data points on a straight line and the other one is parallel to the line with the data points and hence hits none of the data points. The second approach gets none of the data right. Nevertheless the authors argue that one should prefer this theory since it was closer to the truth and more illuminating: "Clearly, Theory 1 is 'empirically preferable' by a 'winning score' of 3–0. The point […] is that Theory 2, despite getting none of the data correct, […] is 'closer to the truth' or 'more illuminating' than the empirically preferable Theory 1. Hence, we believe, Theory 2 is a better working or guiding hypothesis upon which to base future research." (Epstein & Seely 2006: 2)

As we will show in Section 3.4, Minimalist discussions of the important topic of labelling have also been marred by a failure to take account of relevant data.

[8] Jerrold, Clare. 1913. *The married life of Queen Victoria*, London: G. Bells & Sons, Ltd. https://archive.org/stream/marriedlifeofque00jerruoft/marriedlifeofque00jerruoft_djvu.txt, 2018-09-19.



(a) Theory 1 (b) Theory 2

Figure 3: Immunization in Minimalist work: According to Epstein & Seely (2006: Section 1.1) Theory 2, which gets none of the data points, is preferable to Theory 1 with three data points since Theory 2 is "more illuminating" and "closer to to the truth"

2.4 Argumentation for invisible entities and the assumption of innate linguistic knowledge

There are also differences in the kind of arguments that the two frameworks find acceptable. It is common within Minimalism to assume that some phenomenon which cannot be readily observed in some languages must be part of their grammatical system because it is clearly present in other languages. Notable examples would be case (Li 2008) or (object) agreement (Meinunger 2000: Chapter 4), which are assumed to play a role even though there are no visible manifestations within some languages (e.g., Mandarin Chinese and German, respectively). This stems from the longstanding Chomskyan assumption that language is the realization of a complex innate language faculty. From this perspective, there is much in any grammatical system that is a reflection of the language faculty and not in any simple way of the observable phenomena of the language in question. If some phenomenon plays an important role in many languages it is viewed as a reflection of the language faculty, and hence it must be a feature of all grammatical systems even those in which it is hard to see any evidence for it. An example – taken from a textbook on Minimalism (Hornstein, Nunes & Grohmann 2005: 124) – is an analysis of prepositional phrases in English. Figure 4 shows the analysis.[9]

[9]This analysis is actually a much simpler variant of the PP analysis which appeared in an earlier textbook by Radford (1997: 452). For discussion of this analysis see Sternefeld (2006: 549–550) and Müller (2016a: Section 4.6.1.2).

Due to theory internal assumptions the case requirement of the preposition can-

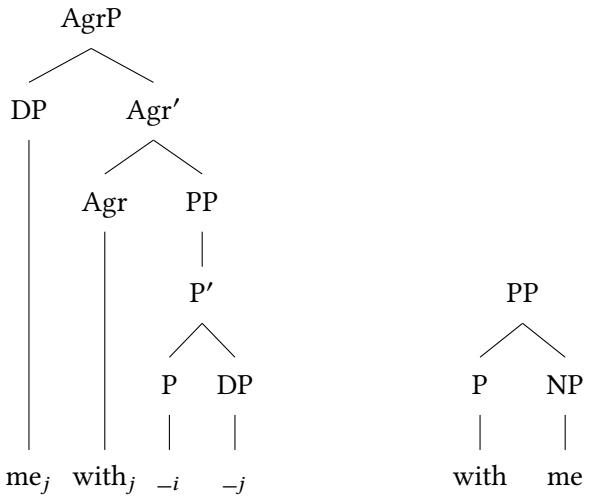


Figure 4: Minimalist analysis of a PP according to (Hornstein, Nunes & Grohmann 2005: 124) and the analysis assumed in HPSG and all other phrase structure-based frameworks

not be checked in the P-DP combination. According to the version of the theory adopted by the authors, case has to be checked in specifier positions. Therefore it was assumed that the preposition moves to an Agr head and the DP moves to the specifier position of this Agr head. The problem is of course that DP and P are in the wrong order now. However, the authors argue that this is the order that is manifested in Hungarian and that Hungarian is a language which has postpositions and these are agreeing with their nominal dependent. The authors assume that Hungarian postpositions are prepositions underlyingly and that the DP following the preposition moves to the left because of a movement process that is triggered by agreement. It is claimed that this movement exists both in Hungarian and in English but that the movement is covert (that is, invisible) in the latter language.

This line of argument would be reasonable if a complex innate language faculty were an established fact, but it isn't, and since Hauser, Chomsky & Fitch (2002), it seems to have been rejected within Minimalism. It follows that ideas about an innate language faculty should not be used to guide research on individual languages. Rather, as Müller (2015b: 25) puts it, "grammars should be motivated on a language-specific basis". Does this mean that other languages are irrelevant when investigating a specific language? Clearly not. As Müller also

puts it, "In situations where more than one analysis would be compatible with a given dataset for language X, the evidence from language Y with similar constructs is most welcome and can be used as evidence in favor of one of the two analyses for language X." (2015b: 43). In practice, any linguist working on a new language will use apparently similar phenomena in other languages as a starting point. It is important, however, to recognize that apparently similar phenomena may turn out on careful investigation to be significantly different.[10]

3 Different views of grammar

We turn now to more substantive differences between HPSG and Minimalism, differences in their conceptions of grammar, especially syntax, and differences in their views of syntactic structure. As we will see, these differences are related. In this section we consider the former, and in the next we will look at the latter.

3.1 Declarative and constraint-based vs. derivational and generative-enumerative approaches

As is emphasized throughout this volume, HPSG assumes a declarative or constraint-based view of grammar. It also assumes that the grammar involves a complex systems of types and constraints. Finally, it assumes that syntactic analyses are complemented by separate semantic and morphological analyses. In each of these areas, Minimalism is different. It assumes a procedural view of grammar. It assumes that grammar involves just a few general operations. Finally, it assumes that semantics and morphology are simple reflections of syntax. We comment on each of these matters in the following subsections.

Whereas HPSG is a declarative or constraint-based approach, Minimalism seems to be firmly committed to a procedural approach. Chomsky (1995b: 219) remarks that: "We take L [a particular language] to be a generative procedure that constructs pairs (π, λ) that are interpreted at the articulatory-perceptual (A-P) and conceptual-intentional (C-I) interfaces, respectively, as 'instructions' to the performance systems.". Various arguments have been presented within HPSG for a declarative view, but no argument seems to be offered within Minimalism for a procedural view. Obviously, speakers and hearers do construct representations and must have procedures that enable them to do so, but this is a matter of

[10] Equally, of course, apparently rather different phenomena may turn out on careful investigation to be quite similar. For further discussion of HPSG and comparative syntax, see Borsley (2018).

performance, and there is no reason to think that the knowledge that is used in performance has a procedural character (see Section 5.1 on processing). Rather, the fact that it is used in both production and comprehension suggests that it should be neutral between the two and hence declarative. See also Wasow (2019: Section 3.1), Chapter 27 of this volume on this point.

Another difference between constraint-based and generative-enumerative approaches is that the first type of proposal provides a way to get graded acceptability into the picture (Pullum & Scholz 2001: Section 3.1). Since HPSG grammars are basically feature-value pairs with equality (or other relations) between values, it is possible to weigh constraints and it is possible to admit constraint violations and work with structures with violated constraints (see for example Sorace & Keller 2005 on cumulative constraint violation). So looking at the sentences in (9) we see that more and more constraints are violated:

(9) a. I am the chair of my department.
b. * I are the chair of my department.
c. * Me are the chair of my department.
d. * Me are the chair of me's department.
e. * Me are chair the of me's department.
f. * Me are chair the me's department of.

In comparison to this a generative-enumerative grammar enumerates a set and a sequence either is in the set or it is not.[11]

For further discussion of the issues, see Section 5.1 of this paper and e. g. Pullum & Scholz (2001), Postal (2003), Sag & Wasow (2011; 2015), and Wasow (2019), Chapter 27 of this volume.

3.2 Underspecification

Another crucial difference between HPSG and Minimalism is that HPSG allows for the underspecification of information. In the absence of constraints, all principle options are possible. This is different in Minimalism. All structures that are derivable are predetermined by the numeration. Features have to be specified and they determine movement and properties of the derived objects. The general characterization of the frameworks is:

(10) a. Minimalism: Only what is explicitly ruled in works.

[11] For a discussion of Chomsky's (1964; 1975: Chapter 5) proposals to deal with different degrees of acceptability see Pullum & Scholz (2001: 29).

b. HPSG: Everything that is not ruled out works.

Let us consider some examples. The availability of type hierarchies makes it possible to underspecify part-of-speech information. For example, Sag (1997) assumes that complementizer (*comp*) and verb (*verb*) have a common supertype *verbal*. A head can then select for a complement with the category *verbal*. So rather than specifying two lexical items with different valence information or one with a disjunctive specification *verb* ∨ *comp*, one has just one lexical item selecting for *verbal*. Similarly, schemata (grammar rules) can contain underspecified types. A daughter in a dominance schema can have a value of a certain types that subsumes a number of other types. Let's say three. Without this underspecification one would need three schemata: one for every subtype of the more general type.

Quantifier scope can be underspecified as well (Copestake, Flickinger, Pollard & Sag 2005; Richter & Sailer 1999; Koenig & Richter 2019, Chapter 23 of this volume): constraints regarding which quantifier outscopes which other quantifier may be left unspecified. The absence of the respective constraints results in a situation where several scopings are possible. In transformational models it is usually assumed that quantifier elements move into certain positions covertly and scope relations are read off of the resulting tree (May 1985; Frey 1993; Sauerland & Elbourne 2002). This is unnecessary in HPSG.[12]

3.3 Types and constraints vs. general operations

The declarative-procedural contrast is an important one, but the contrast between the complex systems of types and constraints that are assumed within HPSG and the few general operations that form a Minimalist grammar is arguably more important.[13] Much work in Minimalism has three main operations Merge, Agree, and Move or Internal Merge. Merge combines two expressions, either words or phrases, to form a larger expression with the same label as one of the expressions (Chomsky 1995b: 244; 2008: 140). Its operation can be presented

[12] Apart from the possibility of a more compact specification of scope relations, HPSG analyses are actually superior on an empirical level. As Kiss (2005) and independently also Fanselow (2001) (working in a Minimalist setting) have shown, movement-based approaches cannot account for cases in which two quantified noun phrases are moved simultaneously while maintaining their relative order. Reconstruction predicts too many readings. Sauerland & Elbourne (2002) provided a solution to the problem but the analysis has an absurd complexity involving several movements, some of them invisible. For more discussion of scrambling and scope and the approaches mentioned here see Müller (2019c: 114–116).

[13] A procedural approach doesn't necessarily involve a very simple grammatical system. The Standard Theory of Transformational Grammar (Chomsky 1965) is procedural but has many different rules, both phrase structure rules and transformations.

as shown in Figure 5. In the case of English, the first alternative is represented by

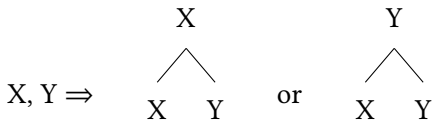


Figure 5: Merge

situations where a lexical head combines with a complement while the second is represented by situations where a specifier combines with a phrasal head. Chomsky (2008: 146) calls items merged with the first variant of Merge *first-merged* and those merged with the second variant *later-merged*.

Agree, as one might suppose, offers an approach to various kinds of agreement phenomena. It involves a probe, which is a feature or features of some kind on head, and a goal, which the head c-commands.[14] At least normally, the probe is a linguistic object with an uninterpretable feature or features with no value and the goal has a matching interpretable feature or features with appropriate values (Chomsky 2001: 3–5).[15] Agree values the uninterpretable feature or features and they are ultimately deleted, commonly after they have triggered some morphological effect. Agree can be represented as in Figure 6 (where the "u" prefix identifies a feature as uninterpretable, and we have just one uninterpretable feature on the probe and just one matching interpretable feature on the goal). Unsurprisingly subject-verb agreement is one manifestation of Agree, where X

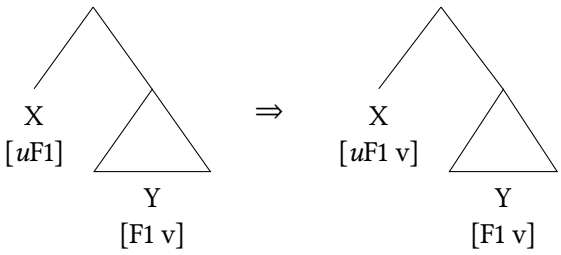


Figure 6: Agree

[14] It is not necessary to state the c-command restriction since it is assumed that linguistic objects are built bottom-up and when a head is combined with its dependent the head can "see" the dependent but not the context in which the resulting object is embedded. Information about dominating material will be available only later in the derivation. (Guido Mensching, p. c. 2018)

[15] Chomsky also assumes that the goal also has an uninterpretable feature of some kind to render it 'active'. In the case of subject-verb agreement, this is a Case feature on the subject.

is T(ense) and Y is a nominal phase, for Minimalism a DP, inside the complement of T. T presumably has two uninterpretable features, person and number, and the DP two matching interpretable features. Here, and elsewhere, Agree is a non-local relation involving elements which are not sisters. This contrasts with the situation in HPSG, in which subject-verb agreement is a consequence of a relation between the subject and its VP sister and a relation between the VP and the V that heads it.

Finally, Move, also called Internal Merge, is an operation which makes a copy of a constituent of some expression and merges it with the expression (Chomsky 1995b: Section 4.4; 2008: 140). The original element that is copied normally undergoes deletion. The process can be presented as in Figure 7.

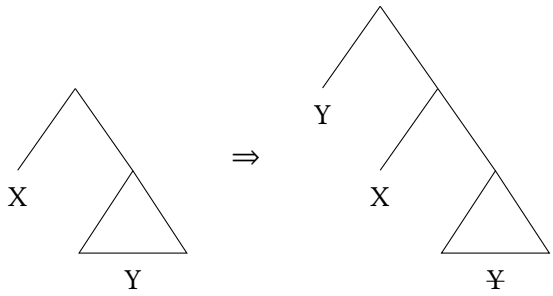


Figure 7: Move

This covers both the A′-movement process assumed for unbounded dependency constructions such as *wh*-interrogatives and the A-movement process assumed for raising sentences and passives. A question arises about so-called head-movement, where a head moves to a higher head position. This appears to mean that it must be possible for the copy to be merged with the head of the expression that contains it. However, this is incompatible with the widely assumed extension condition, which requires Merge to produce a larger structure. One response is the idea espoused in Chomsky (1995a: 368; 2001: 37) that head-movement takes place not in the syntax but in the PF component, which maps syntactic representations to phonetic representations. It seems that its status is currently rather unclear.

The three operations just outlined interact with lexical items to provide syntactic analyses. It follows that the properties of constructions must largely derive from the lexical items that they contain. Hence, the properties of lexical items are absolutely central to Minimalism. Oddly, the obvious implication – that the lexicon should be a major focus of research – seems to be ignored. As Newmeyer

(2005: 95, fn. 9) comments:

> […] in no framework ever proposed by Chomsky has the lexicon been as important as it is in the MP [Minimalist Program]. Yet in no framework proposed by Chomsky have the properties of the lexicon been as poorly investigated. (Newmeyer 2005: 95, fn. 9)

Sometimes it is difficult to derive the properties of constructions from the properties of visible lexical elements. But there is a simple solution: postulate an invisible element. The result is a large set of invisible functional heads. As we will see in Section 4.1.6, these heads do the work in Minimalism that is done by phrase types and the constraints on them in HPSG.

Although Minimalism is a procedural approach and HPSG a declarative approach, there are some similarities between Minimalism and early HPSG, the approach presented in Pollard & Sag (1987; 1994). In much the same way as Minimalism has just a few general mechanisms, early HPSG had just a few general phrase types. Research in HPSG in the 1990s led to the conclusion that this is too simple and that a more complex system of phrase types is needed to accommodate the full complexity of natural language syntax. Nothing like this happened within Minimalism, almost certainly because there was little attempt within this approach to deal with the full complexity of natural language syntax. As noted above, the approach has rarely been applied in detailed formal analyses. It looks too simple and it appears problematic in various ways. It is also a major source of the complexity that is characteristic of Minimalist syntactic structures, as we will see in Section 4.

3.4 Labelling

As we noted in the last section, Merge combines two expressions to form a larger expression with the same label as one of the expressions. But which of the original expressions provides the label for the larger expression? This issue has been discussed but not very satisfactorily. Chomsky defines which label is used in two different cases: the first case states that the label is the label of the head if the head is a lexical item and the second case states the label to be the label of the category from which something is extracted (Chomsky 2008: 145). As Chomsky notes, these rules are not unproblematic since the label is not uniquely determined in all cases. An example is the combination of two lexical elements since in such cases both elements can be the label of the resulting structure. Chomsky notices that this could result in deviant structures, but claims that this concern is unproblematic and ignores it. This means that rather fundamental notions in

a grammar theory were ill-defined. A solution to this problem was provided in his 2013 paper (published five years later). However, this paper is inconsistent (Müller 2016a: Section 4.6.2) and even insiders find it incomprehensible. But this is not the point we want to focus on here. Rather we want to show one more time that empirical standards are not met. Chomsky uses underdetermination in his labeling rules to account for two possible structures in (11), an approach going back to Donati (2006):

(11) what [C [you wrote *t*]]

(11) can be an interrogative clause as in *I wonder what you wrote.* or a free relative clause as in *I will read what you wrote.*. According to the labeling rule that accounts for sentences from which an item is extracted, the label will be CP since the label is taken from the clause. However, since *what* is a lexical item, *what* can determine the label as well. If this labeling rule is applied *what you wrote* is assigned DP as a label and hence the clause can function as a DP argument of *read*.

Chomsky's proposal is interesting but it does not extend to cases involving free relative clauses with complex *wh*-phrases (so-called pied-piping) as they are attested in examples like (12):

(12) I'll read [whichever book] you give me.

The example in (12) is from one of the standard references on free relative clauses: Bresnan & Grimshaw (1978: 333), which is also cited in other mainstream generative work as for example (Groos & van Riemsdijk 1981).

Apart from the fact that complex *wh*-phrases are possible there is even more challenging data in the area of free relative clauses: the examples in (13) and (14) show that there are non-matching free relative clauses:

(13) Sie kocht, worauf sie Appetit hat.[16] (German)
she cooks where.on she appetite has
'She cooks what she feels like eating.'

(14) a. Worauf man sich mit einer Pro-form beziehen kann, […] ist
where.upon one self with a Pro-form refer can is

[16] Bausewein (1990: 154).

eine Konstituente.[17]
a constituent
'If you can refer to something with a Pro-form, [...] it is a constituent.'

b. [Aus wem] noch etwas herausgequetscht werden kann, ist
out who yet something out.squeezed be can is
sozial dazu verpflichtet, es abzuliefern; ...[18]
socially there.to obliged it to.deliver
'Those who have not yet been bled dry are socially compelled to hand over their last drop.'

In (13) a relative clause with a PP relative phrase functions as an accusative object. In (14) the relative clauses function as subjects. (14b) is another example of a relative clause with a complex *wh* phrase. See Bausewein (1990) and Müller (1999a) for further discussion of free relative clauses and attested data.

According to Donati (2006: Section 5), pied piping does not exist in free relatives (see also Citko (2008: 930–932) for a rejection of this claim). Given how much attention the issue of Labeling has received and how central this is to Minimalist analyses this situation is quite surprising: an empirically false claim made in 2002/2003[19] is the basis for foundational work from 2002 until 2013 even though the facts are common knowledge in the field. Ott (2011) develops an analysis in which the category of the relative phrase is projected, but he does not have a solution for nonmatching free relative clauses, as he admits in a footnote on page 187. The same is true for Citko's analysis (2008), in which the extracted XP can provide the label. So, even though the data has been known for decades, it is ignored by authors and reviewers and foundational work is built on shaky empirical ground. See Müller (2016a: Section 4.6.2) for a more detailed discussion of labeling.

3.5 Feature deletion and "crashing at the interfaces"

In Section 3.3, we mentioned Case as an uninterpretable feature which renders a DP active. Like other uninterpretable features this is deleted as a result of Agree because it is not interpretable in LF. This means that Minimalism claims that a

[17] From the main text of: Günther Grewendorf, *Aspekte der deutschen Syntax. Eine Rektions-Bindungs-Analyse.* Studien zur deutschen Grammatik, number 33. Tübingen: Gunter Narr Verlag. 1988, p. 16, quoted from Müller (1999a: 61).

[18] Wiglaf Droste, taz, 01.08.97, p. 16, quoted from Müller (1999a: 61).

[19] Versions of Donati's paper were presented at *Going Romance* in 2002 and the most important Mainstream Generative Grammar conference in Europe GLOW in 2003.

case marked NP like *der Mann* 'the man' is not interpretable unless it is somehow stripped of its case information. So in Minimalism *der Mann* needs something on top of the DP that Agrees with and thereby consumes the case feature. While this seems cumbersome to most working outside Minimalism, there are actually deeper problems connected to the deletion of case features. There are situations in which you need case features more than once. An example of this is free relative clauses as the one in (15b):

(15) a. der Mann
the.NOM man

b. Ich treffe, wen ich treffen will.
I meet who.ACC I meet want.to
'I meet whoever I like to meet.'

wen is the accusative object in the relative clause. Since it is an object its case feature will be checked by the selecting verb *treffen* 'meet'. *wen* will then be a DP without any case information. However, the case of the relative phrase in free relative clauses is not arbitrary. It is important for the integration of the free relative clause in the matrix clause. The case of *wer* 'who' in a complete relative clause has to be known since it is important for the external distribution of the free relative clause, as the examples in (16) show:

(16) a. Wer mich treffen will, kann vorbeikommen.
who.NOM me meet wants.to may over.come
'He who wants to meet me may come over.'

b. * Ich treffe, wer mich treffen will.
I meet who.NOM me meet wants.to
'I meet whoever wants to meet me.'

HPSG also consumes resources in a way: items in valence representations are not projected up the tree once the requirement is saturated, but the difference is that objects with a certain structure and with certain features are not modified. A case-marked NP is not deprived of this case information. We think that this is the right way to deal with morphological markings and with feature specifications in general.

3.6 Some implications

We will look in detail at the implications for syntactic structure of this machinery in the next section. However, we will note some implications in the following

paragraphs as a kind of preview of the next section.

First, the fact that Merge combines two expressions entails that syntactic structures are confined to binary branching and excludes various analyses that have been assumed within HPSG and other frameworks. Second, the assumption that expressions produced by Merge have the same label as one of the expressions that they consist of (Chomsky 2008: 145) is essentially the assumption that all complex expressions are headed. For HPSG, as for many other approaches, there are headed expressions and non-headed expressions, e.g., coordination and the NPN construction discussed in Sections 4.2.2 and 4.2.3, respectively.

As emphasized above, a further important feature of Minimalism is the view that semantics and morphology are simple reflections of syntax. The basic architiecture assumed in Minimalism is shown in Figure 8. Both phonology and semantics are read off the structures produced by syntax. The idea that seman-

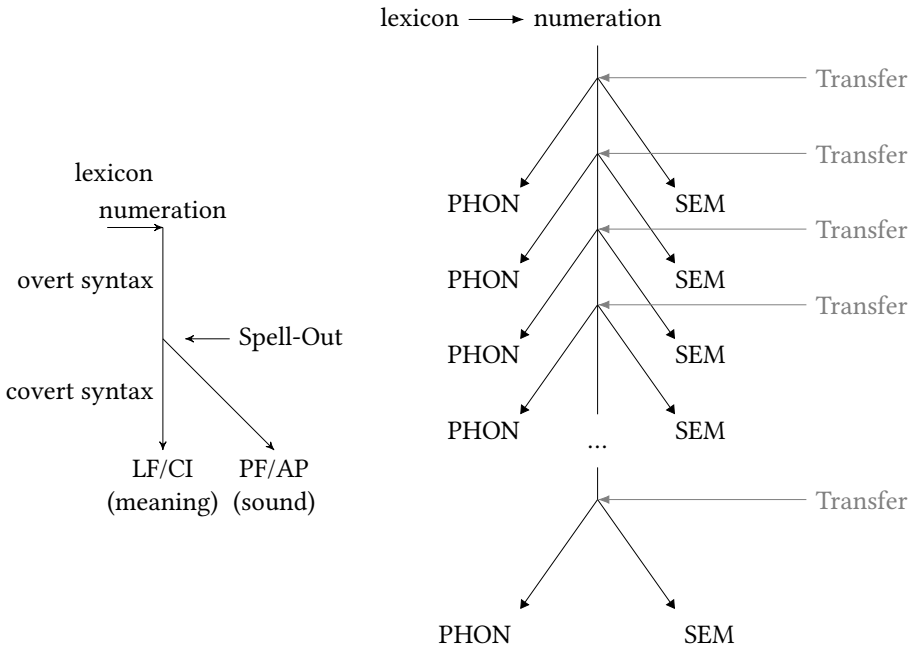


Figure 8: Syntax-centristic architecture in Minimalism before the Phase model (left) and in the Phase model (right) according to Richards (2015: 812, 830))

tics is a simple reflection of syntax goes back to the early years of Transformational Grammar. One aspect of this idea was formalized as the Uniform Theta

Assignment Hypothesis (UTAH) by Baker (1988: 46).

(17) Uniform Theta Assignment Hypothesis
Identical thematic relationships between items are represented by identical structural relationships between those items at the level of D-structure.

Minimalism abandoned the notion of D-structure, but within Minimalism the Hypothesis can be reformulated as follows:

(18) Uniform Theta Assignment Hypothesis (revised)
Identical thematic relationships between items are represented by identical structural relationships between those items when introduced into the structure.

We will look at some of the implications of this in the next section.

The idea that morphology is a simple reflection of syntax is also important. As we will discuss in the next section, it leads to abstract underlying structures and complex derivations and to functional heads corresponding to various suffixes. Again, we will say more about this in the next section.

4 Different views of syntactic structure

The very different views of grammar that are assumed in Minimalism and HPSG naturally lead to very different views of syntactic structure. The syntactic structures of Minimalism are both very complex and very simple. This sounds paradoxical but it isn't. They are very complex in that they involve much more structure than those assumed in HPSG and other approaches. But they are very simple in that they have just a single ingredient – they consist entirely of local trees in which there is a head and a single non-head. From the standpoint of HPSG, they are both too complex and too simple. We will consider the complexity in Section 4.1 and then turn to the simplicity in Section 4.2.

4.1 The complexity of Minimalist structures

For HPSG, as the chapters in this volume illustrate, linguistic expressions have a single relatively simple constituent structure with a minimum of phonologically empty elements.[20] For Minimalism, they have a complex structure containing a

[20] The relatively simple structures of HPSG are not an automatic consequence of its declarative nature. Postal's Metagraph Grammar framework (formerly known Arc Pair Grammar) is a declarative framework with structures that are similar in complexity to those of Minimalism (see Postal 2010).

variety of empty elements and with various constituents occupying more than one position in the course of the derivation. Thus the structures assumed within Minimalism are not at all minimalist. But this complexity is a more or less inevitable consequence of the Minimalist view of grammar outlined above.

4.1.1 Uniformity of structures due to semantic representation

There are a variety of sources of complexity, and some predate Minimalism.[21] This is true especially of the idea that semantics and morphology are simple reflections of syntax (on morphology see Section 4.1.3). For the syntax-semantics relation, UTAH, which we introduced on p. xxiv, is particularly important. It leads to a variety of abstract representations and movement processes. Consider, for example, the following:

(19) a. Who did Lee see?
b. Lee saw who

Who bears the same thematic relation to the verb *see* in (19a) as in (19b). Assuming UTAH, it follows that *who* in (19a) should be introduced in the object position which it occupies in (19b) and then be moved to its superficial position. Consider next the following:

(20) a. Lee was seen by Kim.
b. Kim saw Lee.

Here, *Lee* bears the same thematic relation to the verb *see* in (20a) as in (20b). Hence, it follows that *Lee* in (20a) should be introduced in the object position which it occupies in (20b) and then be moved to its superficial subject position. Finally, consider these examples:

(21) a. Lee seems to be ill.
b. It seems that Lee is ill.

Here, *Lee* bears the same thematic relation to *ill* in (21a) as in (21b). Thus, it follows that *Lee* in (21a) should be introduced in the same position as *Lee* in (21b). The standard Minimalist approach assumes that *Lee* in both examples originates in a position adjacent to *ill* and is moved a short distance in (21b) but a longer distance in (21a).

[21] For interesting discussion of the historical development of the ideas that characterize Minimalism, see Culicover & Jackendoff (2005: Chapters 2 and 3).

These analyses are more or less inevitable if one accepts UTAH. But how sound is UTAH? Work in HPSG shows that it is quite possible to capture both the syntactic and the semantic properties of these sentence types without the assumption that the crucial constituents occupy more than one position. Thus, there is no reason to accept UTAH.

4.1.2 Lexical decomposition a la Generative Semantics

The idea that semantics is a simple reflection of syntax has led to other kinds of complexity. For example, it has led to revival of the idea once characteristic of Generative Semantics that lexical items may derive from complex expressions which in some sense represent their meanings.[22] Thus, Hale & Keyser (1993) argue that (22a) derives from a structure like that of (22b).

(22) a. Kim shelved the books.
b. Kim put the books on the shelf.

One problem with this proposal is that *shelve X* means more than just *put X on the shelf*. Thus, (23a) is not equivalent to (23b).

(23) a. Kim put his elbow on the shelf.
b. Kim shelved his elbow.

Moreover, as Culicover & Jackendoff (2005: 54–55) point out and as Hale & Keyser (1993: 105, Fn. 7) note themselves, denominal verbs can have many different interpretations.[23]

(24) a. Kim saddled the horse.
(Kim put the saddle on the horse.)
b. He microwaved the food.
(He put the food in the microwave and in addition he heated it.)
c. Lee chaired the meeting.
(Lee was the chairperson of the meeting.)
d. Sandy skinned the rabbit.
(Sandy removed the skin from the rabbit.)

[22] For typical Generative Semantics proposals of this kind, see McCawley (1968) and Postal (1970). Like Minimalism, Generative Semantics was characterized by extremely complex syntactic structures and for similar reasons. See Newmeyer (1986: Chapter 4) for discussion.

[23] The examples in (24c), (24g) and (24h) are taken from (Culicover & Jackendoff 2005: 54–55) or parallel to examples they discussed.

e. Kim pictured the scene.
(Kim constructed a mental picture of the scene.)
f. They stoned the criminal.
(They threw stones at the criminal.)
g. He fathered three children.
(He was the biological father of three children.)
h. He mothers his students.
(He treats his students the way a mother would.)

Denominal verbs need to be associated with the correct meanings, but there is no reason to think that syntax has a role in this.[24]

4.1.3 Complex structures and morphology

The idea that morphology is a simple reflection of syntax also leads to syntactic complexity. The fact that verbs in English and many other languages are marked for tense leads to the assumption that there is a T(ense) head at the heart of clause structure. Thus the sentence in (25) has the analysis in Figure 9.

(25) The cat chased the dog.

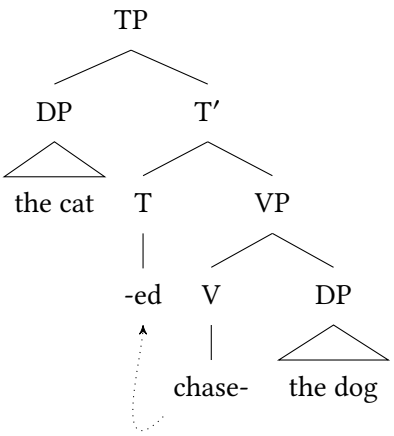


Figure 9: TP/VP analysis of simple English sentences

The verbal stem moves to the T head to pick up the *-ed* suffix.

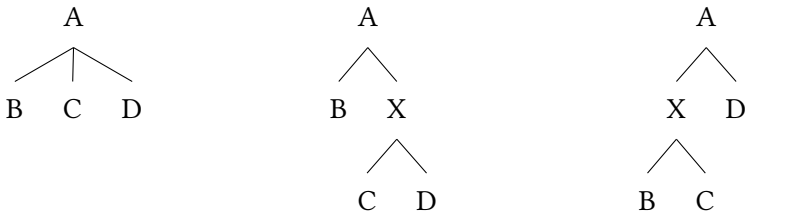
Similarly the fact that nouns in English and other languages are marked for number leads to the assumption that there is a Num(ber) head at the heart of noun

[24] See Culicover & Jackendoff (2005: 53–56) for further discussion.

phrase structure. These elements are not solely motivated by morphology. The assumption that verbs move to T and nouns to Num in some languages but not others provides a way of accounting for cross-linguistic word order differences (Pollock 1989). However, assumptions about morphology are an important part of the motivation. As discussed in Crysmann (2019), Chapter 22 of this volume, HPSG assumes a realizational approach to morphology, in which affixes are just bits of phonology realizing various properties of inflected words or derived lexemes. Hence, analyses like these are out of the question.

4.1.4 Binary branching

Another source of complexity which also predates Minimalism is the assumption that all structures are binary branching. As Culicover & Jackendoff (2005: 112–116) note, this idea goes back to the 1980s. It entails that there can be no structures of the form in Figure 10a. Rather all structure must take the form in Figure 10b or Figure 10c. As Culicover & Jackendoff discuss, the arguments for



(a) flat branching (b) binary branching (c) binary branching

Figure 10: Flat and binary branching

the binary branching restriction have never been very persuasive. Moreover, it is incompatible with various analyses which have been widely accepted in HPSG and other frameworks. We will return to this topic in Section 4.2.

4.1.5 Unbounded dependency constructions

As noted in Section 3, the simplicity of the Minimalist grammatical system means the properties of constructions must largely derive from the lexical items that they contain. Hence, the properties of lexical items are absolutely central to Minimalism and often this means the properties of phonologically empty items, especially empty functional heads. Thus, such elements are central feature of Minimalist syntactic structures. These elements do much the same work as phrase

types and the associated constraints in HPSG.

The contrast between the two frameworks can be illustrated with unbounded dependency constructions. Detailed HPSG analyses of various unbounded dependency constructions are set out in Sag (1997; 2010) and Ginzburg & Sag (2000), involving a complex system of phrase types. For Minimalism, unbounded dependency constructions are headed by a phonologically empty complementizer (C) and have either an overt filler constituent or an invisible filler (an empty operator) in their specifier position. Essentially, then, they have the structure in Figure 11. All the properties of the construction must stem from the properties

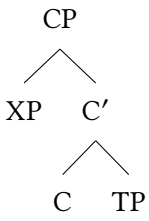


Figure 11: CP structures in Minimalism

of the C that heads it.

An important unbounded dependency construction is relative clauses. In English there are *wh*-relatives and non-*wh*-relatives and finite and non-finite relatives. *Wh*-relatives are illustrated by the following:

(26) a. someone [who you can rely on]
b. someone [on whom you can rely]

(27) a. * someone [who to rely on]
b. someone [on whom to rely]

These show that whereas finite *wh*-relatives allow either an NP or a PP as the filler, non-finite *wh*-relatives only allow a PP. In the HPSG analysis of Sag (1997), the facts are a consequence of constraints on two phrase types. A constraint on the type *fin-wh-fill-rel-cl* allows the first daughter to be an NP or a PP while a constraint on *inf-wh-fill-rel-cl* requires the first daughter to be a PP. For Minimalism, the facts must be attributed to the properties of the complementizer. There must be a complementizer which takes a finite TP complement and allows either an NP or a PP as its specifier and another complementizer which takes a non-finite TP complement (with an unexpressed subject) and only allows a PP as its specifier.

Non-*wh*-relatives require further phrase types within HPSG and further complementizers in Minimalism. However, rather than consider this, we will look at another unbounded dependency construction: *wh*-interrogatives. The basic data that needs to be accounted for is illustrated by the following:

(28) a. Who knows?
b. I wonder [who knows].
c. Who did Kim talk to?
d. I wonder [who Kim talked to].
e. I wonder [who to talk to].

Like *wh*-relatives, *wh*-interrogatives can be finite and non-finite. When they are finite their form depends on whether the *wh*-phrase is subject of the highest verb or something else. When it is subject of the highest verb, it is followed by what looks like a VP although it may be a clause with a gap in subject position. When the *wh*-phrase is something else, the following clause shows auxiliary-initial order if it is a main clause and subject-initial order if it is not. Non-finite *wh*-interrogatives are a simple matter, especially as the filler does not have to be restricted in the way that it does in non-finite *wh*-relatives. Ginzburg & Sag (2000) present an analysis which has two types for finite *wh*-interrogatives, one for subject-*wh*-interrogatives such as those in (28a) and (28b), and another for non-subject-*wh*-interrogatives such as those in (28c) and (28d). The latter is subject to a constraint requiring it to have the same value for the features IC (INDEPENDENT-CLAUSE) and INV (INVERTED). Main clauses are [IC +] and auxiliary-initial clauses are [INV +]. Hence the constraint ensures that a non-subject-*wh*-interrogative shows auxiliary-initial order just in case it is a main clause.

How can the facts be handled within Minimalism? As noted above, Minimalism analyses auxiliary-initial order as a result of movement of the auxiliary to C. It is triggered by some feature of C. Thus C must have this feature just in case (a) it heads a main clause and (b) the *wh*-phrase in its specifier position is not the subject of the highest verb. There are no doubt various ways in which this might be achieved, but the key point is the properties of a phonologically empty complementizer are crucial.

Borsley (2006b; 2017) discusses Minimalist analyses of relative clauses and *wh*-interrogatives and suggests that at least eight complementizers are necessary. One is optionally realized as *that*, and another is obligatorily realized as *for*. The other six are always phonologically empty. But it has been clear since Ross (1967a) and Chomsky (1977) that relative clauses and *wh*-interrogatives are not the only unbounded dependency constructions. Here are some others:

(29) a. What a fool he is! (*wh*-exclamative clause)
b. The bagels, I like. (topicalized clause)
c. Kim is more intelligent [than Lee is]. (comparative-clause)
d. Kim is hard [to talk to]. (*tough*-complement-clause)
e. Lee is too important [to talk to]. (*too*-complement-clause)
f. [The more people I met], [the happier I became]. (*the*-clauses)

Each of these constructions will require at least one empty complementizer. Thus, a comprehensive account of unbounded dependency constructions will require a large number of such elements. But with a large unstructured set of complementizers there can be no distinction between properties shared by some or all elements and properties restricted to a single element. There are a variety of shared properties. Many of the complementizers will take a finite complement, many others will take a non-finite complement, and some will take both. There will also be complementizers which take the same set of specifiers. Most will not attract an auxiliary, but some will, not only the compementizer in an example like (28c) but also the complementizers in the following, where the auxiliary is in italics:

(30) a. Only in Colchester *could* such a thing happen.
b. Kim is in Colchester, and so *is* Lee.
c. Such *is* life.
d. The more Bill smokes, the more *does* Susan hate him.

Thus, there are generalizations to be captured here. The obvious way to capture them is with the approach developed in the 1980s in HPSG work on the hierarchical lexicon (Flickinger, Pollard & Wasow 1985; Flickinger 1987), i.e. a detailed classification of complementizers which allows properties to be associated not just with individual complementizers but also with classes of complementizers. With this it should be possible for Minimalism not just to get the facts right but to capture the full set of generalizations. In many ways such an analysis would be mimicking the HPSG approach with its hierarchy of phrase types.[25] But in the present context the main point is the simplicity of the Minimalist grammatical system is another factor which leads to more complex syntactic structures than those of HPSG.

[25]For a fuller discussion of the issues see Borsley (2006b; 2017).

4.1.6 Syntactification of semantic categories

The left periphery of the clause is often much more complex than assumed in the last section as a result of the syntactification of semantic properties (Rizzi 2014), which is one aspect of the idea that semantics is a simple reflection of syntax. This is especially apparent in a sub-school that calls itself "cartographic". MGG comes with strong claims about the autonomy of syntax. There is a syntactic component and than there are the components of Phonological Form (PF) and Logical Form (LF), in more recent versions of the theory this is the articulatory-perceptual system (AP) and the conceptual-intentional system (CI). Figure 8 shows the early Minimalist architecture and the architecture assumed in the Phase-based models. Syntax was always regarded primary and PF and LF derived from syntactic representations. This is similar in Minimalism. The problem is that questions of intonation are connected to semantic and information structural properties (Halliday 1970: 36). A way around this is to stipulate syntactic features that can be interpreted by both PF and LF (Gussenhoven 1983). Another way of dealing with the data is to employ empty elements that are responsible for certain ordering of elements and that can be interpreted in the semantics. The accounts of Rizzi and Cinque are very prominent in this school of thought. For example, Rizzi (1997) suggests an analysis of the left periphery of clauses that incorporate special functional projections for topic and focus. His analysis is shown in Figure 12. In comparison no such projections exist in HPSG theories. HPSG grammars are surface oriented and the syntactic labels correspond for the most part to classical part of speech categorizations. So in examples with frontings like (31) the whole object is a verbal projection and not a Topic phrase, a Focus Phrase or a Force phrase.

(31) Bagels, I like.

Of course the fronted elements may be topics or foci but this is a property that is represented independently of syntactic information in parts of feature descriptions having to do with information structure. For treatment of information structure in HPSG see Engdahl & Vallduví (1996), De Kuthy (2000) and also Kuthy (2019), Chapter 24 of this volume. On determination of clause types see Ginzburg & Sag (2000) and Müller (2016b). For general discussion of the representation of information usually assigned to different linguistic "modules" and on "interfaces" between them in theories like LFG and HPSG see Kuhn (2007).

Cartographic approaches also assume a hierarchy of functional projections for the placement of adverbials. Some authors assume that all sentences in all languages have the same structure, which is supposed to explain orders of ad-

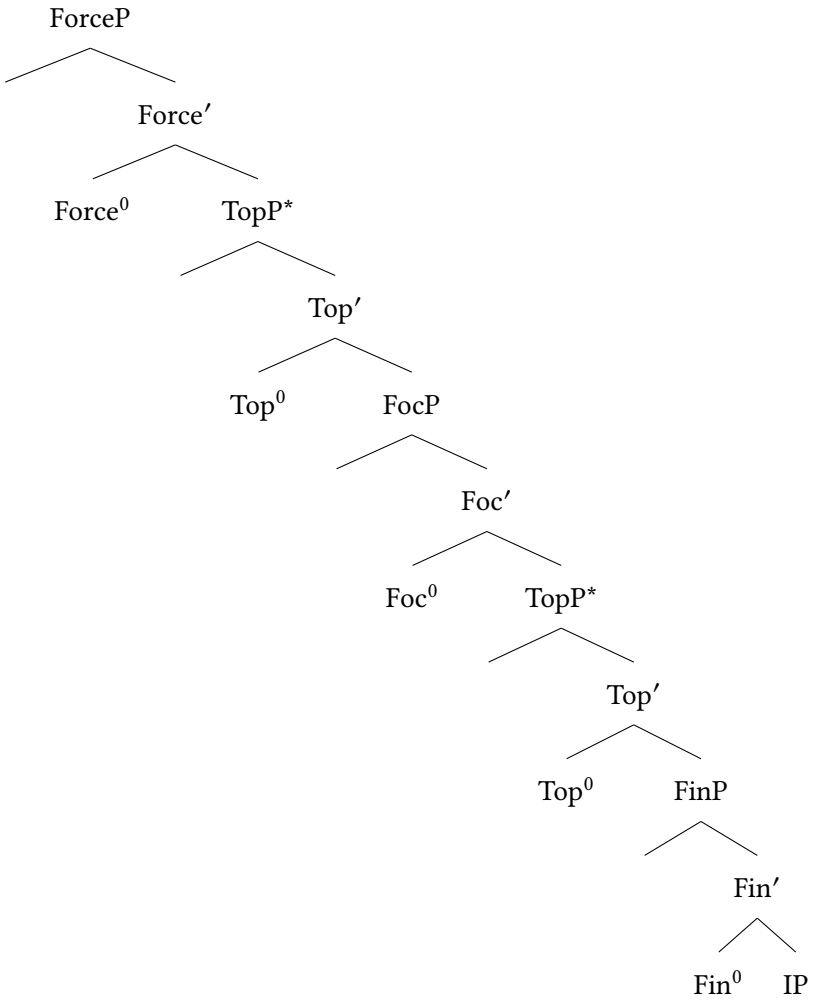


Figure 12: Syntactic structure of sentences following Rizzi (1997: 297)

verbials that seem to hold universally (e.g., Cinque 1999: 106 and Cinque & Rizzi 2010: 54–55). A functional head selects for another functional projection to establish this hierarchy of functional projections and the respective adverbial phrases can be placed in the specifier of the corresponding functional projection. Cinque (1999: 106) assumes 32 functional projections in the verbal domain. Cinque & Rizzi (2010: 57, 65) assume at least four hundred functional heads, which are – according to them – all part of a genetically determined UG.

In comparison, HPSG analyses assume that verbs project: a verb that is combined with an argument is a verbal projection. If an adverb attaches, a verbal projection with the same valence but augmented semantics results. Figure 13 shows the Cartographic and the HPSG structures. While the adverbs (Adv_1 and

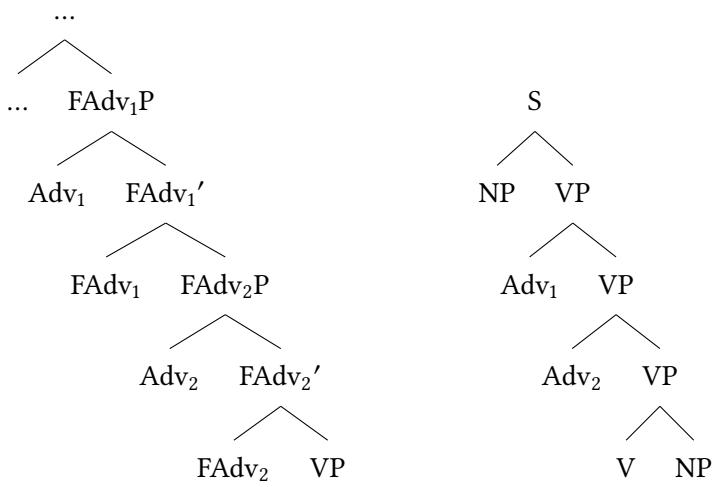


Figure 13: Treatment of adverbial phrases in Cartographic approaches and in HPSG

Adv_2 in the figure) attach to verbal projections in the HPSG analysis (S and VP are abbreviations standing for verbal projections with different valence requirements), the Cartographic approach assumes empty heads that select a clausal projection and provide a specifier position in which the adverbs can be realized. For the sake of exposition we called these heads $FAdv_1$ and $FAdv_2$. For example, $FAdv_2$ can combine with the VP and licences an Adv_2 in its specifier position. As is clear from the figure, the Cartographic approach is more complex since it involves two additional categories ($FAdv_1$ and $FAdv_2$) and nine nodes for the adverbial combination rather than five.

An interesting difference is that verbal properties are projected in the HPSG analysis. By doing this it is clear whether a VP contains an infinitive or a participle.

(32) a. Kim has met Sandy.
b. Kim will meet Sandy.

This property is important for the selection by a superordinate head, e.g., the auxiliary in the examples in (32). In a Cartographic approach one either has to assume that adverbial projections have features correlated with verbal morphology or one has to assume that superordinate heads may check properties of linguistic items that are deeply embedded.

If one believed in Universal Grammar (which researchers working in HPSG usually do not) and in innately specified constraints on adverb order, one would not assume that all languages contain the same structures, some of these structures being invisible. Rather one would assume linearization constraints (see Müller (2019a: Section 2), Chapter 10 of this volume) to hold crosslinguistically.[26] If adverbs of a certain type do not exist in a language, the linearization constraints would not do any harm. They just would never apply since there is nothing to apply to (Müller 2015b: 46).

4.1.7 Summary

Having discussed uniformity in theta role assignment, Generative Semantics-like approaches, branching, nonlocal dependencies and Cartographic approaches to the left periphery and adverb order within clauses, we conclude that a variety of features of Minimalism lead to structures that are much more complex than those of HPSG. HPSG shows that this complexity is unnecessary given a somewhat richer conception of grammar.

4.2 The simplicity of Minimalist structures

As we emphasized above, while minimalist structures are very complex, they are also simple in the sense that they have just a single ingredient, local trees

[26] Adjuncts are usually not siblings in local structures in HPSG (but see Kasper (1994) and Bouma & van Noord (1998: 62, 71)). There are nevertheless ways to impose order constraints on non-siblings. Engelkamp, Erbach & Uszkoreit (1992) discuss one approach, another approach would be to have Reape-style order domains (Reape 1994) in addition to the immediate dominance schemata for head-adjunct combination. See Müller (2019a), Chapter 10 of this volume for order domains.

consisting of a head and a single non-head. Most outsiders agree that this is too simple.

4.2.1 Binary branching, VPs, and verb-initial clauses

We look first at binary branching.[27] As we noted above, the assumption that all branching is binary is incompatible with various analyses which have been widely accepted in HPSG and other frameworks. For example, it means that the bracketed VP in (33), which contains two complements, cannot have the ternary branching structure in Figure 14, which is suggested in Pollard & Sag (1994: 36) and much other work.

(33) Kim [gave a book to Lee].

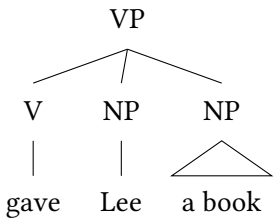


Figure 14: Flat structure for the VP *gave Lee a book*

Instead it has been assumed since Larson (1988) that the VP in examples like (33) has something like the structure in Figure 15. It is assumed that the verb originates in the lower VP and is moved into the higher VP. The higher V position to which the verb moves is commonly labelled *v* ("little *v*") and the higher phrase *v*P. The main argument for such an analysis appears to involve anaphora, especially contrasts like the following:

[27] In addition to structures with two or more branches, HPSG uses unary branching structures both in syntax and in the lexicon (lexical rules basically are unary branching structures, see Meurers (2001) and Davis & Koenig (2019: Section 5), Chapter 4 of this volume. For example, unary branching syntactic rules are used for semantic type shifting (Partee 1987). For respective HPSG analyses see Flickinger (2008: 91–92) and Müller (2009; 2012). The lack of unary branching structures in Minimalism is no problem since empty heads can be used instead. The empty head projects the properties that would be otherwise assigned to the mother node of the unary projection. See for example Ramchand (2005: 370). So, while the effects of unary projections can be modeled, the resulting structures are more complex. For a general discussion of empty elements and unary projections and lexical rules see Müller (2016a: Sections 19.2 and 19.5).

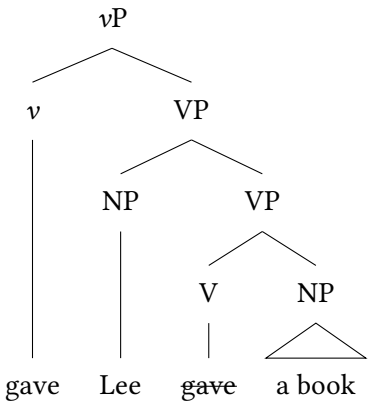


Figure 15: Larson-type analysis of VPs involving little *v*

(34) a. John showed Mary herself in the picture.
b. * John showed herself Mary in the picture.

The first complement can be the antecedent of a reflexive which is the second complement, but the reverse is not possible.

If constraints on anaphora refer to constituent structure as suggested by Chomsky (1981), the contrast suggests that the second NP should be lower in the structure than the first NP. But, as suggested by Pollard & Sag (1992), it is assumed in HPSG that constraints on anaphora refer not to constituent structure but to a list containing all arguments in order of obliquenss, in recent versions of HPSG the ARG-ST list (see also **chapters/binding** Chapter **??** of this volume). On this view, anaphora can provide no argument for the complex structure in Figure 15. Therefore, both flat structures and binary branching structures with different branching directions as in Figure 16 are a viable option in HPSG. Müller (2015a: Section 2.4; 2019b) argues for such binary branching structures as a result of parametrizing the Head-Complement Schema for various variants of constituent order (head-initial and head-final languages with fixed constituent order and languages like German and Japanese with freer constituent order).

The fact that Merge combines two expressions also means that the auxiliary-initial clause in (35) cannot have a flat structure with both subjects and complement(s) as sisters of the verb, as in Figure 17.

(35) Will Kim be here?

It is standardly assumed in Minimalism that it has a structure of the form in Figure 18 or more complicated structures, as explained in Section 4.1.6. *Will* is

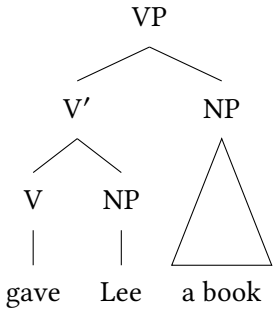


Figure 16: Possible analysis of VPs in HPSG with a branching direction differing from Larson-type structures

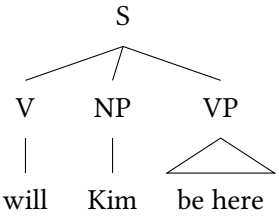


Figure 17: Flat structure for *Will Kim be there?*

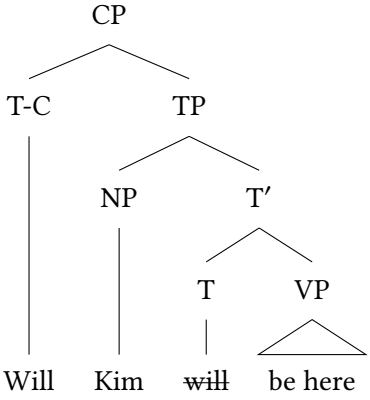


Figure 18: CP/TP structure for *Will Kim be there?*

analysed as a T(ense) element which moves to the C(omplementizer) position. A binary branching analysis of some kind is the only possibility within Minimalism provided the usual assumptions are made.

It is not just English auxiliary-initial clauses that cannot have a ternary branching analysis within Minimalism but verb-initial clauses in any language. A notable example is Welsh, which has verb-initial order in all types of finite clause. Here are some relevant examples:[28]

(36) a. Mi/Fe gerddith Emrys i 'r dre. (Welsh)
PRT walk.FUT.3SG Emrys to the town
'Emrys will walk to the town.'

b. Dywedodd Megan [cerddith Emrys i 'r dre].
say.PAST.3SG Megan walk.FUT.3SG Emrys to the town
'Megan said Emrys will walk to the town.'

A variety of transformational work, including work in Minimalism, has argued for an analysis like Figure 18 for Welsh finite clauses (see e.g., Jones & Thomas 1977, Sproat 1985, Sadler 1988, Rouveret 1994, and Roberts 2005). But Borsley (2006a) argues that there is no theory-neutral evidence for a structure of this kind. Hence, at least for Welsh, it seems that a simpler flat structure like Figure 17 is preferable.[29] Note, that we do not argue that structures like the one in Figure 18 are not appropriate for any language. The analog to head-movement analyses is standard among HPSG grammarians of German and there is data from apparent multiple frontings that seems to make a head-movement analysis unavoidable. See Müller (2017) for a book-length discussion of German clause structure. Müller (2019a: Section 4.1), Chapter 10 of this volume also discusses head-movement in HPSG.

4.2.2 Headedness and coordination

We turn now to the idea that all structures are headed. For HPSG, and many other approaches, there are headed structures and non-headed structure. Probably the most important example of the latter are coordinate structures such as those in (37) (see Sag 2003 and Abeillé & Chaves (2019), Chapter 17 of this volume for HPSG analyses).

[28] Positive main clause verbs are optionally preceded by a particle (*mi* or *fe*). We have included this in (36a) but not in (36b). When it appears it triggers so-called soft mutation. Hence (36a) has *gerddith* rather than the basic form *cerddith*, which is seen in (36b).

[29] Borsley (2016) argues for a similar flat structure for the Caucasian ergative SOV language Archi.

(37) [Kim and Lee] [wrote poems and painted pictures].

Much work in Minimalism assumes that coordinate structures are headed by the conjunction (Larson 1990: 596; Radford 1993: 89; Kayne 1994: Chapter 6; Johannessen 1998; Van Koppen 2005: 8; Bošković 2009: 474; Citko 2011: 27).[30] This suggests that both coordinate structures in (37) are conjunction phrases. This is highly problematic since the category of the phrases plays a role in accounting for their external distribution. So the VPs *wrote poems* and *painted pictures* have to be combined with a DP/NP to form a complete sentence. But according to the ConjP theory *Kim and Lee* is not a DP or NP it is a ConjP and hence incompatible with any requirements. Similarly, a T head in the analysis of (37) requires a VP argument but instead of a VP *wrote poems and painted pictures* there is only a ConjP.[31] It is fairly clear that conjunctions cannot be ordinary heads. Johannessen (1996: 669) suggests an analysis in which a coordinate structure has the features of the first conjunct. She depicts the analysis as in Figure 19. The prob-

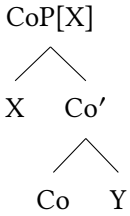


Figure 19: Analysis of coordination with projection of features from the first conjunct according to Johannessen (1996: 669)

lem is that it is unclear how this should be formalized: either the head category

[30] Kayne (1994: 57) differs from other proposals in not assuming the category Conj for the conjunction. Instead, he uses X^0 as the category in his structured examples. Since X is an underspecified variable his theory is underdetermined: while a ConjP is not compatible with any requirement by a governing head, an XP could appear as an argument of any dominating head. Kayne needs to work out a theory that determines the properties of the projected XP in relation to the coordinated items. We discuss this below.

[31] If one considers the part of speech labels only, one would expect the two ConjPs to be interchangeable, but of course they are not:

(i) * [Wrote poems and painted pictures] [Kim and Lee].

Of course the two ConjPs are not exactly of the same category since there may be further features that distinguish the two ConjPs. But how these features are distributed between the conjuncts and the mother is not worked out.

For a more detailed critique of the ConjP approach see Borsley (2005).

of the complete object is ConjP or it is X. Governing heads have to know where to look for the category. If they look at X, why is the part of speech information of Co projected? Why would governing heads not look at the category of other specifiers rather than their heads? Furthermore, coordinations are not equivalent to the first conjunct. There are cases where the coordination is a sum of the parts. For example, *Kim and Sandy* is a plural NP, as the agreement with the verb shows:

(38) Kim and Sandy laugh.

Johannessen's analysis seems to predict that the coordination of *Kim* and *Sandy* behaves like *Kim*, which is not the case. So, if one wants to assume an analysis with the conjunction as a head, one would have to assume that the head is a functor taking into account the properties of its specifier and complement, and projecting nominal information if they are nominal, verbal if they are verbal, etc (Steedman 1991). This would make them a unique type of a head with a unique relation to their specifier and complement. A problem for this approach is coordinate structures in which the conjuncts belong to different categories, e.g., the following:

(39) a. Hobbs is [a linguist and proud of it].
b. Hobbs is [angry and in pain].

Such examples have led to HPSG analyses in which coordinate structures have whatever properties are common to the two conjuncts (Sag 2003). Within Minimalism, one might try to mimic such analyses by proposing that conjunctions have whatever properties are common to their specifier and complement. But a problem arises with an example like (40), where the conjuncts are not phrases but words.

(40) Kim [criticized and insulted] his boss.

To accommodate such examples, conjunctions would have to acquire not only part of speech information from the conjuncts but also selectional information. They would be heads which combine with a specifier and a complement to form an expression which, like a typical head, combines with a specifier and a complement. This would be a very strange situation and in fact it would make wrong predictions since the object *his boss* would be the third-merged item. It would hence be "later-merged" in the sense of Chomsky (2008: 146) and therefore treated as a specifier rather than a complement.[32]

[32]There have been attempts to argue that conjuncts are always phrases (Kayne 1994, Bruening 2018). But this position seems untenable (Abeillé 2006, Müller 2018b: Section 7).

4.2.3 Binary branching and headless structures: The NPN construction

Another problem for Minimalist theories is the NPN Construction discussed by Matsuyama (2004) and Jackendoff (2008). Examples are provided in (41):

(41) a. Student after student left the room.
b. Day after day after day went by, but I never found the courage to talk to her. (Bargmann 2015)

As Jackendoff argued it is not possible to identify one of the elements in the construction as the head. The construction has several peculiar properties and we share Jackendoff's view that these constructions are best treated by a phrasal configuration in which these highly idiosyncratic properties are handled. The construction is discussed in more detail in Müller (2019d), Chapter 36 of this volume and Bargmann's analysis within HPSG is provided. Bargmann's analysis also captures multiple repetitions of the PN sequence as they occur in (41b). Until now there is one proposal for NPN in the Minimalist framework: G. Müller (2011). G. Müller develops a reduplication account. He states that reduplication applies to words only and claims that German differs from English in not allowing adjective noun sequences in NPN constructions. He is aware of the possibility of these constructions in English (*miserable day after miserable day*) and states that his analysis is intended to account for the German data only. While this alone is a serious shortcoming of the analysis, the empirical claim does not hold water either as the following example from Müller (2019d), Chapter 36 of this volume shows:

(42) Die beiden tauchten nämlich geradewegs wieder aus dem heimischen
the two surfaced namely straightaway again from the home
Legoland auf, wo sie im Wohnzimmer, schwarzen Stein um
Legoland PART where they in.the living.room black brick after
schwarzen Stein, vermeintliche Schusswaffen nachgebaut hatten.[33]
black brick alledged firearms recreated had
'The two surfaced straightaway from their home Legoland where they had recreated alledged firearms black brick after black brick.'

Apart from failing on the reduplication of adjective-noun combinations like *schwarzen Stein* 'black brick', the reduplication approach also fails on NPN patterns with several PN repetitions as in (41b): if the preposition is responsible for reduplicating content it is unclear how the first *after* is supposed to combine

[33] taz, 05.09.2018, p. 20, quoted from Müller (2019d: xxxvii).

with *day* and *day after day*. It is probably possible to design analyses of the NPN construction involving several empty heads but it is clear that these solutions would come at a rather high price.

4.2.4 Movement for more local phenomena like scrambling, passive and raising

We want now to consider the dependencies that Minimalism analyzes in terms of Move/Internal Merge. In the next section we look at unbounded dependencies, but first we consider local dependencies in passives, unaccusatives, raising sentences, and scrambling. The following illustrate the first three of these:

(43) a. Kim has been hit.
b. Kim has disappeared.
c. Kim seems to be clever.

These differ from unbounded dependency constructions in that whereas the gaps in the latter are positions in which overt NPs can appear, this is not true of the supposed gap positions in (43):

(44) a. * It has been hit Kim.
b. * It has disappeared Kim.
c. * It seems Kim to be clever.

This is a complication if they involve the same mechanism, but is unsurprising if they involve different mechanisms, as in HPSG and most other frameworks.

4.2.4.1 Passive

In the classical analysis of the passive in MGG, it is assumed that the morphology of the participle suppresses the agent role and removes the ability to assign accusative case. In order to receive case the underlying object has to move to the subject position, i.e. Spec,TP where it gets nominative (Chomsky 1981: 124).

(45) a. The mother gave [the girl] [a cookie].
b. [The girl] was given [a cookie] (by the mother).

The analysis assumed in recent Minimalist work differs in detail but is movement-based like its predecessors. While movement-based approaches seem to work well for SVO languages like English, they are problematic for SOV languages like German. To see why consider the examples in (46):

(46) a. weil das Mädchen dem Jungen den Ball schenkte
because the.NOM girl the.DAT boy the.ACC ball gave
'because the girl gave the ball to the boy'

b. weil dem Jungen der Ball geschenkt wurde
because the.DAT boy the.NOM ball given was
'because the ball was given to the boy'

c. weil der Ball dem Jungen geschenkt wurde
because the.NOM ball the.DAT boy given was

In comparison to (46c), (46b) is the unmarked order (Höhle 1982). *der Ball* 'the ball' in (46b) occurs in the same position as *den Ball* in (46a), that is, no movement is necessary. Only the case differs. (46c) is, however, somewhat marked in comparison to (46b). So, if one assumed (46c) to be the normal order for passives and (46b) is derived from this by movement of *dem Jungen* 'the boy', (46b) should be more marked than (46c), contrary to the facts. To solve this problem, an analysis involving abstract movement has been proposed for cases such as (46b): the elements stay in their positions, but are connected to the subject position and receive their case information from there. Grewendorf (1993: 1311) assumes that there is an empty expletive pronoun in the subject position of sentences such as (46b) as well as in the subject position of sentences with an impersonal passive such as (47):[34]

(47) weil heute nicht gearbeitet wird
because today not worked is
'because there will be no work done today'

A silent expletive pronoun is something that one cannot see or hear and that does not carry any meaning. Such entities are not learnable from input and hence innate domain specific knowledge would be required and of course, approaches that do not have to assume very specific innate knowledge are preferable. For further discussion of language acquisition see Section 5.2 and Ginzburg (2019), Chapter 26 of this volume.

HPSG does not have this problem since passive is treated by lexical rules that map verbal stems onto participle forms with a reduced argument structure list. The first element (the subject in the active) is suppressed so that the second element (if there is any) becomes first. In SVO languages like English and Ice-

[34] See Koster (1986: 11–12) for a parallel analysis for Dutch as well as Lohnstein (2014) for a movement-based account of the passive that also involves an empty expletive for the analysis of the impersonal passive.

landic this element is realized before the verb: there is a valence feature for subjects/specifiers and items that are realized with the respective schema are serialized to the left of the verb. In SOV languages like German and Dutch the subject is treated like other arguments and hence it is not put in a designated position before the finite verb (Müller 2019a: Section 4, Chapter 10 of this volume). No movement is involved in this valence-based analysis of the passive. The problem of MGG analyses is that they mix two phenomena: passive and subject requirement. Since these two phenomena are kept separate in HPSG, problems like that discussed above can be avoided. See Müller (2016a: Section 3.4, Chapter 20) for further discussion.

4.2.4.2 Scrambling

Discussing passive, we already touched on problems related to local reordering of arguments, so-called *scrambling*. In what follows, we want to discuss scrambling in more detail. Languages like German have a freer constituent order than English. A sentence with a ditransitive verb allows for six permutations of the arguments, two of which are given in (48):

(48) a. [weil] der Mann der Frau das Buch gibt
because the.NOM man the.DAT woman the.ACC book gives
'because the man gives the book to the woman'

b. [weil] das Buch der Mann der Frau gibt
because the.ACC book the.NOM man the.DAT woman gives

It was long argued that scrambling should be handled as movement as well (Frey 1993). An argument that has often been used to support the movement-based analysis is the fact that scope ambiguities exist in sentences with reorderings which are not present in sentences in the base order. The explanation of such ambiguities comes from the assumption that the scope of quantifiers can be derived from their position in the superficial structure as well as their position in the underlying structure. If the position in both the surface and deep structure are the same, that is, when there has not been any movement, then there is only one reading possible. If movement has taken place, however, then there are two possible readings (Frey 1993: 185):

(49) a. Es ist nicht der Fall, daß er mindestens einem Verleger fast
it is not the case that he at.least one publisher almost

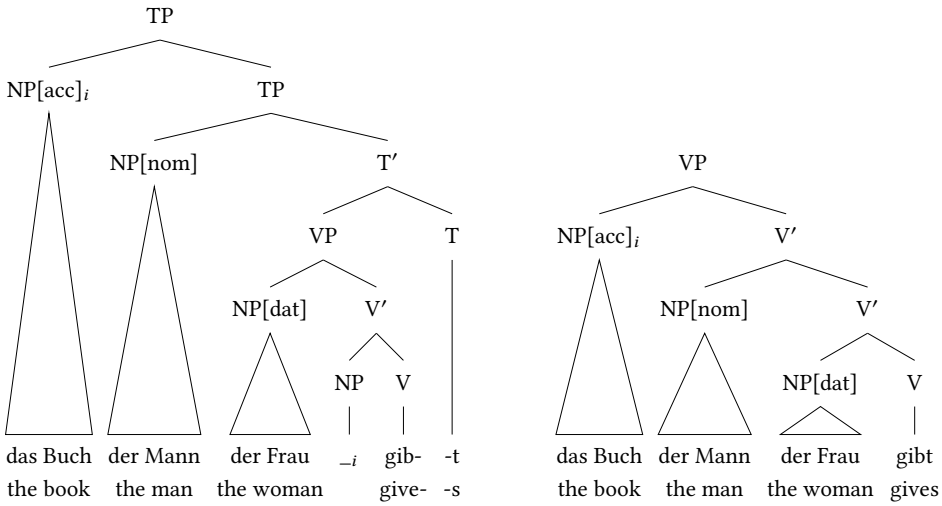


Figure 20: Analysis of local reordering as movement to Spec TP and "base-generation" analysis assumed in HPSG

jedes Gedicht anbot.
every poem offered

'It is not the case that he offered at least one publisher almost every poem.'

b. Es ist nicht der Fall, daß er fast jedes Gedicht$_i$ mindestens einem
it is not the case that he almost every poem at.least one
Verleger $_i$ anbot.
publisher offered

'It is not the case that he offered almost every poem to at least one publisher.'

It turns out that approaches assuming traces run into problems as they predict certain readings which do not exist for sentences with multiple traces (see Kiss 2001: 146 and Fanselow 2001: Section 2.6). For instance in an example such as (50), it should be possible to interpret *mindestens einem Verleger* 'at least one publisher' at the position of $_i$, which would lead to a reading where *fast jedes Gedicht* 'almost every poem' has scope over *mindestens einem Verleger* 'at least one publisher'. However, this reading does not exist.

(50) Ich glaube, dass mindestens einem Verleger$_i$ fast jedes Gedicht$_j$ nur
I believe that at.least one publisher almost every poem only

dieser Dichter $_i$ $_j$ angeboten hat.
this poet offered has
'I think that only this poet offered almost every poem to at least one publisher.'

The alternative to movement-based approaches are so-called "base-generation" approaches in which the respective orders are derived directly. Fanselow (2001), working within the Minimalist Program, suggests such an analysis in which arguments can be combined with their heads in any order. This is the HPSG analysis that was suggested by Gunji (1986) for Japanese and is standardly used in HPSG grammars of German (Hinrichs & Nakazawa 1994a; Kiss 1995; Meurers 1999; Müller 2003; 2017). See also Müller (2019a), Chapter 10 of this volume.

Sauerland & Elbourne (2002: 308) discuss analogous examples from Japanese, which they credit to Kazuko Yatsushiro. They develop an analysis where the first step is to move the accusative object in front of the subject. Then, the dative object is placed in front of that and then, in a third movement, the accusative is moved once more. The last movement can take place to construct either a structure that is later passed to LF or as a movement to construct the Phonological Form. In the latter case, this movement will not have any semantic effects. While this analysis can predict the correct available readings, it does require a number of additional movement operations with intermediate steps.

4.2.5 Nonlocal dependencies

Having dealt with phenomena treated via Move/Internal Merge in Minimalism but involving more local phenomena, we now turn to genuine nonlocal dependencies and compare the Move/Internal Merge approach to the HPSG approach to nonlocal dependencies.

4.2.5.1 Gaps without filler

The Move/Internal Merge approach seems quite plausible for typical examples of an unbounded dependency, but issues arise with less typical examples. Within this approach one expects to see a clause-initial filler-constituent and a gap somewhere in the following clause. This is what we commonly find, but there are unbounded dependency constructions in which there is a gap but no visible higher constituent matching it. Consider e.g., the following:

(51) a. the book [Kim bought _]
b. Lee is too important [for you to talk to _].

c. Lee is important enough [for you to talk to _].
d. Kim is easy [for anyone to talk to _].

Within Minimalist assumptions, it is more or less necessary to assume that such examples contain an invisible filler (a so-called empty operator). Unless there is some independent evidence for such invisible fillers, they are little more than an ad hoc device to maintain the Move/Internal Merge approach. Within the HPSG SLASH-based approach to unbounded dependencies, there is no assumption that there should always be a filler at the top of an unbounded dependency (Pollard & Sag 1994: Chapter 4, see also Borsley & Crysmann (2019), Chapter 14 of this volume). Hence, the examples in (51) are completely unproblematic.

4.2.5.2 Filler without gaps: Resumptive pronouns

There are also unbounded dependency constructions which seem to have not a gap but a resumptive pronoun (RP). Among many languages that are relevant here is Welsh, which has RPs in both *wh*-interrogatives and relative clauses, as the following illustrate:

(52) a. Pa ddyn werthodd Ieuan y ceffyl iddo *fo*?
which man sell.PAST.3SG Ieuan the horse to.3SGM he
'Which man did Ieuan sell the horse to?'

b. y dyn werthodd Ieuan y ceffyl iddo *fo*
the man sell.PAST.3SG Ieuan the horse to.3SGM he
'the man that Ieuan sold the horse to'

Willis (2011) and Borsley (2010; 2013) present evidence that Welsh RPs involve the same mechanism as gaps. Within Minimalism, this means that they must involve Move/Internal Merge. But one expects to see a gap where Move/Internal Merge has applied. One Minimalist response suggests that instead of being deleted, the copy left behind by Move/Internal Merge is somehow turned into a pronoun (see McCloskey 2006). A problem for this approach is that it makes it surprising that RPs universally look like ordinary pronouns (McCloskey 2002). Another approach exploits the complexity of Minimalist structures and proposes that there is a gap in the structure somewhere near the RP. Thus, for example, Willis (2011) proposes that examples like those in (52) with an RP in prepositional object position have a coindexed operator in the specifier position of PP, which undergoes movement. Similar approaches are outlined in Aoun et al. (2001) and Boeckx (2003). For detailed objections to both approaches, see Borsley (2013: Section 3). Within the SLASH-based approach of HPSG, there is no reason to think that there

will always be a gap at the bottom of a dependency, and it is not difficult to accommodate RPs. See Vaillette (2001), Taghvaipour (2010), Borsley (2013) and Crysmann (2012; 2016) for slightly different approaches.[35] See also Borsley & Crysmann (2019), Chapter 14 of this volume for a more detailed discussion of nonlocal dependencies.

4.3 Conclusion

Thus, there are variety of phenomena which suggest that the Minimalist view of constituent structure is too simple. The restriction to binary branching, the assumption that all structures are headed, and Move/Internal Merge all seem problematic. It looks, then, as if the Minimalist view is both too complex and too simple.

5 Psycholinguistic issues

Although they differ in a variety of ways, HPSG and Minimalism agree that grammatical theory is concerned with linguistic knowledge. They focus first and foremost on the question: what form does linguistic knowledge take? But there are other questions that arise here, notably the following:

- How is linguistic knowledge put to use?
- How is linguistic knowledge acquired?

Both questions are central concerns for psycholinguistics. Thus, in considering the answers that HPSG and Minimalism can give we are considering their relevance to psycholinguistics. Chomskyan approaches, including Minimalism, have focused mainly on the second question and have paid little attention to the first. HPSG has had more to say about the first and has shown less interest in the second. However, there is a large body of work on acquisition in Construction

[35] Also relevant here are examples with more than one gap such as the following:

(i) a. Who does Kim like _ and Lee hate _?
b. Which book did you criticize _ without reading _?

There have been various attempts to accommodate such examples within the Move/Internal Merge approach, but it is not clear that any of them is satisfactory. In contrast such examples are expect within the SLASH-based approach (Levine & Sag 2003). See also (Pollard & Sag 1994: Section 4.6).

Grammar and since HPSG is a constructionist theory (Müller 2019d, Chapter 36 of this volume) all the insights carry over to HPSG. Clearly an adequate grammatical theory should be able to give satisfactory answers to both questions. In this section we will look briefly at the relation of the two theories to processing and then consider more fully their relation to acquisition.

5.1 Processing

We noted in Section 3 that whereas HPSG is a declarative or constraint-based approach to grammar, Minimalism has a procedural view of grammar. This contrast means that HPSG is much more suitable than Minimalism for incorporation into an account of the processes that are involved in linguistic performance.

The most obvious fact about linguistic performance is that it involves both production and comprehension. As noted in Section 3, this suggests that the knowledge that is used in production and comprehension should have a declarative character as in HPSG and not a procedural character as in Minimalism.

A second important feature of linguistic performance is that it involves different kinds of information utilized in any order that is necessary. Sag & Wasow (2011: 367–368) illustrate with the following examples:

(53) a. The sheep that was sleeping in the pen stood up.
b. The sheep in the pen had been sleeping and were about to wake up.

In (53a), morphological information determines the number of sheep before non-linguistic information determines that pen means 'fenced enclosure' and not 'writing implement'. In (53b), on the other hand, non-linguistic information determines that pen means 'fenced enclosure' before morphological information determines the number of sheep. This is unproblematic for an approach like HPSG in which linguistic and non-linguistic knowledge takes the form of constraints which are not ordered in any way.[36] It is quite unclear how the facts can be accommodated within Minimalism given that linguistic knowledge with its procedural form is quite different from non-linguistic knowledge.

Other features of HPSG also make it attractive from a processing point of view. Firstly, there is the fact emphasized earlier that linguistic expressions have a single relatively simple constituent structure with a minimum of phonologically empty elements. Secondly there is the fact that all constraints are purely local and never affect anything larger than a local tree consisting of an expression and its

[36] See also Lücking (2019), Chapter 31 of this volume of this volume on the interaction of gesture and speech.

daughters. Both these properties make processing easier than it would otherwise be. Minimalism has neither property and hence again seems less satisfactory than HPSG in this area.

Someone might suppose that the fact that Minimalism treats linguistic knowledge as knowledge about how to construct syntactic structures means that it is well-suited for incorporation into accounts of linguistic performance. In fact this is not at all the case. The way standard Minimalism[37] constructs syntactic structures is quite unlike the way speakers and hearers construct them. Speakers begin with representations of meanings they want to communicate and gradually turn them into an appropriate sequence of sounds, constructing whatever syntactic structures are necessary to do this. Hearers in contrast begin with a sequence of sounds from which they attempt to work out what meanings are being communicated. To do this, they have to segment the sounds into words and determine what sorts of syntactic structures the words are involved in. Language processing is incremental and all channels are used in parallel (Marslen-Wilson 1975; Tanenhaus et al. 1995; 1996). Information about phonology, morpho-syntax, semantics, information structure and even world knowledge (as in the examples (53) above) are used as soon as they are available. Hence, parsing (54) is an incremental process: the hearer hears *Kim* first and as soon as the first sounds of *may* reach her the available information is integrated and hypothesis regarding further parts of the utterance are built.[38]

(54) Kim may go to London.

The construction of syntactic structures within Minimalism is a very different matter. It begins with a set of words, and they are gradually assembled into a syntactic structure, from which representations of sound and meaning can be derived either once a complete structure has been constructed or at the end of each phase if the derivation is broken up into phases. Moreover, the nature of English means that the construction of a syntactic structure essentially proceeds from right to left. Consider the analysis of (54): here, *go* can only be integrated into the structure after its complement to London has been constructed, and may

[37] For a discussion of non-standard versions like Phillips (2003) and Chesi (2015) see Sag & Wasow (2011) and Müller (2019c: 525).

[38] Note that the architecture in Figure 8 poses additional problems. A *numeration* is a selection of lexical items that is used in a derivation. Since a multitude of empty elements are assumed in Minimalist analyses it is unclear how such a numeration is constructed since it cannot be predicted at the lexical level which empty elements will be needed in the course of a derivation. Due to the empty elements, there are infinitely many possible numerations that might be appropriate for the analysis of a given input string. The problem would disappear if derivations could draw lexical items from the lexicon directly.

can only be integrated into the structure after the construction of its complement *go to London*, and only after that can *Kim* be integrated into the structure. This is quite different from construction of syntactic structures by speakers and hearers, which proceeds from left to right.

These issues have led researchers like Phillips (2003) and Chesi (2015) to propose rather different versions of Minimalism. However, they are still procedural approaches, and they have the problem that any system of procedures which resembles what speakers do will be very different from what hearers do and vice versa. The right response to the problems outlined above is not a different procedural version of Minimalism but a declarative version, neutral between production and comprehension. It would probably not be difficult to develop a declarative version of the framework. It would presumably have an external merge phrase type and an internal merge phrase type both subject to appropriate constraints. This would be better from a processing point of view than any procedural version of Minimalism. However, the complexity of its structures and the fact that its constraints are not purely local would still make it less satisfactory than HPSG in this area.

5.2 Acquisition

Acquisition has long been a central concern for Chomskyans and it has long been argued that acquisition is made possible by the existence of a complex innate language faculty (Chomsky 1965: Section I.8). Since the early 1980s the dominant view has been that the language faculty consists of a set of principles responsible for the properties which languages share and a set of parameters responsible for the ways in which they may differ (Chomsky 1981: 6). On this view acquiring a grammatical system is a matter of parameter-setting (Chomsky 2000: 8). Proponents of HPSG have always been sceptical about these ideas (see e.g., the remarks about parameters in Pollard & Sag (1994: 31) and have favoured accounts with "an extremely minimal initial ontology of abstract linguistic elements and relations" (Green 2011: 378). Thus, the two frameworks appear to be very different in this area. It is not clear, however, that this is really the case.

The idea that acquiring a grammatical system is a matter of parameter-setting is only as plausible as the idea of a language faculty with a set of parameters. It seems fair to say that this idea has not been as successful as was hoped when it was first introduced in the early 1980s. Outsiders have always been sceptical, but they have been joined in recent times by researchers sympathetic to many Chomskyan ideas. Thus, Newmeyer (2005: 75) writes as follows:

> […] empirical reality, as I see it, dictates that the hopeful vision of UG as providing a small number of principles each admitting of a small number of parameter settings is simply not workable. The variation that one finds among grammars is far too complex for such a vision to be realized.

At least some Minimalists have come to similar conclusions. Thus, Boeckx (2011: 206) suggests that:

> some of the most deeply-embedded tenets of the Principles-and-Parameters approach, and in particular the idea of Parameter, have outlived their usefulness. (Boeckx 2011: 206)

Much the same view is expressed in Hornstein (2009: 164–168).

A major reason for scepticism about parameters is that estimates of how many there are seem to have steadily increased. Fodor (2001: 734) considers that there might be just twenty parameters, so that acquiring a grammatical system is a matter of answering twenty yes/no-questions. Newmeyer (2005: 44) remarks that "I have never seen any estimate of the number of binary-valued parameters needed to capture all of the possibilities of core grammar that exceeded a few dozen". However, Roberts & Holmberg (2005) comment that "[n]early all estimates of the number of parameters in the literature judge the correct figure to be in the region of 50–100". Clearly, a hundred is a lot more than twenty. Newmeyer (2017: Section 6.3) speaks of "hundreds, if not thousands". This is worrying. As Newmeyer (2006: 6) observes, "it is an ABC of scientific investigation that if a theory is on the right track, then its overall complexity decreases with time as more and more problematic data fall within its scope. Just the opposite has happened with parametric theory. Year after year more new parameters are proposed, with no compensatory decrease in the number of previously proposed ones.".

The growing scepticism appears to tie in with the proposal by Hauser, Chomsky & Fitch (2002: 1573) that "FLN [the "Faculty of language–narrow sense"] comprises only the core computational mechanisms of recursion as they appear in narrow syntax and the mappings to the interfaces". On this view there seems to be no place for parameters within FLN. This conclusion is also suggested by Chomsky's remarks (2005) that "There is no longer a conceptual barrier to the hope that the UG [Universal Grammar] might be reduced to a much simpler form" (p. 8) and that "we need no longer assume that the means of generation of structured expressions are highly articulated and specific to language" (p. 9). It's hard to see how such remarks are compatible with the assumption that UG includes 50–100 parameters. But if parameters are not part of UG, it is not at all clear what their status might be.

It looks, then, as Chomskyans are gradually abandoning the idea of parameters. But if it is abandoned, grammar acquisition is not a matter of parameter-setting. Hence, it is not clear that Chomskyans can invoke any mechanisms that are not available to HPSG.

This might suggest that HPSG and Minimalism are essentially in the same boat where acquisition is concerned. However, this is not the case given the very different nature of grammatical systems in the two frameworks. The complex and abstract structures that are the hallmark of Minimalism and earlier Chomskyan frameworks pose major problems for acquisition. Furthermore the machinery that is assumed in addition to the basic operations Internal and External Merge are by no means trivial. There are numerations (subsets of the lexicon) that are assumed to play a role in a derivation, there is Agree and it has to be somehow acquired what the restriction on possible probe/goal relations is and which features are interpretable and which uninterpretable. Certain categories are Phase boundaries, others are not. There are complex conditions on Labeling. It is this that has led to the assumption that acquisition must be assisted by a complex language faculty. In contrast, HPSG structures are quite closely related to the observable data and so pose less of a problem for acquisition and hence create less need for some innate apparatus. Thus, HPSG probably has an advantage over Minimalism in this area too.

5.3 Restrictiveness

There is one further issue that we should discuss here. It appears to be quite widely assumed that one advantage that Minimalism has over alternatives like HPSG is that it is more "restrictive", in other words that it makes more claims about what is and is not possible in language. It looks then as if there might be an argument for Minimalism here. It is not clear, however, that this is really the case.

Minimalism would be a restrictive theory making interesting claims about language if it assumed a relatively small number of parameters. However, the idea that there is just a small number of parameters seems to have been abandoned, and at least some minimalists have abandoned the idea of parameters altogether (see Section 5.2). If there is either a large number of parameters or no parameters at all, Minimalism is not restrictive in the way that it once was. However, it does still embody some restrictions on grammatical systems. The assumption that syntactic structures are confined to binary branching is an important restriction, as is the assumption that expressions produced by Merge have the same label as one of the expressions that they consist of. But we have argued that both assump-